

LEAMAN GEOPHYSICS

Registered office:

3 MALUKA STREET, BELLERIVE, TAS. 7018

All correspondence to:

GPO BOX 320 D, HOBART, TAS. 7001

Telephone: (002) 44 1233

Fax: (002) 44 6674

NORTH EAST TASMANIA

REVIEW GOLD POTENTIAL AND EXPLORATION METHODOLOGY

for
BASS MINING NL

by
D. E. Leaman

May 1994

NETGOLD

CONTENTS

	page
SUMMARY	
INTRODUCTION	1
THE NETGOLD PACKAGE	2
GOLD FIELD CHARACTERISTICS	
Introduction	4
Mangana-Lyndhurst zone	5
Mangana	6
Mangana East	7
Tower Hill	7
Mathinna	8
Dans Rivulet	9
Alberton	10
Warrentina-Mt Horror	11
Lyndhurst	12
Gladstone	13
Hogans Road (Brilliant Creek)	14
Lisle-Golconda-Denison	15
Lefroy	16
Other goldfields	16
Summation	17
REGIONAL ASSEMBLY	18
CONCLUSIONS	22
RECOMMENDATIONS	24
APPENDICES	
1. Requirements of the Alberton Goldfield	
2. Ideas and exploration concepts for NE Tasmania	
3. Use of magnetic methods for exploration	
MAP (in pocket)	

FIGURES

1. Location of Tasmanian goldfields
2. Location of NE goldfields
3. Findlay's shear idea Mathinna axis
4. Keele's Mathinna concept
5. Leaman's thrust concept Mathinna
6. Mangana: A magnetics, B radiometrics, C trends, D regional
7. Mangana E: A magnetics, B trends
8. Tower Hill: A magnetics, B trends
9. Mathinna: A magnetics, B radiometrics, C trends, D regional
10. Dan Rivulet: lwr A magnetics, B trends
upper C magnetics, B trends
11. Alberton: A magnetics, B trends, C regional, D ground mags
12. Warrentina: A magnetics, B Forester location, C regional
13. Lyndhurst: A magnetics, B radiometrics, C granite section
14. Gladstone: A magnetics, B radiometrics, C granite relation
15. Hogans Road: regional
16. Lisle area: A magnetics, B trends, C radiometrics, D model
17. Lefroy: A magnetics/radiometrics, B radiometrics/trends
18. N coast regional section

SUMMARY

Previous regional assessments of the foci of gold mineralisation in North-east Tasmania have been limited by the quality and distribution of geophysical and geochemical data. The new NETGOLD release has done much to transform the geophysical view but remain limited in terms of assessment of gold chemistry, associates and alteration. There is no evaluation of the potential for bulk low grade deposits within the literature supplied which tends to focus on vein systems in one part of the region. And it offers no explanation for these, their focus, or the means to discriminate between them, nor find others.

Leaman Geophysics has previously identified some regional trends (namely ENE) as possibly significant and also shown that some discrimination seemed possible using magnetic methods at all scales. The new data package leaves little doubt that this is indeed the case but that the trends tend to be imposed by deep crustal structures and present very subtly in the particular data sets collected. The new data have, however, drawn attention to a second fracture set (ESE) which is at least as significant. Mineralisation occurs where these narrow fracture corridors intersect and the the tabled orientations of vein directions observed over the past century is wholly consistent with the imposition and control by these structural trends. There is a limited network of such fractures and all known sites fall on nodes. There are some additional, unexplored, nodes. It is not possible at this stage to rank the nodes but some are certainly associated with major crustal displacements. Large systems are likely to be related to large deposits and increased fluid transfer at the time of mineralisation (all types) and granitoid emplacement.

Some sites, thought to be of little consequence - or previously negligible producers - occur at some critical nodes given the implied magnitude of the structures involved and must be reviewed. Two of these, Myrtle Bank and Burns Creek remain to be properly surveyed geophysically. The Denison Goldfield, however, should be considered a primary target.

The Mangana-Lyndhurst axis is probably an irrelevant distraction and mechanisms proposed for its unconfirmed existence cannot explain the other significant fields in the region.

Local targets can be selected by consideration of re-processed geophysical data, refinement of trend location perhaps followed by ground survey, and association with elevated total count radiometric anomalies which may reflect altered host rocks. Host rocks in such areas should be sampled for gold content. There is also considerable scope for alluvial deposits within the Tertiary valley systems. Only shallow deposits local to major fields have been worked or examined to date. This potential could be examined near all northern deposits and some near and south of Mathinna.

This report offers a preliminary view of the data available and may be refined followed uniform scaling, derivative processing and recompilation of the data now available.

INTRODUCTION

North-east Tasmania has been a significant gold producer with a total recorded output of 54 t. Most of this gold was recovered prior to 1910 and there has been negligible exploration, development or mining since. About one third of this output was derived from alluvials - mainly at Lisle and Lefroy and the remainder was produced from quartz vein systems. No mass resources have been found to date.

The location of the principal gold fields is shown in Figures 1 and 2.

This report considers all publicly available material (and some information private to Leaman Geophysics) relevant to gold exploration in North-east Tasmania. Most of this information has been summarised and released by Mineral Resources Tasmania as part of the state government's "NETGOLD package" to encourage interest and exploration in the region.

The NETGOLD data base offers the first comprehensive and unified geophysical data and the opportunity to rank and discriminate possible targets and ideas.

The review applies all data and ideas to each gold field in order to identify common denominators or critical elements and thus perhaps suggest a feasible genesis and workable exploration methodology.

It should be noted that I have been down this path before, with much poorer and more limited data. Previous summations are provided as appendices. The first (on Alberton) was generally circulated by the lease holder and the third (published paper) was derived from the second (Leaman Geophysics files). Each of these documents is now more than three years old but have not been clearly displaced by the new government work. Indeed, the government summaries have ignored some of the findings reported, and held, in their own files. The appendices also provide much background material on the area and its exploration and should be used for reference. A discriminating exploration path was suggested in Appendix 3.

In order to test earlier ideas and to properly appraise the new data for its contribution this review attempts a physical description of the characteristics of each field and its most productive mines. These descriptions have then been consolidated and compared in order to identify any common factors or control principles which may have influenced mineralisation.

The aim of the review has been solely to recognise any such factors and so either

to predict which parts of the known fields, or which fields, might be worthy of exploration,

or

suggest whether other, virgin, areas might exist with gold-bearing potential.

There is certainly scope for more detailed appraisal of ranked areas.

THE NETGOLD PACKAGE

The "NETGOLD package" data release for North-east Tasmania prepared by Mineral Resources Tasmania (previously known as the Mines Department) consists of a series of reports outlining historic, location, production, geological and geophysical data.

Previously published geological maps and explanatory notes have been included.

The special reports provided are

- 1992/10 - Northeast Goldfields: A summary of the Tower Hill, Mathinna and Dans Rivulet Goldfields by J. Taheri & R.H. Findlay.
- 1992/29 - The Mangana goldfield and adjacent gold mining areas by R.S. Bottrill.
- 1993/34 - Northeast Goldfields: A summary of the Alberton goldfield by J. Taheri.
- 1994/01 - The Lisle-Golconda-Denison goldfields (including some adjacent gold mining areas) by R.S. Bottrill.
- 1994/02 - Geology and mineral resources of the Mount Horror Exempt Area by R.S. Bottrill.
- 1994/03 - A summary of the Beaconsfield, Lefroy, Back Creek and Gladstone goldfield by M.P. McClenaghan.
- 1994/04 - Geochemical reconnaissance of the Four Mile Creek Exempt Area by D. McP. Duncan.
- 1994/05 - A study of the nature and origin of gold mineralisation, Mangana-Forester area, northeast Tasmania by J. Taheri & R.J. Bottrill (contrib. G.R. Green, R.A. Keele).
- 1994/06 - Structure and veining in the Devonian-aged Mathinna-Alberton Gold Lineament, northeast Tasmania by R.A. Keele (contrib. J. Taheri, R.S. Bottrill).
- 1994/07 - Structure of the GIS databases by M.P. McClenaghan, M.J. Roach & R.S. Bottrill.
- 1994/08 - An interpretation of recent geophysical surveys, northeast Tasmania by R.G. Richardson & M.J. Roach.
- 1994/09 - Specification summary - aeromagnetic surveys, Northeast Tasmania by R.G. Richardson.

The information provided by these reports is qualitative, descriptive, repetitive and largely historic. Its value lies in the consolidation offered and the collection of references.

Little new is included and the exceptions are reports 5, 6 and 8 especially. The comments and conclusions espoused are generally unimaginative and rooted in the past, namely the pan and measurement of schistosity, and offer no new exploration ideas. The authors "hope that the collations will inspire others..."

Findings include suggestions that there are no consistent correlations between gold-bearing sites and geophysical data (1994/08) although there is a "need to look at subtleties".

Great stress is placed upon the Mangana-Lyndhurst structure but no one can justify or explain it, or even prove it exists (1992/10, 1994/05, 6).

In 1992/29, 1994/01 it is stated that no private company exploration has been innovative. While this is largely true of companies it is definitely true of the government survey. Fundamentally, however, it is untrue. This package would not have existed without the inspired efforts of three explorers who, unfortunately, for financial or policy reasons did not follow through. It was these explorers (Placeco, Pegasus Gold, Oceania) who showed that the geology of the northeast could be examined using magnetic and radiometric methods and even set the specifications employed for this package and its surveys. Indeed, those trail-blazing surveys were of higher specification and are included in this release. The implications and use of such data and the published work on ground follow-up (e.g. Appendix 1 and 3) have been totally ignored.

There is little recognition of previous structural work suggesting that particular fracture or trend systems might be important and that these might be subtle.

The package is also flawed in its omission of some reference material including some of the Mines Department's own drilling at Lefroy. The principal flaw in the package, and one which has greatly frustrated this review, is the complex presentation of maps. Radiometric, magnetic, mine location, geology maps have all been presented at various scales. There is no universal set for the region and only a standard scale set (at 25000) is provided for the Mangana-Mt Horror portion of the Mathinna Lineament. It is not a simple matter to unscramble this but I feel that a little thought might have helped.

Perhaps the release was too hurried to do justice to the information, albeit largely dated - except for the work on veins and geophysics, contained and it may not prove as successful as the government might wish.

The emphasis on vein styles to the exclusion of alluvial (including unworked deep deposits) or mass alteration systems (wholly ignored by Netgold research) may also be a mistake.

In conclusion it may be said that the release provides useful summaries of filed information but is weak in presentation and modern research content. But, when the data scale problem is overcome, the geophysical compilations will prove useful. Many of these are more resolving in contour form since the colour definition of many of the regional images does not allow useful feature discrimination. This observation reflects the very subtle and low relief nature of some of the data sets.

GOLDFIELD CHARACTERISTICS

INTRODUCTION

Each goldfield shown in Figure 2 has been reviewed separately and particular or anomalous features described. Each description must be based on the NETGOLD geophysical compilations and, to a lesser extent, geological mapping due to poor exposure and the need to find common parameters. Trends interpreted are derived directly from such data or anomalous geological features.

Anomalous geological sites are defined as those places where structures form triple points, kinks, unusual trend changes, intrusion changes or controls, drainage patterns or trends intersect or are exceptional. These elements may be poorly exposed and are commonly related to fundamental basement structures. Where anomalous sites form groups or alignments then the approximate location of the fundamental structure can be inferred even though its propagated forms may be varied in presentation.

The review has considered the qualitative characteristics of the data available and does not constitute an interpretation of that data. In the same way work with images is only an aid to interpretation and not an interpretation itself since images are only a form of data presentation. A trend may be recognised, for example. It may be assigned an orientation. But describing its response is not the same as describing *the actual source* of the effect. Samples of this type of interpretation appear in the appendices but are beyond the scope of this review.

Various combinations of diagrams have been used to suggest the features of each field and attention is drawn to the orientation of veins or the major producers. The indication of a major producer must be treated with caution since other sites may prove to be more worthwhile in future. In each field only one or two sites have produced more than 100 kg gold and this has to be a fair indication of the worth of that vein system. Additionally it must be recognised that the fields are not even equal in this respect; for example none of the producers at Mangana were comparable with some average yields elsewhere.

Each discussion is focussed on the characteristics of the site and a search for either common factors, regional setting, or control on mineralising processes.

THE MANGANA-LYNDHURST ZONE

The NETGOLD package is dominated by thoughts and reports on the Mangana-Lyndhurst axis. Most of the detailed maps supplied relate to the southern two thirds of this zone.

Much gold has been produced from this zone. Even so it is not predominant. Large producers like Lefroy and Beaconsfield lie far away - as does the very different Lisle. Indeed the largest producer in the Dan Valley - which runs along "its" central portion - lies more than 2 km from it to the east! And some fields such as Hogans Road receive no comment in the package.

Several comments must be made about the presumptions concerning this axis.

Findlay (in 1992/10) summarises what is known and suggests an explanation. This is shown in Figure 3 where a presumed dextral shear has been jogged to produce some extensional zones. This is thought to explain the clusters of sites and the changes in vein orientations noted right along the axis.

There are, however, some fundamental problems

1. The veins are not systematic and many orientations are in opposition to the predictions of this idea.
2. General clustering is not supported. The Mangana, Dan Rivulet and Alberton groups are extended or spotty.
3. Findlay and Bottrill note that there is no supporting evidence of surface dextral movements. (This does not mean that a dextral structure in basement is excluded, simply that it does not penetrate the host sequence)
4. Keele suggests a dextral sense in the zone - but no movement. He explains Mathinna with a cross structure to the NE (Figure 4). This feature is not supportable geophysically or on ground.
5. Is there a flower structure? (A shear impressed into covering rock with a resultant complex of normal and reverse faulting) Could the predominant motion be upward, east side up?
6. The vein orientations reflect random stress deviations and no coherence regionally but do show local curl. Findlay's idea should lead to E-W veining in all groups if the shear remains active. The curl to E-W is always local and many orientations reflect unit strike or are random.
7. Is there some relationship with the batholiths intruded to east and west? Is the zone a dilatationary pull-apart?
8. Why is Mangana offset from the main axis direction? Are such offset styles common and simply disguised by limited information?

These comments show that there are no simple answers for the zone which the package has sought to emphasize on the presumption that it, and vein systems, are the optimum target style.

Others, including me (Appendices 1, 2), have suggested that the zone might not exist at all, or be formed of *en-echelon* structures which individually trend more NW and which curl to the ENE. The shearing noted may be due to upward motions and overthrusting (Figure 5) due to the greater source depths of the granodiorites to the east. These bodies lie toward the core of the Blue Tier Batholith.

MANGANA

The Mangana field was small and produced only 208 kg. Nearly half of this was produced at 'Golden Entrance'. The deposits worked form two groups and although some were alluvial most were vein operations.

Figures 6A-D present the geophysical data and the vein locations.

Figure 6A shows the detail of the magnetic field and the vein orientations. Veins marked * were significant producers for the field (not necessarily large producers). The magnetic anomalies are dominated by dolerite-rich gravels in the local streams but these streams and their Tertiary incision display some interesting orientations. The general strike of units in the area is NNW and secondary magnetic features may be observed which reflect changes in lithology. Most veins, however, are in areas where the field is quiet or uniform.

There is no obvious relationship between magnetic field and veins.

Figure 6B presents the total count radiometric data and this suggests that the vein systems fringe some alteration effect. The northern group of veins rings such a feature and these yielded one third of the production in the area.

All sites are within an area of elevated counts. This suggests a primary difference in formation or rock type.

Figure 6C combines a trend interpretation with the vein sets. When this is done it may be noted that the veins occur in groups *between* particular trend sets and that where the veins change orientation a trend intersection is also implicit.

Note that many of the trends shown have been observed only in radiometric data and some are only apparent in magnetic data (base for the diagram).

Only one trend can be assigned from the available gravity data and its approximate position is shown by a line of 'G'.

The circled points represent nodal or anomalous geological features as described in introduction. These are linked to the primary trends and intersections.

It is clear from 6C that there are few subtle or local correlations with the veins from two of the three data sets although this may be unfair in terms of the gravity data base which is too coarsely spaced. There is a distinct link with the radiometrics and the regional trend pattern derived from all three data sets. Other orientations could be drawn, especially approximately N-S, but these are obvious while the sub E-W elements are not. It is these features which account for the vein direction changes which indicates that they predate them and could well have focussed fluids during venation.

The regional setting of the data sets is shown in Figure 6D. Note the twist in the river deposits south of Mangana and the orientation change of the stream arms. One of these radiates to the Golden Entrance vein set. Is the main Mangana zone a tensional fan?

MANGANA EAST

Five isolated sites occur several kilometres east of the main fields at Mangana. These are much closer to any projection of a principal axial trend than the Mangana sites but the veins were poorly mineralised and erratic in orientation.

The magnetic field is shown in Figure 7A and it is generally of very low relief. Some lithological trends are apparent and some subtle cross trends can be detected.

The original data for this area (flown for Pegasus Gold) was presented in more detail and Figures 15 -17 of Appendix 1 and Figures 2 and 3 of Appendix 2 are more informative. A revised analysis is also shown in Figure 8 of Appendix 3.

The variations in the trend judgments evident in all these diagrams reflects the subtleties of the responses and the experience gained by reconsideration over a four year period (1987-1991). The ESE trend shown in figures 6C and 7B is evident in the older presentations; it simply was not thought significant. This is an example of blinkered vision. I have tried, in viewing the new compilations, to objectively record all subtle features and have applied the anomalous geological point concept to test them.

Radiometric correlations are indefinite and there is no marked change in counts near these sites. The entire radiometric picture is different.

The vein trends observed, however, can be directly associated with regional trend and fracture systems (Figure 7B). These can be traced westward through the Mangana area (examine Figure 6D) and the only alignment which can link these sites with the Mangana groups is ENE.

TOWER HILL

No local character can be discerned in the magnetic data (Figure 8A) but all sites are near the edge of a total count high in radiometric data and the veins parallel the edge of the count change where the site falls off the feature.

Figure 8B suggests possible cross trend directions based on both data sets. These account for the variations in vein orientation and presumably location.

Gravity data do suggest a possible true E-W change at the northing of Tower Hill and although the feature can be recognised to both east and west of Tower Hill it seems poorly represented in the immediate (2-5 km each side) area. This type of problem suggests that the gravity data, even with limited resolution, should be re-processed and presented in gradient form.

The large magnetic anomaly west of Tower Hill has been produced by a large dolerite dyke (Jurassic in age). Its orientation is interesting since it is consistent with a primary stress or shear aligned ENE. It is terminated by the two older trend systems; critical point confirmation of underlying control.

MATHINNA

The correlation between veins and magnetic field is not simple nor direct (see Figure 9A). Lithological changes are apparent but the vein system is not obviously related and it is evident that any cross trends must be much subtler.

The radiometric data (Figure 9B) show that the area has elevated counts but that the region has patchy responses. All major producers, however, are at the edges of the total count anomalies as at Mangana.

When the two data sets are combined and viewed in a slightly more regional context (e.g., Figure 9D) then some cross trends can be recognised. These are systematic and typical of the entire region southward of Mangana. Curls in vein direction and the actual orientations make sense in this context but inspection of the picked trends suggest some small errors in location. This reflects the inferences which have to be made with this data as presented. Again, note the higher quality original presentation given in the Appendices.

Both data sets would benefit from a more detailed contouring and derivative analysis to enhance the edges and subtleties. A second derivative might be necessary in order to properly display the cross trends. This has not been done since tests were undertaken with the original Pegasus data set.

The more regional presentation superimposing both radiometric and magnetic data reinforces the effect of sub E-W change in a way which is not apparent at the smaller scales.

The linkage with radiometric data becomes more apparent, as do the ENE and ESE terminations of the elevated count materials.

The "Golden Gate" is located at the northern tip of the elevated radiometric anomaly at the intersection of both cross trends. This cannot be accident.

Examination of Figure 9D suggests that some large ENE structures are present at approximately 5402 500 and 5409 000 mN but no known gold is linked with these. This suggests that other factors are also essential and the abnormal shearing and extension at an intersection with an acute shear might well be sufficient - if there is a competent host material to fracture. The lithology variant which occurs near Mathinna is more radiant but also magnetically quiet. These were exactly the characteristics of both Mangana groups but only two of them are present at Tower Hill (see bottom of Figure 9D).

Note that neither data set represents any NNW-trending structure through the Mathinna area. Such trends are present within the region, as are many others, but are not apparent in the Dans Rivulet region.

Regional gravity data present a diffuse picture locally but two global trends can be recognised. The approximate location of these within the Mathinna area is shown in Figure 9D (labelled G). These would intersect very close to Mathinna township but no finer resolution is presently possible. Their orientation is consistent with local data (Figure 9C).

DANS RIVULET REGION

The Dans Rivulet goldfields are a rather diffuse alignment of isolated vein systems extending from a point about 2 km north of Mathinna irregularly to Alberton.

The general alignment is indicated in Figures 10A, C, as is the scatter of vein orientations. There is no grouping and no firm alignment. There is also no suggestion of a primary NNW trend in either data set (see Figure 10E).

NW and N trends can be recognised but these occur west and east of the 'axis' respectively. This incongruity is suggestive of a major contact or break of some sort but the actual location is certainly not defined. The figures also show that several sites are located well away from the main axis and, indeed, the principal producer in the Lower Dans Rivulet region is at 577 000, 5412 000.

The vein orientations for much of the valley are aligned to either ESE or ENE and not true east as the concept of Findlay would produce, and not NNW as a megashear would generate. This effectively confirms a region, imposed trend fracture control on these veins. The major producer is located near the intersection of trends. Note that the sub E-W trends are much subtler than the general regional and lithological features in each set, and especially in the magnetics.

Many veins are located in areas where the magnetic field is undisturbed but most occur marginal to, or in, areas of much elevated total counts. Such zones tend to be patchy in the Dan zone but the result is general. This is consistent with areas already described.

It is not possible to define large scale gravity trends into this region due to interference from the batholiths to east and west but there are no sub N-S trends evident in the residual Bouguer anomalies. There are, however, suggestions of sub E-W structures crossing the 'axis' at about 5410, 54155, 5419 000 mN. The trends and approximate locations are shown in Figure 10E. These features bear a clear and positive relationship with trend changes and suggest that they have exerted some control on the vein system.

ALBERTON

The Alberton field was one of the most vigorous producing areas but there is some debate as to exactly how much gold has been extracted. However most gold was produced from the southern group of workings which includes the Mercury, Long Struggle and Mt Victoria mines.

Figures 11A, B, C show several characteristics of this field.

There are many veins and many carried some gold.

Most orientations are east of north and not west of north even though the geophysical data sets suggest, for the first time, a clear NNW element in the area. The veins would suggest that this orientation or control is irrelevant.

The veins display an 'S' shape connecting the groups and the field consists of three groups which are not widely separated. The first group is oriented NNW with veins radiating within it, the second group trends N with a more NNE tendency and the third group begins to return from an east of north sense to one west of north. This *en-echelon* form is consistent with a gross shear of the Findlay model (Figure 3) but the internal orientations are a problem. There are strong local influences on vein location even if a large shear system has operated.

The field is abruptly terminated to north and south and these are the points at which a NNW shear should become evident. No such character is represented in the radiometric or magnetic data from these positions.

Major sub E-W structures are evident in both local and regional data at these northings and one is readily observed north of the field in both data sets. Its character is abnormal and unambiguous and carries an ENE trend (see Figure 11C). Gravity data indicate that at least two elements cross the field as suggested in Figure 11C. These bracket the producing area!

Local ENE and ESE structures within the field; some may not be continuous across it, can easily account for many of the vein orientations observed. Figure 11D reproduced from Appendix 1 is so important that any doubt on this point can be removed. The ground magnetic survey shown suggests not only a discrimination of sources within the southern mine group but also both orientations. Note how the arcs of anomaly swing smoothly from ENE to ESE near each anomalous area. This suggests an intersection with bulk alteration in the obtuse angle between them (also Appendix 1). This kind of direct and crucial information has not been appreciated by the authors of the package. (Nor did I fully until the ESE elements were recognised - see Appendix 3; they were omitted/missed!)

The correlation of veins with magnetic data is as before - in quiet areas. The radiometrics, however, are more definitive; the southern producing group is associated with a total count high - unlike the other groups - and thus the pattern of radiometric lithological or alteration variant and key joint intersection is reproduced.

WARRENTINA-MT HORROR

Production from this field was very minor and the largest mine was located just east of Warrentina (Figure 12A).

There were very few worked sites (see Figure 12C for a regional plan showing all) and the vein details are not generally known.

All sites fringe radiometric highs but the total count values in this region are much less than in more southern fields. It is not clear whether this is related to the surveys or to some regional metamorphic effect. The radiometric gradient effect is present.

The intense magnetic responses south of Warrentina are due to Tertiary basalts and many of the obvious trends displayed in this region are relatively recent in origin. There are suggestions of other trends and these are indicated in Figure 12C. There is no pronounced NNW axis effect and most variations evident in the host rocks trend NW or ESE-WSW. It is possible that some of the isolated magnetic anomalies are due to basalt vents and their alignment would indicate the position of deep crustal control. Such alignments tend to be ENE or ESE. These have not been marked in the diagram but several such groupings can be found.

The southern group of Warrentina sites (Figure 11A) may be aligned ENE and thus bear no simple relationship to any NNW axis.

All sites suggest that any correlation with a NNW corridor is exceptional and perhaps illusory given the distribution of granitoids on either side of the zone. An upthrust, or updragged, zone could produce the same effects when superimposed on a crustal fracture set nearly normal to the lifted zone. The uplift can be implied from the depth of crystallization of the granodiorites exposed to east and west. Such intersections make for a longitudinal region in which gapes are likely but the critical fluid control has remained with the primary crustal orientations.

The two larger producers, in the north (site 11, Figure 12B) and Warrentina in the south are located near the intersection of the easterly fracture system. The northern site also occurs in an area of quiet magnetic field. The situation at the southern site is unclear due to the covering materials.

The quality of gravity data is fairly poor in this area and was not upgraded by the NETGOLD surveys. Two possible cross trends can be recognised and these are shown in Figure 12C (marked G). The southern feature trending ENE near Warrentina can be identified with reasonable confidence along a strike length of nearly 50 km and its location is adequately defined. The Warrentina group of mines is clearly associated with it.

The northern feature is not well defined and its orientation is uncertain. More data are required in this part of the region.

A major NNW-trending structure is apparent in the gravity data north of Warrentina but some 5 km to the west. This feature extends toward Bass Strait. The deposits in the far west of the Forester area (Figure 12B) may be associated with it. There is no corresponding change in the magnetic field in this western area.

LYNDHURST

The Lyndhurst Goldfield lies at the northern extremity of the 'axis' from Mangana. Production was relatively small but much of the potential of the area is uncertain due to sand cover.

A previous review of the magnetic data is included in Appendix 2 (Figures 6, 7). This suggested a number of trend patterns which have been supported by observations noted above. The magnetic data used in this earlier work has not been displaced by the NETGOLD compilation and the presentation of it shown in both the Appendix and Figure 13A is more detailed than in the new release.

The data has been reviewed in light of the findings reported further south. Consideration has been given to abnormal geological or strike changes. This has stressed ENE and ESE trends. The latter had not been described previously.

The radiometric survey completed in 1987 has not been examined previously but was included in the new release. This compilation is shown in Figure 13B. Blocks with clear ENE and ESE outlines are unambiguously defined. Known mineralisation can be associated with intersections of these trends near a marked change in total counts. There are no suggestions of major sub N-S trends in the Lyndhurst area.

Gravity data have not been upgraded and the only identified cross trend is shown in Figure 13B. Its position is only approximate but the position is clearly of some interest in terms of the known deposits.

Figure 13C presents a model of local structures completed in 1991 to assess the possible local linkage with a granodiorite as discussed in Appendices 2 and 3. The model suggests that a low magnetic granodiorite underlies the deposits at a depth of no more than 1500 m.

GLADSTONE

The Gladstone Goldfield is the first to be reviewed which lies far from the Mathinna axis.

The Gladstone area has been subject to some previous detailed reviews since it was the site of the first high resolution airborne surveys undertaken anywhere in Tasmania. Unfortunately the E-W line bias has limited assessment of the sub E-W trends which have now been defined elsewhere. Some additional original information and an early interpretation is included in Appendix 2. Appendix 3 includes a complete map of the Gladstone survey (Figure 2).

Some vein production was obtained, mainly from the Royal Tasman near Gladstone and the remainder from Portland. Two thirds of all production was alluvial.

Figure 14A presents a new version of interpretation using the anomalous spots linkage technique. This view ties a number of subtle inflexions but there are others which are ill-defined in this data set.

The radiometric total count data (Figure 14B) offers a completely different view and this is a new compilation; the original data was uncorrected and not analysed due to collapse of the small company involved. This map shows that the gross sub N-S lithological trends which dominate the magnetic map have been reproduced but in the region north of Portland Mine a number of elements trending ESE are clearly defined. Some fragments trending ENE may also be present. The northern vein deposits can be associated with slight increases in total count intensity but the linkage is frail.

The position near Gladstone itself is more complicated due to the intrusion of the siliceous granitoids of the Blue Tier Batholith but all deposits occur at the base of the gradient from the granite effects. No conclusions can be drawn in this zone but there are suggestions of ESE trends.

Figure 14C presents an interpretation of the depth to granite - various compositions - in the Gladstone region. This is based on analysis of the type shown in Figure 13C. It draws attention to a fundamental suture in the host-basement rocks and this is marked by a series of cross marks. This is the locus of the contact between primary granitoid types (Gardens Granodiorite) and the later Blue Tier Batholith. The crispness of the boundary suggests an original fracture control which runs almost N-S. The three northern vein deposits straddle this axis.

Gravity data coverage is satisfactory in much of the Gladstone region and several sub E-W features can be recognised. The largest of these corresponds to the southern face of the Musselroe Pluton (see Figure 14C) and the northern face of the Mt Cameron Pluton which occurs at Gladstone. The others are subtler and shown in Figure 14B. Some data enhancement is warranted. These data leave no doubt that ENE elements have controlled granite intrusion and sympathetic structures may well have formed nodes on the N-S fractures.

HOGANS ROAD (BRILLIANT CREEK)

The Hogans Road field has not been described in the NETGOLD release and not a lot is known about it. It was a small vein producer and some of these veins were intimately associated with granodiorite.

The new geophysical data sets have been superimposed to give the combined effect of the radiometric and magnetic trends and some have been suggested in Figure 15. The local granitoid is magnetically very quiet but the radiometrics of the contact zone and surrounding materials is highly variable. All sites occur in a zone of elevated total counts and several in a portion with very high counts. Several sites occur close to major gradients in this data set.

ESE and ENE trends are evident in both data sets and the drainage pattern. These clearly reflect local fracture systems.

Many of the deposits of this field occur in the metamorphic halo of the local granitoid which has a very low magnetisation. This location may be contrasted with the findings at both Lyndhurst and Gladstone where the granite is at least 1500 m away and the deposits are clear of the alteration halo. Only Lisle appears to be similar (below). These may represent different deposit styles.

Gravity data is adequate and reveals a single major NNW trend and several subtle sub E-W trends. Their location is shown in Figure 15. Nothing like this northerly trend can be observed along the Mangana-Lyndhurst axis south of Warrentina and it is possible that the structure has been offset near Alberton. The secondary trends clearly define nodes on this structure as suggested by the location of the known mineralisation.

LISLE-GOLCONDA-DENISON GOLDFIELDS

These fields occur east of the central axis and have been significant producers. The production from the Lisle area was enormous but principally from alluvial deposits. Working out of these deposits led to collapse of the field without any appraisal of the source of gold or its means of concentration. Vary suggestions have been proposed including concentration of trace gold within a topographic basin by destruction of the roof halo of the local granitoid. This roof halo may also have included a vein stockwork.

The NETGOLD package includes data from an older survey and the original compilation is shown in Figure 16A (also Fig 3, Appendix 3). Trends deduced from this data were shown in Figure 11 of Appendix 2 and these have been revised (Figure 16B) after review of both the original data presentation and the new version. The adjustments are minor.

Figure 16B also shows the location of the gravity gradients in this region where the data base has been modestly upgraded. These need tighter location but would suggest some element of fundamental control has been recognised which would account for the three tiers of the field - Denison, Golconda, Lisle.

The radiometric data are, however, most informative even though a complete coverage of the region is not available. There is no simple explanation for the Denison and Lebrina fields (see location in Figure 16A) which lie far outside the disturbed magnetic field and its direct lithological controls. Few strong gradients have been observed in magnetic data north of Golconda. The radiometric data present a complete surprise by displaying a strong gradient across this magnetically quiet region. The gradient has NNW, ENE, NNE and ESE arms and the two anomalous fields are located on it. The count level increases markedly at each site and all other Golconda fields lie on the elevated count platform. As far as can be judged these vein sites lie on lesser gradients.

Appendices 2 and 3 discuss the role of different granitoid compositions in the emplacement process and it is possible that some review may be forced here by the implications of the radiometric data. The correlations are striking even though such data normally relate only to shallow changes.

Figure 16D gives a file extract of earlier interpretation about the bulk granitoid relationships in the region to suggest how particular compositions may have intruded each other and controlled the thermal disposition of fluids. See Appendix 2.

LEFROY AREA

The isolated Lefroy area has been a significant producer. Whatever has controlled vein disposition here has absolutely no relationship with the central system. Although much production was obtained from a few substantial vein systems a significant proportion was won from alluvial deposits north of the town.

The orientation of the vein systems has long been known - sub E-W. The reason for this is apparent from an inspection of the first magnetic and radiometric data to be acquired in the area (Figure 17A, B). The magnetic field is generally subdued but is very noisy north of Lefroy due to the presence of Tertiary basalts. The total count compilation is less restrictive. Both data sets, however, support the trend compilation.

The major vein systems were clearly controlled by major pre-existing fracture systems with a regional orientation comparable to every other field. This is not an anomalous site.

The gravity coverage of the region leaves much to be desired and this was unaltered by the recent project and package. The only trends which can be recognised in the regional data are shown in Figure 17B and these suggest a major regional focus near Lefroy.

The productive vein systems also lie adjacent to local increases in total counts and although the relief of the change is quite subdued the pattern is not dissimilar to other areas.

A regional view of the setting of possible granitoids and primary controls west of Lyndhurst is shown in Figure 18. This suggests that the very large magnetic anomaly in the region has been generated by granodiorites and that these occur at relatively shallow depth below Lefroy. These bodies would provide the heat engine necessary to cycle the vein fluids. This type of relationship can be inferred in all the northern fields and, as implied in old modelling near Mathinna (Fig 6, Appendix 3), may apply elsewhere.

The data now exist to properly test this hypothesis.

These tests were not incorporated into the options discussed in package report 1994/08.

OTHER GOLDFIELDS

Two other goldfields might be discussed in any review of north-east Tasmanian goldfield but no data has been compiled or presented in the package. These include Beaconsfield and Burns Creek.

The Beaconsfield area has been a major producer while the vein system at Burns Creek was apparently quite minor.

It would be useful to compare the geophysical signature of the Beaconsfield province with the body of the north-east but this is not yet possible. The comparison would be interesting since it the mineralisation is directly within 'west Tasmania' style rocks which I have argued form the basement to north-east Tasmania and which have supplied the gold for the vein systems.

SUMMATION

This review of each goldfield using the enlarged and refined data bases for north-east Tasmania has established that there are some common denominators present in all productive regions and which are focussed near all known major producers. These factors might allow some discrimination between, and identification of, other sites.

The factors noted include

1. intersecting ESE and ENE trends. Some of these can be traced across the entire region.
2. marked radiometric gradients, especially within areas displaying elevated count levels.
3. primary granitoid intrusions appear to be directly related in terms of thermal or structural setting.

There is no evidence of any near N-S wrenching or shearing at any site although some structures with NNW-NNE orientations do exist.

REGIONAL ASSEMBLY

The summaries and observations provided in the previous section of this review were based on direct judgments and recognition of the setting relationships of each field within limits allowed by the best data presentations supplied as part of the NETGOLD package. There are many instances where these leave something to be desired (see Recommendations) or where the data coverage (especially gravity) remains inadequate.

Regardless of any such deficiencies, perceived or real, a positive relationship has emerged which represents a refinement of the views expressed in the appendices. It is perhaps fortunate (in respect of those who may yet take up opportunities which may be inferred) and disappointing that the Netgold workers have neither recognised these elements, considered them as feasible, nor sought to test or develop such older innovative ideas which have clearly been in the public domain for at least three years.

The summary given on page 17 represents a partial confirmation of previous ideas and an amplification. The generally improved and extended coverage of geophysical data has allowed recognition of subtle and widespread features. The present data set remains weak in terms of gravity data and uneven in other forms of data presentation. Every attempt has been made in this review to rescale and correlate the data sets but this has not been possible at satisfactory uniform scales.

Map 1 summarises the geology and structural inference within North-east Tasmania.

The map shows the locations of all established goldfields and the granitoids. Heavy bounding lines mark the extent of substantial post-Carboniferous cover. No exploration can be commended beyond this boundary until firmer targetting procedures have been established for the exposed host areas.

Trend lines are based on all geophysical data sets and the origin of the lineaments has not been discriminated. Where more than one data set reflects the feature the line is multiplied. This process gives the effect of continuity and significance.

Heavier line weights indicate the location of major gradients or changes in a data set. All data sets may be involved. These positions may be adjusted after derivative analysis but the present marking provides both the sense of scale, character (including curvature) and orientation. Inspection shows that some trend systems merge with these features. Examples occur southeast of Mathinna or northeast of Golconda.

Dot marking indicates the loci of anomalous geophysical and geological elements. Larger dots mark sites where warps or kinks occur in the primary geophysical gradients which must reflect imposed distortions by underlying structures. Smaller dots mark those sites where intrusions or high level geological units show comparable, if lesser, distortions. Many of these dot sites can be directly correlated with normal lineament elements.

The SLOTS technique (name coined by Leaman Geophysics)(Surface Location Of Transfer Structures) has not, to my knowledge, been so systematically employed anywhere - let alone in North-east Tasmania - even though many workers have noted structural distortions may be aligned across wide areas.

The existence of such distortions demonstrates the presence of major crustal breaks. Such structures can be expected to have great age, considerable size and permeability and thus continue to evolve and determine subsequent events - including fluid passage and mineralisation.

If exploration is to be targetted upon large structures, or intersections of large structures, then such deep systems must be a fundamental guide. Where lineaments exist, and have been recognised, and are not associated with major distortions or local structure control then it must be surmised that such trends are real but not crustally significant and must be down-rated in terms of their importance. It may be that this is an invalid judgment given the association of quite subtle features with mineralised sites but the next phase of exploration in the region must surely be focussed on the sites with the greatest potential. Should this fail then, perhaps, secondary sites may be examined even though it is unlikely that they have generated a large deposit.

This concept can be tested against the framework of the current findings - which are interim pending the completion of the recommendations - and the scale of the known goldfields.

Several theories and formulations have been tested in order to provide some objective scaling and ranking. These schemes have included whether

- intersecting ESE, ENE trends are present,
- a magnitude factor for each trend reflecting its regional extension
- the number of geophysical kink points,
- the number of anomalous geological points,
- the presence and extension of asymptotic curls in intrusion form, or major gradients,
- the length of the gradients,
- how many data sets support the trend orientation and extension.

It is obvious that such factors were intended to scale the features and their proportional significance. Although a rating scheme devised on this basis was able to highly rank such sites as Beaconsfield, Mathinna, Lefroy and Mangana, for example, it is beset by limitations on exposure, granitoid evidence and the bias which occurs across the wedge-shaped region which tends to favour central rather than lateral sites.

These schemes have been temporarily discounted in favour of more qualitative comments.

Consider Mathinna, which may be used as a type case for a significant producing area.

The site is framed by intersecting trends. Each of these can be tracked into major gradients which are evident in at least two data

sets and which are linked to major points of distortion. These are clearly primary structural controls. They also extend for at least 50 km. Any ranking must consider them significant and they can be defined within a width of about 1 km each. Magnetic data suggest a refinement at some points but when all anomalous distortions are collated it is found that these fall within an envelope and not along a line. This is what we should expect for impositions from an underlying structure.

Similar arguments can be applied to all other known sites.

On this basis areas such as Lefroy, Denison, South Alberton, Warrentina, North Gladstone, Burns Creek and Mangana stand out. Note the presence of Burns Creek in this list; hardly a well known area. Myrtle Bank has a similar ranking since it is associated with a trend which corresponds to the largest magnetic anomaly offset in the northern half of the region.

Lefroy occurs at a primary intersection of trends which extend more than 100 km and which involve many major distortions. Several granitoid variations have intruded along the ESE element. If we examine these features we find that the north Gladstone field lies along the ENE member at its intersection with a major gradient and structural change and that the ESE member passes into the Denison and Golconda areas with splays on to Alberton north.

Beaconsfield is always included in Tasmanian goldfield discussions even though the host rocks and location are distinct from those normally associated with North-east Tasmania. Although data become impoverished as the Tamar Valley is approached the regional gravity set are able to trace a significant ENE structure through the Beaconsfield zone from more than 50 km to the west. Traces of the same structure can be recognised at Pipers Brook and north Scottsdale in map 1. This same structure is very clearly defined at Gladstone (South field) where it lies between the north field-Lefroy structure and the Forester-Denison line. The ESE element from Beaconsfield is well defined SE of Lisle which also lies along it - as does Alberton South.

This initial discussion serves to stress a key point. No one site can be discussed without mentioning others which are related by the same structures or structural patterns. This would suggest that the sites may not be as random as they at first appear and that such concepts as the great Mathinna Lineament are both irrelevant and in error.

Inspection of the map shows that Burns Creek and Mathinna are related and that Upper Dans Rivulet and Hogans Road are also tied. The latter fields are linked by a gradient segment which suggest some major structural changes north east of Mathinna. Warrentina and Lisle are also comparable in siting.

Some sites, such as Myrtle Bank, present useful juxtapositions and a good structural address but their location has limited full appraisal by previous workers. This condition must be changed.

Sites such as Forester and Lyndhurst, or Tower Hill, are not as favourable in all these respects. Southern Lyndhurst may need review since an ESE element can be traced to the coast at Ansons Bay where it has been a major intrusive boundary. Few signature elements appear on the map because radiometric data are not available, the granite tends to be magnetically uniform across a substantial area, and gravity coverage is relatively poor. Lineaments are not well defined but may be present.

This review can, however, only consider sites which can be appraised with existing data.

On this basis the obvious sites for mass alteration and mineralisation occur near Mathinna, Mangana, southern Alberton, Lefroy, Denison, Warrentina, north Gladstone, Burns Creek, Lisle (although it may have already been eroded from the granitoid roof) and Myrtle Bank.

These are the known fields.

Some comparable sites are evident in areas where little exploration or discovery has ever been undertaken previously. These include Pipers Brook (A), Retreat (B), South Lebrina (C), Bridport (D), Mangana west (E), Tullochgorum (F), Pyengana east (G) and Mathinna west (H). Each of these sites can be associated with named fields and all have compatible structural relationships.

The minor traces of alluvial gold near some of these sites (such as A, B, C, F) may have their origins in something important.

This interlocking view has never been possible before but some refinement is almost certainly required.

It should be commented that while continued review of the data may reveal additional details it is clear that no other trend system can account for the goldfield pattern. Nor is there any evidence for any other coherent fracture set even though extensive dilation and extension has occurred between east and west along the sub N-S features. None of these has continuity and this is easily demonstrated by tracing most of the intrusion margins. All are offset by the sub E-W elements.

The great paradox in the region is clearly associated with the subtle presentation of the sub E-W features when such structures clearly controlled many parts of every granitoid, distorted structures regionally and are ubiquitous. The subtle magnetic properties of all materials has effectively disguised the structures since similar rocks occur on each side of them, and above them. Where gravity data permit discrimination such data may be given greater weight since any feature evident in gravity data has to be very large indeed and the method is sensitive to deep and minor variations in density contrast which is a much less specific parameter and more likely recorded in the observed responses.

The critical exploration must now be; how can one discriminate between good and bad targets and between mined sites within an established field? This topic has been covered in Appendices 1 and 3 and the conclusions remain valid. They have been reinforced.

CONCLUSIONS

The present work, coupled with previous studies, has indicated

1. Mineralised vein systems are related to ENE, ESE fractures. These fractures control vein orientation. Mineralised systems occur near the intersection of such fractures. Large mineralised systems occur where the primary lineaments are crustal in scale and extensive. This view links goldfields and explains the regional distribution of fields without any particular bias to single structures.
2. The Mangana-Lyndhurst Lineament is almost certainly irrelevant and, if it exists at all, occurs in only part of the region and is offset from the fields of the zone. No exploration presumptions or focus should be linked to this concept. Where such NNW/NNE-trending features occur they are most likely either thrust fronts, which explains some of the curvature noted, or simple normal or reverse faults. The shear-jog concept does not explain the known distribution of veins, nor is it supported by any geophysical data set.
3. A fundamental relationship between the goldfields, the origin of the gold and granodiorites has not been disproven by the new data or associated reports and discussion. The role of the granitoids as a thermal engine and cause of fluid circulation should not be dismissed but this association does not offer any pragmatic means of targetting sites for further work. Direct lineament analysis and parallels with known sites, does.
4. Identification of trends, fractures and linears is notoriously difficult in very detailed data or if the view taken is too site specific. This explains the failure for the Netgold authors to find the patterns described here; they did not believe previous published work suggesting their existence and they have not taken the broader view of the setting of each site. Thus the absence of clear responses in, say, magnetic data at many sites near the vein locations is misleading when it is possible that the rocks of the near vicinity are altered and when it the coarser regional images displaying more data in finer detail so clearly show many of them. In all such cases the axis of the linear can be traced *through* the site by projection from beyond. The role of radiometric data as discriminator cannot be overlooked since it shows that the mineralised sites are more altered and that the change is abrupt.
5. There appear to have been very few significant producers in each field but all such producing mines can be linked to the primary trend system and radiometric alteration. Ground magnetic surveys have already been proven as useful discriminators and such surveys should form a standard means of assessing target areas of 1 to 2 sq km.

6. Altered areas have never been sought, nor analysed. There is scope for much research. There is already evidence that physical properties are changed in the host rocks (magnetic susceptibility and total counts, at least).

7. All previous exploration has been based on the presumption that any additional finds will be derived from vein systems or shallow alluvial deposits.

The entire bias of the Netgold study, and associated reports, was toward vein systems and particular systems in the centre of the region.

Little research has been undertaken on the deep lead system of NE Tasmania since the collapse of the tin price and it is possible that worthwhile deposits occur within the Tertiary sediments of the major river systems. Only the specialised catchment at Lisle, and part of the Lefroy area, have ever been seriously worked, or examined. There remains considerable alluvial potential.

Additional vein potential occurs at several sites, including the established fields and at places such as Retreat, Pipers Brook, Denison, Burns Creek and Mangana if we presume that the magnitude of the structural controls forms an accurate guide.

Each site near the focus of the regional fracture net should also be examined for the nature of any alteration nearby and for any bulk disseminated deposits. These have only been recorded in the Lisle area previously but have not been generally sought. Values in excess of 5 g/t have been reported in the Lisle zone. Any such concentration is most likely close to the locus of fluid control and the trend pattern defines these locations.

8. There is scope for much more analysis - after some recompilation and representation of the data sets.

9. The review indicates that a number of areas, not previously considered of any potential, may have been under-rated and that established areas have also been under-explored. The definition of a regional control system for the gold province means that each site or sub region must be treated on its merits until it can be dismissed. Only areas such as Lyndhurst (parts) and perhaps Forester can be placed in this category at this stage. Some sites, such as Denison, Mangana and Burns Creek, for example, have not been given sufficient attention.

RECOMMENDATIONS

The judgments and conclusions described in this review could be tested, refined and enhanced by re-compilation and treatment of the data available. While such re-processing would not alter the limitations in coverage of radiometric data, or gravity data, it would transform them and allow easier identification of boundaries and correlations. Many trends are also not easily defined in the subtle magnetic data due to its presentation as a total field residual. Report 1994/08 includes two very small maps where some filtering was tested. The results are much sharper and more useful but the map scale prevents any useful conclusions.

1. All data sets should be reprocessed and presented at a standard scale - say 1: 50000. All geological maps should be rescaled to the same value.
2. Gravity and magnetic maps should be reprocessed into first and second derivative formats in order to sharpen location of unit boundaries and clarify trend location. The same kind of treatment may also assist use of the radiometric data but some trials are advised. The radiometric data should be plotted in channel format in order to test whether alteration changes are indeed being mapped. Total count presentation, while useful, is not necessarily the best format.
3. Radiometric methods should be used as target discriminators.
4. Ground magnetic methods are likely to prove the most effective means of discriminating between significant and also-ran type sites within a field and may also allow comprehensive target selection within a field (see South Alberton example, Appendix 1). Such methods have the double advantages of being low cost as well as able to offer good coverage.
There is absolutely no point in further, higher density, aeromagnetic surveys. No airborne survey possesses the necessary resolution in this environment for any purpose other than for assesment of regional or semi-regional structure.
5. Any exploration licence of any dimension (>5 sq km) should be covered by a gravity survey with a station spacing of no more than 500 m. Gravity data offer some of the best means of defining large structures but any new acquisition of this type must be inset in an enlarged regional coverage and public domain access of the surrounding areas should also be surveyed.
6. There is scope for quantitative assessments in order to define altered rock masses, granitoid relationships, form of fractures in depth and control or setting of sites. Some older examples of this type of treatment appear in the appendices.

Report submitted on behalf of Leaman Geophysics

by

A handwritten signature in cursive script that reads "D. E. Leaman". The signature is written in black ink and is positioned above the printed name.

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

Date: 30/5/94

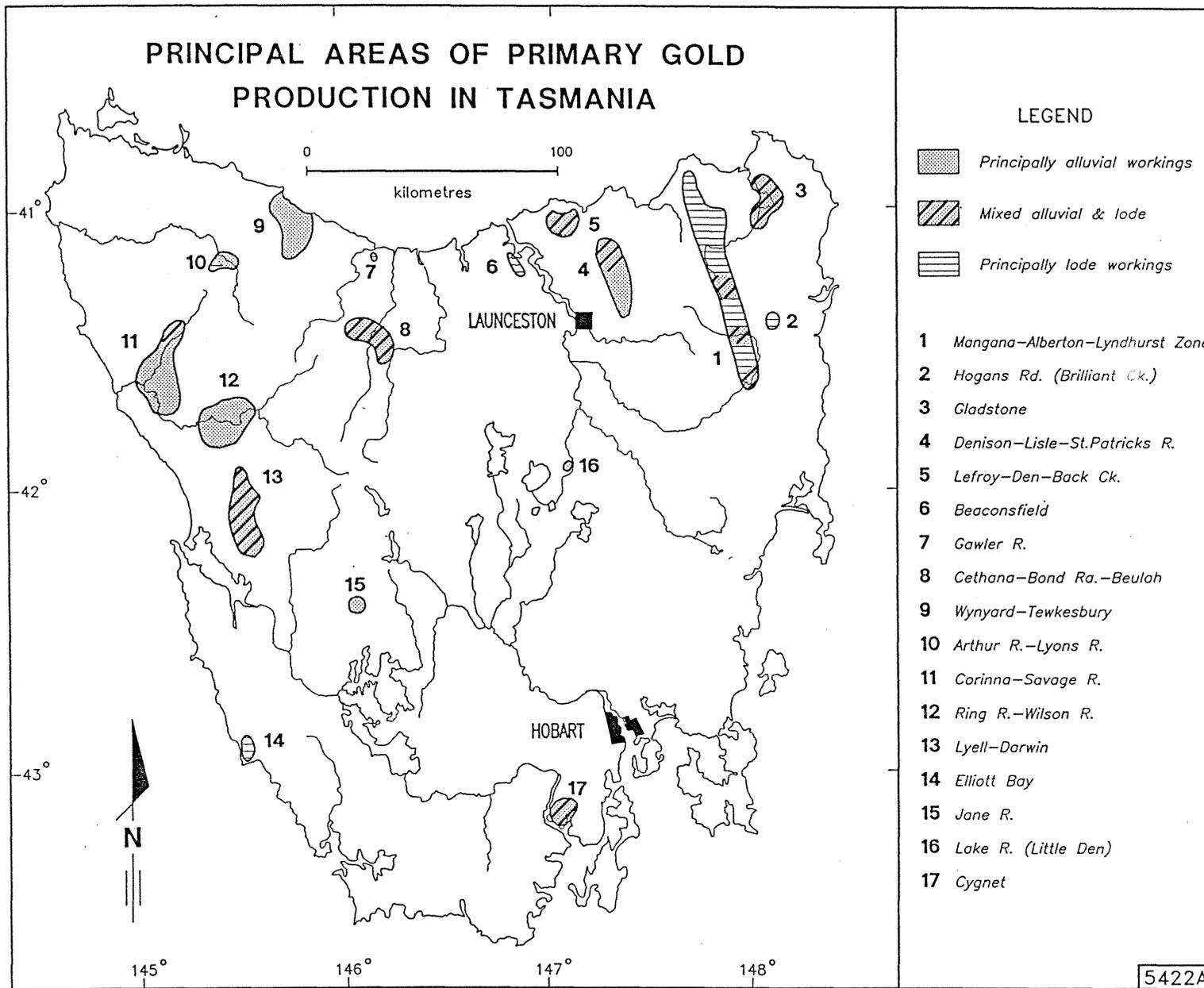


Figure 1. The distribution of major goldfields in Tasmania

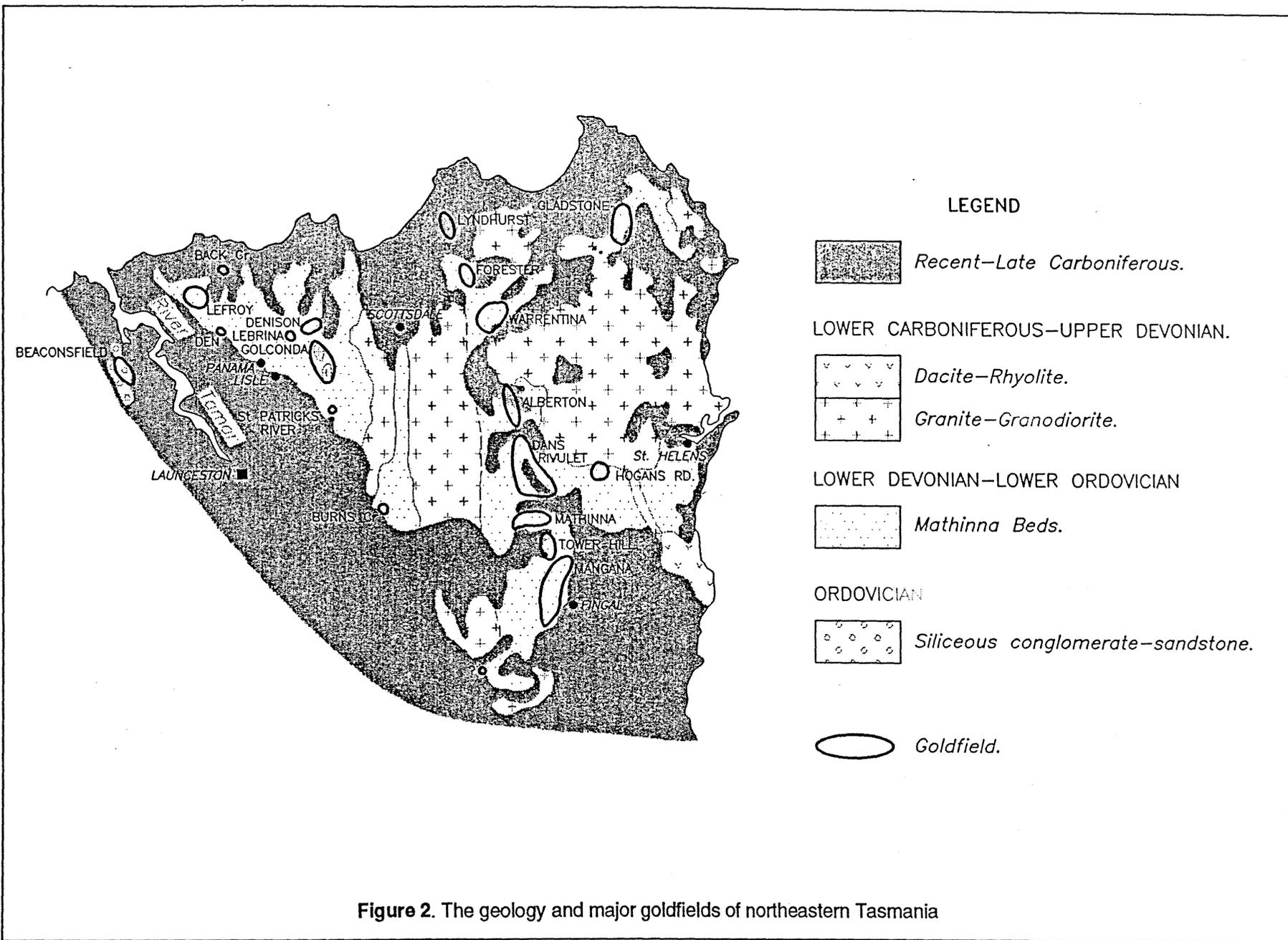


Figure 2. The geology and major goldfields of northeastern Tasmania

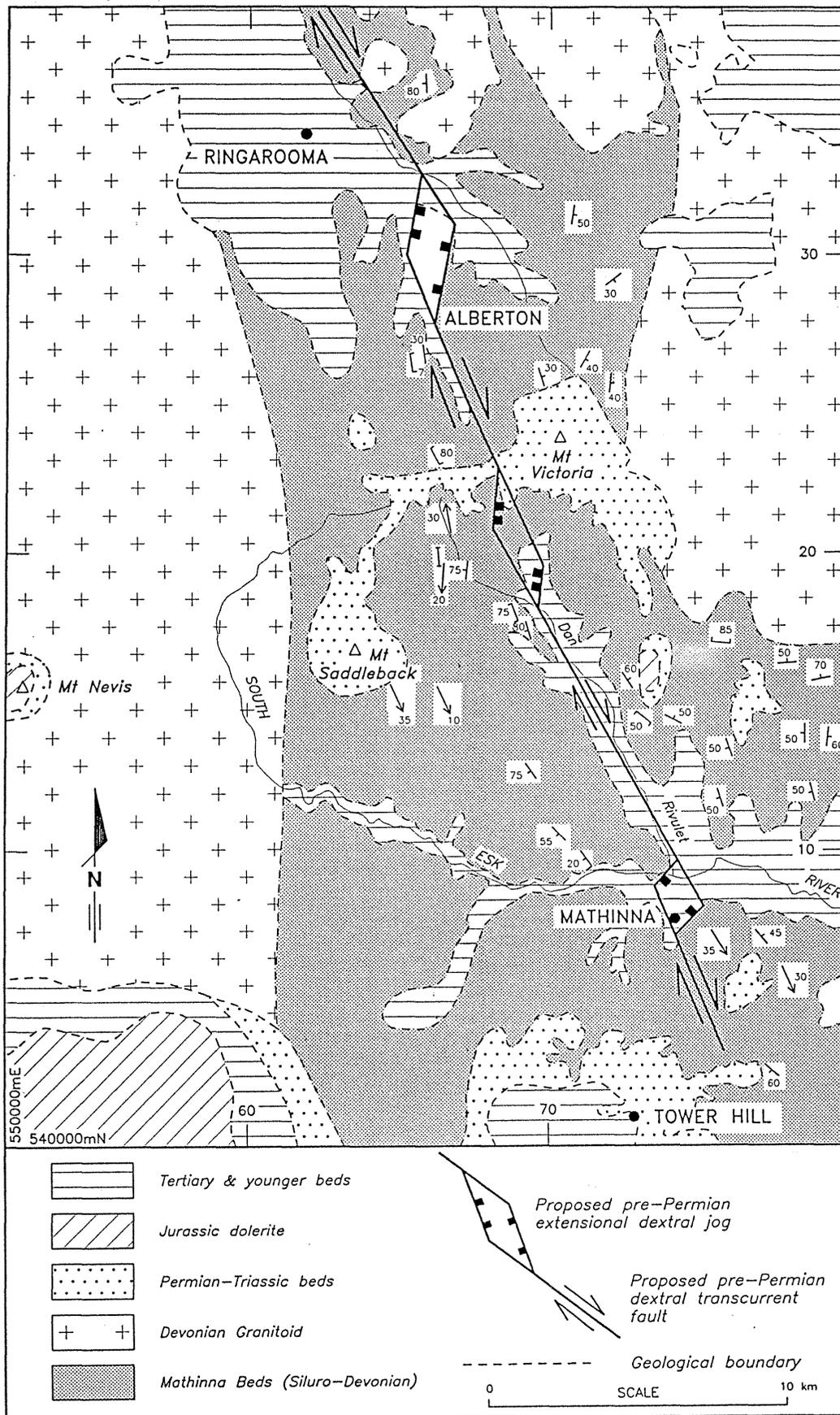


Figure 3

Simplified geology of Tower Hill — Ringarooma area, showing proposed pre-Permian extensional jog and dextral transcurrent fault.

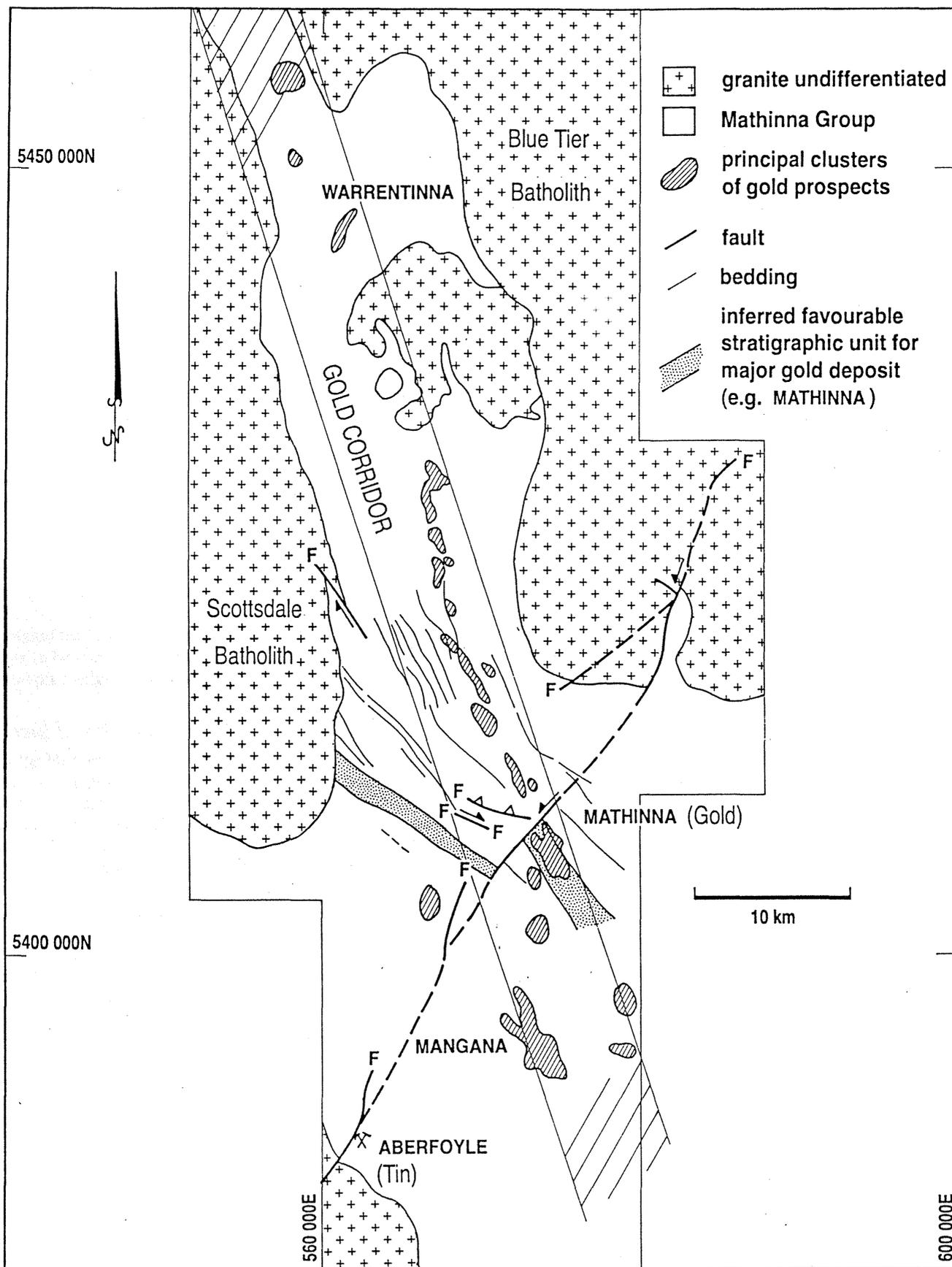
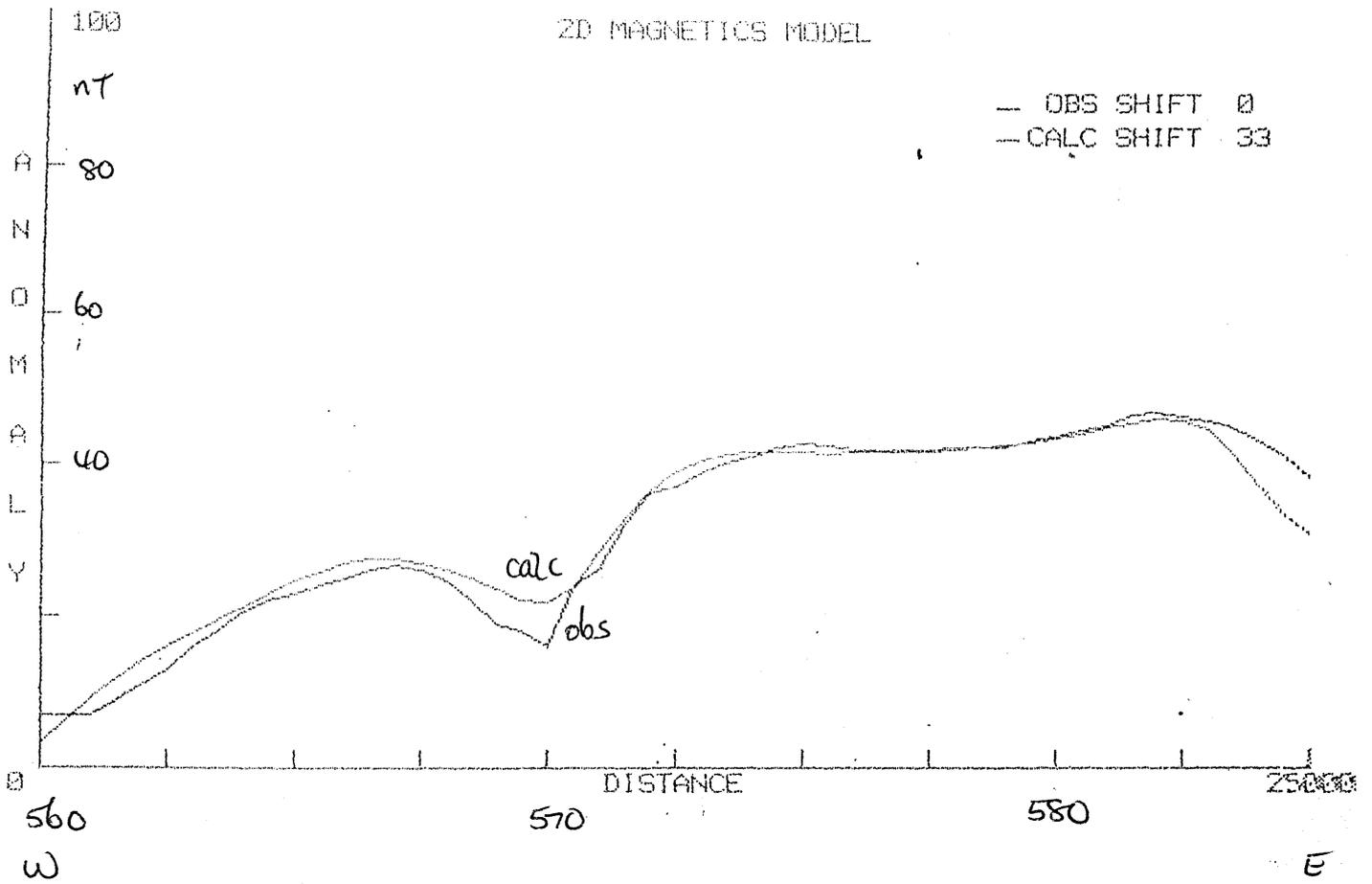
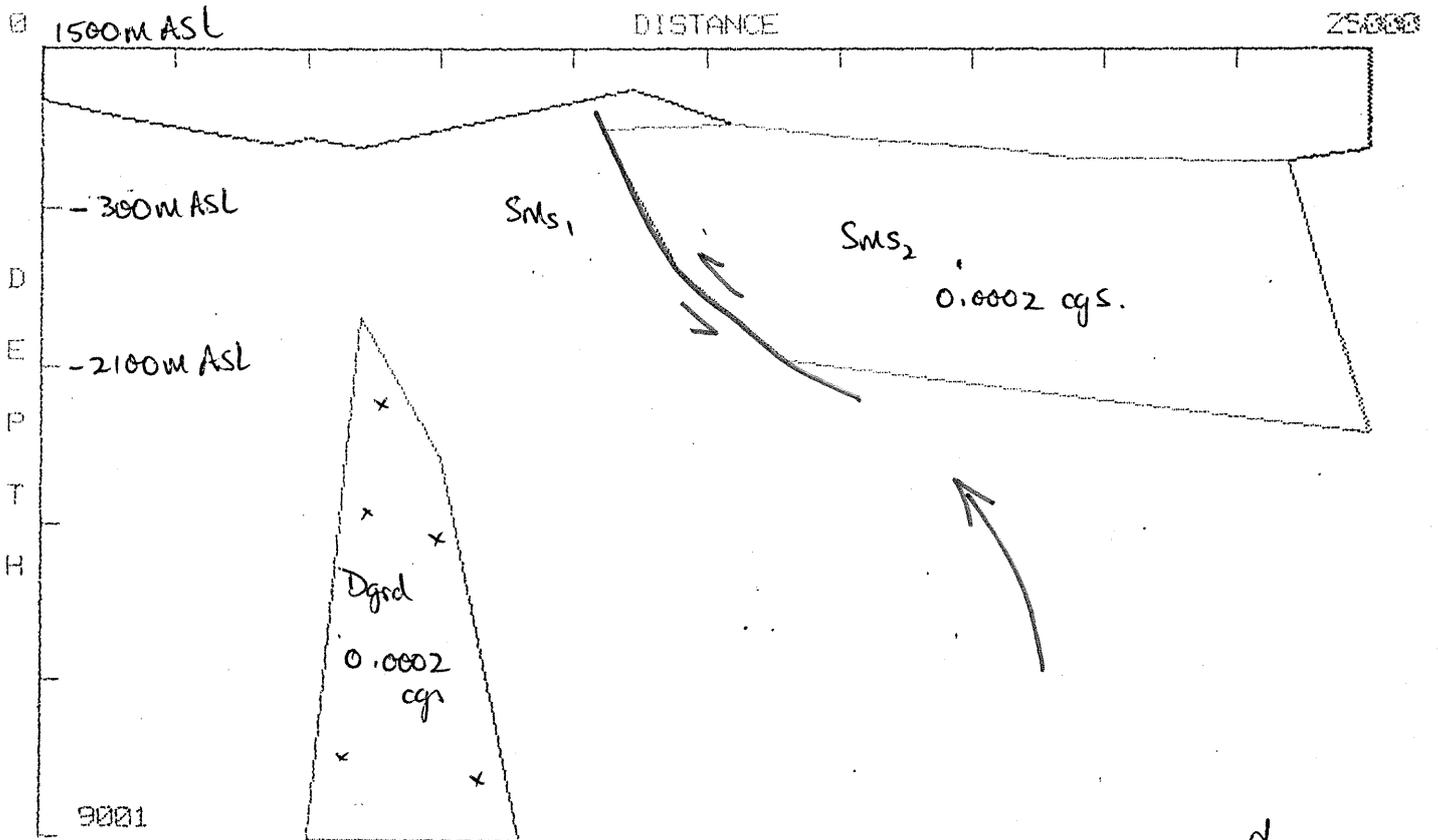


Figure 4 The Mathinna-Alberton Gold Lineament. The 70 by 6 km corridor contains the majority of the gold occurrences in the region. Bedding trends range from being parallel to the lineament to being markedly oblique to it. The main feature of this diagram is the NE-trending transfer fault zone which passes north of Mathinna. It has been extended to show how it appears also to control the position of the major Aberfoyle tin deposit, southwest of Mathinna. Sinistral offsets of about 500-600 m are apparent on this structure in the granites of the Blue Tier Batholith.

2D MAGNETICS MODEL

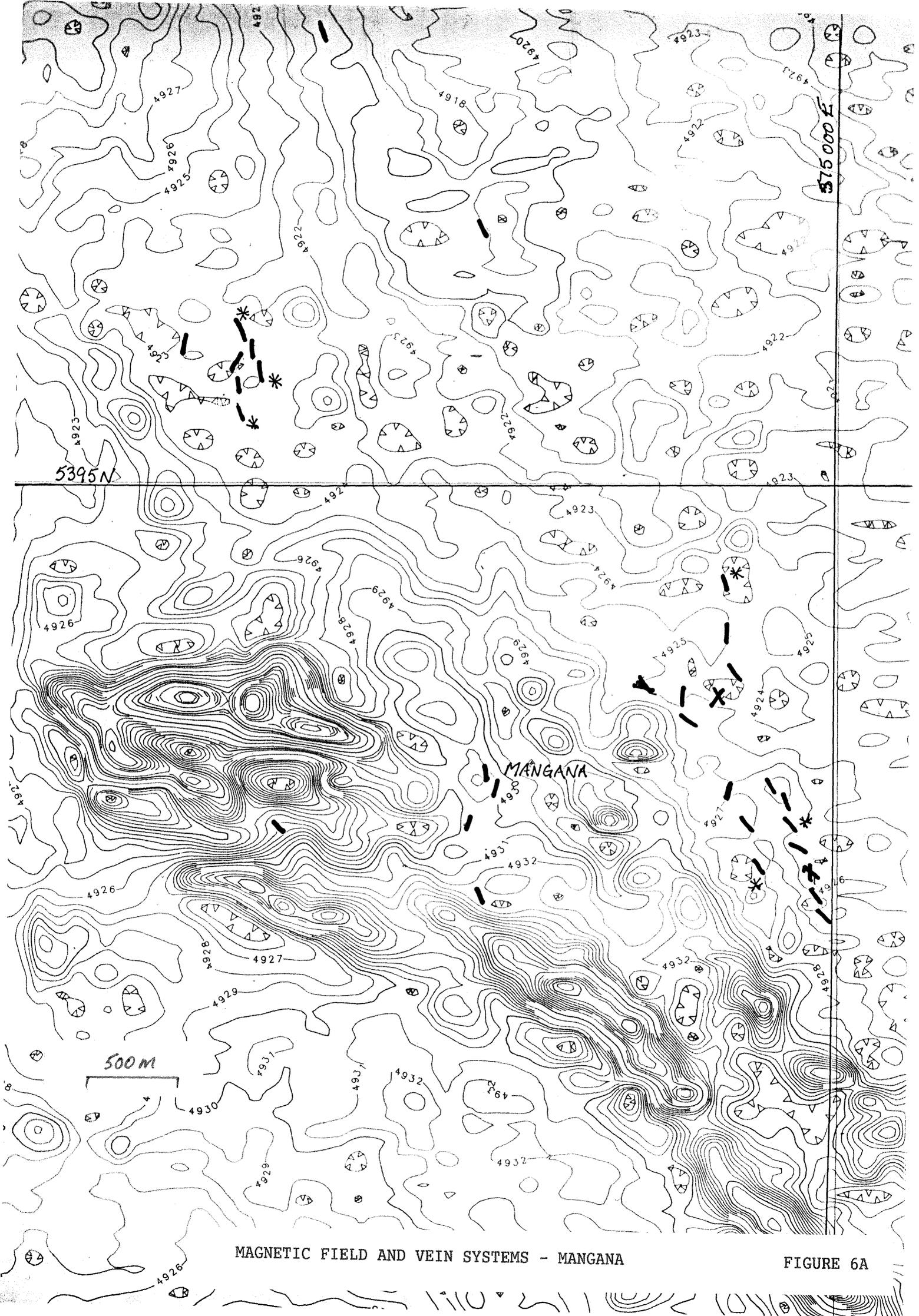


MATHINNA GOLD12 5400N 560-585E 1500M ASL



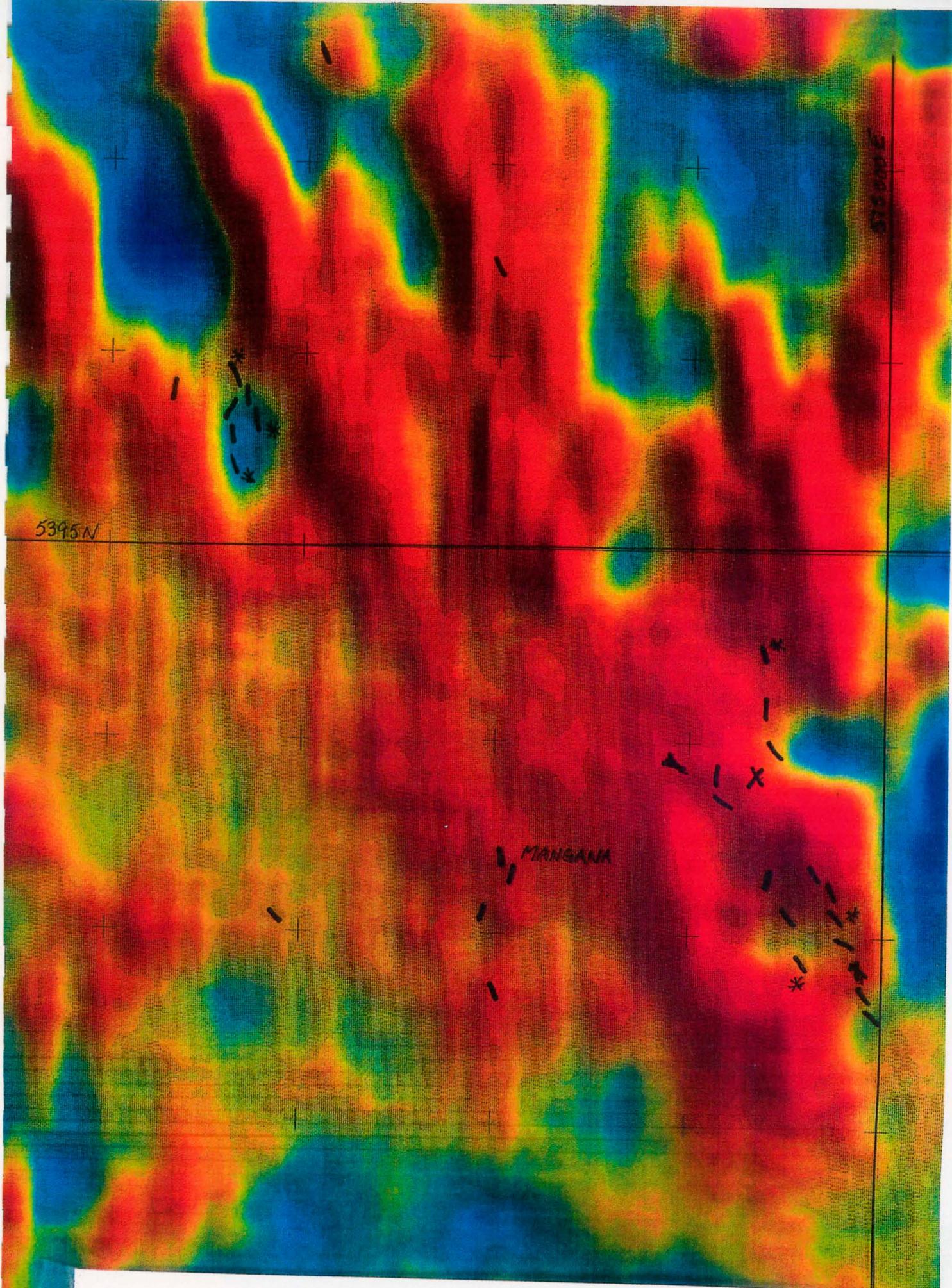
19/11

LEAMAN GEOPHYSICS
GPO Box 320 D
Hobart Tas 7001
Australia



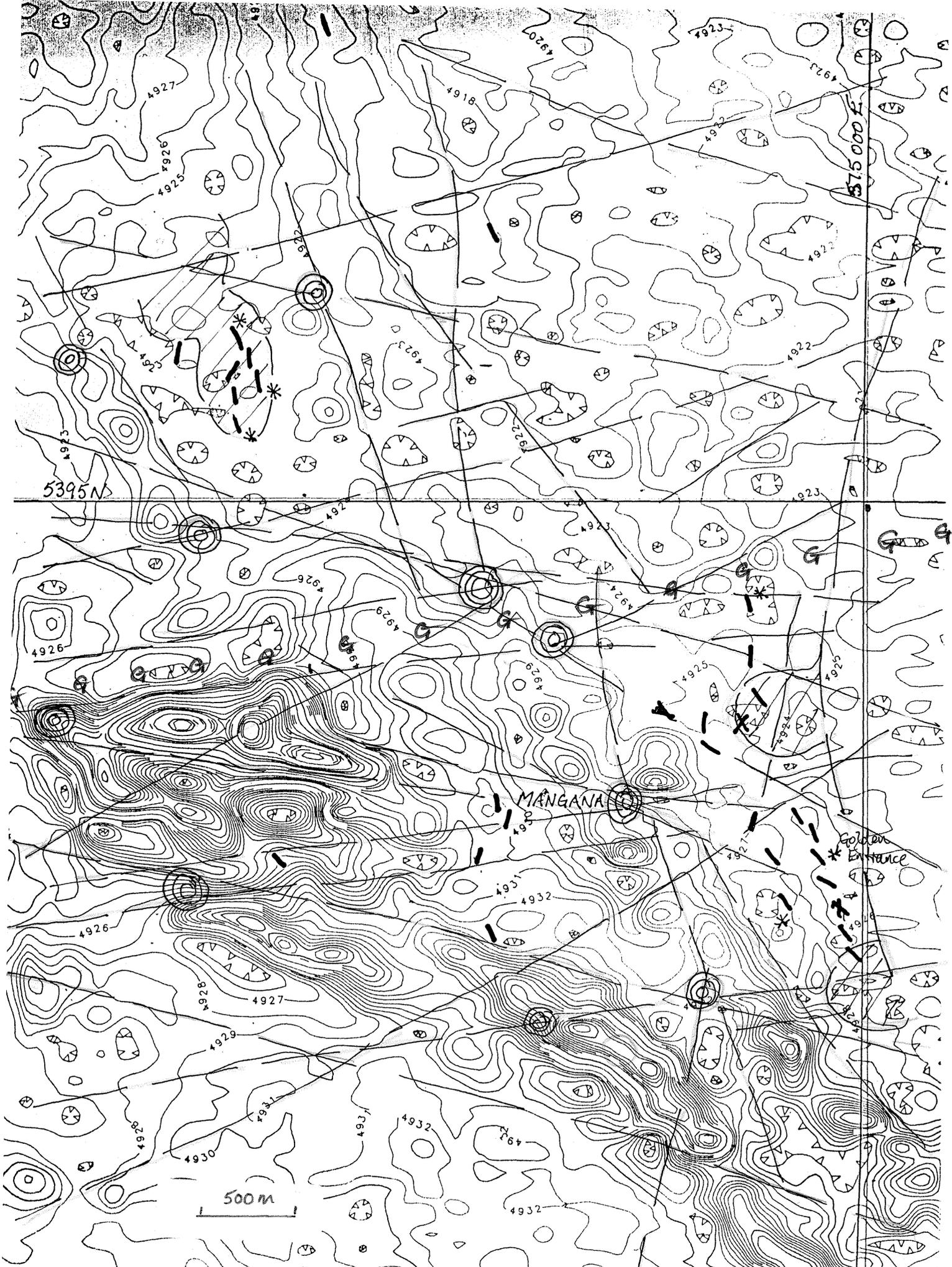
MAGNETIC FIELD AND VEIN SYSTEMS - MANGANA

FIGURE 6A



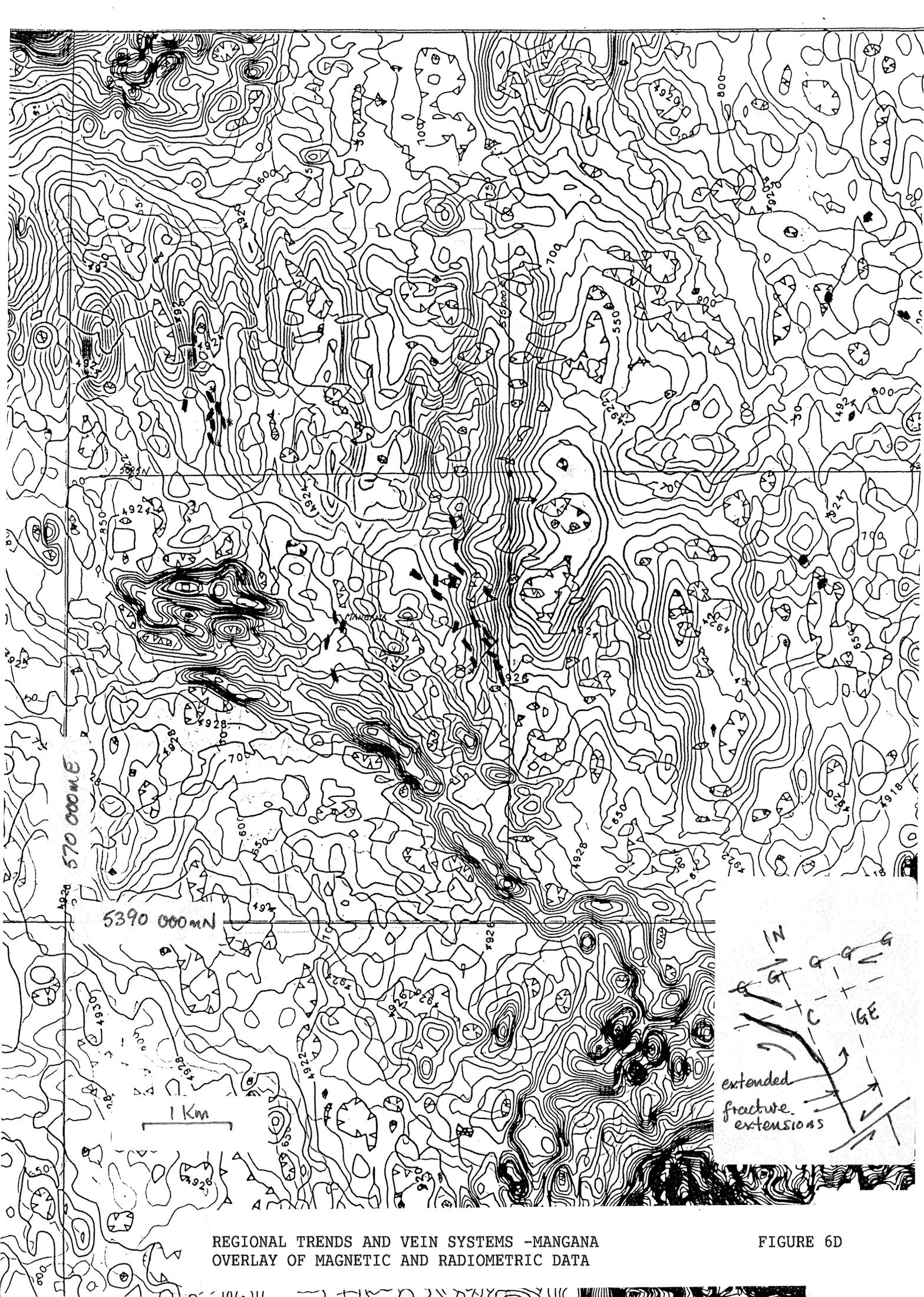
TOTAL COUNT RADIOMETRICS AND VEIN SYSTEMS - MANGANA

FIGURE 6B



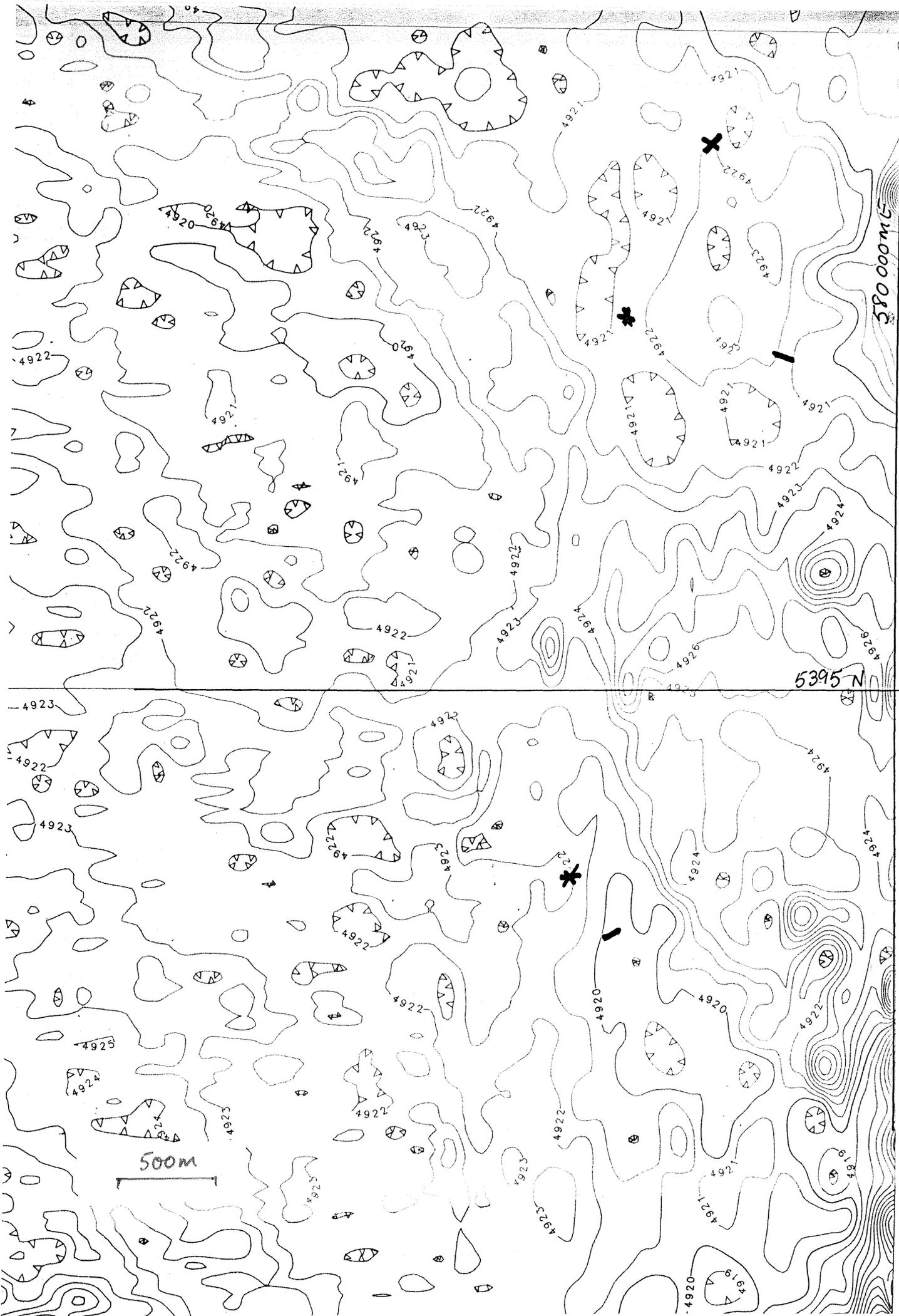
LOCAL TRENDS AND VEIN SYSTEMS - MANGANA

FIGURE 6C



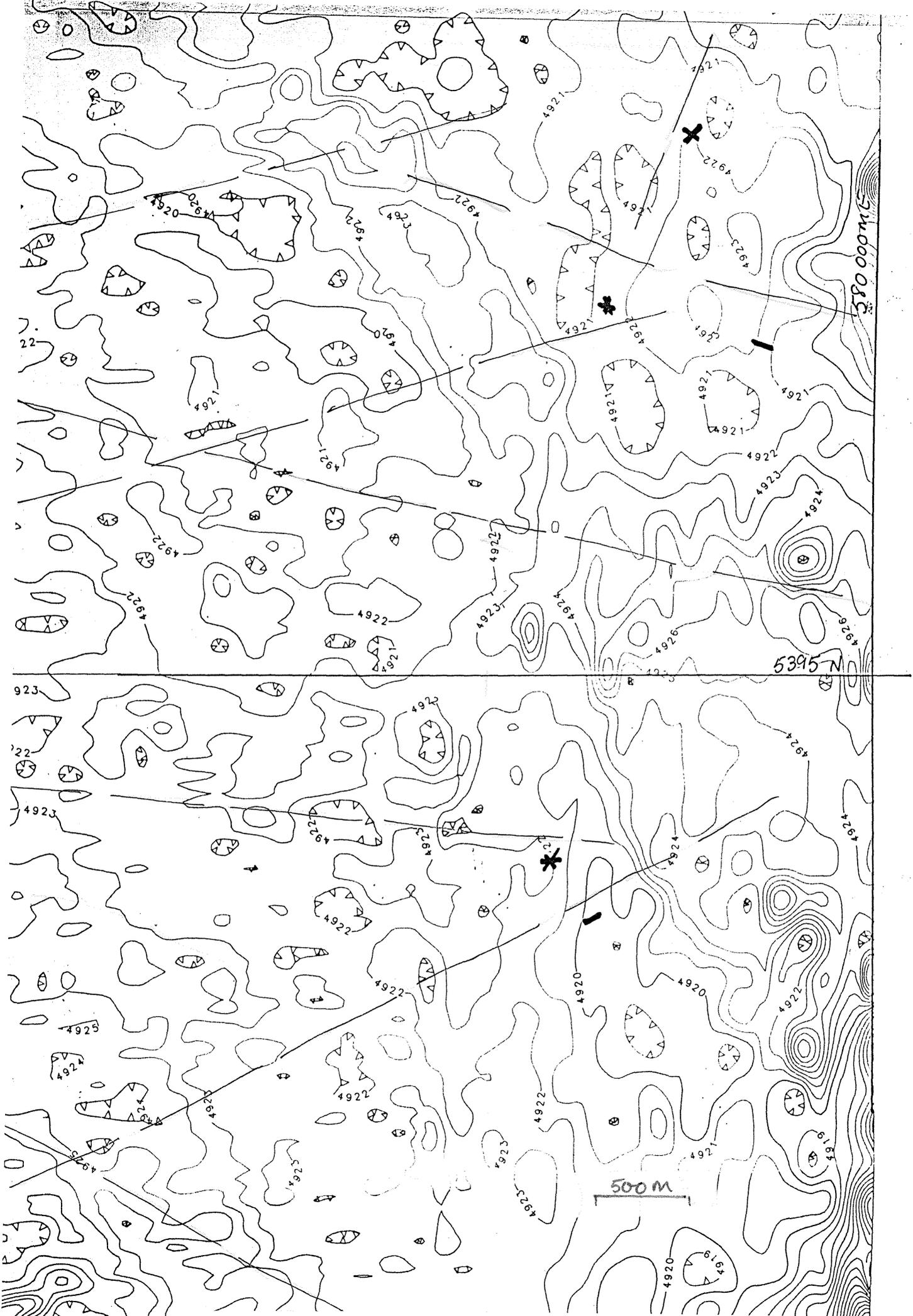
REGIONAL TRENDS AND VEIN SYSTEMS -MANGANA
 OVERLAY OF MAGNETIC AND RADIOMETRIC DATA

FIGURE 6D



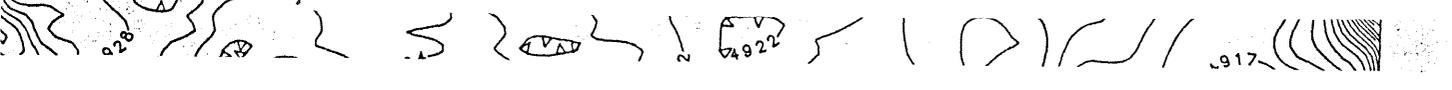
MAGNETICS AND VEIN SYSTEMS - EAST MANGANA

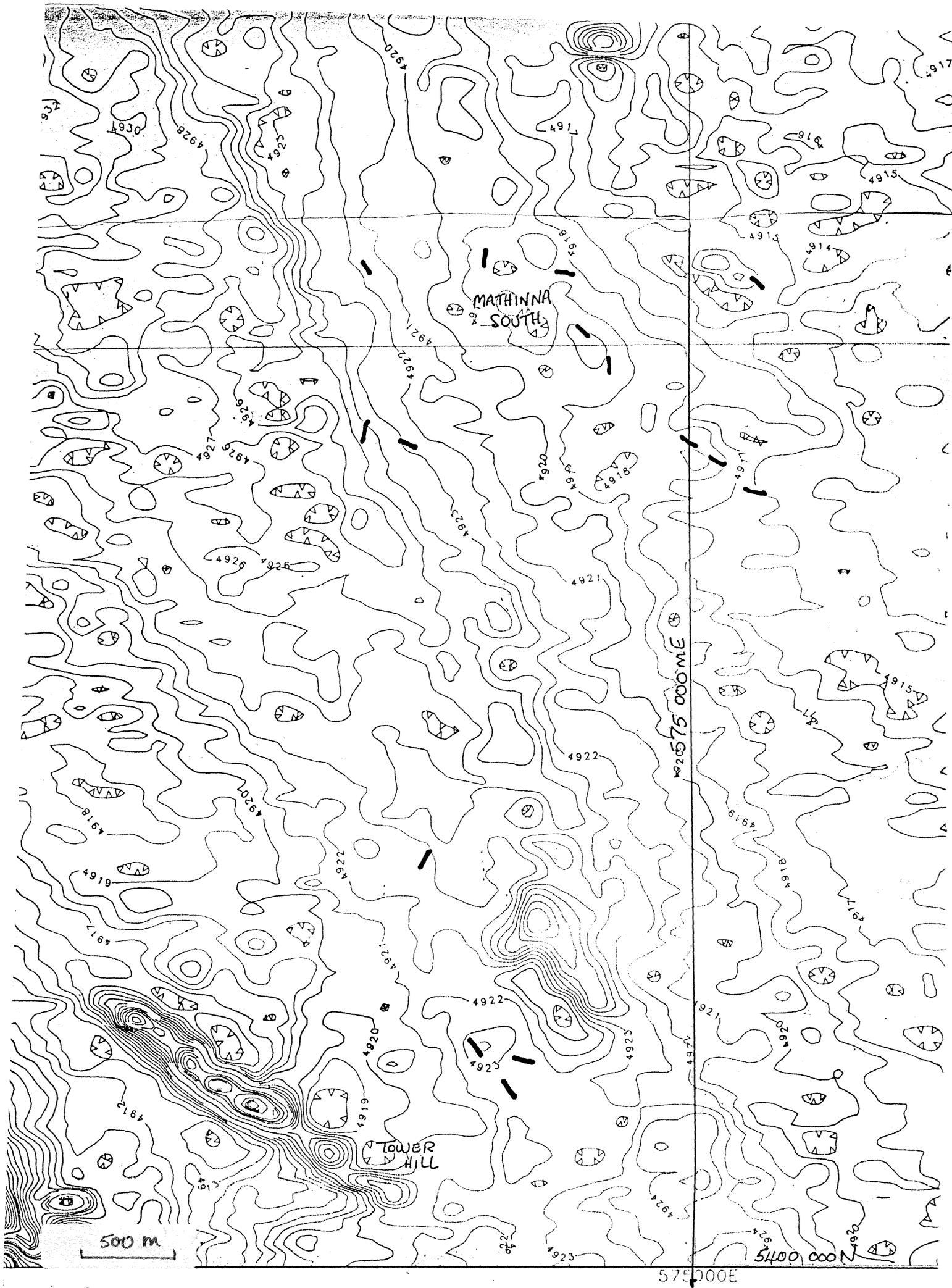
FIGURE 7A



LOCAL TRENDS AND VEIN SYSTEMS - EAST MANGANA

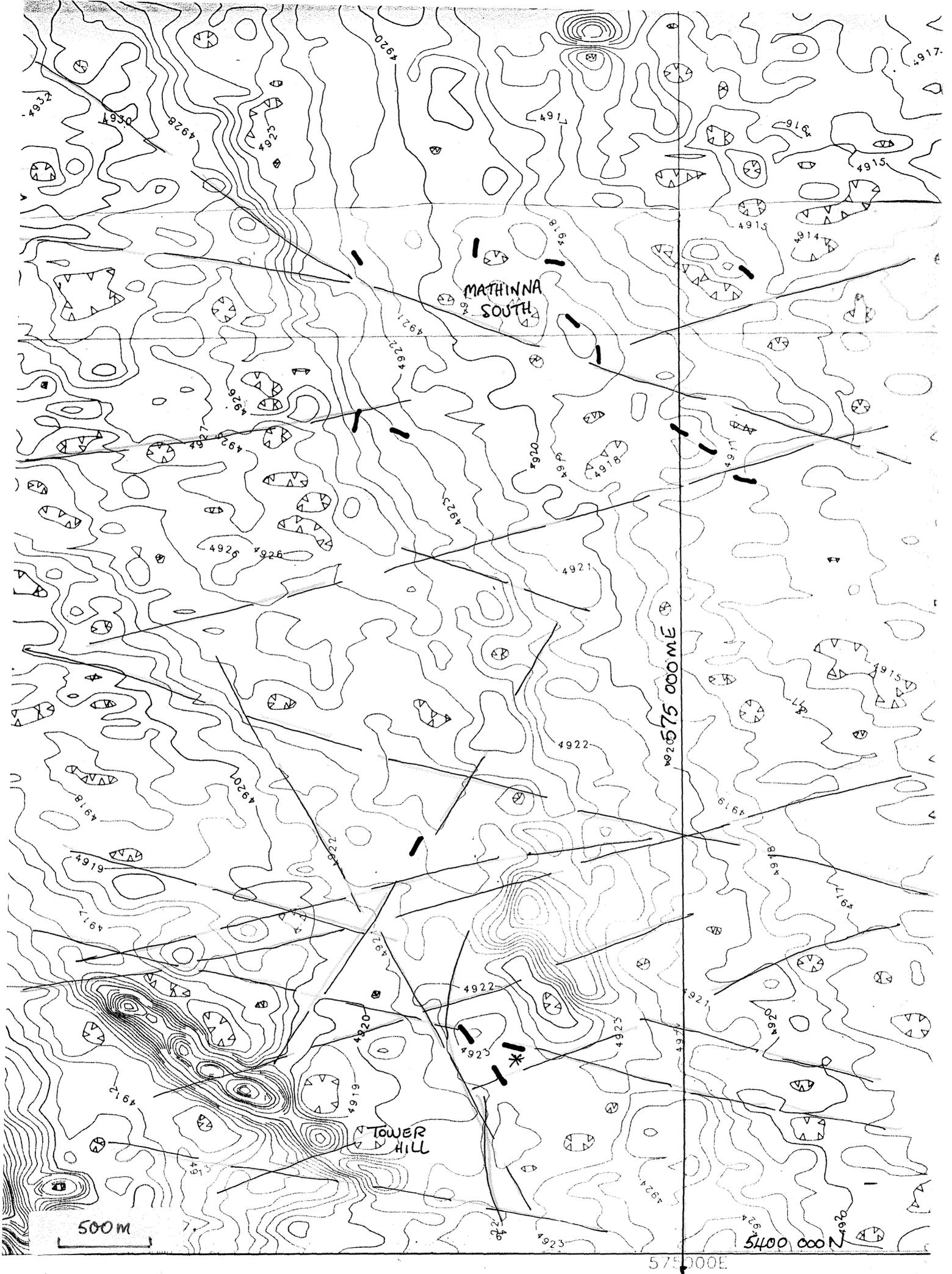
FIGURE 7B





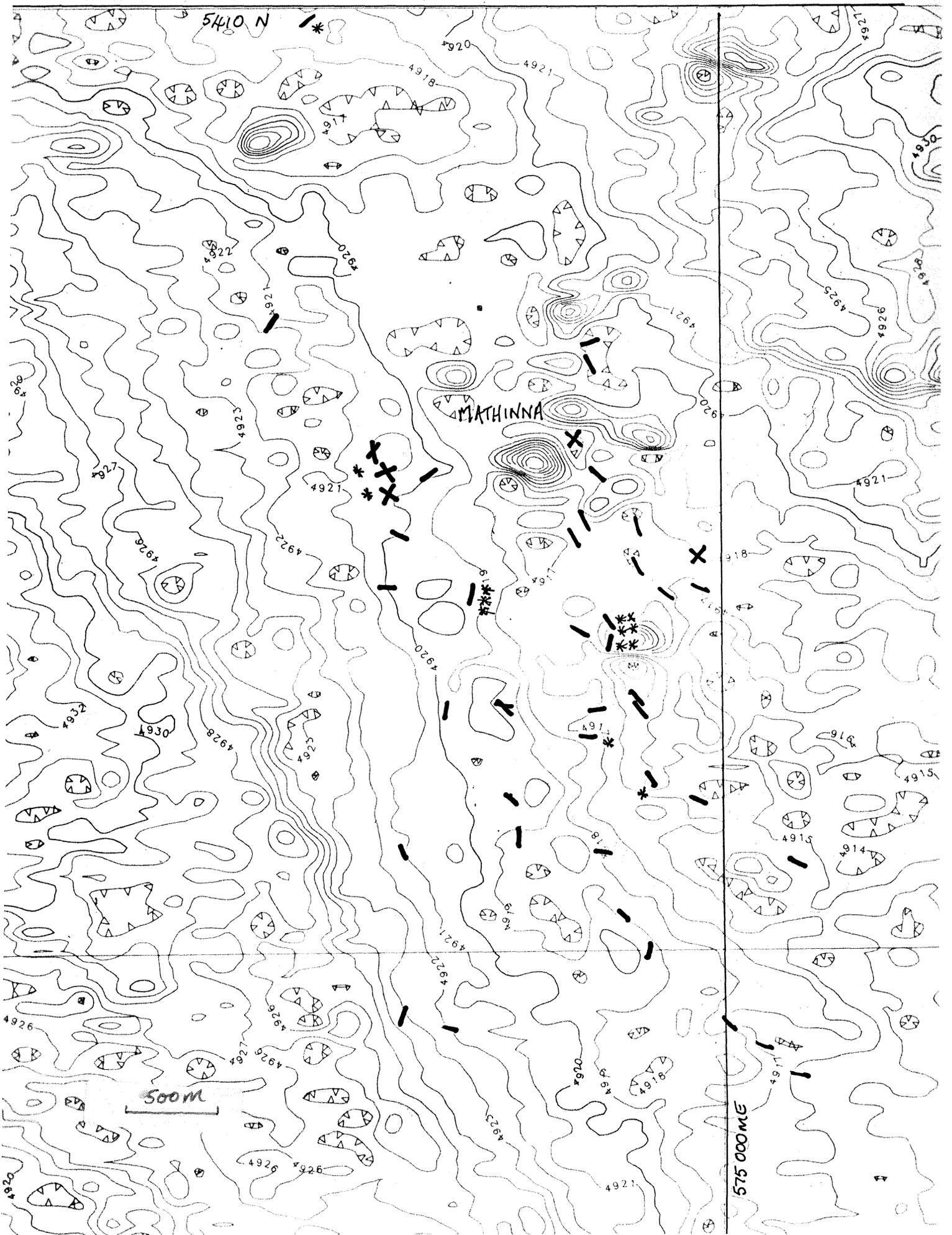
MAGNETICS AND VEIN SYSTEMS - TOWER HILL NORTH

FIGURE 8A



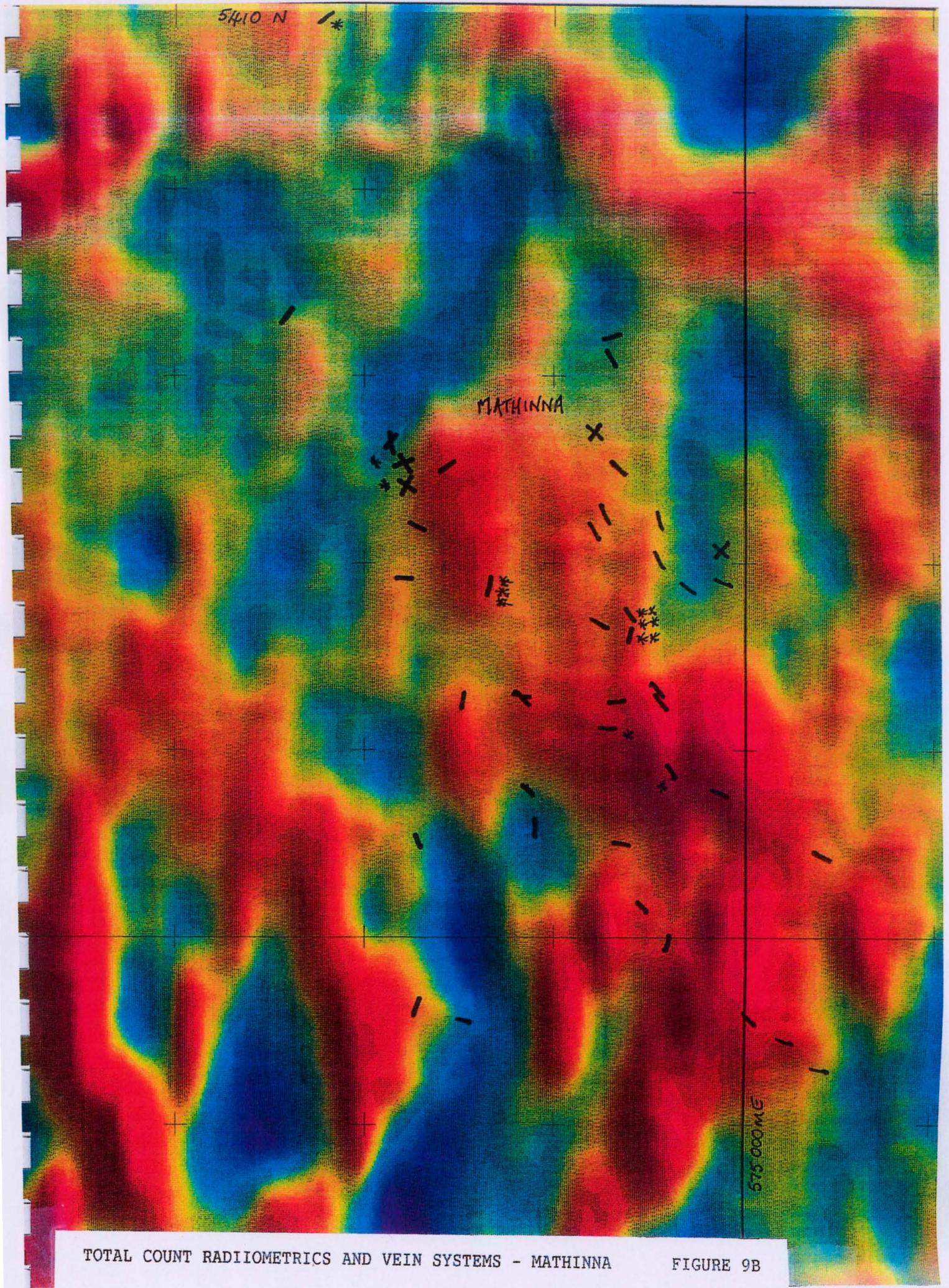
LOCAL TRENDS AND VEIN SYSTEMS - TOWER HILL NORTH

FIGURE 8B



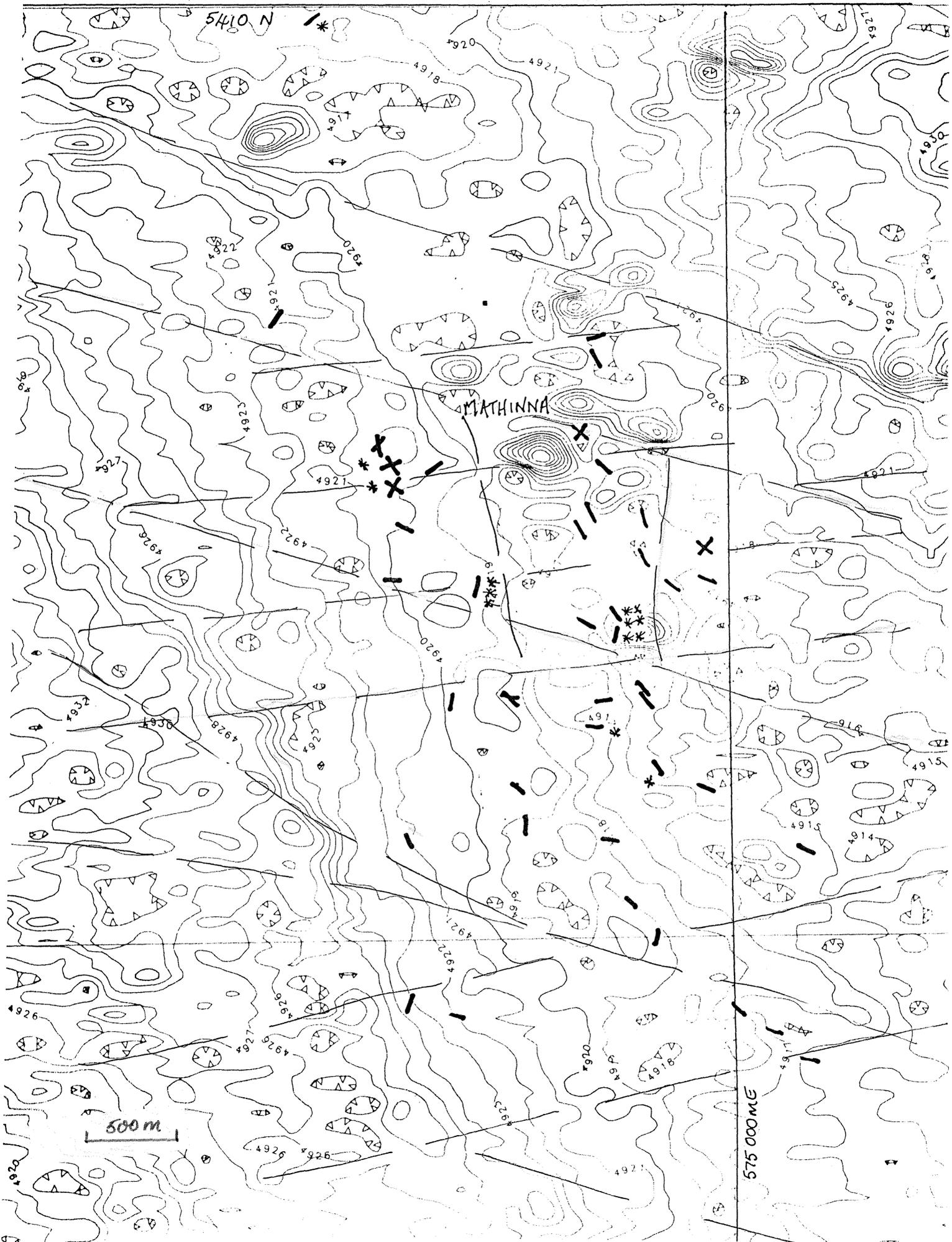
MAGNETICS AND VEIN SYSTEMS - MATHINNA

FIGURE 9A



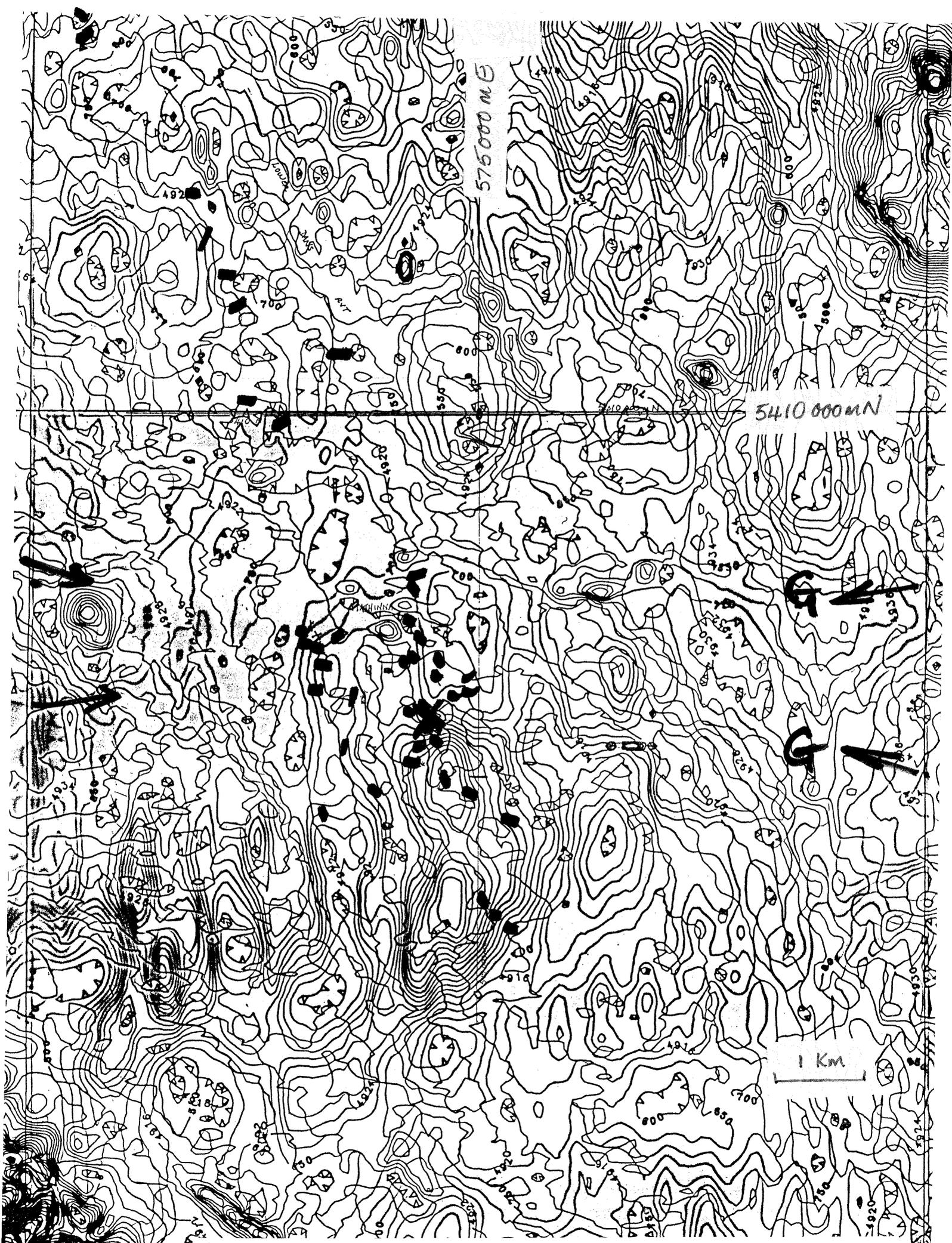
TOTAL COUNT RADIOMETRICS AND VEIN SYSTEMS - MATHINNA

FIGURE 9B



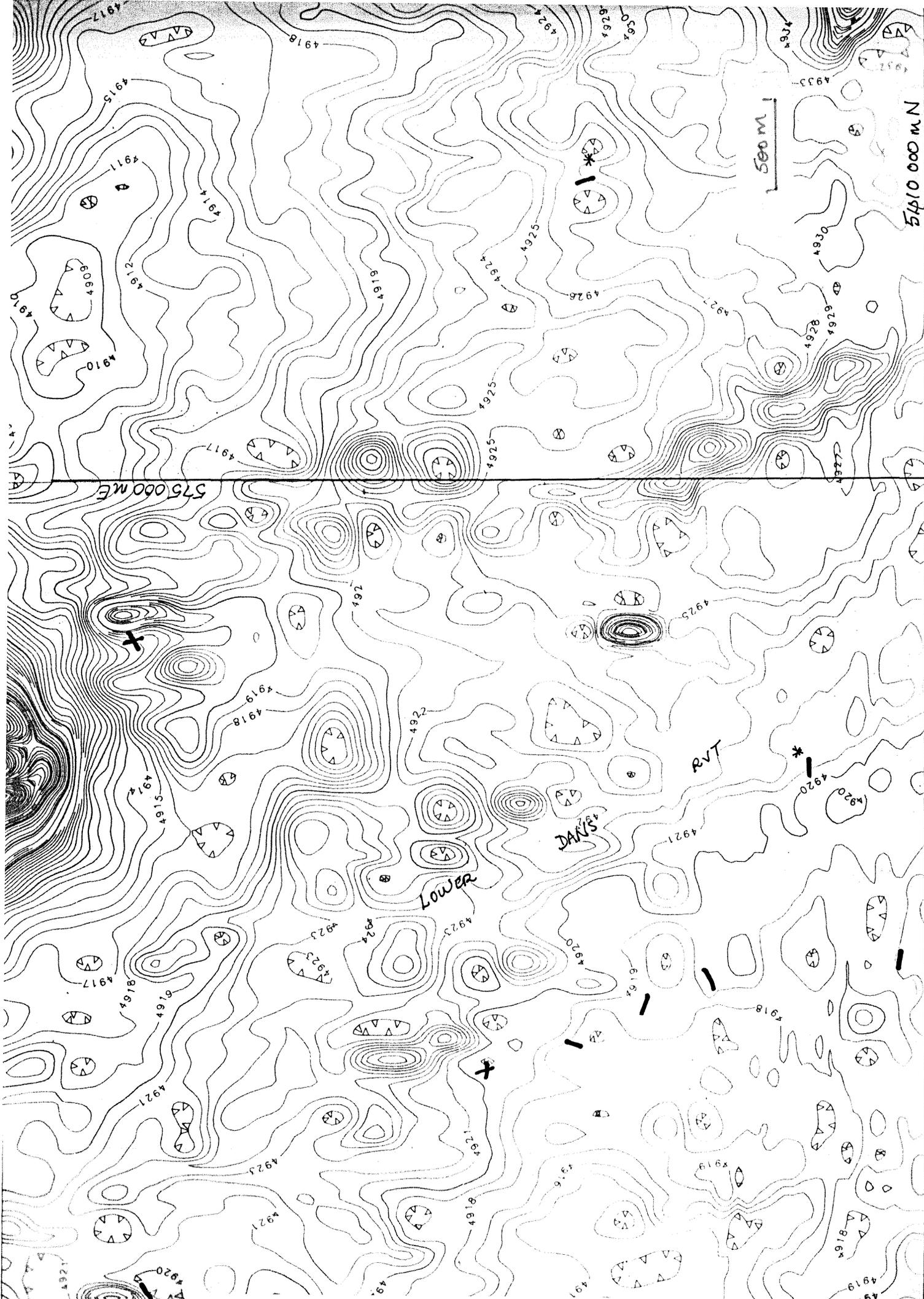
LOCAL TRENDS AND VEIN SYSTEMS - MATHINNA

FIGURE 9C



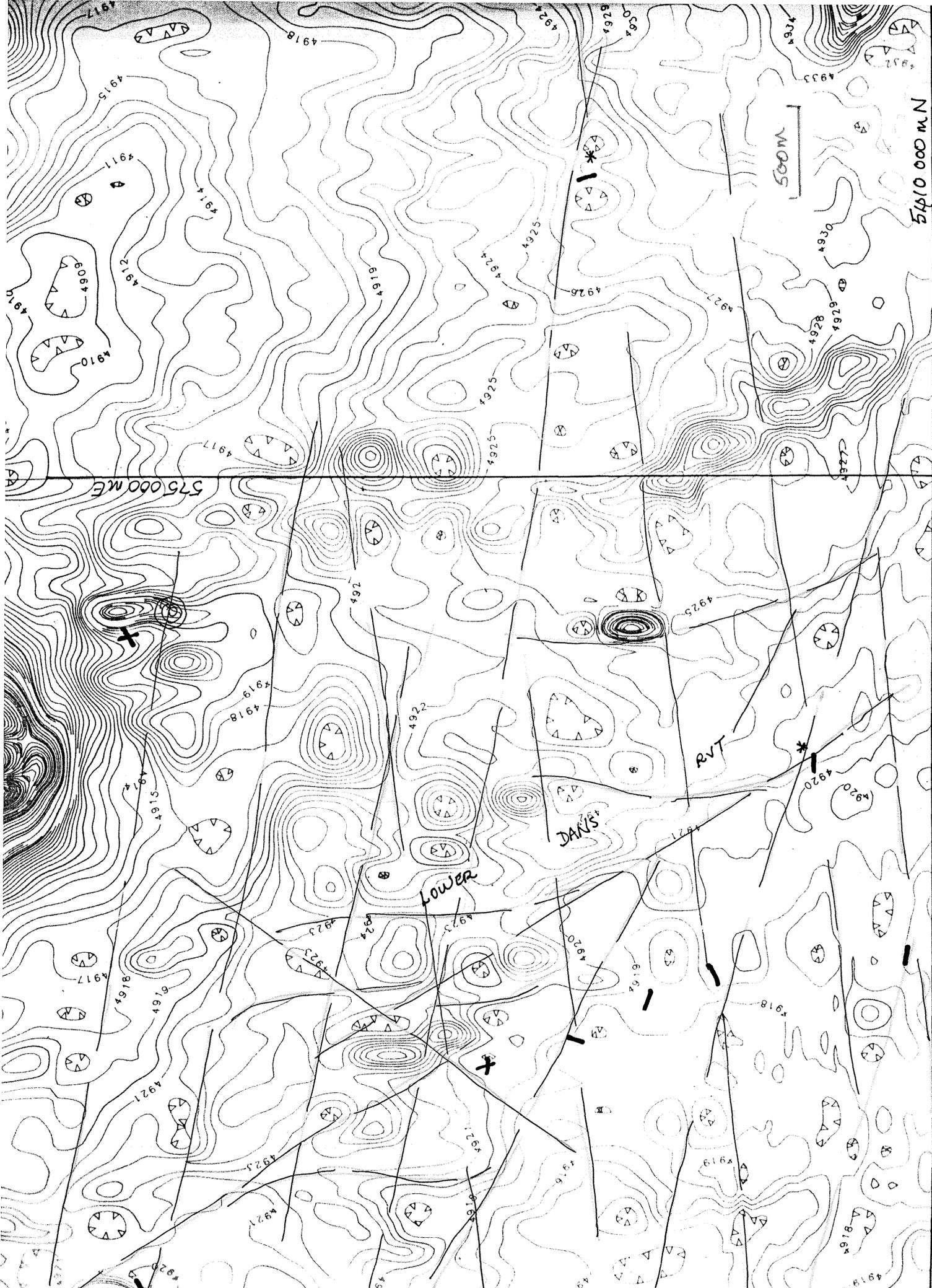
REGIONAL TRENDS AND VEIN SYSTEMS - MATHINNA
MAGNETICS AND RADIOMETRICS SUPERIMPOSED

FIGURE 9D



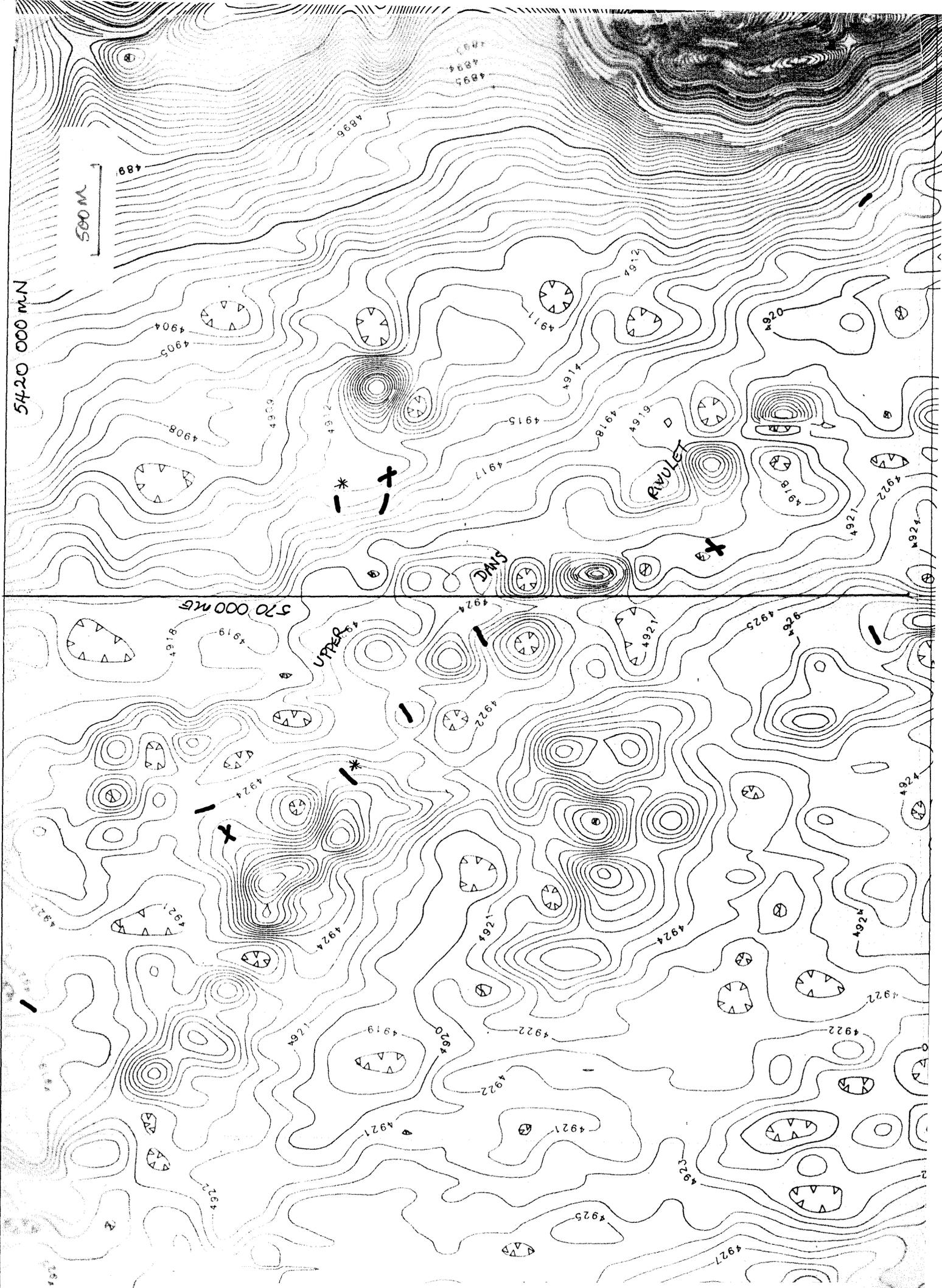
MAGNETICS AND VEIN SYSTEMS - LOWER DANS RIVULET

FIGURE 10A



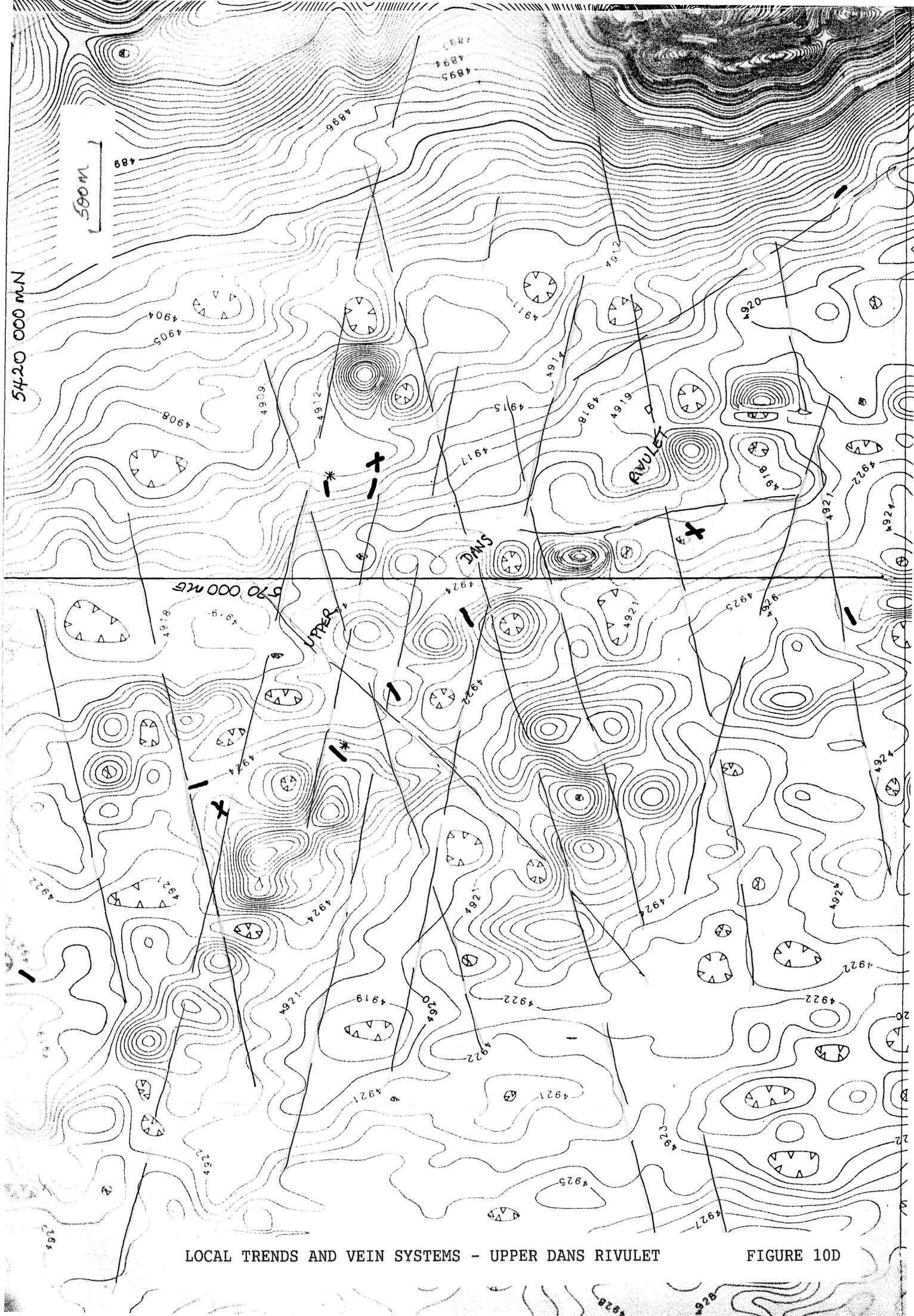
LOCAL TRENDS AND VEIN SYSTEMS - LOWER DANS RIVULET

FIGURE 10B



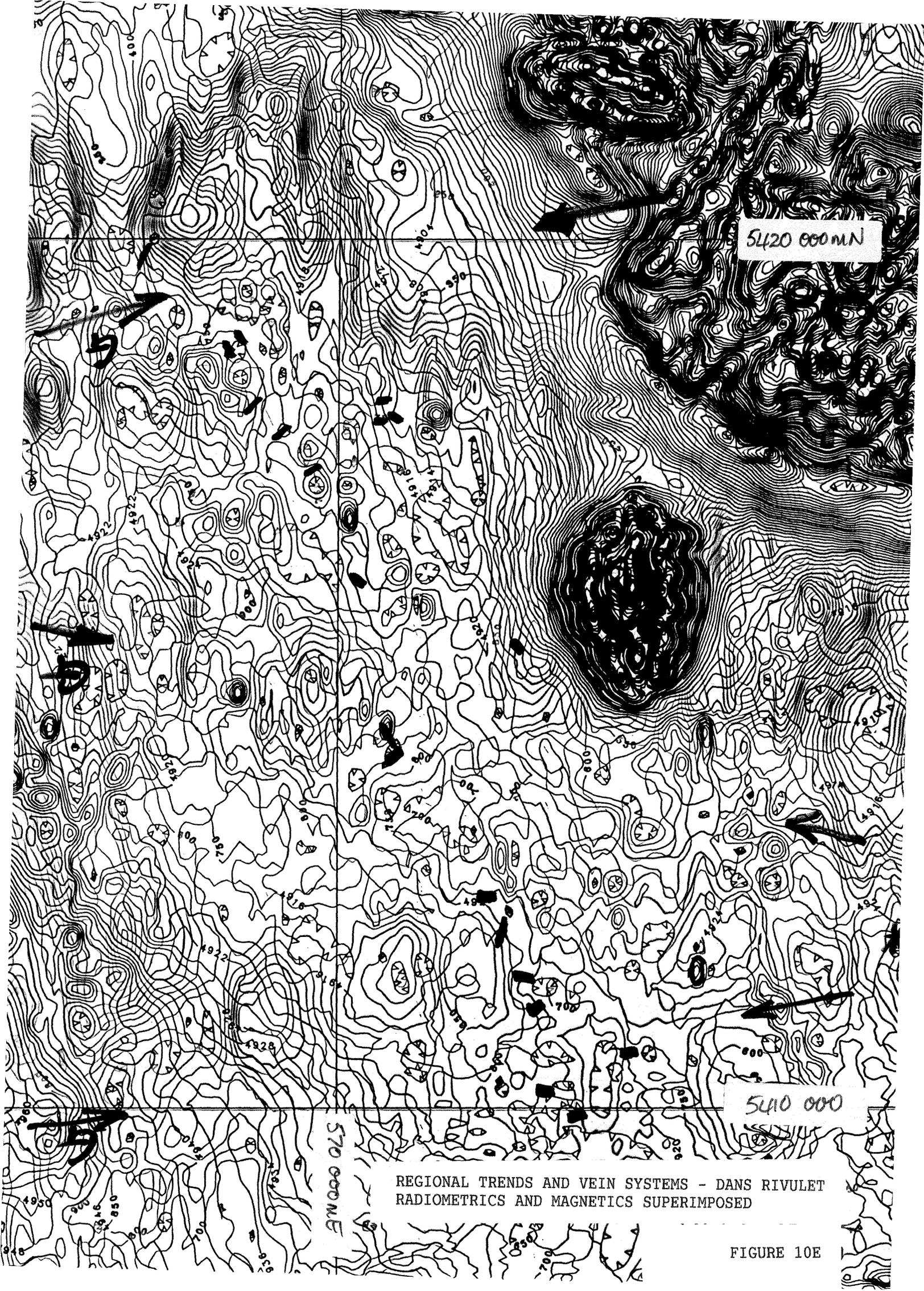
MAGNETICS AND VEIN SYSTEMS - UPPER DANS RIVULET

FIGURE 10C



LOCAL TRENDS AND VEIN SYSTEMS - UPPER DANS RIVULET

FIGURE 10D



5420 000 MN

5410 000

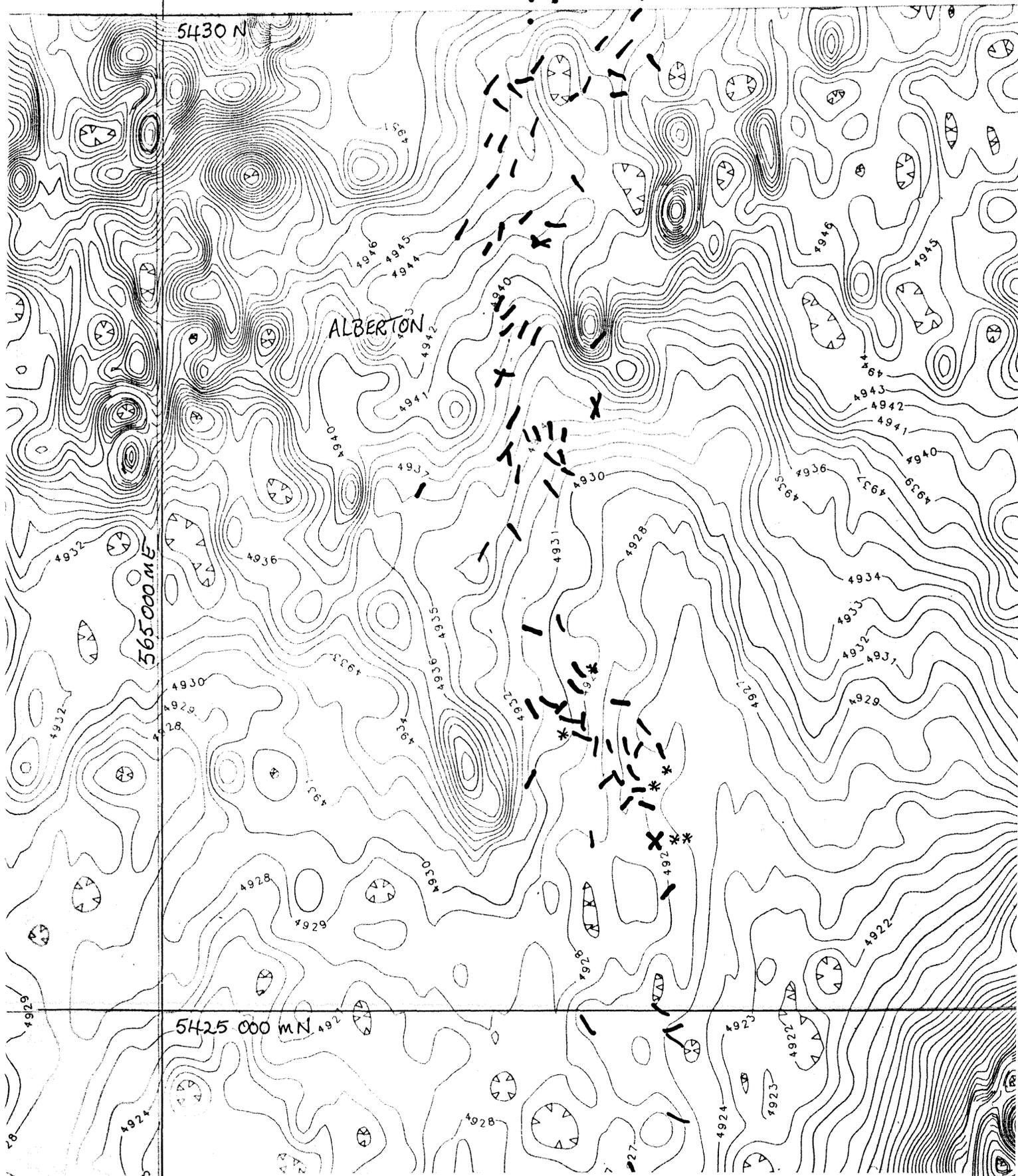
570 000 ME

REGIONAL TRENDS AND VEIN SYSTEMS - DANS RIVULET
RADIOMETRICS AND MAGNETICS SUPERIMPOSED

FIGURE 10E

LE GOLD - Residual VICT

1 Km

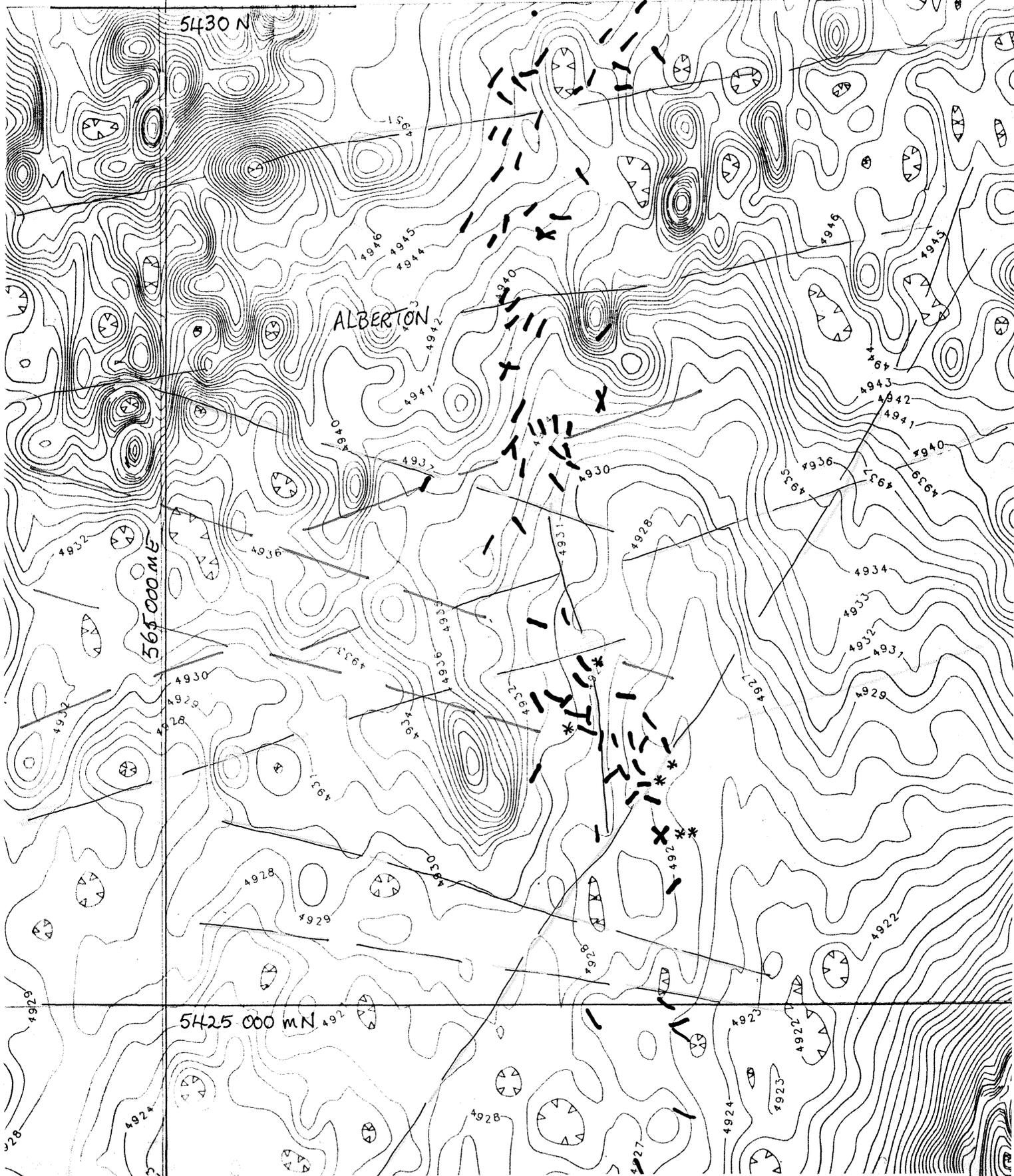


MAGNETICS AND VEIN TRENDS - ALBERTON

FIGURE 11A

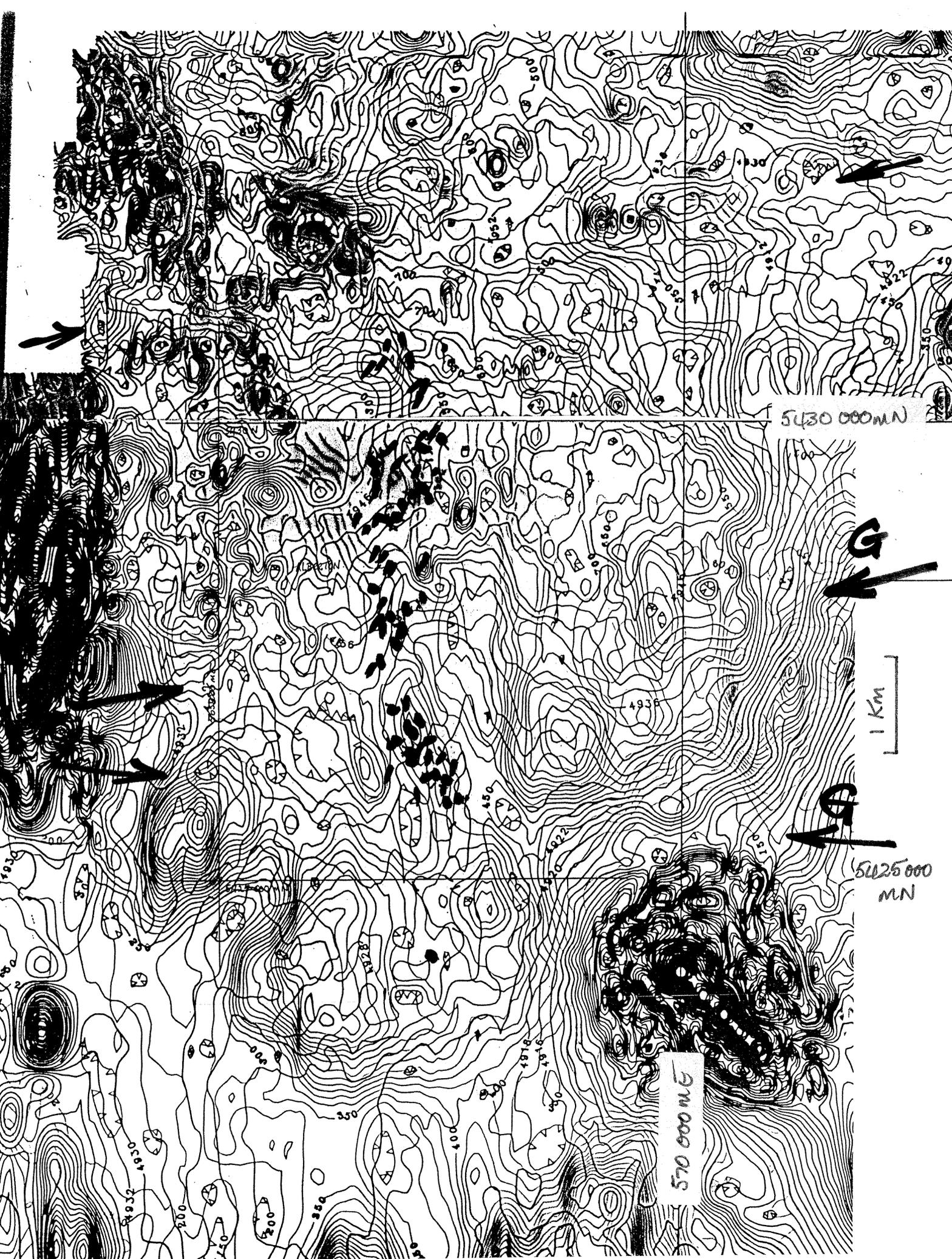
ALBERTON - Residual VICT

1 Km



LOCAL TRENDS AND VEIN SYSTEMS - ALBERTON

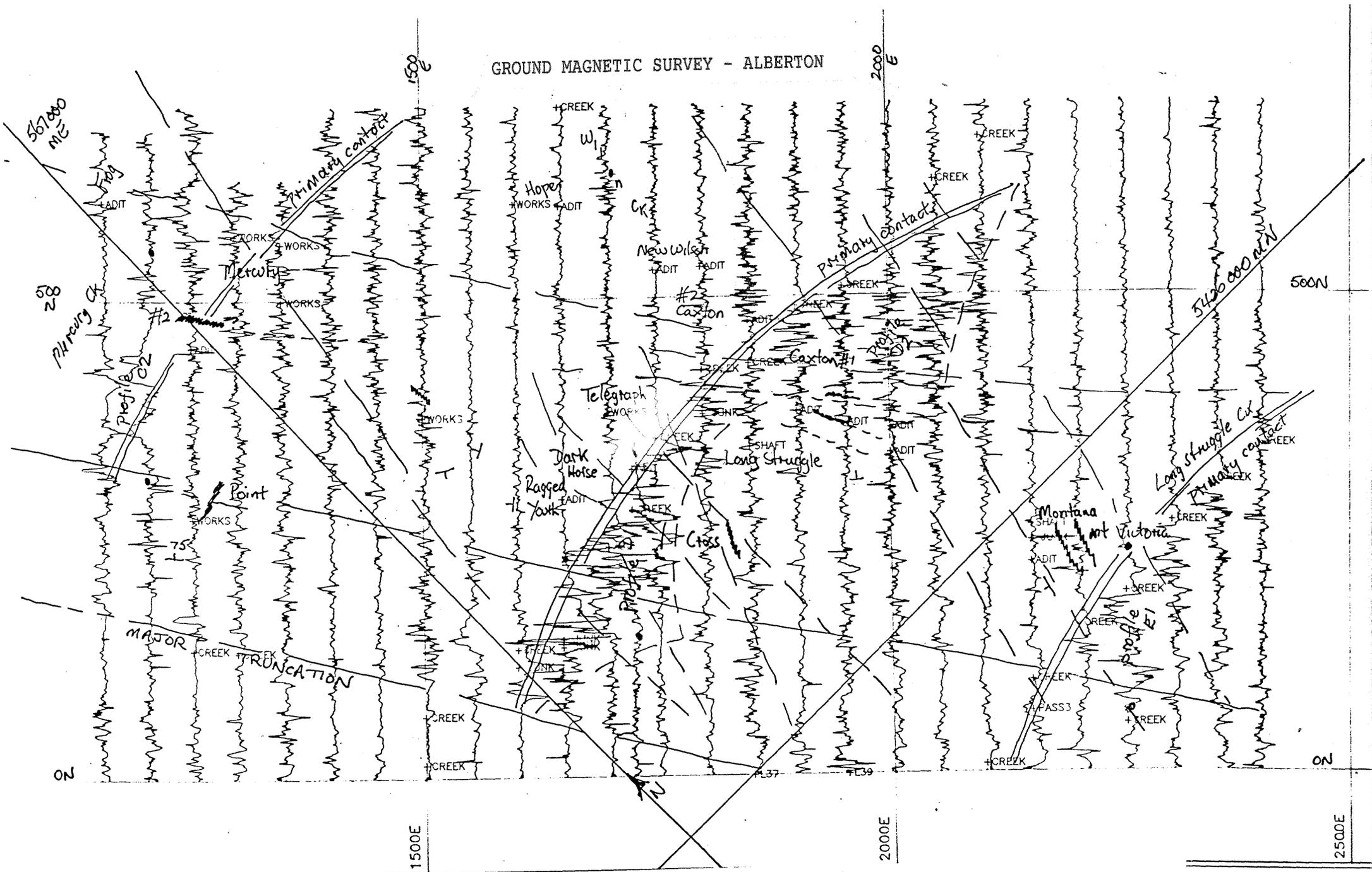
FIGURE 11B



RADIOMETRICS AND MAGNETIC SUPERIMPOSED - ALBERTON
REGIONAL COMPILATION

FIGURE 11C

GROUND MAGNETIC SURVEY - ALBERTON



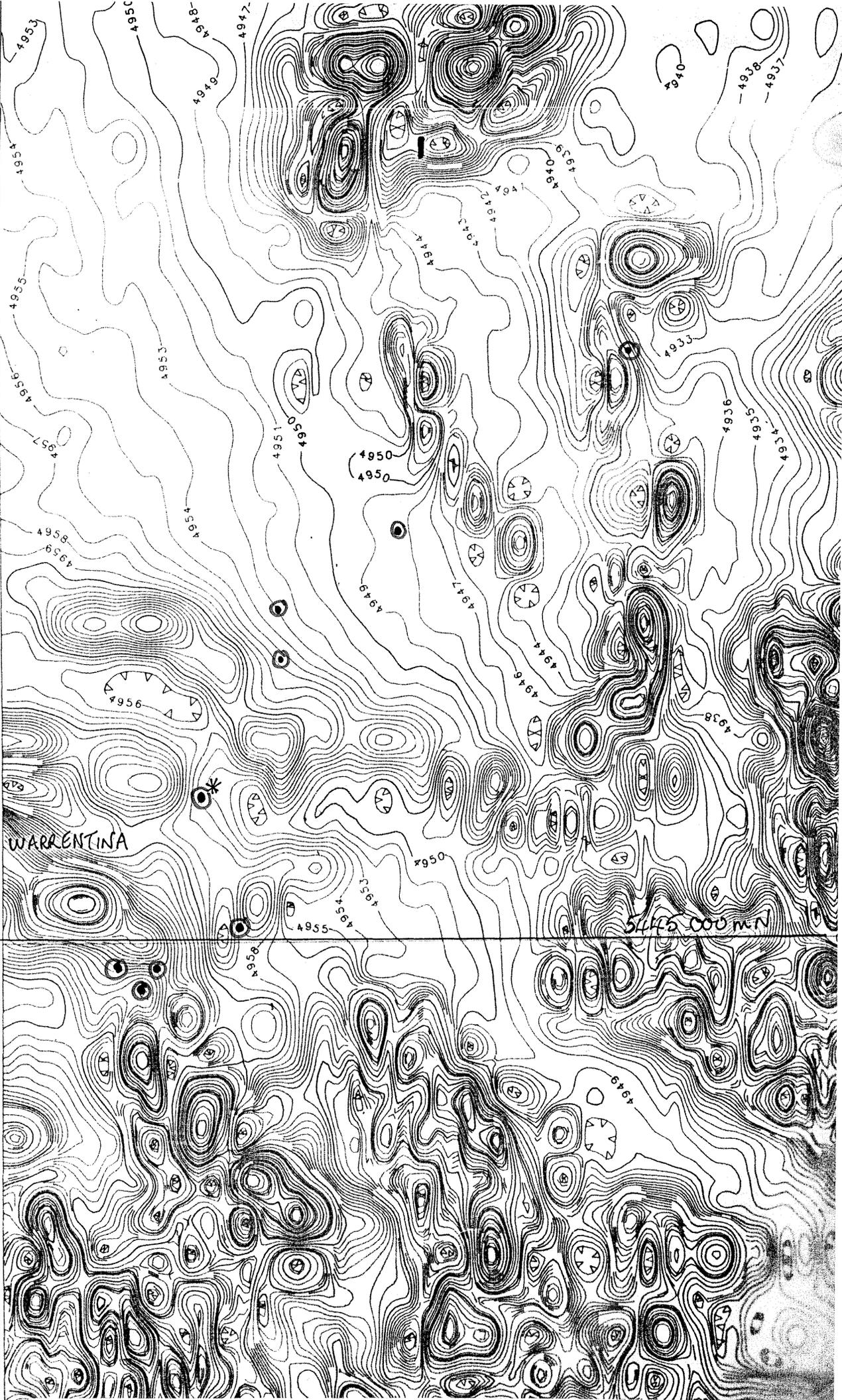
INTERPRETATION AND LOCATION OF TRENDS AND CULTURAL FEATURES
(superimposed on magnetic profiles)

FIGURE 110

1 Km

560 000mE

5445 000
5445000mN
MN



MAGNETICS AND VEIN LOCATIONS - WARRENTINA

FIGURE 12A

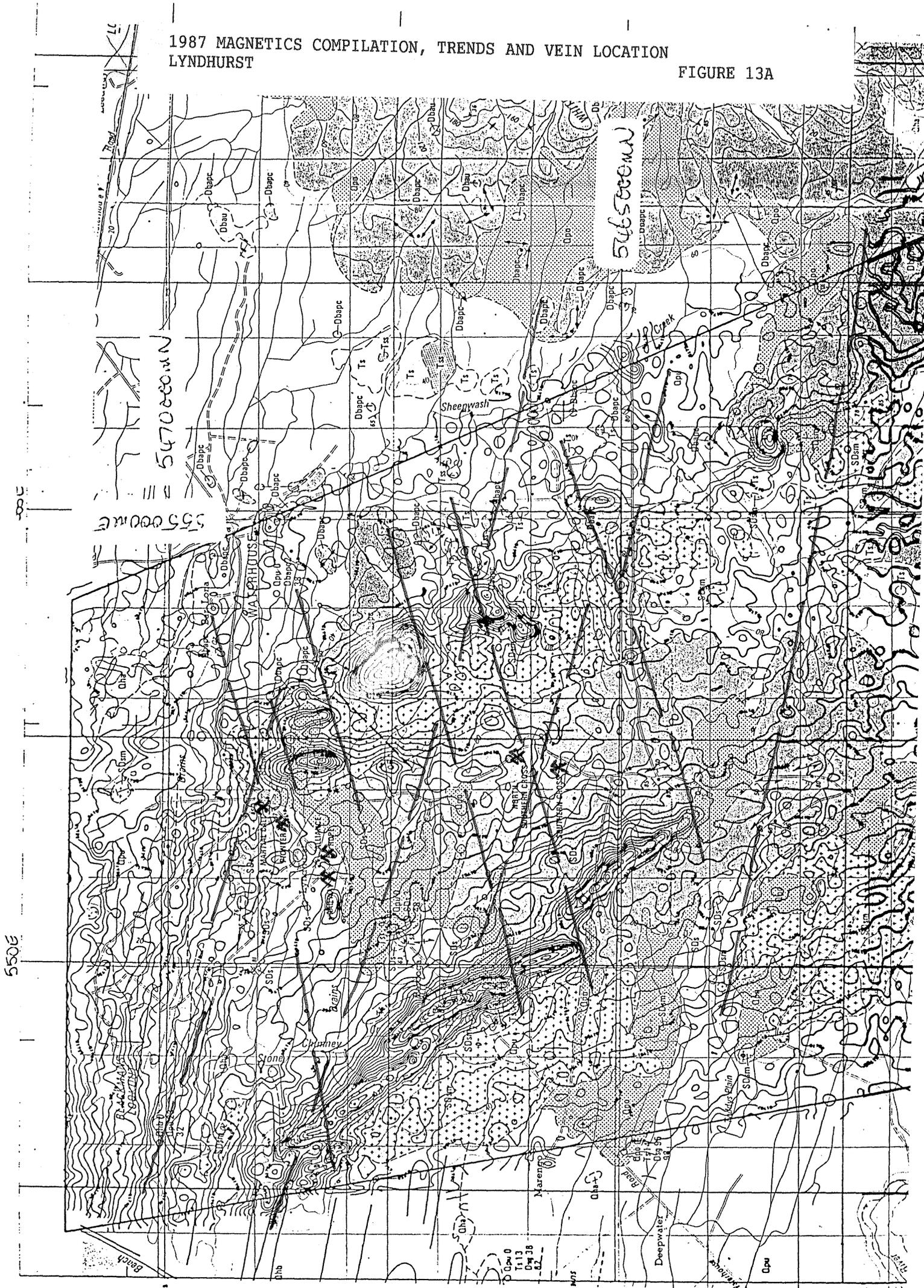


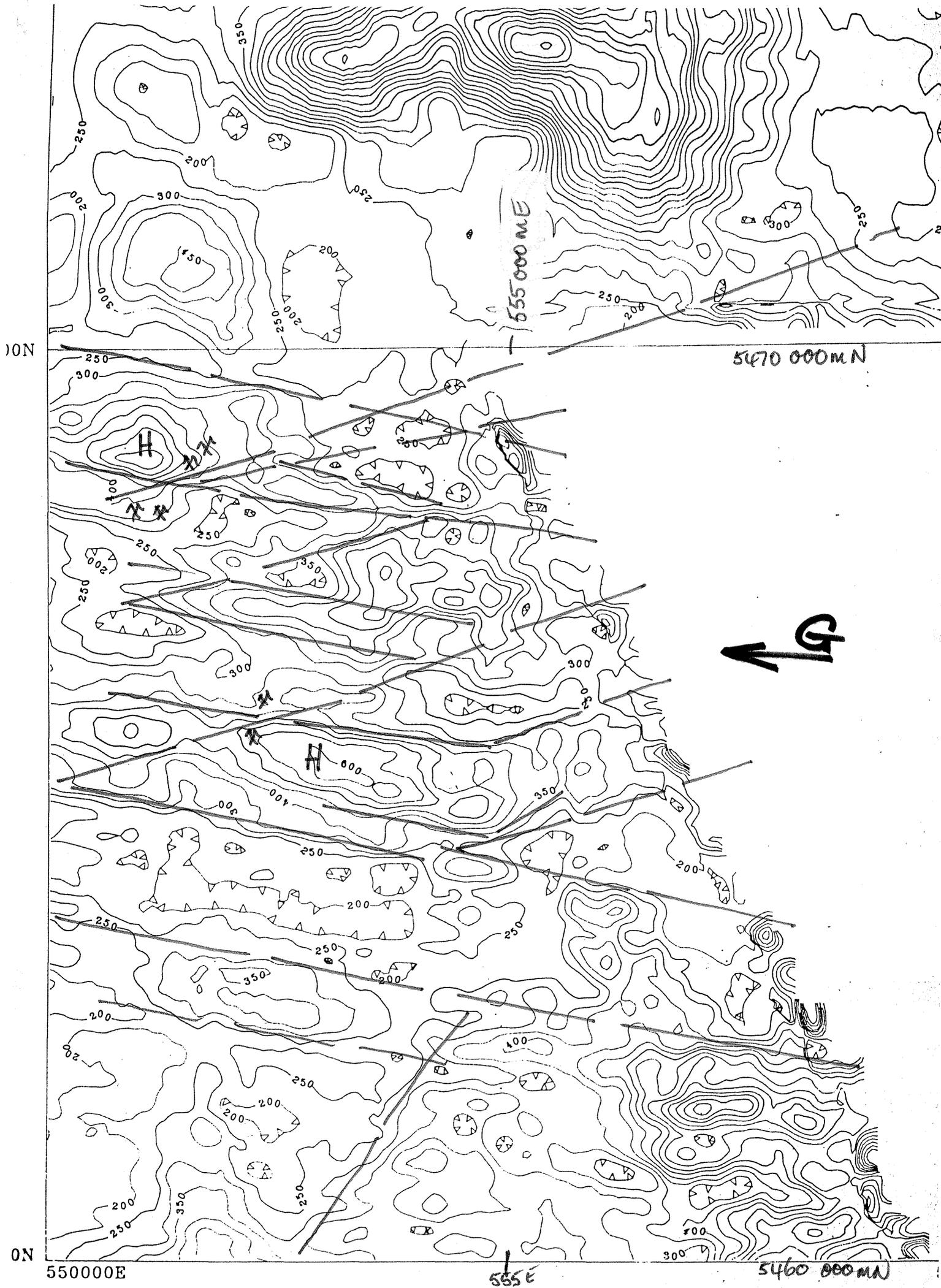
REGIONAL COMPILATION - WARRENTINA/FORESTER
 MAGNETICS AND RADIOMETRICS SUPERIMPOSED

FIGURE 12C

1987 MAGNETICS COMPILATION, TRENDS AND VEIN LOCATION
LYNDHURST

FIGURE 13A

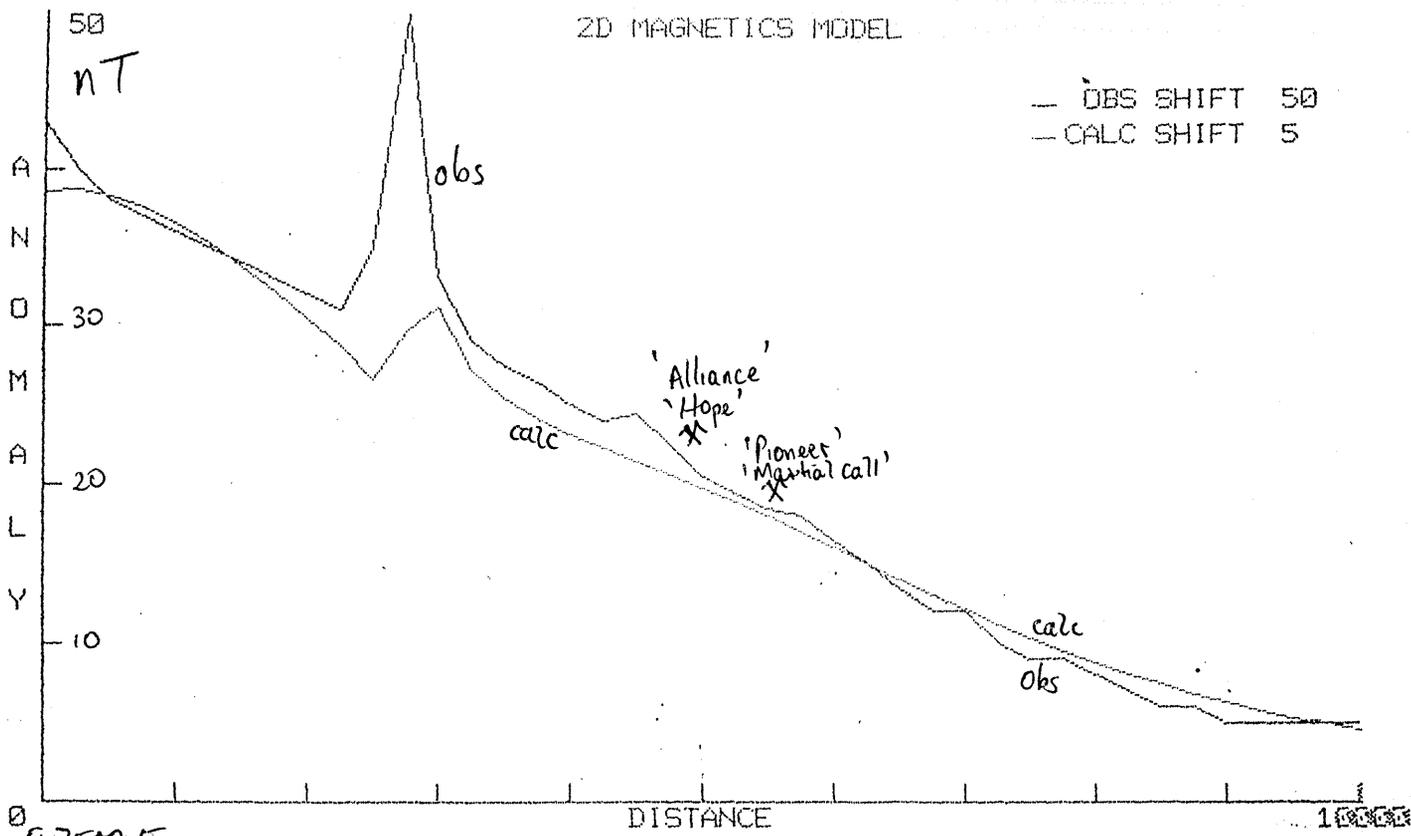




RADIOMETRICS AND VEIN LOCATION - LYNDHURST

FIGURE 13B

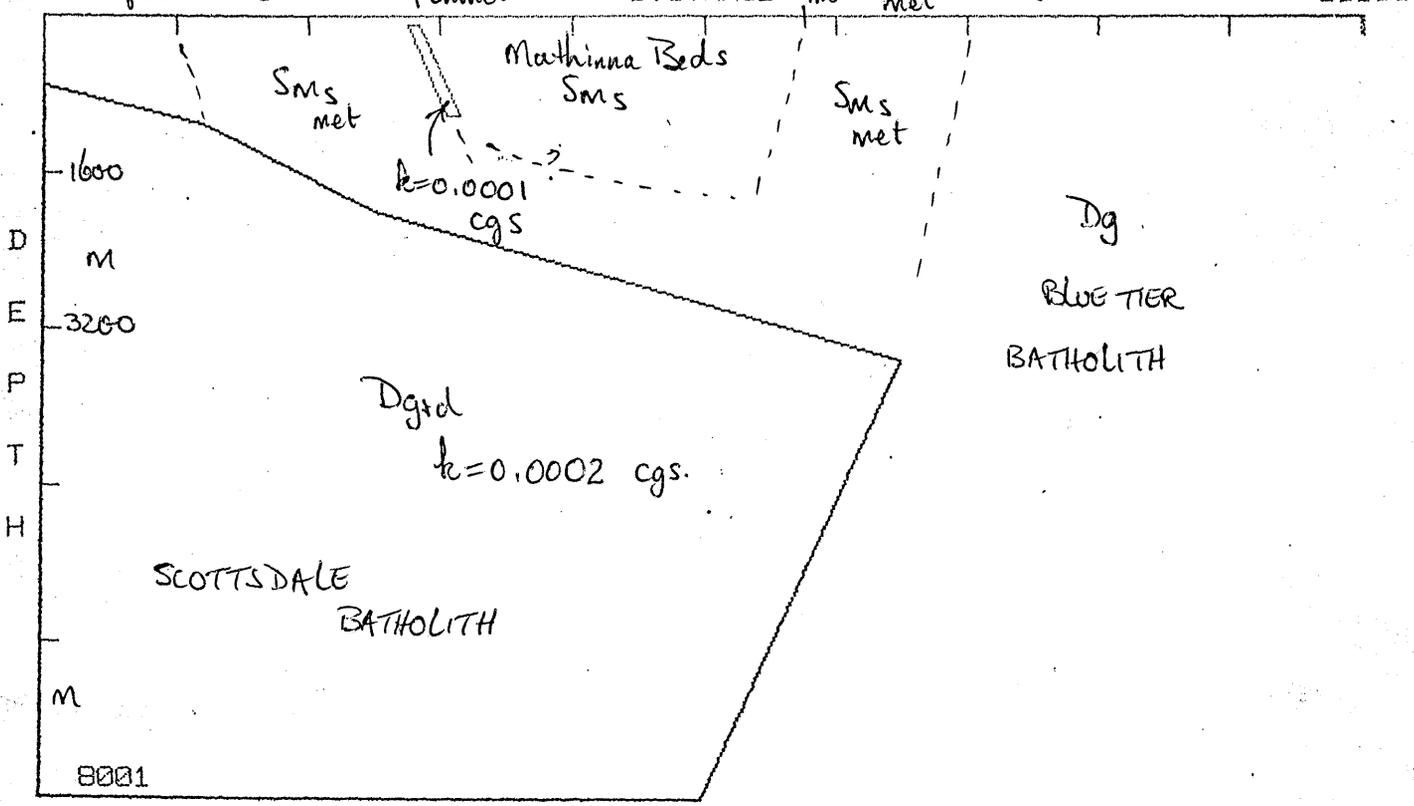
2D MAGNETICS MODEL



567500 E
5665000 N SW
5671000 NE

LYNDHURST M1
depths cont
aircraft

Dgrd Sms metamorphosed unmet onmet Sms met Dg
DISTANCE met met met



Richard
491

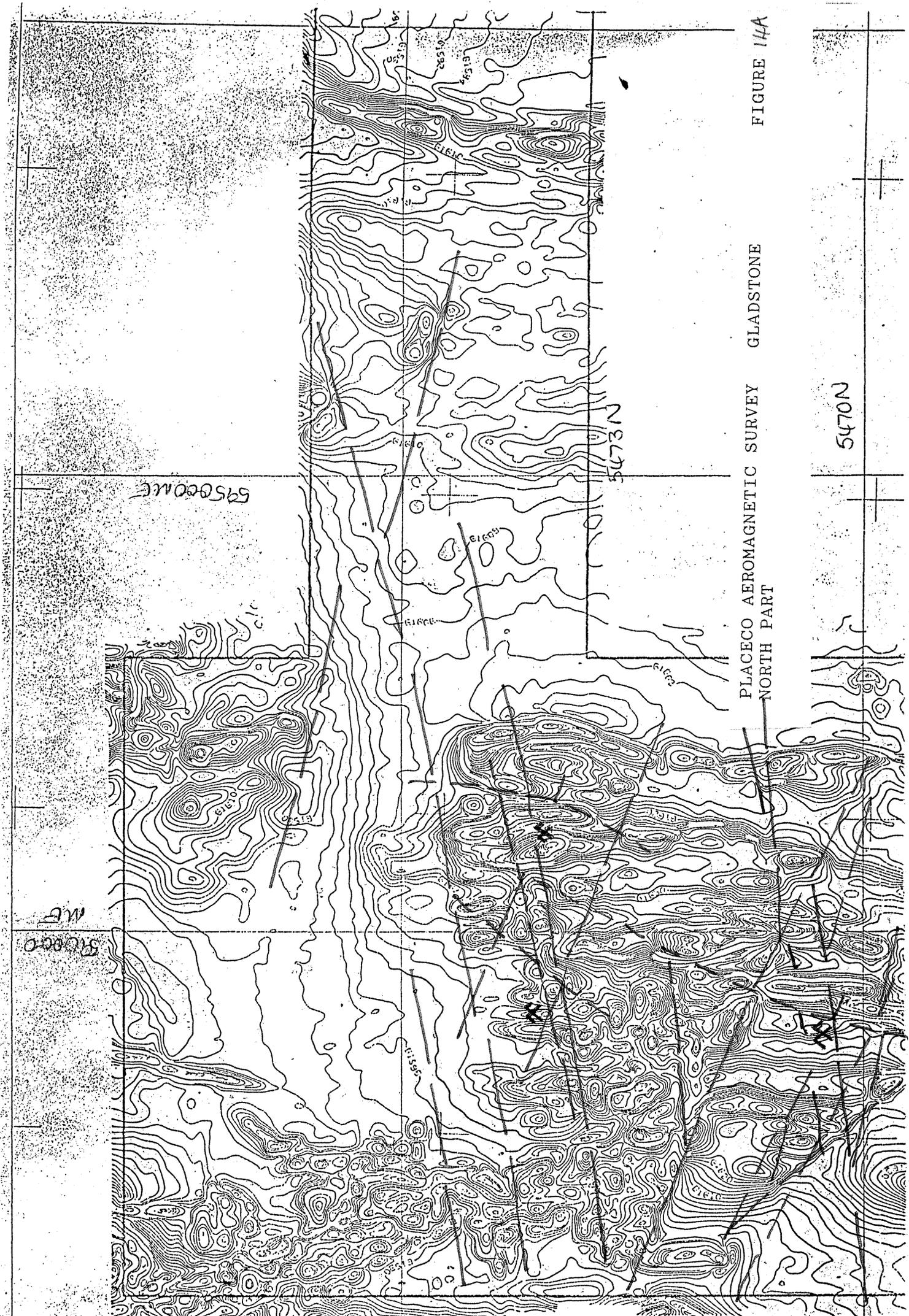
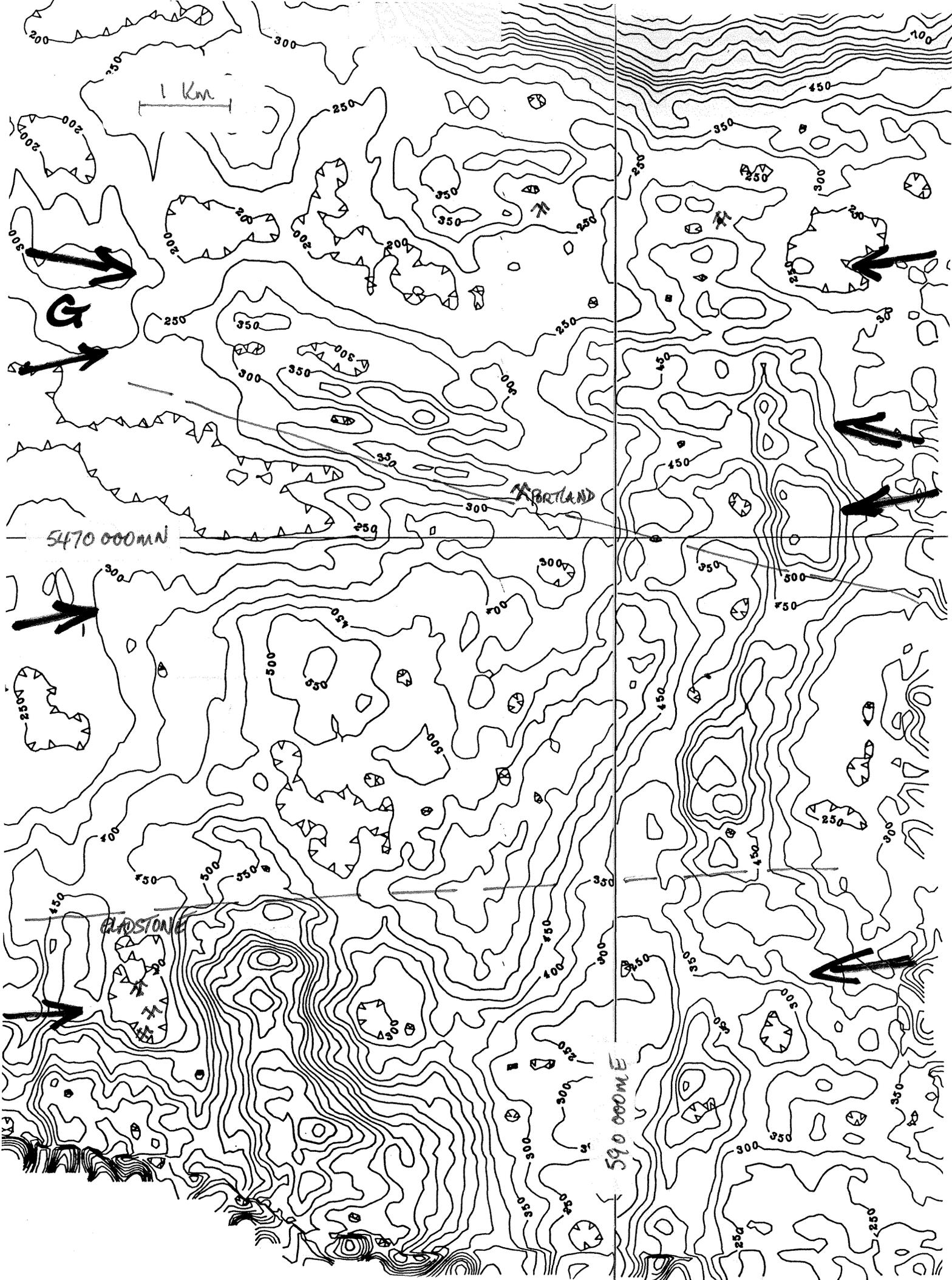


FIGURE 14A

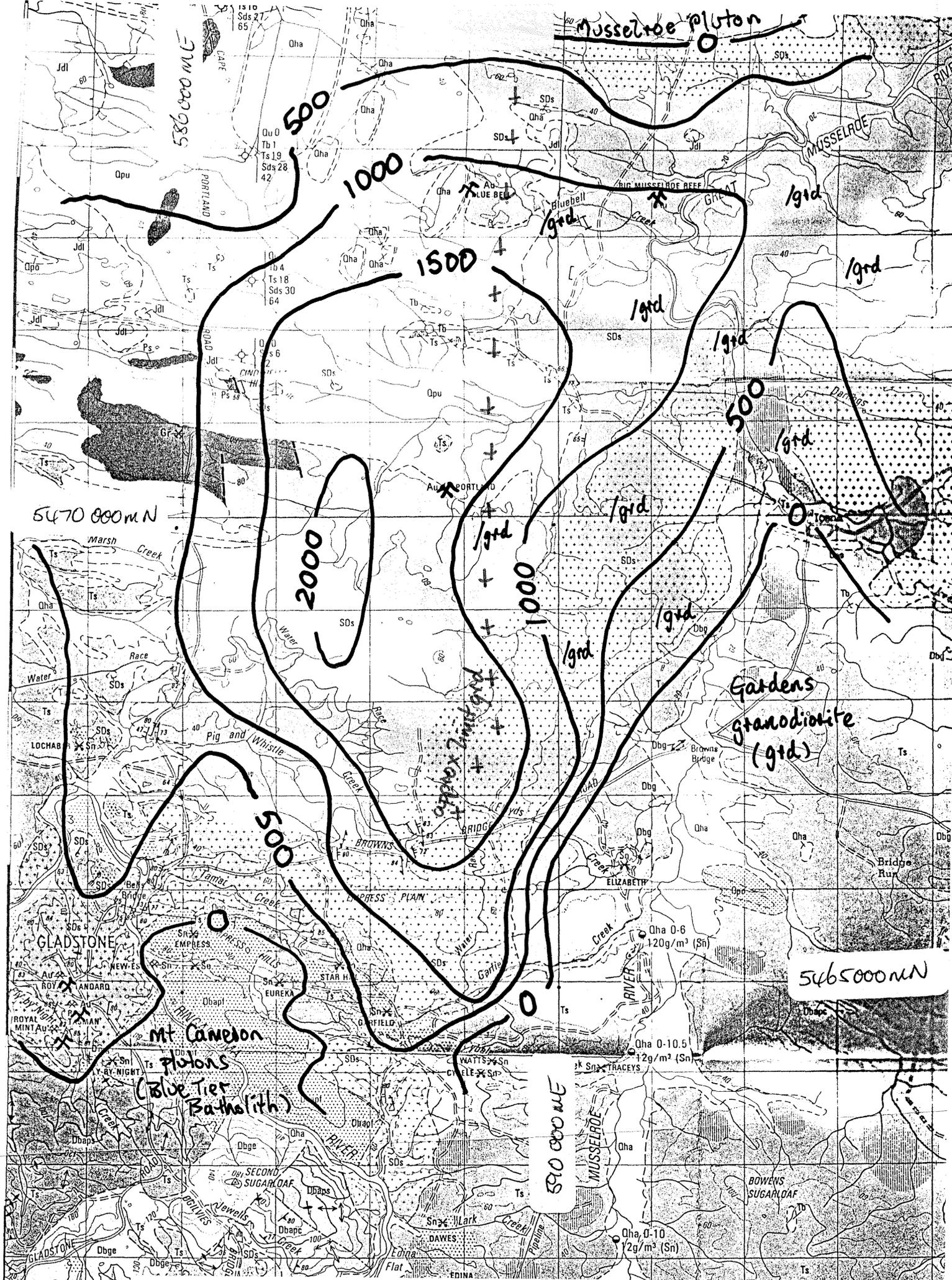
PLACECO AEROMAGNETIC SURVEY
GLADSTONE
NORTH PART

5470 N

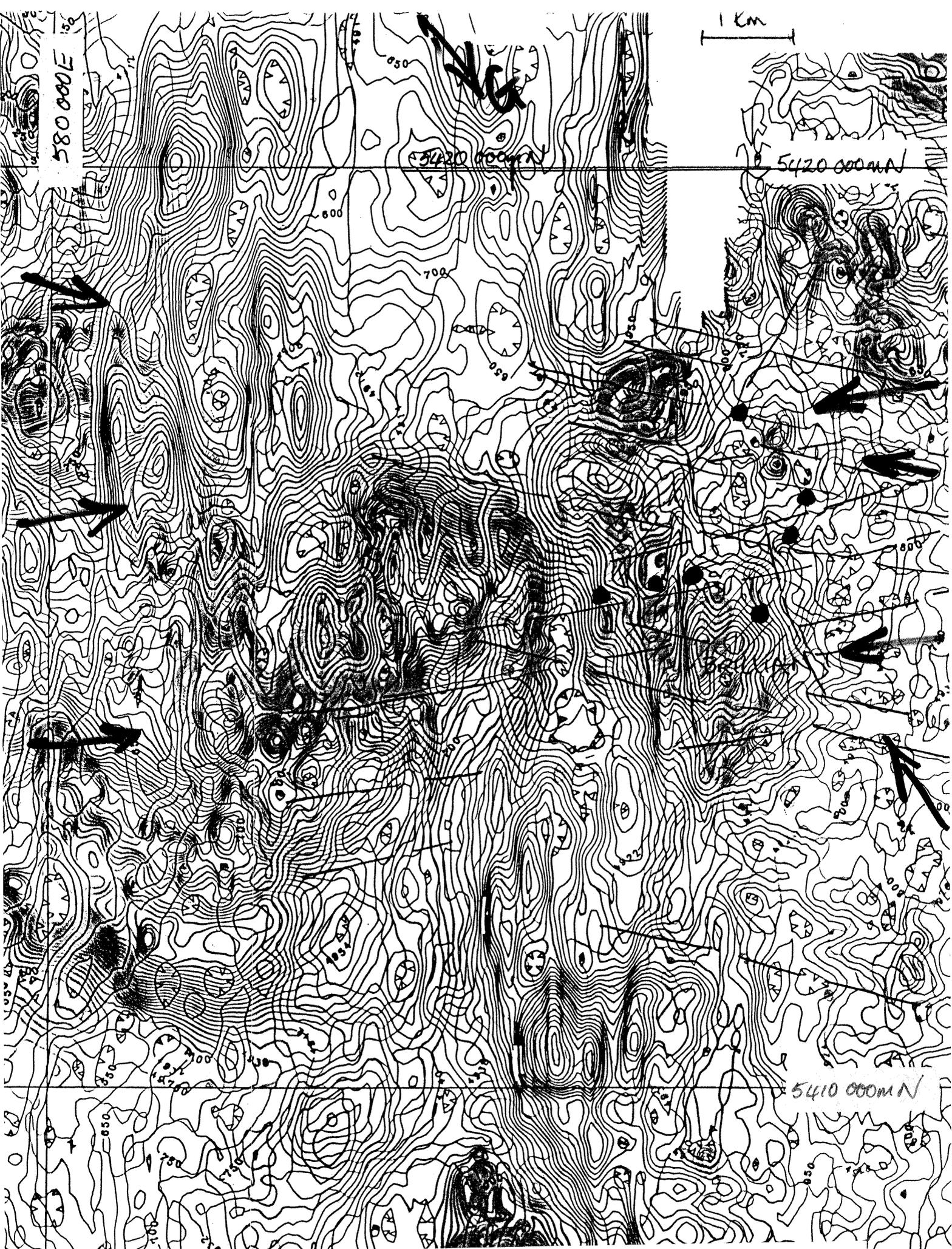


RADIOMETRICS AND VEIN LOCATION - GLADSTONE NORTH

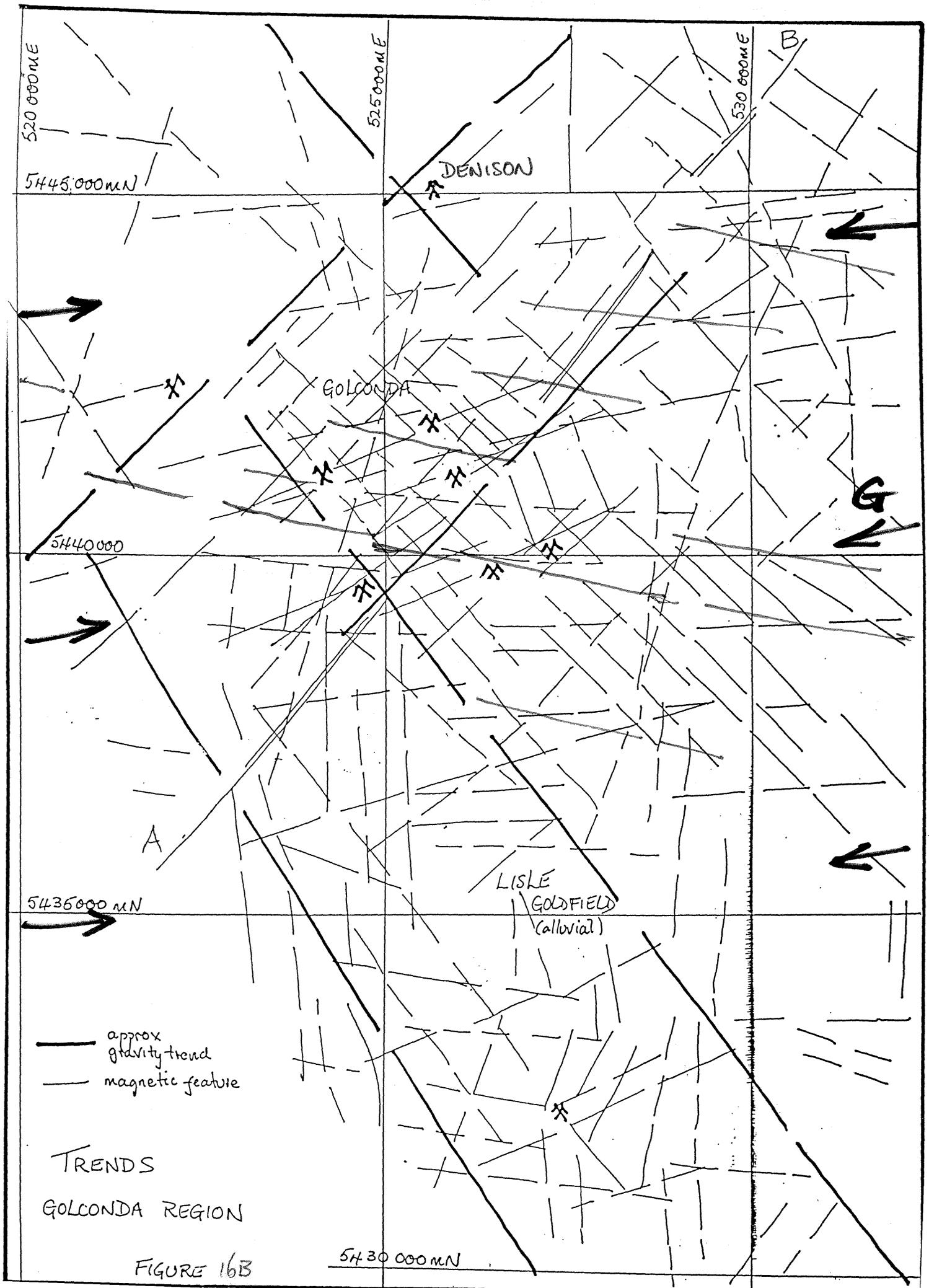
FIGURE 14B

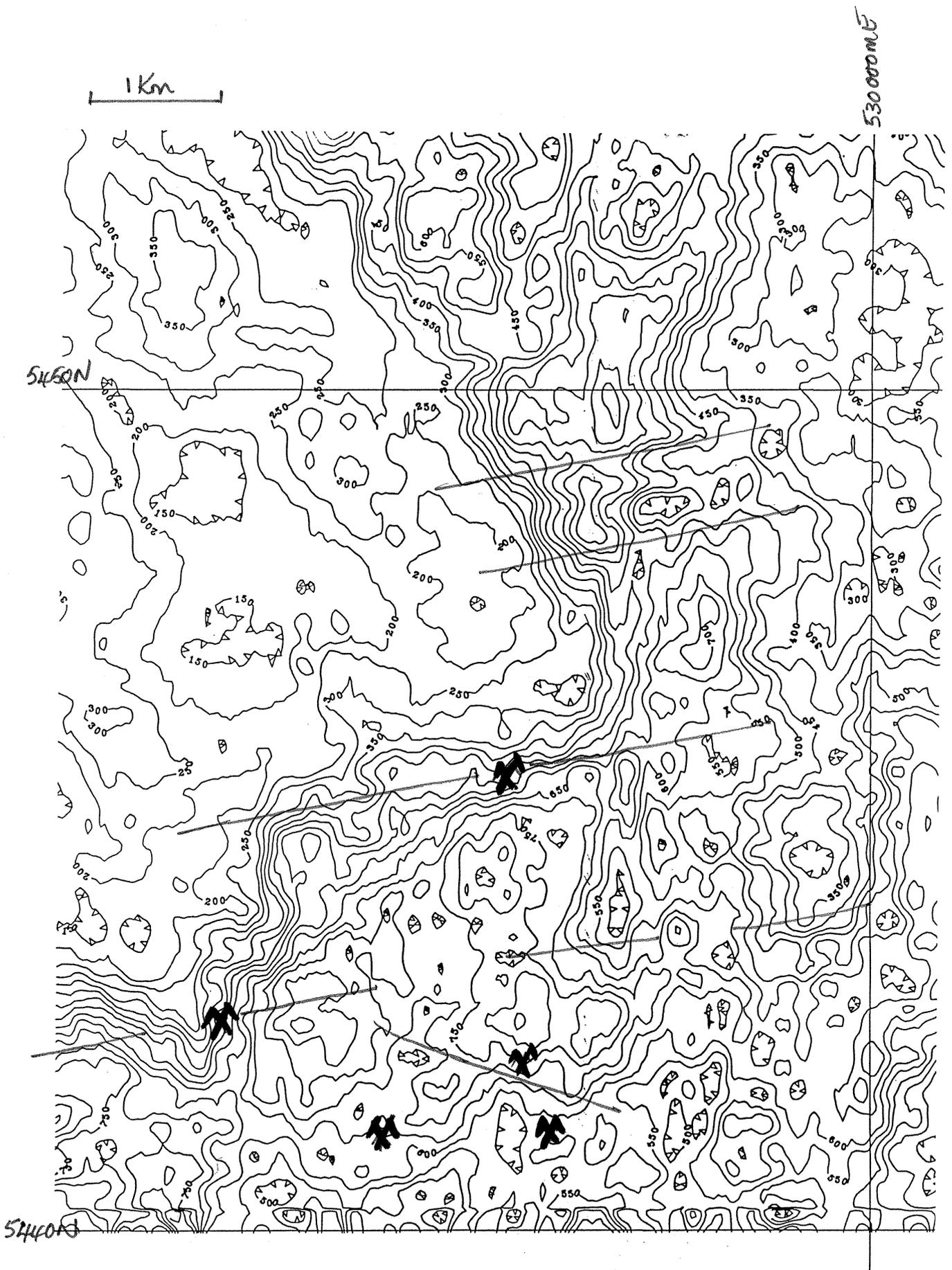


DEPTH OF GRANITE ROOF AND VEIN CONTROL - GLADSTONE NORTH
 FIGURE 14C



REGIONAL COMPILATION - HOGANS ROAD (BRILLIANT CREEK) FIGURE 15
RADIOMETRICS AND MAGNETICS SUPERIMPOSED





RADIOMETRICS, TRENDS AND NORTHERN GOLCONDA FIELDS

FIGURE 16C

62000.0

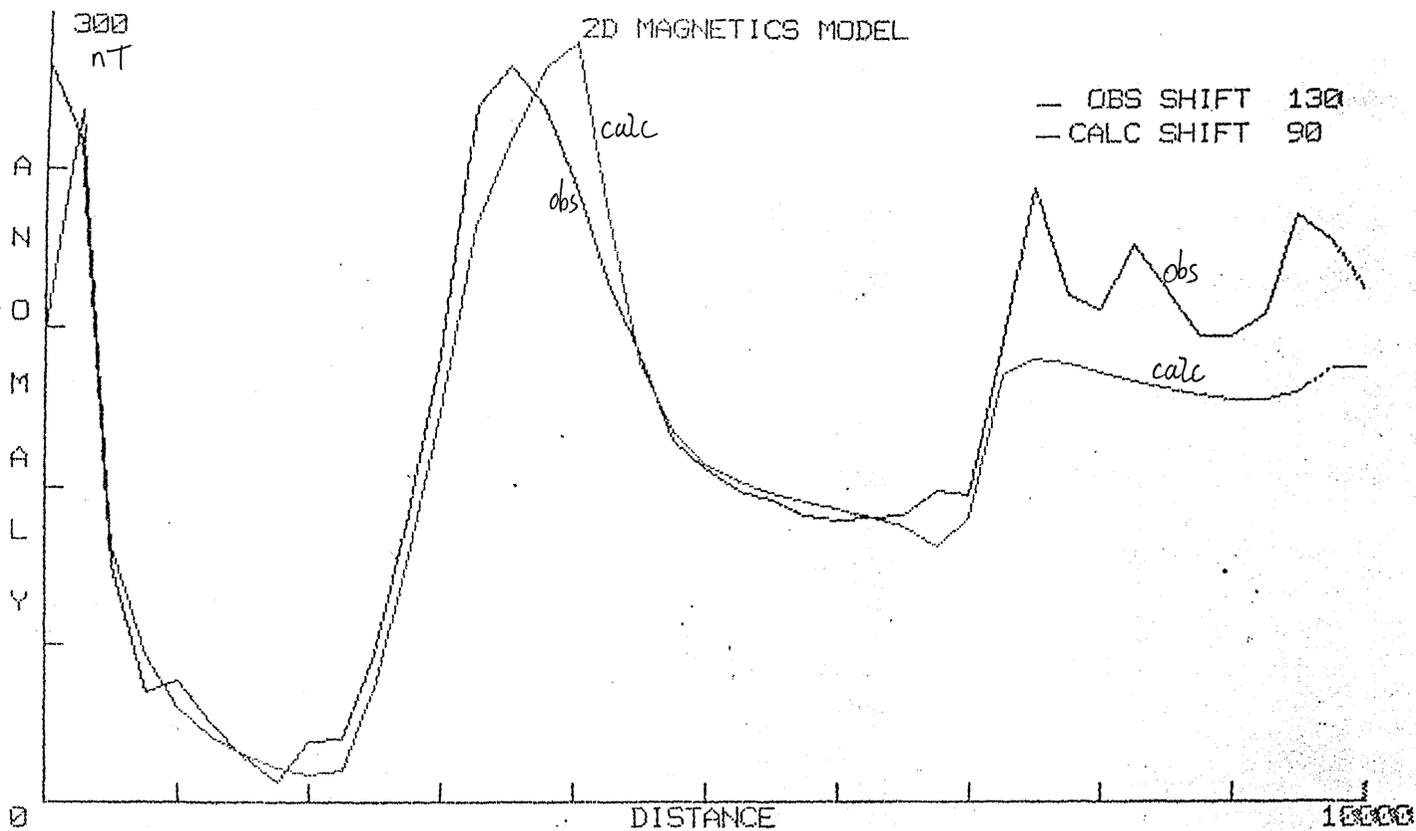
-71.0

13.0

70.0

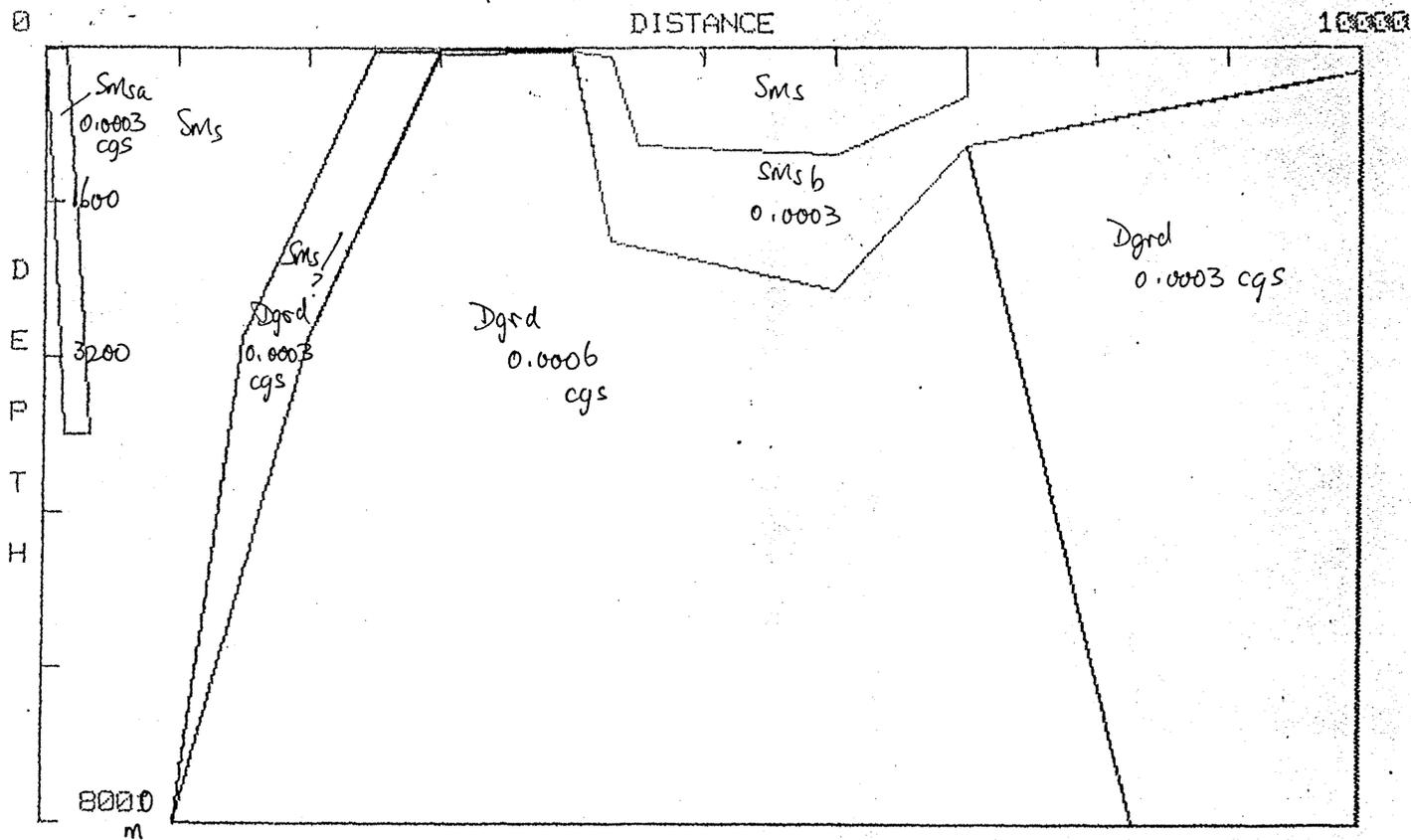
45.0

LINE PARAMETERS - ORIGIN,LIMIT,INCR : 0 10000 250



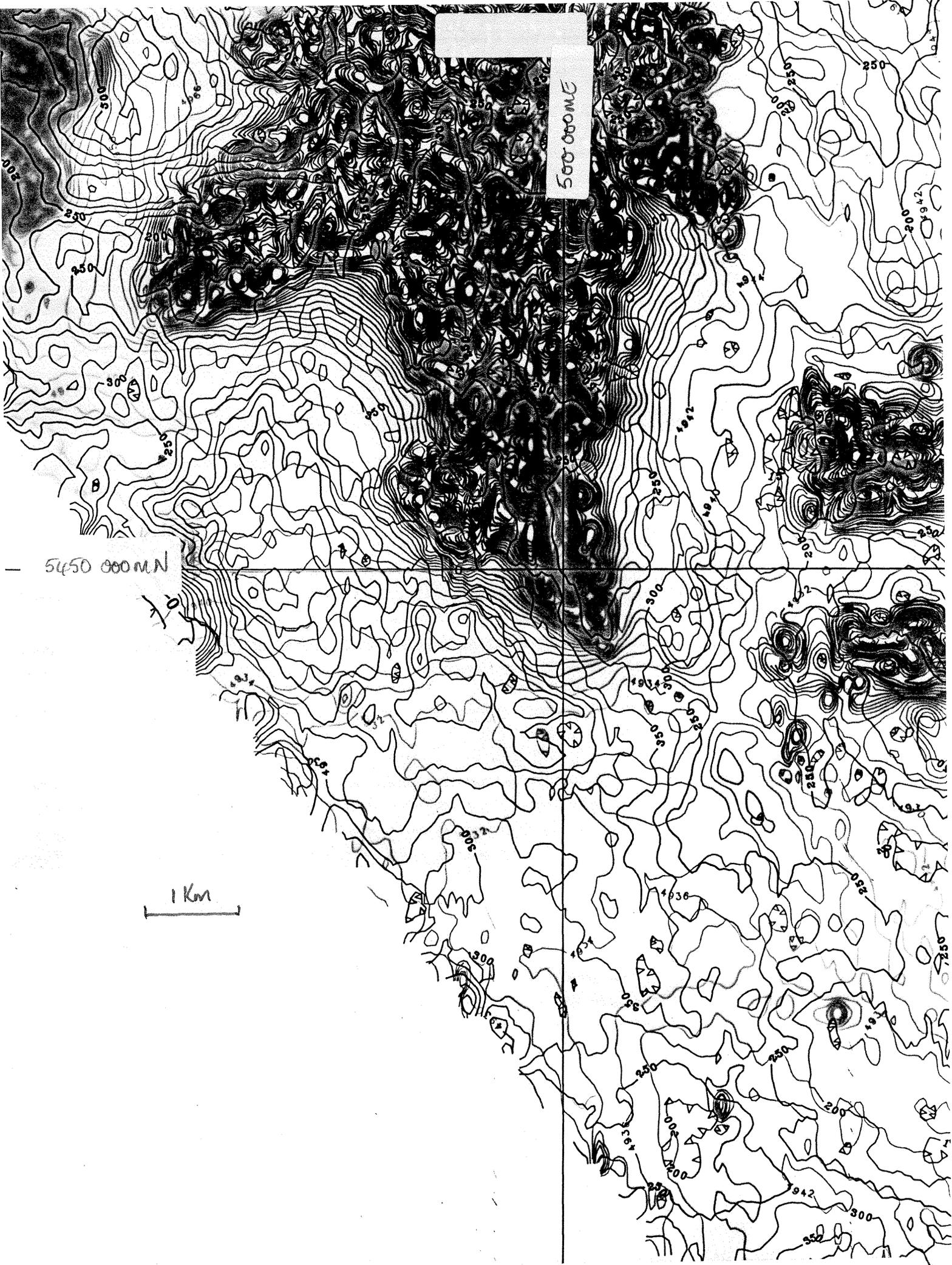
LISLE MAGNETICS M5

LISLE
GOLDFIELD



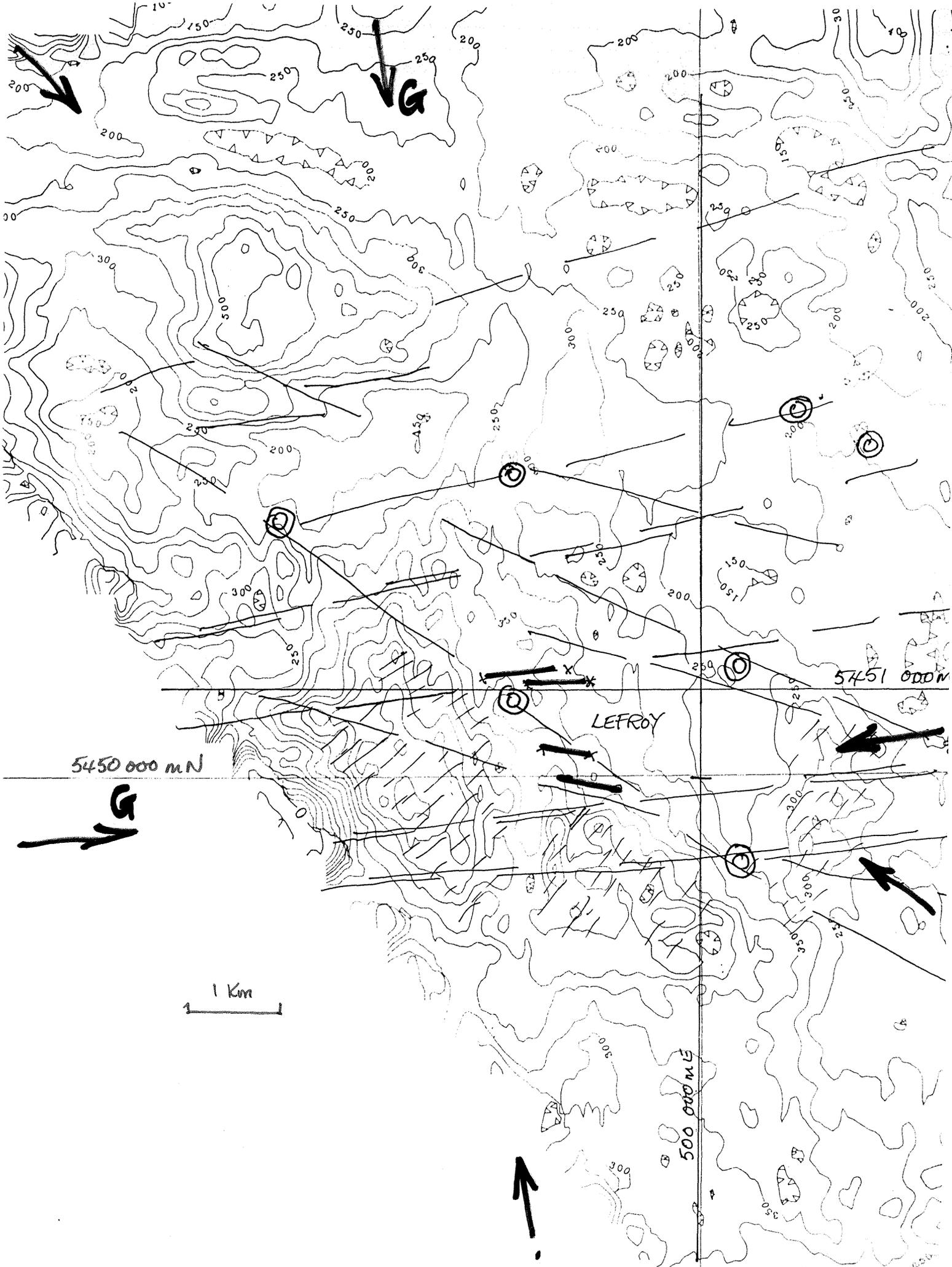
MODEL OF A POSSIBLE RELATIONSHIP BETWEEN GRANITOIDS AND THE LISLE
GOLDFIELD

FIGURE 16D



REGIONAL COMPILATION - LEFROY
RADIOMETRICS AND MAGNETICS SUPERIMPOSED

FIGURE 17A



RADIOMETRICS, TRENDS AND PRINCIPAL VEIN LOCATIONS
LEFROY

FIGURE 17B

HOW TO "READ" THE MODEL INTERPRETATION DIAGRAMS

The model interpretation diagrams have a standard form and may be appraised consistently.

A title, describing the model or the particular version, is given at the bottom of the page.

A header, at the top of the page, describes the nature of the methods used (e.g. two dimensional - 2D) and whether gravity or magnetic data is involved.

Two scales are provided on the left hand side of the diagram. The upper scale defines the magnitude of the anomalous response. The full scale range is stated and there are five divisions of this range. The lower scale defines the depth range in the model. This is also divided into five parts and the maximum depth range is stated beneath the model.

A distance scale is given in the centre of the diagram. The length of the profile is stated and it is divided into ten equal parts.

All distances and depths are quoted in metres.

The magnetic anomaly scale is in nT, and the gravity scale in mgal.

The upper part of the diagram contains two profiles; the broken line represents the observed data and the heavier, continuous line the calculated effect of the model shown in the lower part of the diagram.

The model is defined by colour or pattern according to the sources and contrasts used. Separate magnetic and gravity models may be provided for the same section or profile since not all units may contribute to each calculation. Separate presentation allows for clear appraisal of what contributes to each anomaly type without confusion of many profiles in the upper half of the diagram.

Some other information is also provided in the diagram. The two shift statements in the lower right hand corner define precisely what was required to produce the curve match shown. The magnitude of the shift values is not usually important; their relationship is - and this should be consistent within a given area or data set. Irregularities in fit differential may indicate inconsistent or faulty solutions. This indication is provided regardless of the quality of fit, which may be absolutely perfect, but also quite irrelevant.

The issues involved in sound modelling practice and judgement about validity of solutions may be complex but have been distilled into five critical criteria. These have been discussed in three publications and review is recommended. Some of these criteria are often quoted but it is rare to find all five applied consistently. Most modern modelling programs either do not display, or do not retain, the crucial shift information which forms a critical part of one test.

The reader is referred to:

EAEG Extended Abstracts, 54th Annual Meeting, Paris, 1992, p 372-3.

First Break. April 1994.

Exploration Geophysics course manual. Vol 13. University of Tasmania Key Centre for Ore Deposit and Exploration Studies.

All papers are titled " Criteria for evaluation of potential field interpretations"

APPENDIX 1

ALBERTON EXPLORATION REVIEW

This appendix presents material which was placed in the public domain by Oceania Pty Ltd in 1991.

It has been included here in order to allow some idea of the evolution of concepts, data and implications. Alberton South remains a key site for exploration and the work discussed here was innovative and was the direct result of an original exploration train. This sequence is nowhere discussed in the NETGOLD release.

LEAMAN GEOPHYSICS

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

Registered office:

3 MALUKA STREET, BELLERIVE, TAS. 7018

All correspondence to:

GPO BOX 320 D, HOBART, TAS. 7001

Telephone: (002) 44 1233

Fax: (002) 44 6674

EXPLORATION REQUIREMENTS OF THE ALBERTON GOLDFIELD

for
OCEANIA PTY LTD
by
Dr. D.E. Leaman

July 1991

ALBERTON

SUMMARY

A very detailed magnetic survey across the known mineralised areas of the Alberton Goldfield by Oceania Pty. Ltd. has revealed a series of irregular but sub-parallel magnetic patterns. Each correlates closely with the location of known mineralisation but extends laterally beyond it for some distance. Although the precise origin of the effect has yet to be established it is clear that the magnetic data are able to discriminate mineralised ground from barren ground.

The patterns are oriented a little east of ENE. This trend is far from obvious in north east Tasmania and all available geophysical data sets have been inspected for its presence. A case can now be argued to suggest that it represents a diagnostic indicator for mineralisation; every gold deposit can be associated with such a trend, where data permits - even though the feature is often very subtly represented.

Large deposits, such as the "Golden Gate" at Mathinna, are associated with local and specific features of this type, as has been observed at Alberton, and with primary regional trends with the same orientation. These are much rarer. Mineralisation occurs at the intersection of ENE-trending and, usually, NNW-trending structures. A major intersection of this type occurs within the Alberton Goldfield but the available regional data is of insufficient coverage and quality to define its location with certainty. A major deposit of "Golden Gate" proportions is predicted to lie at the node inferred and acquisition of regional data in the vicinity of the lease areas is recommended in order to locate this site.

INTRODUCTION

Geophysical surveys across the Alberton Mining Leases held by Oceania Pty Ltd in the centre of North-east Tasmania have generated several specific and emphatic target zones. Each can be associated with known mineralisation, mineralisation which has been previously worked. Mines Department drilling of 20 and 50 years ago has also encountered quite anomalous character in the host rocks, including the presence of gold-bearing quartz porphyries (?) and keratophyres (?). None of this information, including the magnetic targets, have yet been properly appraised or explained. Nor is it possible to rank the indicated targets for efficient exploration and, perhaps, mining using information available within the vicinity of Alberton.

These notes review what is known in the Alberton area, what Oceania has discovered, what implications this information might have if added to knowledge acquired in other gold-producing areas and how it might assist future exploration and appraisal.

North-eastern Tasmania is littered with numerous minor gold shows and workings. Only a handful have ever proved profitable. A means must be found to discriminate between these and what may be termed, pending more knowledge, the prototypical and desirable target in this environment - a "Golden Gate". The "Golden Gate" Mine yielded more than 7.5 tonnes of gold at grades averaging 25 g/t from a quartz vein system. This review considers what is known of this deposit and whether its characteristics can be described and identified elsewhere - in particular within the Alberton Goldfield. Recognition of such parameters would clearly influence the direction of exploration and its location.

GENERAL COMMENTS - GOLD AND EXPLORATION

Before considering what is known at Alberton, or what might constitute a "Golden Gate" target it is necessary to review the knowledge base and the data available.

Gold occurs at many sites in north-east Tasmania but many occurrences are concentrated along a NNW-trending axis between Mangana and Bass Strait at Lyndhurst (see Figure 1). The important Mathinna (including the "Golden Gate") and Alberton occurrences occur on this axis. Most sites have, however, been minor producers. All deposits occur as veins of quartz within the monotonous series of mudstones and sandstones of Ordovician to Devonian age known as the Mathinna Beds. These host rocks have been folded, faulted, overthrust and multiply deformed and also intruded by massive bodies of granitic rocks known as the Scottsdale and Blue Tier Batholiths. The location of these units is shown in Figure 1. The mineralised Mangana-Lyndhurst axis has been described as a major shear but may be faulted thrust zone. There is evidence for both views in my opinion.

Were all gold mineralisation associated with such a feature then appraisal and exploration would simply depend on the location of crucial structural nodes which might control emplacement of mineralisation. Unfortunately this is not the case. Major and minor deposits occur elsewhere. The important Lefroy and Lisle fields are displaced many kilometres and many minor fields such as Gladstone and Burns Creek are unrelated. Yet all are quartz vein-based deposits in Mathinna Beds. Lisle is a special case since it is an alluvial deposit derived from these materials.

The only common geological features are the vein and host association. Veins possess random patterns, orientations and mineral associations. Some are sulphide rich, others are not. No systematic regional controls have been recognised and mineralisation appears to have been determined by local factors only. These might include local effects at change of rock type (ductility contrasts along rock surfaces producing openings under stress) or fracture controls due to folding or gross stress fields. These observations have led all previous explorers to accept that "gold is where you find it" and that more careful observation might lead to discovery of a universal factor.

Classic panning or trenching methods have, therefore, formed the mainstays of the exploration tool box for more than a century since these will at least find gold-bearing sites - provided they are exposed. They cannot find concealed deposits or assess the scale of the find. History shows that most are insignificant and hopelessly uneconomic in modern terms.

Geochemical methods have also proved to be of dubious value. Direct location of gold has proven difficult in this environment and other indicators, notably arsenic, have been used. Unfortunately these tend to spread and disperse and lack specificity and may have an array of sources. Arsenopyrite is common in the vein systems and no direct correlation has yet been established between sulphide content of any type and gold other than that some high sulphur concentrations are not associated with gold (McIntosh Reid, 1925). Various cut off levels appear to occur and there is no way of discriminating a large ore system from many small or barren systems.

New research into the possible associations between type of quartz and its magnetic properties (at atomic level) and gold has yet to be demonstrated practically.

Geophysical methods have long been dismissed since no property contrasts between mineralisation, quartz and hosts were thought to exist. Explorers have always sought the vein systems rather than the setting of the veins but neither element was considered geophysically approachable. Early research (Leaman, 1974) showed this to be a fallacy at Lefroy; veins could be found and traced using thermal, self potential and piezoelectric methods. Magnetic methods yielded odd results which were not explained until Leaman (1987a) showed that a good instrument, careful methods and close sample spacings could locate the oxidation along the vein-host contact and so map the veins as well (Figure 2). None of these findings were accepted or used for many years.

The more important issues of how to find the critical and mineralised vein systems in the first place, or assess whether they might be mineralised once found were left open.

A breakthrough in regional assessment was achieved in the Gladstone Goldfield by Placeco Australia using very high resolution airborne magnetic surveys. The results were reported by Leaman (1987b). These surveys showed that structure and formations within the Mathinna Beds host rocks could be mapped in considerable detail (Figure 20). Thus, if any structural patterns now visible could be judged systematic and related to known deposits then targets for the ground methods could be defined.

The Gladstone survey led to a small spate of similar surveys covering

the Lyndhurst, Lisle-Golconda and Mangana-Mathinna areas as well as a government regional survey of the Mathinna area (Figures 19; 15-16; 9-10, 24-25). Note that Mathinna contains the "Golden Gate" prototype. Parts of these surveys have been reproduced in this review but none of the acquiring companies survived long enough to realise (all meanings) the value of the data acquired and the regional survey suffered from quality control problems. Indeed, most companies were unable to fund any interpretation or analysis of their data. I have now done this as part of my on-going research in the region. Some of the findings have been outlined in following sections of this review. I have been associated with all the exploration programmes and results utilised and have therefore had opportunity to integrate and consider the implications and results. All the data used is now in the public domain.

Each of the aeromagnetic surveys appears to present different results but analysis shows that this is not the case. All recover information about structural trends, the Mathinna Beds and the intruded granitoids. The quality of the surveys, with the exception of the government regional survey and that by Seltrust at Golconda, has been high and improving. The two poorer surveys have been reprocessed but remain less than ideal while still useful.

Ground magnetic applications have also evolved since their successful application at the "Portland" Mine near Gladstone (Leaman, 1987a). The more rigorous Tower Hill survey (Figures 12-14) sought to assess a mineralised site rather than "chase" veins. An altered volume of host rocks was inferred adjacent to known mineralisation but the

problem of how to process and present the data was not resolved (Leaman, 1989). No detailed interpretation was undertaken. The lessons of these surveys was fed into the specification for coverage of the Oceania leases at Alberton and the result was the finest survey yet undertaken (Figures 5-6) with improved presentation of results. The Alberton survey was the first survey, of any type - whether geological, trenching, geochemical or geophysical - to define regular patterns which appear to be related in some way to gold mineralisation. The patterns are very specific and localised as well.

The data now available can be used to show that elements of the batholiths are probably genetically related to the gold mineralisation. There has been considerable argument and disbelief associated with any such concepts but Klominsky & Groves (1970) have argued for a link. The apparent absence of granodiorites, the granitoid type considered essential, in many areas - such as Beaconsfield, Lefroy and Mathinna - has led others to argue against any such link even though Leaman et al (1973) showed that granodiorite is within 1.5 km of the Lefroy mineralisation at depth. Arguments based on the nearest outcrop distance (30 km) are irrelevant. The magnetic surveys now available show that granodiorites are associated with all gold-bearing regions and are never more than 1.5 to 2.5 km from the deposits - including those at Mathinna (Figure 11). The surveys also indicate that there are at least three granodiorites and only one of these, with distinctive low contrast properties, has a gold association. Thus, discussions of

granodiorite associations must also be tempered with this caution - which granodiorite? Gravity data have been used to support some of these deductions but the coverage, while locally good, is generally poor. Gravity gradients observed near Mangana, Lefroy and Warrentina seem to be associated with mineralisation (e.g. Figures 18 and 22). Gravity data may be of more value than has previously been realised.

No patterns have been recognised, in regional geological or geophysical data which might be relevant to gold mineralisation or exploration, by any company. This observation accounts for the general lack of interest in both the province; interest that is hardly likely to be rekindled unless targets of the "Golden Gate" type can be assigned a signature, or response pattern, and sought on a routine basis.

This review considers whether the detailed information available at Alberton is sufficient, in association with other data sets - including surveys at Mathinna, to provide the necessary clues and, at the same time, indicate whether one of the mineralised sites at Alberton might also be of the "Golden Gate" type.

THE "GOLDEN GATE"

The "Golden Gate" Mine, which has been defined as a most desirable target in the geological environment of north-east Tasmania was located about 1 km south of the township of Mathinna (see Figure 1). This very rich ore deposit consisted of a set of gold-bearing quartz reefs which filled numerous but randomly oriented fractures apparently unrelated to structures within the host rocks (Mathinna Beds). The reefs range up to nearly 10 m in width and were up to 300 m long although most were much thinner and less than 30 m long. Mining at the "Golden Gate" proceeded to a depth of nearly 500 m with a total production of 7895 kg of gold.

The quartz reefs were typical of the region in that they also contained gold-bearing sulphides (pyrite, arsenopyrite) and other sulphides (chalcopyrite, galena, sphalerite) and silver. Unlike most small producers the grade was maintained at depth (about 25 g/t) with an increasing silver content. Sulphide concentrates were very rich. Water, mining difficulties and gold price effectively terminated production of deep Tasmanian mines (including the "Tasmania" at Beaconsfield).

Many prospects display similar grades at shallow depth but these rapidly diminish to less than 3 g/t at depths of less than 30 to 50 m. This element has destroyed many hopeful prospects. Any prospect, in which grades are maintained, is likely to prove very profitable.

All explorers agree that other deposits of "Golden Gate" type must exist in the region; the problem is how to identify them or distinguish them from the plethora of minor deposits.

INSIGHTS FROM ALBERTON

The regional location of the Alberton area is shown in Figure 1 and the specific location of the leases is given in Figure 3. Figure 4, using a basemap prepared by Renison Exploration, indicates the general location of mineralisation and old mines in the southern part of the Alberton Field. The field has been a significant producer of gold and, although one may dispute the actual quantities in detail, much of it has come from only one or two mines, such as the Mt Victoria and the Ringarooma United - essentially the extremities of the field. Mining in this field has not been on a large scale nor to great depths yet there are indications of severe reductions in grade with depth. This is the typical behaviour in the province and it is not possible to point to any mine as being a probable "Golden Gate", or one in which the ore will extend economically in depth.

The problem, therefore, of where to direct exploration dollars is a real one.

Ground magnetic surveys were undertaken in order to provide some kind of ranking within the area. Figures 5 and 6 present the results in profile form based on a survey utilising very sensitive vapour magnetometers and sampling at about 20 cm along lines about 50 m apart. The data was fully corrected for diurnal, total field and normal survey links. It reveals about six distinct patterns with sub parallel relationships. These unexpected patterns trend ENE to E-W, are 200 to 500 m long and are directly associated with the known mineralised sites. Although the precise origin of these features can

as yet only be surmised, it does indicate that more than half of the lease area may be of no interest whatsoever.

I infer that the patterns reflect a change in quartz content within units of the Mathinna Beds coupled with long wavelength effects due to variations in rock type (mudstone-sandstone) and perhaps bulk alteration. Figure 7 suggests the possible origin of some of the larger features near the "Long Struggle". These implications have yet to be confirmed.

The best developed magnetic pattern is associated with the "Caxton" and "Long Struggle" group of reefs and it has been presumed that these might represent a good target for further exploration.

Chemical indicators, such as the presence of arsenopyrite and other sulphides, are endemic and offer far less spatial control.

Does one of these magnetic patterns conceal a "Golden Gate" and, if so, which one? Past production from shallow depth is not a reliable indicator and this field has produced a total of about 8.3 tonnes. The limited Alberton zone in itself is rich. Note that one "Golden Gate" has produced almost this amount of gold.

The key elements of what is presently known may be simply stated; near E-W or ENE magnetic anomalies can be correlated with mineralised zones in narrow zones barely more than 300 m long which lie adjacent to major structures trending NNW but which appear to express negligible correlation with the primary structures or local controls. Regional magnetic data are available (Figures 9-10; 24-25) and express similar trends but there are no gravity data.

EXTENSION TO OTHER FIELDS

Available data from other gold fields has been inspected to test whether the regional and local implications of a structural control upon gold mineralisation may occur. No such correlation has been recognised previously. Consider, for example, Figure 17 which represents the last stage of analysis for Pegasus Gold during its tenure of the Mathinna-Mangana area. No further interpretation was undertaken for that company because they felt it showed no correlation with the many gold occurrences in the area. And it does not. I was responsible for this diagram (Leaman, 1990) and it shows the clear trends evident in the many forms of the data inspected. ENE or E-W trends are relatively rare and some do pass through or near mineralised sites.

The significance of this was not appreciated until other data sets were inspected in association with the fact of the correlation at Alberton.

If now the actual data, with 0.5 nT contour interval, is inspected it can be shown that EVERY known site in the area of survey, as well as those just beyond it to the east (such as "Great Fingal"), either lie on such trends or their projected continuation; including "Golden Gate". This correlation is indicated in Figures 15 and 16 which ignore the more obvious trends due to regional structure, unit lithologies and so on to emphasize the ENE elements. It will be noted that the definition is subtle but real and this reflects the mistake of flying the survey with a 4 to 1 E-W to N-S line bias. The line bias problem did not arise at Alberton due to use of NE-SW orientations which were able to define the nominal E-W character. The

correlation might have been expected after the earlier Tower Hill ground survey (Leaman, 1989) but the concerns about presentation of the data restricted acceptance of the compilation (Figure 14). In this survey the data was filtered using continuations of the data, which merely show what it might look like if observed at an increased height above the ground. Such processing smoothes the data (Figure 13) and can remove some important character. The Alberton work shows that the filter used at Tower Hill was too powerful. Even so Figure 14 shows that the two mine sites, "Sunbeam" and "Tower Hill", are actually aligned along a trend a little east of ENE! Just as at Alberton.

If this data were converted to appear in a form observed at 80 m above the ground (where Figures 15 and 16 were) then the ENE character will persist but be subtle. It is. So subtle it was ignored. It should not have been.

Other work in the vicinity of the "Tower Hill" Mine reveals character not unlike that observed near the "Long Struggle" at Alberton (compare Figures 7 and 12 for long wavelength - not spike effects).

Regional evidence is even more important. The only good gravity data is available for the area south of Tower Hill (Figure 18) and it shows that gravity gradients can be correlated with the clusters of mineralised sites - including those well east of Mangana. The groupings occur on offsets of the gradient which must reflect major structures or granitoid wall projections. The offsets are oriented between E-W and NE (could be ENE) but cannot be specified more

accurately. This may ultimately prove to be decisive information for the exploration process.

Regional magnetic data, although of variable quality, is presented in Figures 9 and 10. Figure 9 presents the data as observed as an approximate drape of the land surface with a clearance of about 150 m (specified; actual clearance 100 to 700 m) while Figure 10 presents the data as it would have been observed at a fixed level of 1500 m above sea level. The second diagram smoothes much of the character but represents a true comparison of responses. The large anomalies are due to exposed or concealed granodiorites. Gross ENE and E-W trends can be recognised in these maps and major trend corridors with this orientation occur in the Mathinna ("Golden Gate"), Mangana (south) and Alberton zones. Figure 25 shows that, at high altitude, the trend sweeps from ENE to E-W at Alberton in precisely the same manner as the ground data.

Regional data show that these trends are not universal and are zonally localised. Detailed data, such as shown in Figures 15 and 16, show that even subsets of the major elements are not general. Local and regional trends overlap at South Mangana, Mathinna central and Alberton; each the site for substantial mineralisation.

This work suggests the characteristics for a "Golden Gate" signature; impressed local and regional sub ENE trends in magnetic data, and a probable matching offset in gravity data. Fracture and local bedding relationships are random and not diagnostic.

The validity of these inferences has been tested elsewhere.

Figure 19 presents a portion of the magnetic survey completed by Placeco Australia in the Lyndhurst area. Geological information used as base was derived from regional mapping of the Geological survey. ENE trends can be recognised in this data but they are subtle and although linked with mineralised sites generally lack continuity. There is no evidence of regional trends of this type in either gravity or magnetic data and no evidence of any response related to the small mines a few kilometres further south. It may be concluded that these deposits are quantitatively different from those at either Alberton, Mathinna or Mangana. Their history would support this conclusion. The "Golden Gate" response is absent.

Figure 20 presents data from part of the Gladstone Goldfield, also acquired by Placeco Australia (see Leaman, 1987b). This data is distinctive for its definition of structure within the Mathinna Beds and for displaying disruption of the folds. It does, however, also reveal some ENE trends. Two of these are beyond dispute and can be correlated with the "Big Musselroe" and "Bluebell" pits. Another feature has been inferred in the region of the "Portland" Mine but the 10 to 1 E-W bias of this data within a strongly magnetic and fault-bounded terrain has restricted definition. Ground survey, as shown in Figure 2, does confirm its presence a little north of the shaft where lithological and vein responses, which normally trend NNW, are partially truncated and modified. The mine may line in a narrow corridor between two such features since there are suggestions of a second a little south of the shaft. Old workings and cross

trenching in this mine zone seems to suggest that the miners considered both the vein orientation (NNW) and its conjugate (ENE) important.

Figure 21 summarises the conclusions drawn from the magnetic and gravity data in the Lisle-Golconda area. The predominant elements are not obviously related to the mineralisation but the second order ENE trend is, at all sites. This data set is unique in having a N-S line bias and these features are more easily seen. Indeed, observation of the trend at Alberton and its representation here led to the rechecking described for the Mathinna, Lyndhurst and Gladstone areas. Stream patterns and gravity data north of Golconda might indicate a regional overprint of the same trend is also present.

Examination of data from Golconda, Lyndhurst and Gladstone has confirmed the association with granodiorite for all gold-bearing regions. In every case the nearest granodiorite, usually beneath the deposits, is the first intruded of a series and bears relatively low contrast properties. Explanation of this association is beyond the scope of this review and it is not relevant to Alberton - although the granodiorites are present nearby - since the site is known to be mineralised and does not have either to be found or accounted for.

Only regional gravity data sets are available for the remainder of north-east Tasmania. While these may only crudely define trend and rock patterns an unmistakable ENE-trending gradient may be observed

near Warrentina (Figure 22) which links the gold occurrences there, and at and south of Lefroy.

If one considers also the observations derived from the structural analyses of central and northern Tasmania provided for Conga Oil using its regional gravity and magnetic coverage similar regional trends pass through Beaconsfield and the Little Den Goldfield (Figure 23).

Can there be any doubt as to the importance of ENE to E-W structuring? Its association with gold mineralisation cannot, I believe, be disputed. It is fundamental as an indicator at all scales and can be defined using magnetic or gravity data. All known major mineralised sites occur where regional corridors intersect major structures which usually trend NNW. "Golden Gates" can be expected in these nodes.

How, and how well, can these rare nodes be defined. Good data, such as acquired by Pegasus at Mathinna, would indicate within perhaps a hundred metres in regional terms using an airborne magnetic survey and very much better on the ground.

LESSONS FOR ALBERTON

The original insights drawn from the very detailed ground magnetic surveys at Alberton have been shown to have provincial significance and that the implication has been overlooked in the absence of such definitive results and associations.

The superposition of detailed surveys and more extensive regional surveys in the Mathinna, Mangana and Alberton areas (the government survey, Figure 9) shows that these sites are the exceptions. This is encouraging in itself. The absence of equivalent data superpositions elsewhere precludes recognition of other key sites. Thus if other "Golden Gates" occur one may be expected near Mangana, and another near Alberton.

Does one of the known mine sites represent the location of a new "Golden Gate"? Unfortunately the available regional magnetic data cannot define this with certainty since the survey was terminated at the latitude of Alberton and its east-west character is disrupted by the peripheral influences of basalts (to the west) and granodiorite (to the east). Enlargements of the Alberton area, as presented in Figures 24 and 25, do show that sub E-W character is evident between 5427 and 5429 000 mN in observed data. This band encloses the northern mine group centred on the "Strahan" and "Hannah". Unfortunately this may be a false location due to terrain clearance problems since the corrected map with a reference level would suggest that the placement is further south, at perhaps 5426 000 mN. This

position lies between the "Mt Victoria" and "Long Struggle" groups and the conclusions seem like an each-way bet. The data does not permit a better judgment.

The data available do imply a "Golden Gate" response but cannot locate it precisely. This is certainly a condition which should be corrected since to do so would enable limited exploration funds to be concentrated on that part of the lease area most likely to yield the greatest return.

There is thus a need to provide some indication of regional setting and control. This cannot be done with surface surveys in the conditions which apply at Alberton, although such surveys could be locally extended around the northern mine group. Basically, such surveys are too costly and cannot cover sufficient area.

The necessary information can only be provided in two ways, given the experience elsewhere as described in this review. Either acquire a modest but high precision airborne survey (helicopter required) of a few square kilometres and/or infill the regional gravity coverage. Gravity surveys are here suggested only in a supporting role since the application requires much more evaluation but the extra information may provide a useful control. Tightly specified barometric elevations would be adequate for this purpose and such surveys would not add substantially to the cost of the helicopter survey. No other methods can be recommended as either worthwhile or cost effective.

A notional specification might be:

AEROMAGNETIC SURVEY

Helicopter based, high sensitivity magnetometer, flown with N-S lines no more than 200 m apart and with a sample interval of about 10 m along lines. Relief in the area suggests that the survey be flown as a 100 m drape of the terrain. The object of the survey must be to define any sub E-W gradients in the area of Garden Ridge.

A conservative cost of \$50 per line kilometre should be allowed for the survey (including mobilisation and map production) and this would provide for a coverage of 5 km N-S by 3 km E-W for about \$5000.

GRAVITY SURVEY

Reasonable coverage of the same area should be possible in perhaps 4 days at a cost of perhaps \$1500.

These estimates are approximate but suggest the general probable costs involved.

This work is recommended and would be undertaken in any standard exploration programme as a means of achieving target focus.

It may be commented that the transfer of Alberton exploration from the detailed to the regional is a reversal of normal practice. Regional data would usually be available prior to specific examination but the programme undertaken here reflects the history of evaluation of mine leases, rather than large exploration areas.

Other forms of local exploration, such as detailed review of the origin of the anomalies (by trenching and rock inspection plus sampling) is still required.

REFERENCES

- Klominsky, J., & Groves, D.I., 1970. The contrast in granitic rock types associated with tin and gold mineralisation in Tasmania. Proc. Australas. Inst. Min. Metall. 234: 71-77
- Leaman, D.E., 1974. Geophysics of the Lefroy Goldfield. Tech. Rept. Dep. Mines Tas. 17, 79-87.
- Leaman, D.E., 1987a. Report on trial survey, Portland Mine. EL 34/86 Report for Placeco Australia by Leaman Geophysics, August.
- Leaman, D.E., 1987b. Acquisition report, airborne geophysical surveys EL 34/86 Gladstone. Report for Placeco Australia by Leaman Geophysics, September.
- Leaman, D.E., 1989. Ground magnetic survey, EL 55/83, Mangana. Report for Pegasus Gold Australia by Leaman Geophysics, October.
- Leaman, D.E., 1990. Aeromagnetic survey EL 55/83 Mangana. Acquisition report including preliminary interpretation. Report for Pegasus Gold Australia by Leaman Geophysics, April.
- Leaman, D.E., & Richardson, R.G., 1981. Gravity survey of the east coast coal fields. Bull. geol. Surv. Tasm. 60
- Leaman, D.E., Symonds, P.A., & Shirley, J.E., 1973. Gravity survey of the Tamar Region, northern Tasmania. Geol. Surv. Tasm. Pap. 1
- McIntosh Reid, A., 1925. The properties of the Ringarooma Gold Mining Co., Alberton, Tasmania. Unpub. Rept. Dep. Mines Tas.

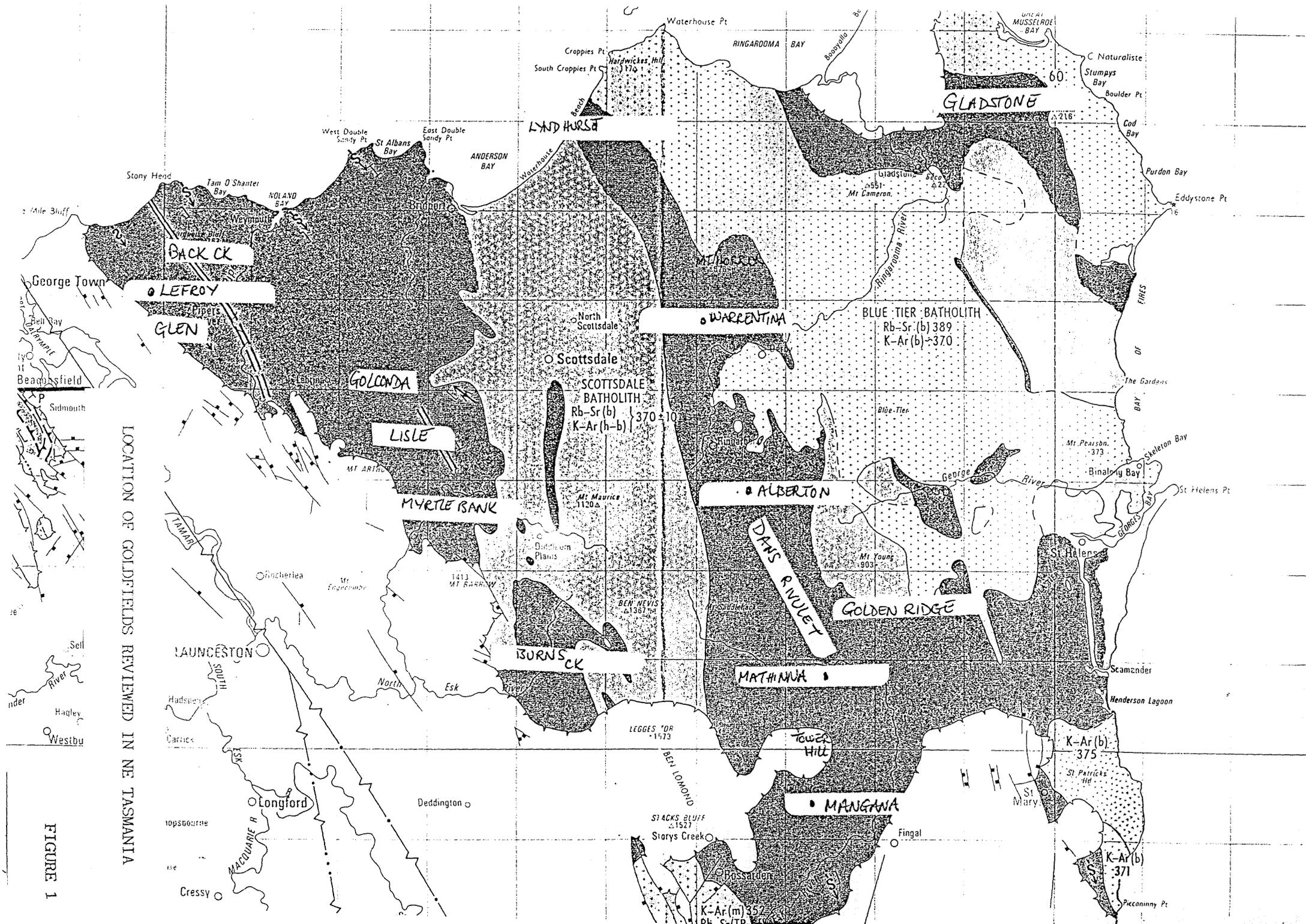
Report submitted on behalf of Leaman Geophysics

by



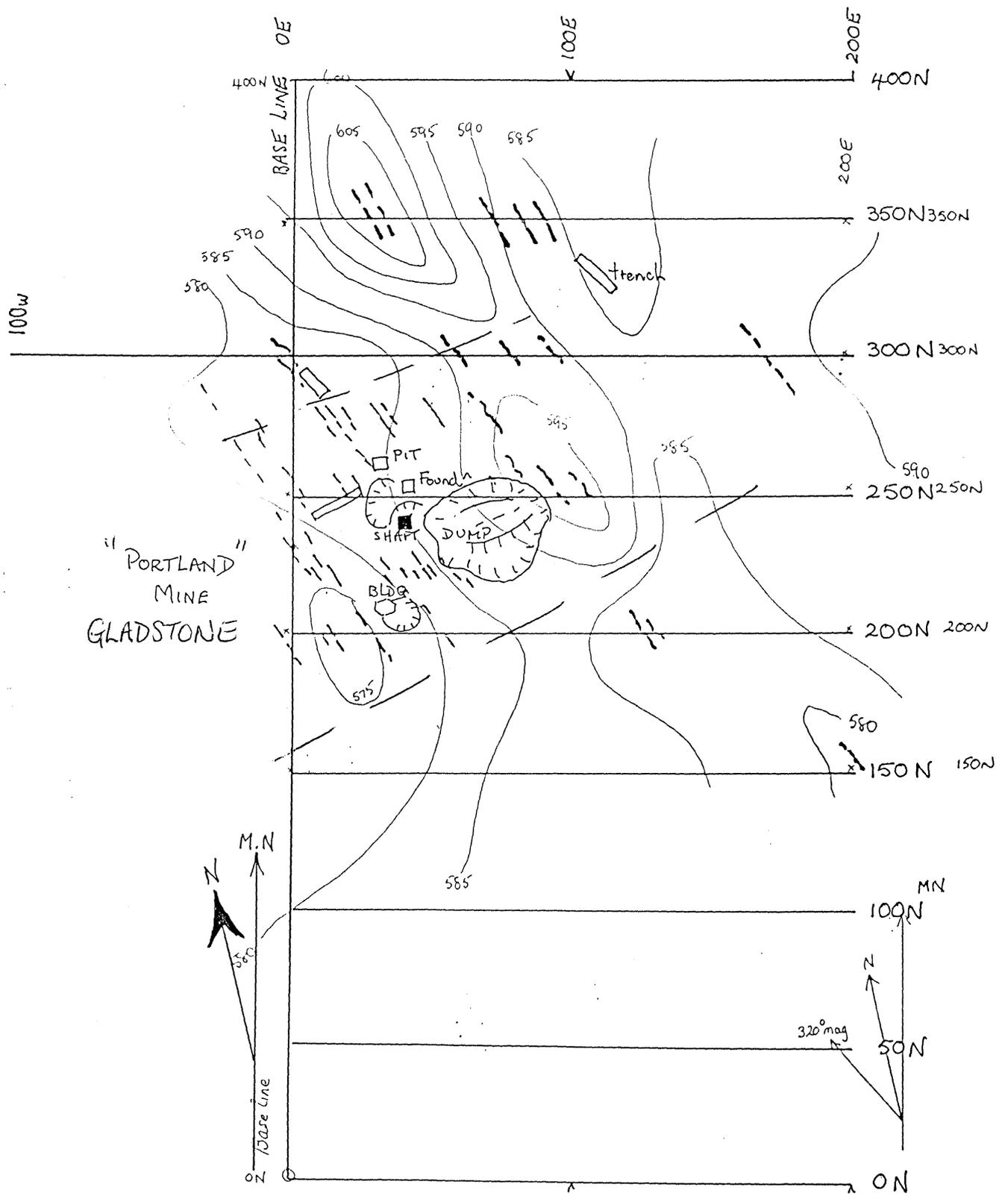
Dr. D. E. Leaman, B.Sc., Ph.D.,
F. Aus. I.M.M., M.M.I.C.A.

Date: 23/7/91



LOCATION OF GOLDFIELDS REVIEWED IN NE TASMANIA

FIGURE 1

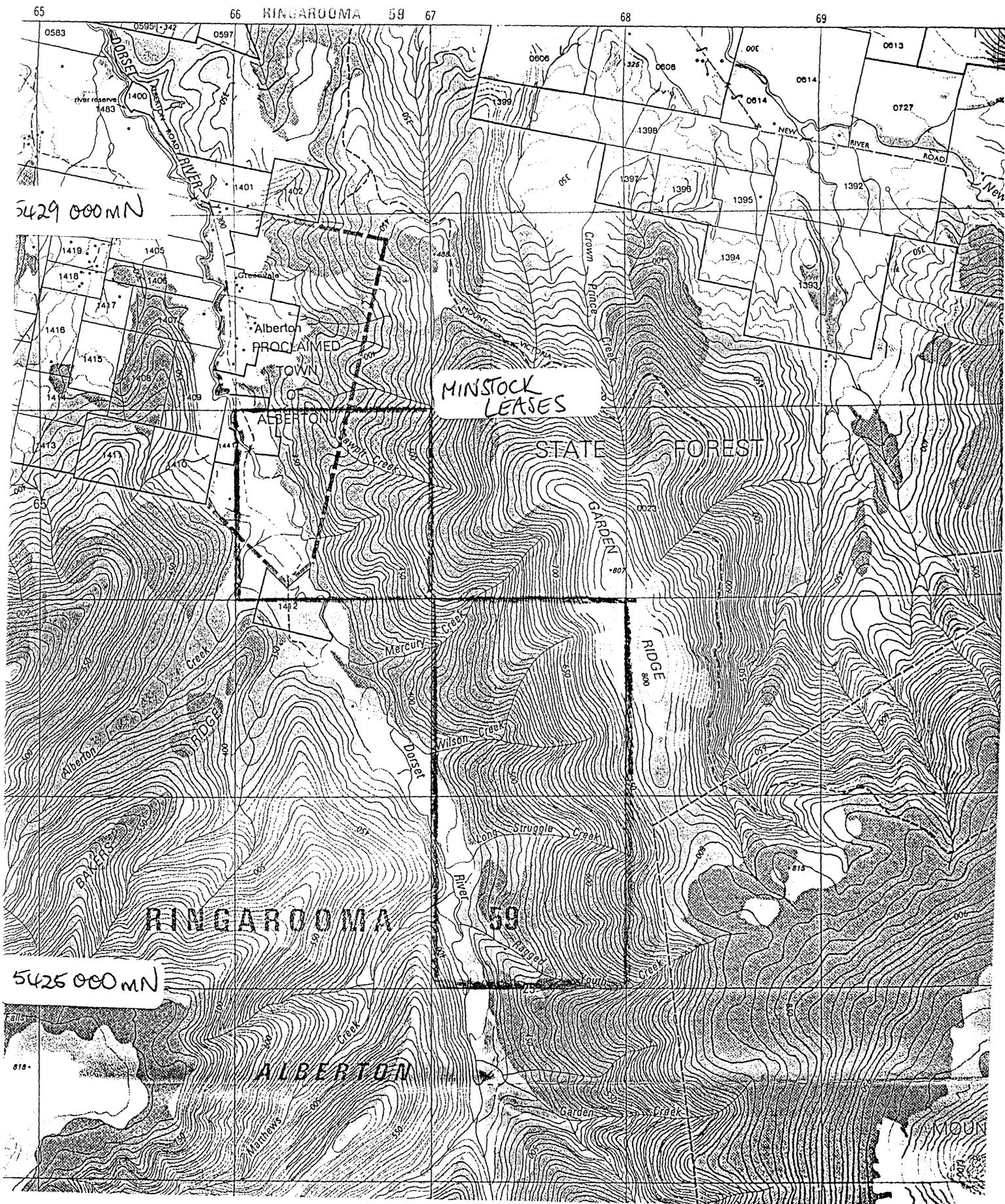


GROUND SURVEY

FIGURE 2

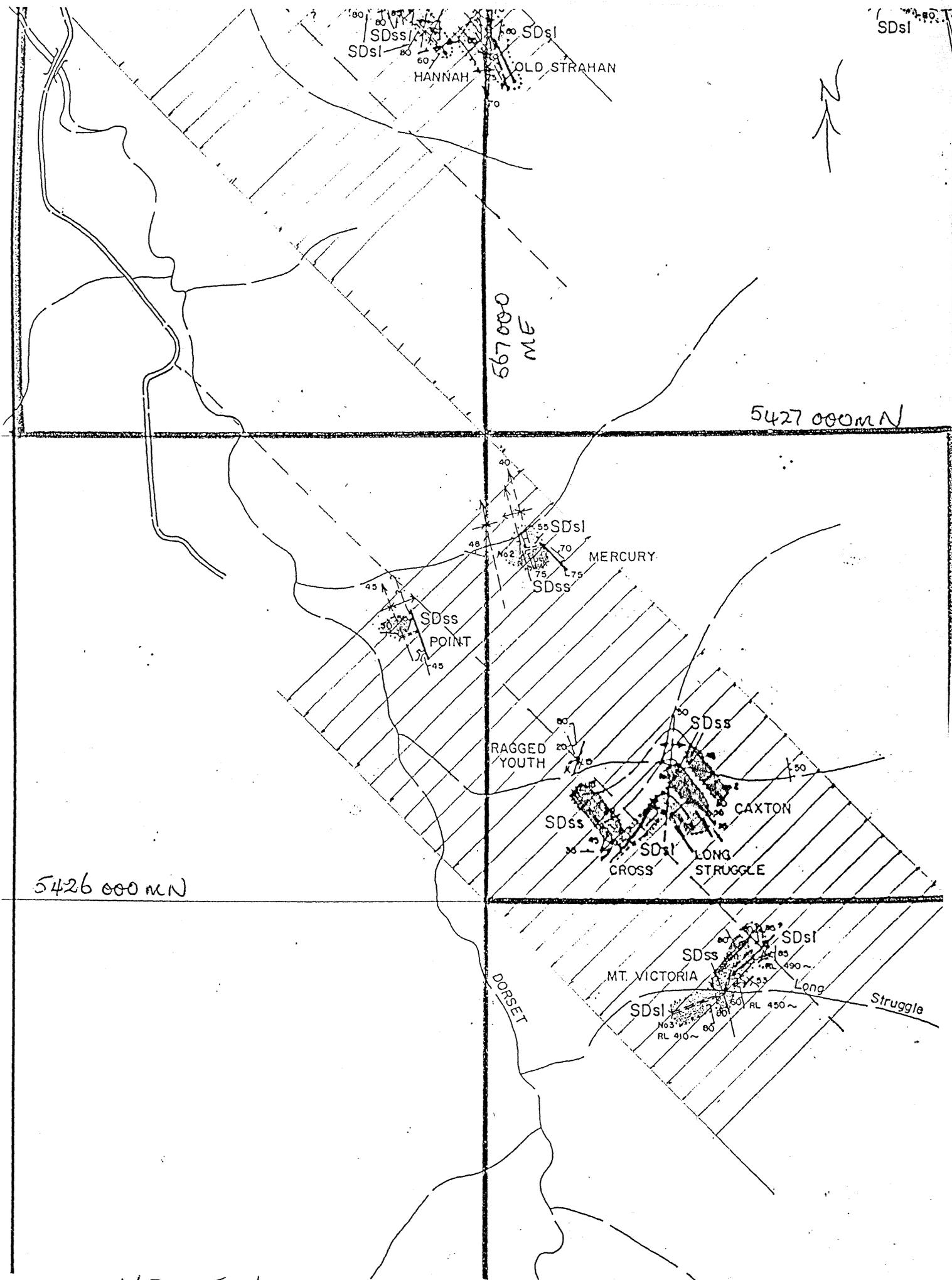
CONTOURS OF MAGNETIC FIELD SHOWING LOCATION OF SPIKE FEATURES. Interval 5 nT, based on noise smoothed profiles.

567000 ME



LOCATION OF ALBERTON LEASES

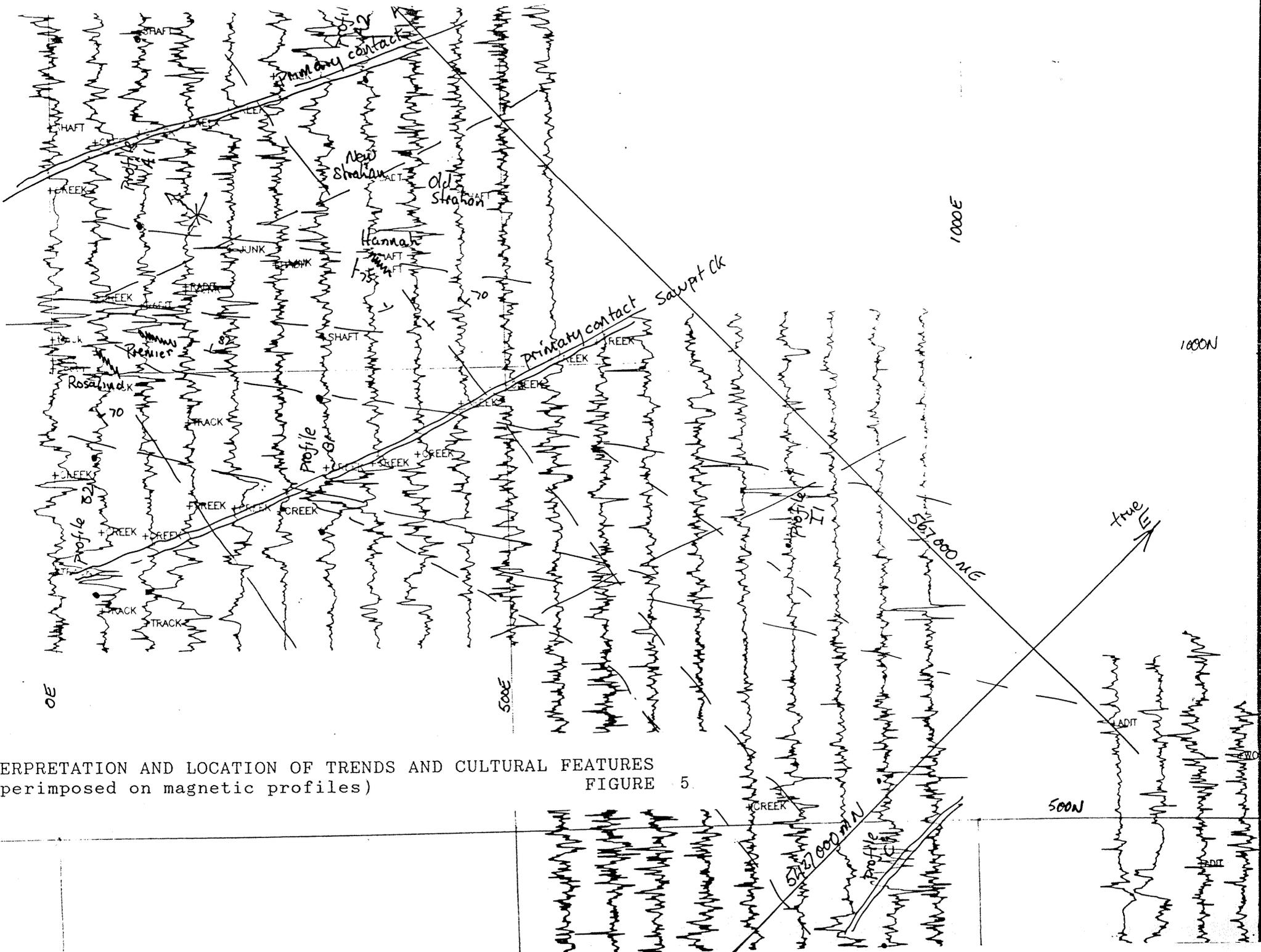
FIGURE 3



ALBERTON

LOCATION OF MAGNETIC SURVEY GRIDS
 Magnetic Fields Exploration

FIGURE 4

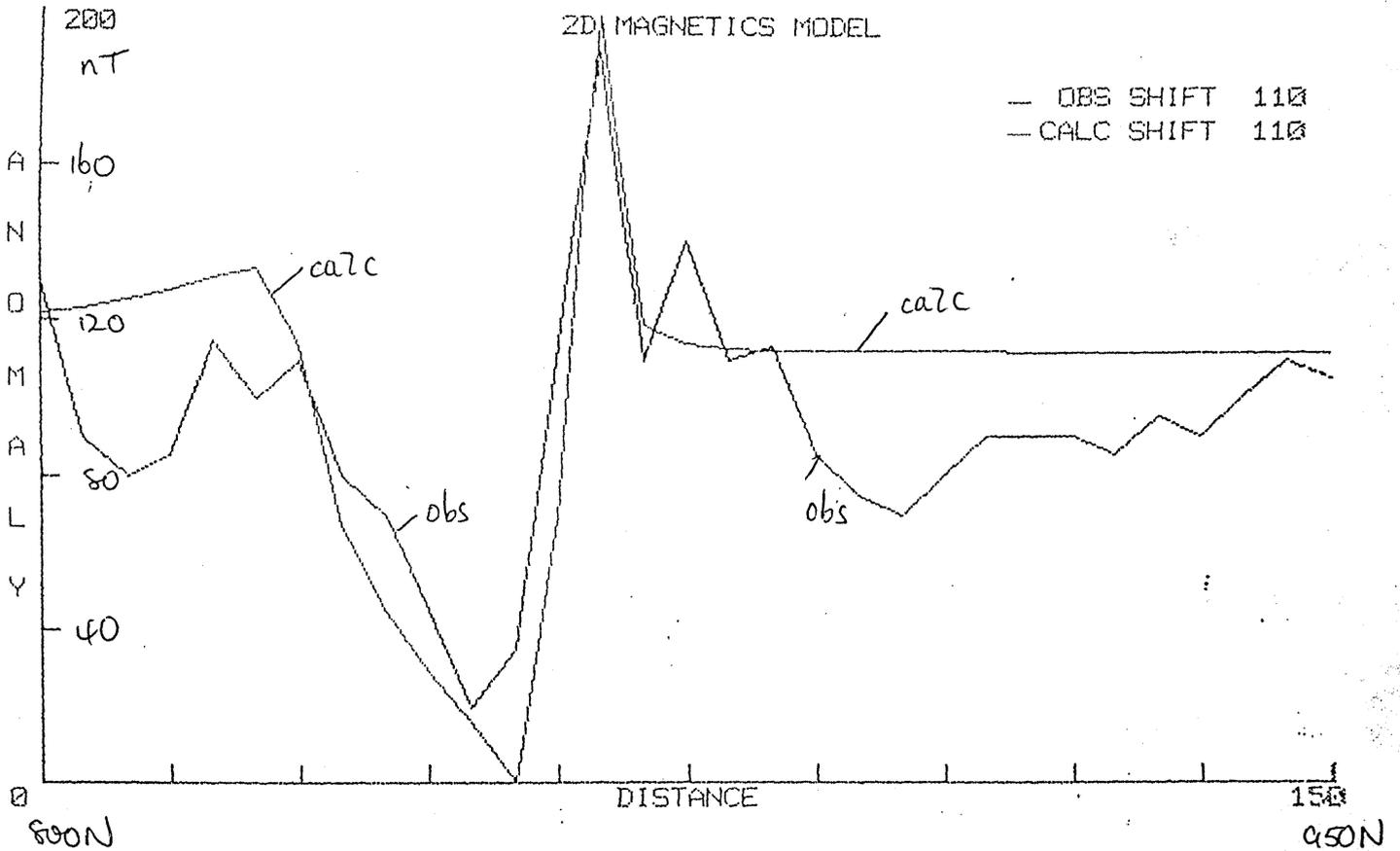


INTERPRETATION AND LOCATION OF TRENDS AND CULTURAL FEATURES
(superimposed on magnetic profiles)

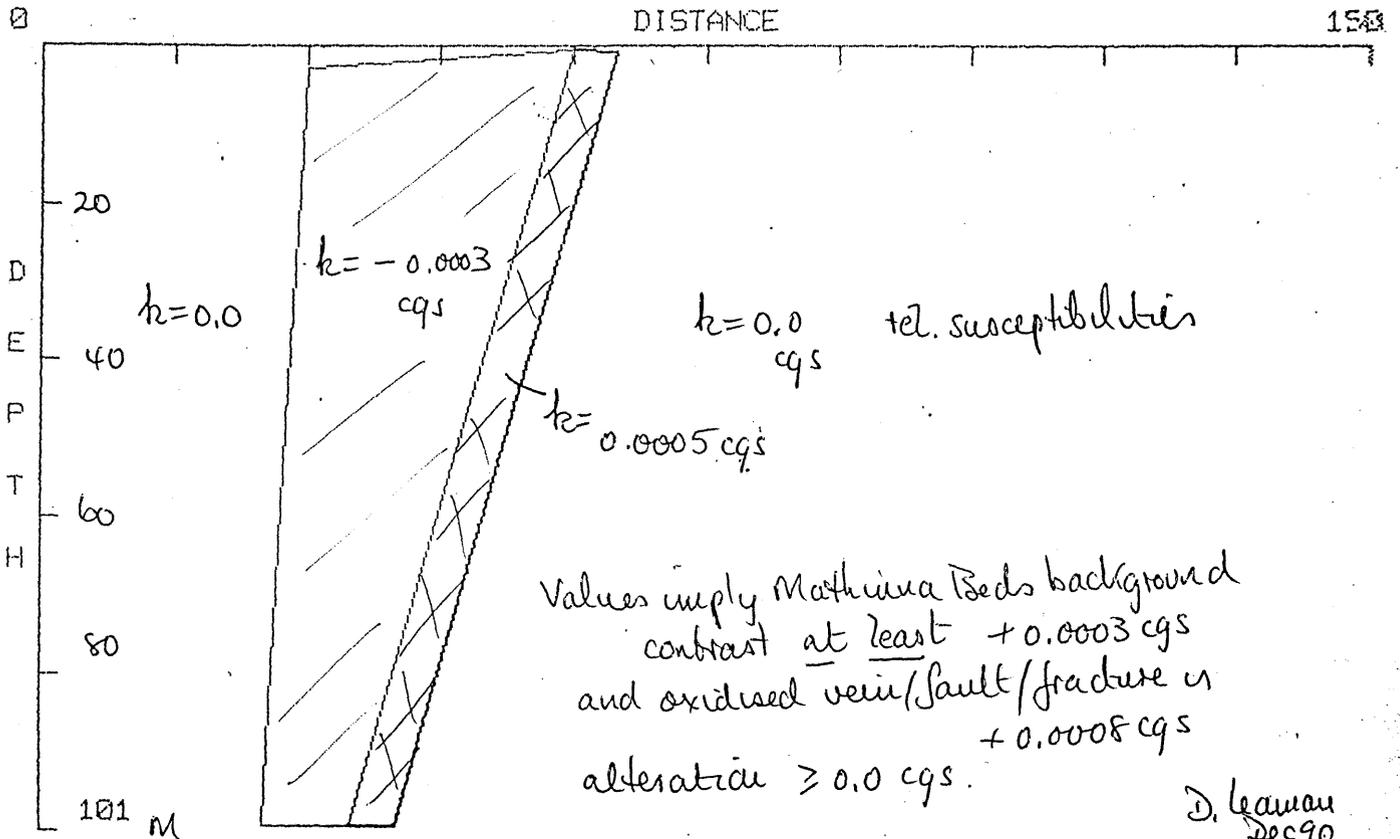
FIGURE 5

60 1 35 100 25 100 30 3

LINE PARAMETERS - ORIGIN,LIMIT,INCR : 0 150 5

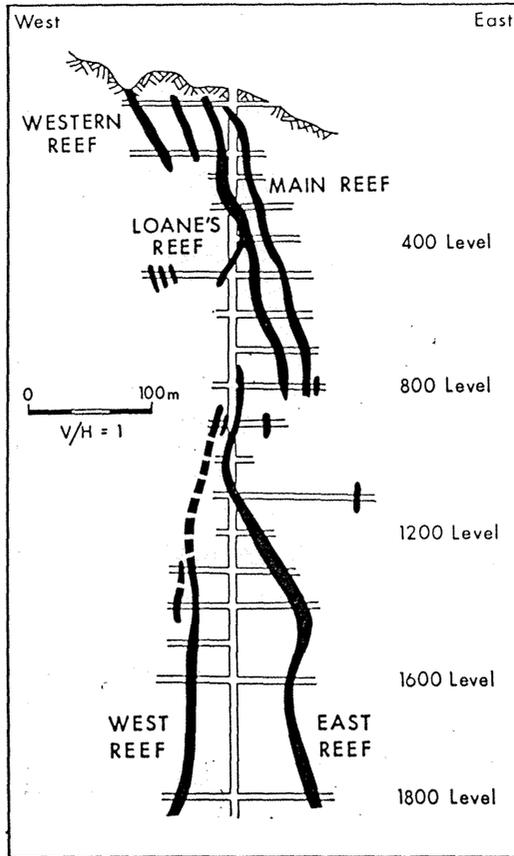


ALBERTON B1 306E 800-950N

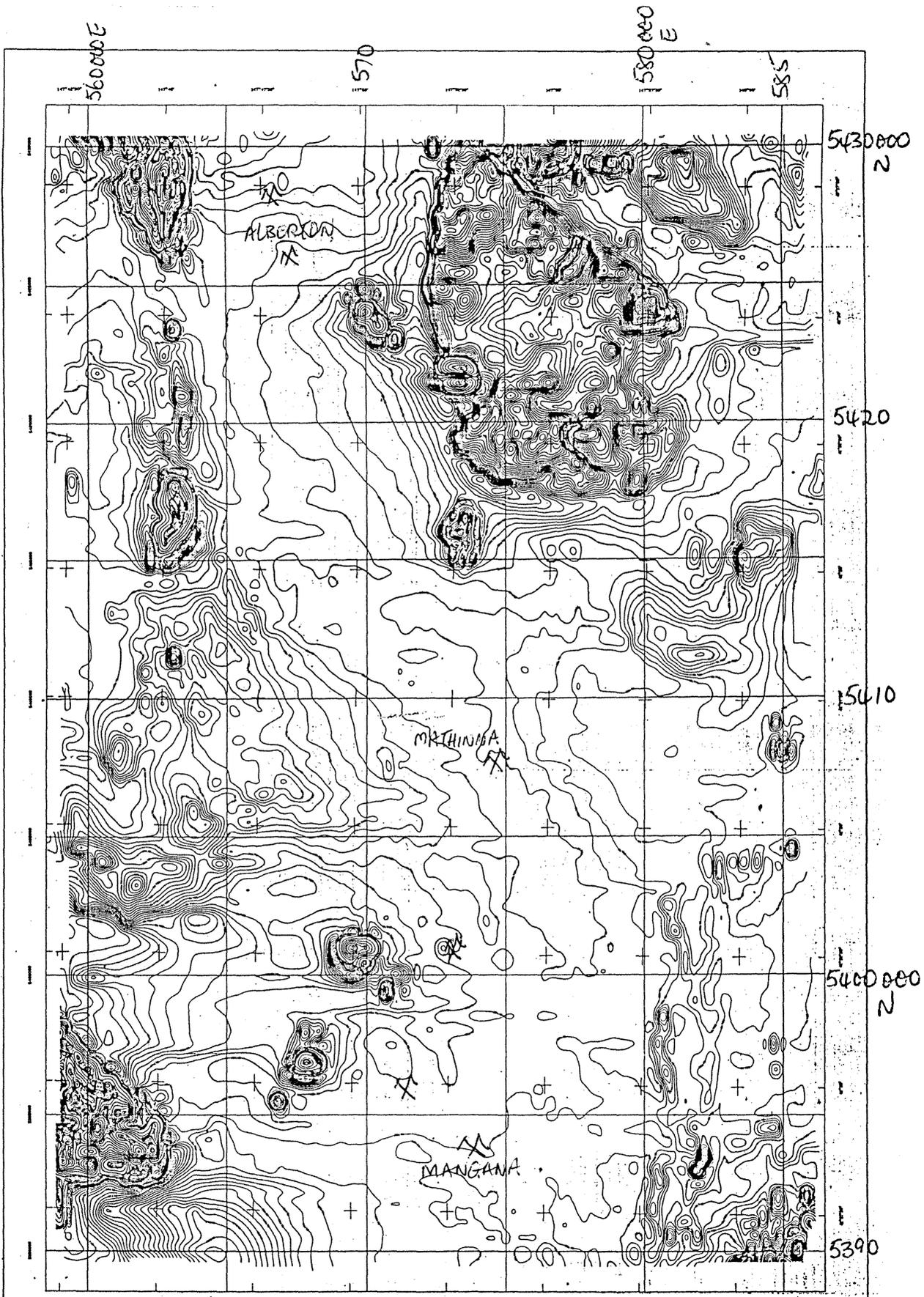


MAGNETICS MODEL PROFILE B1:
(WITH WALL ALTERATION)

FIGURE 7



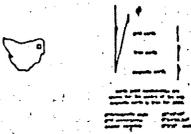
Cross section of the New Golden Gate mine, Mathinna showing the main reefs hosted by the Mathinna beds



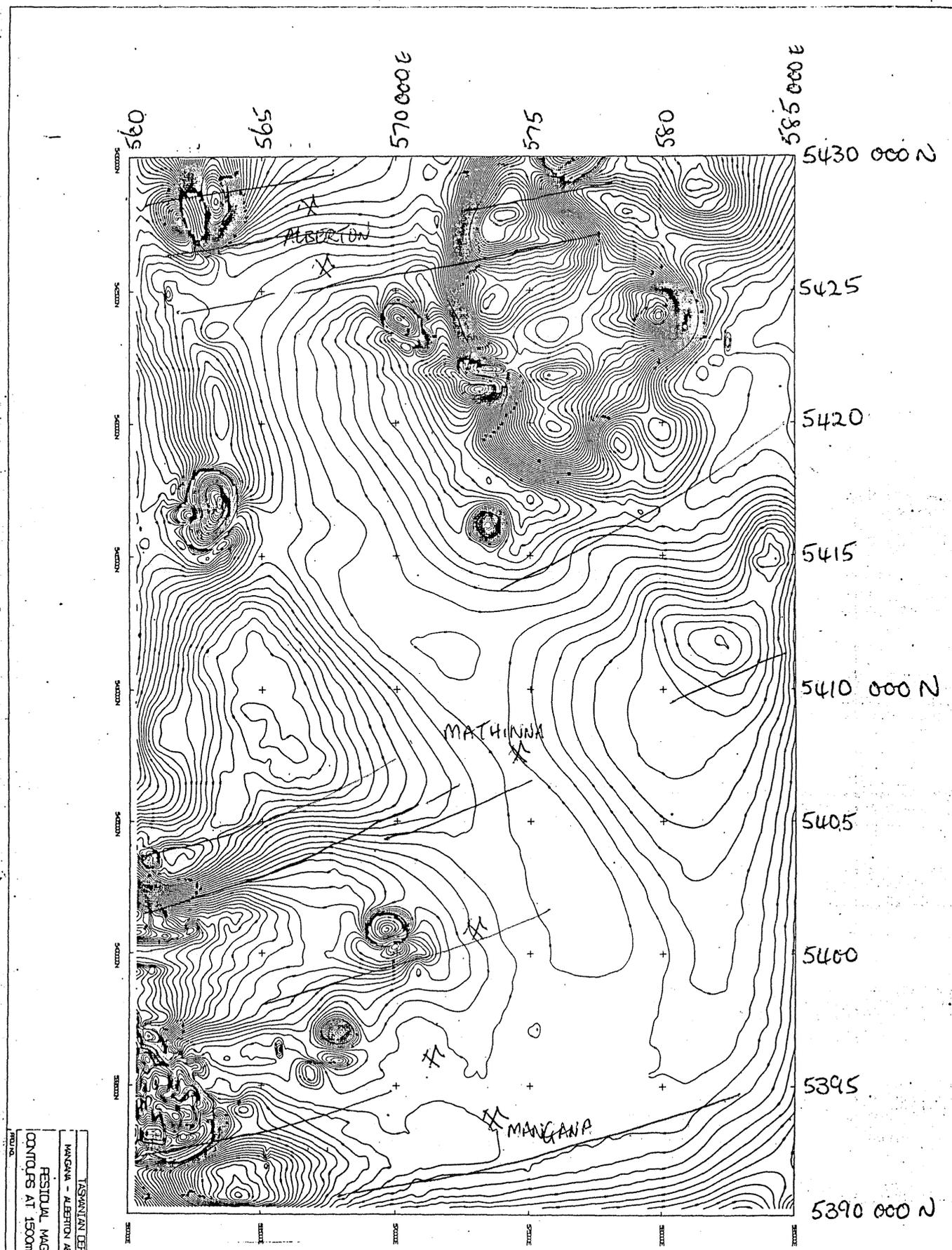
PROJECT
 AIRBORNE GEOPHYSICAL SURVEY
 MAP SCALE 1:50,000
 PHOTO SCALE 1:25,000
 PHOTO DATE 1964
 PHOTO TYPE 100mm
 PHOTO SIZE 100mm
 PHOTO AREA 100mm
 PHOTO ORIENTATION
 PHOTO COORDINATES
 PHOTO SCALE
 PHOTO DATE
 PHOTO SIZE
 PHOTO AREA
 PHOTO ORIENTATION
 PHOTO COORDINATES
 PHOTO SCALE

N.E. TASMANIA
AIRBORNE GEOPHYSICAL SURVEY

Department of Mines Tasmania
 Geophysical Survey Unit
 Hobart, Tasmania



MINES DEPARTMENT REGIONAL AEROMAGNETIC SURVEY MATHINNA AREA FIGURE 9



ISMANTANI DEPARTMENT OF MINES
 MANGANA - ALBERTON AEROMAGNETIC SURVEY (1988)
 RESIDUAL MAGNETIC INTENSITY
 CONTOURS AT 1500m BAROMETRIC ALTITUDE
 PROJECT: _____
 DATE: _____
 SHEET: _____

DATA PROCESSING
 Project Name: _____
 Date: _____
 Operator: _____
 Station: _____
 Instrument: _____
 Scale: _____
 Contour Interval: _____
 Contour Style: _____
 Contour Label: _____
 Contour Color: _____
 Contour Width: _____
 Contour Dash: _____
 Contour Offset: _____
 Contour Join: _____
 Contour Break: _____
 Contour Style: _____
 Contour Label: _____
 Contour Color: _____
 Contour Width: _____
 Contour Dash: _____
 Contour Offset: _____
 Contour Join: _____
 Contour Break: _____

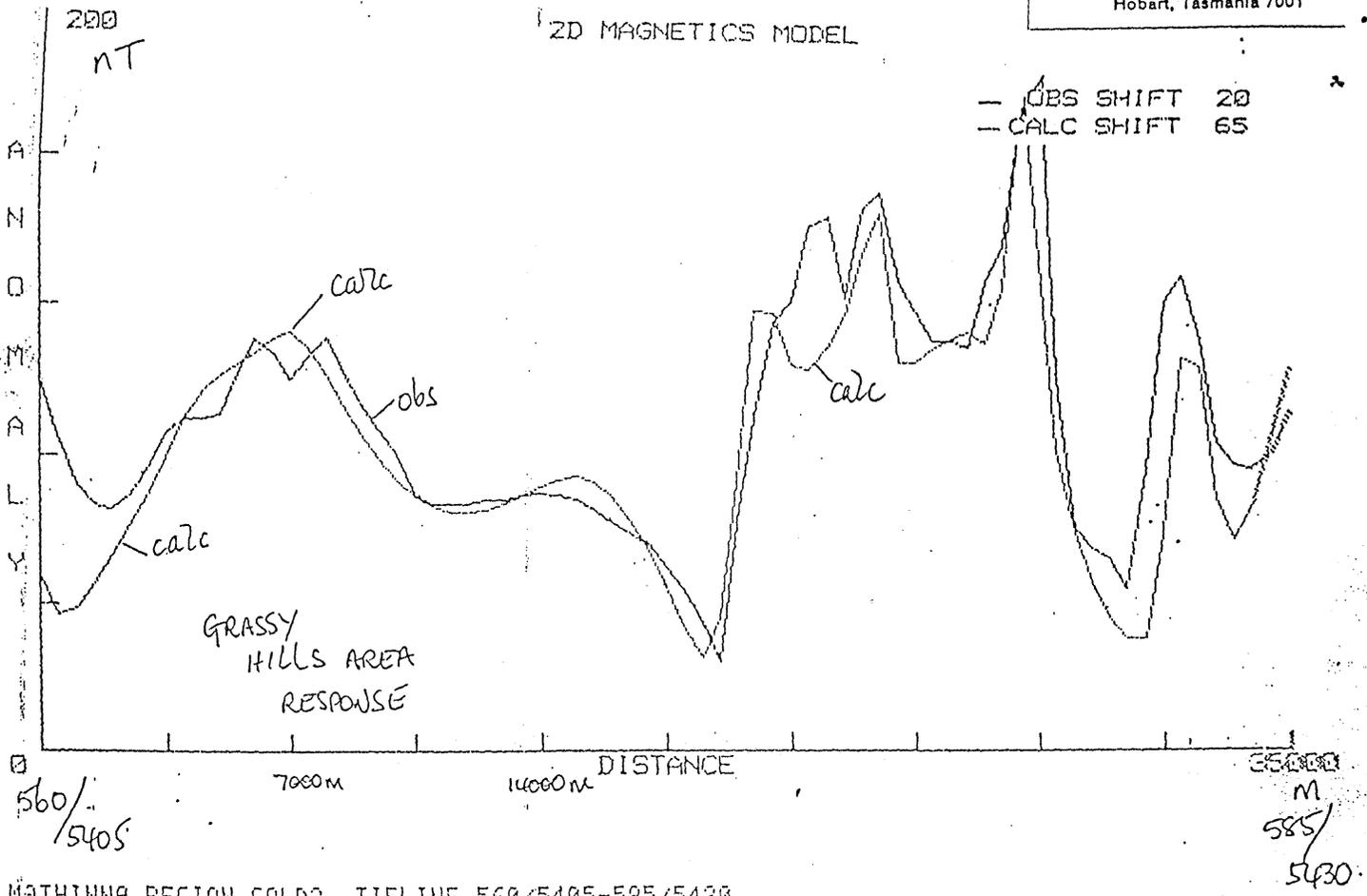
MINES DEPARTMENT AEROMAGNETIC SURVEY
 CORRECTED TO 1500 M ASL
 FIGURE 10

DATA UNIT

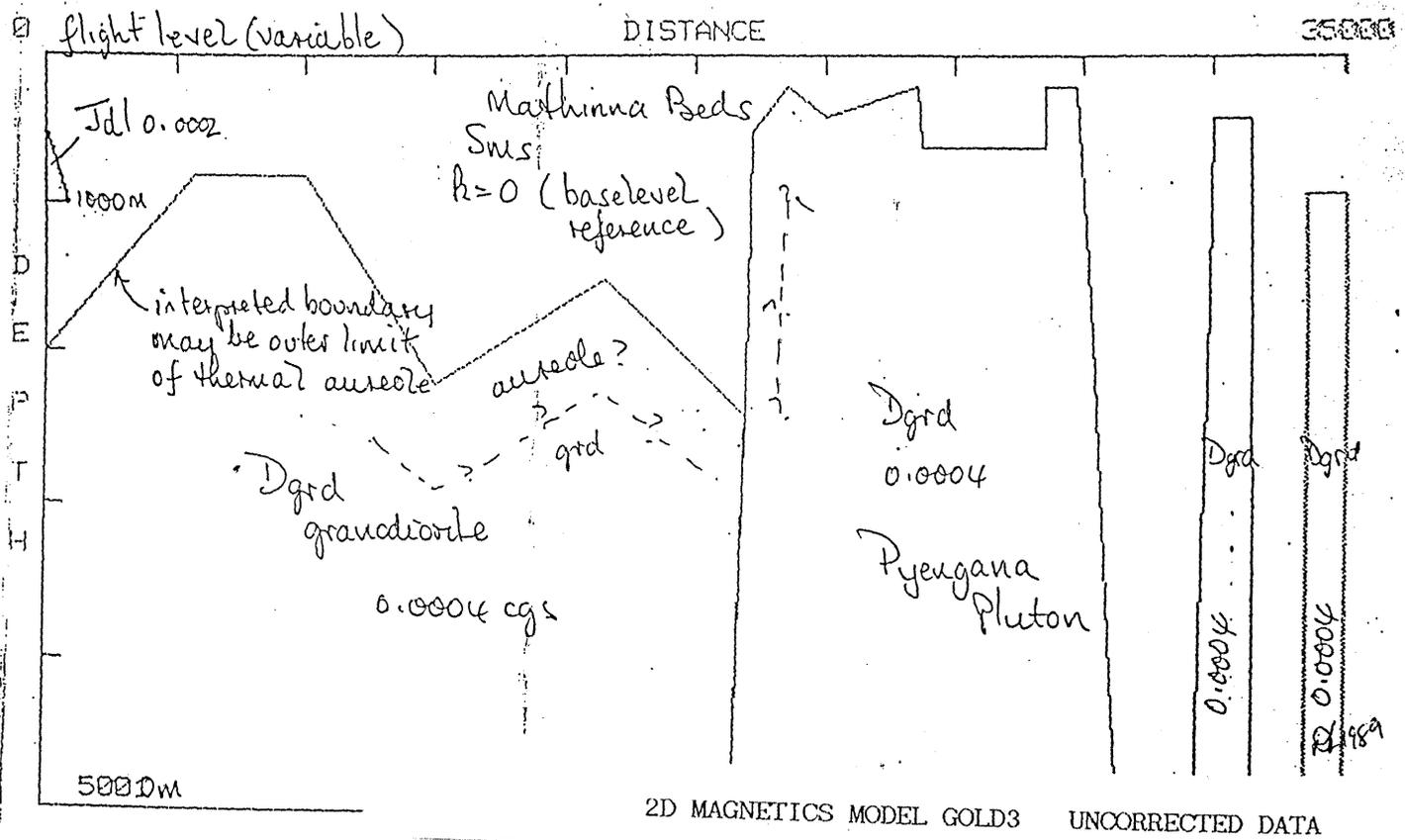
LINE PARAMETERS - ORIGIN, LIMIT, INCR : 0 35000 500

500

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



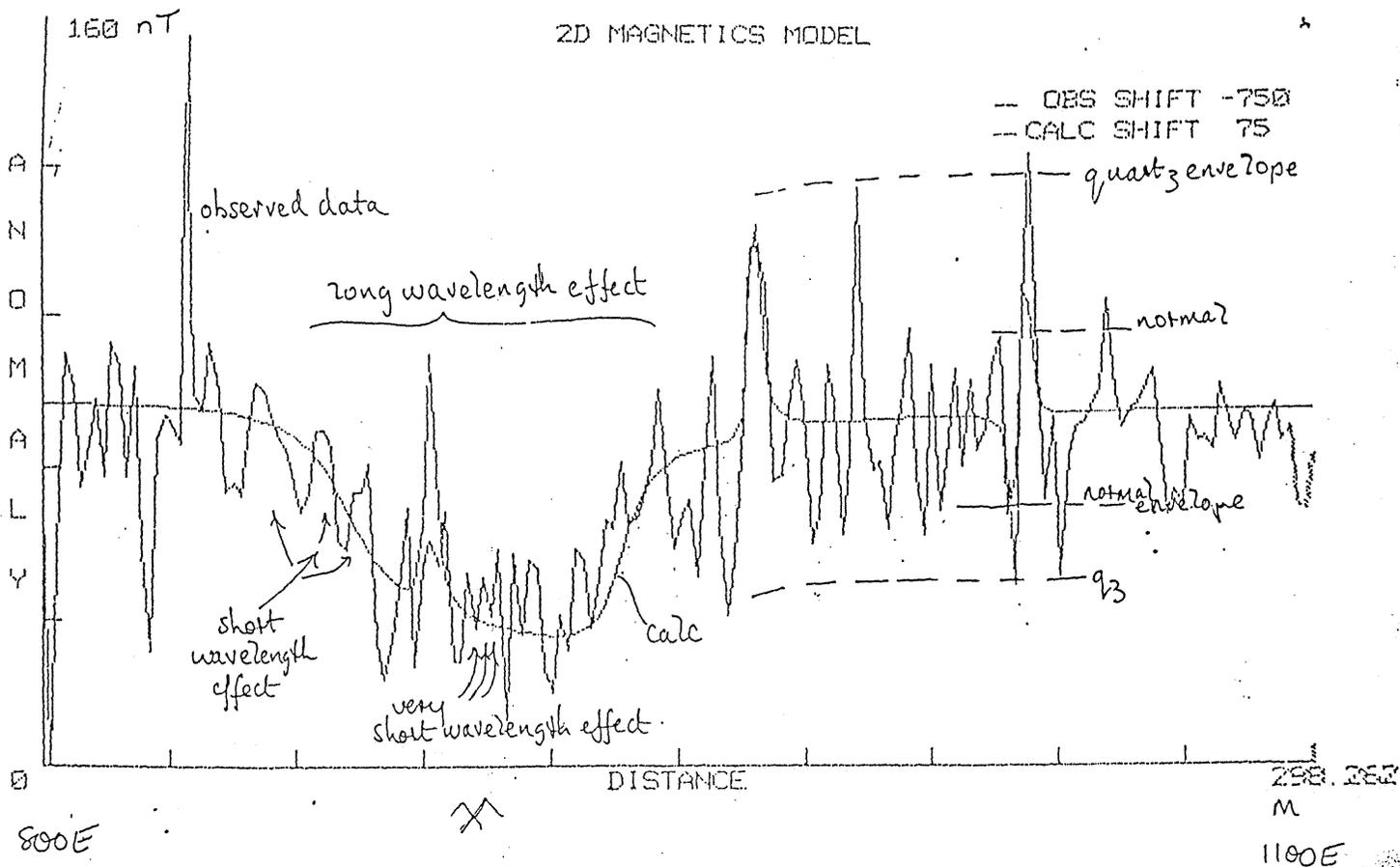
MATHINNA REGION GOLD3 TIELINE 560/5405-585/5430



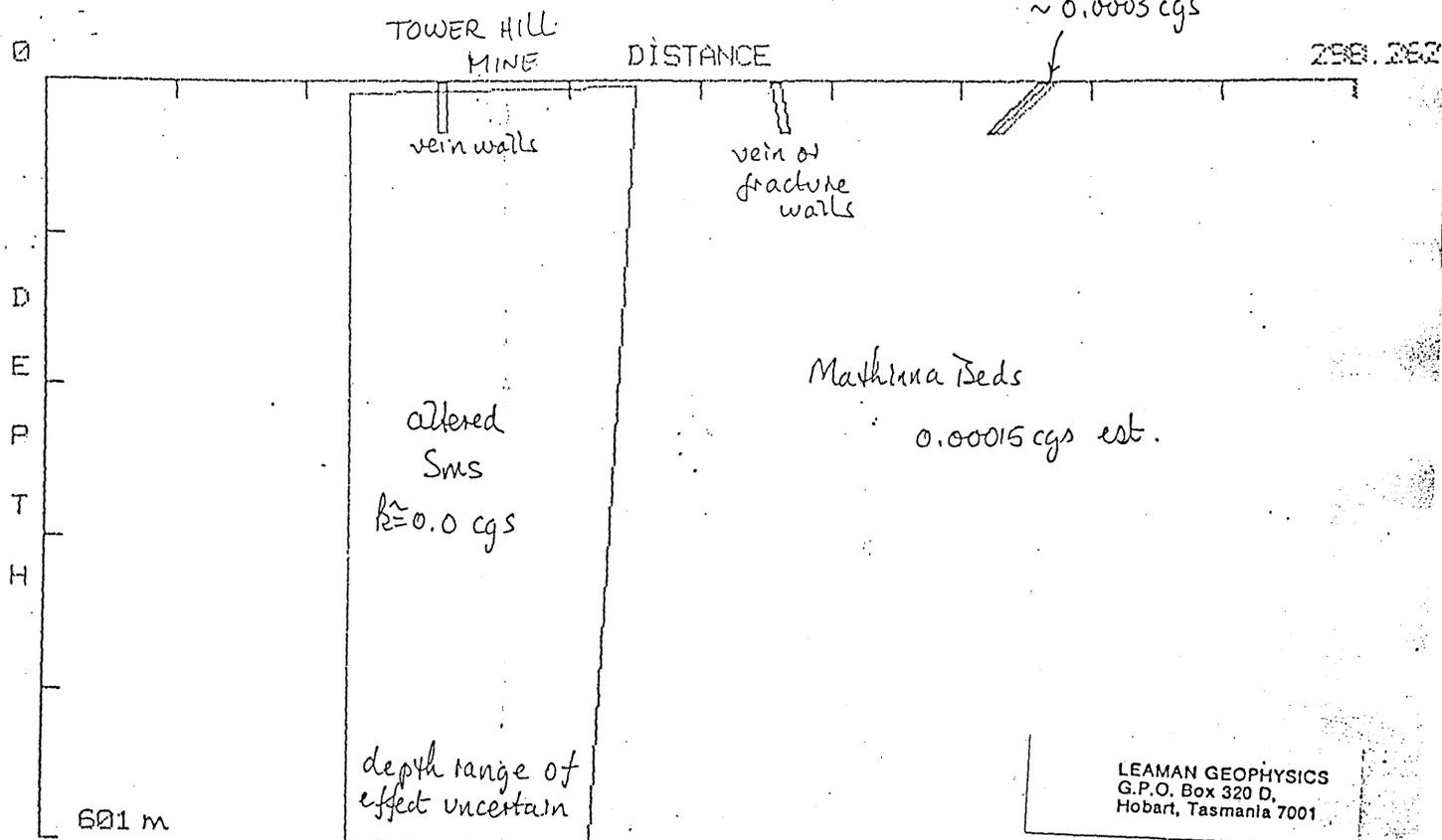
2D MAGNETICS MODEL GOLD3 UNCORRECTED DATA

MATHINNA REGION: REGIONAL ASSESSMENT OF MAGNETIC FIELD CHARACTER SW-NE LINE FROM 560/5405 FIGURE 11

LINE PARAMETERS - ORIGIN, LIMIT, INCR : 0 300.048 1.786



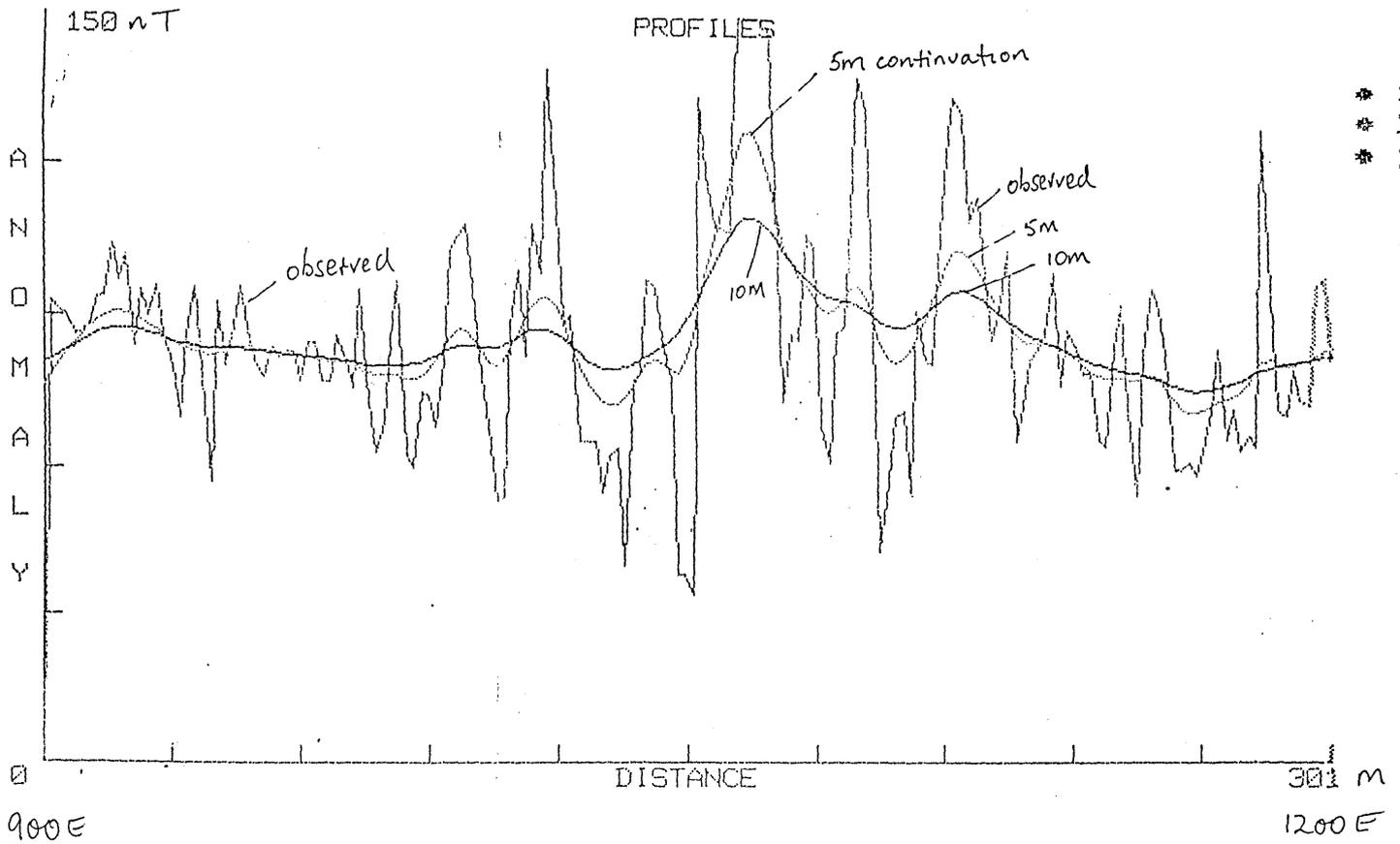
TOWER HILL MAGNETICS TEST SOURCES 950N 800-1100E W GRID K5=-00015 5/1=70/10 (DEEPER L TOP)



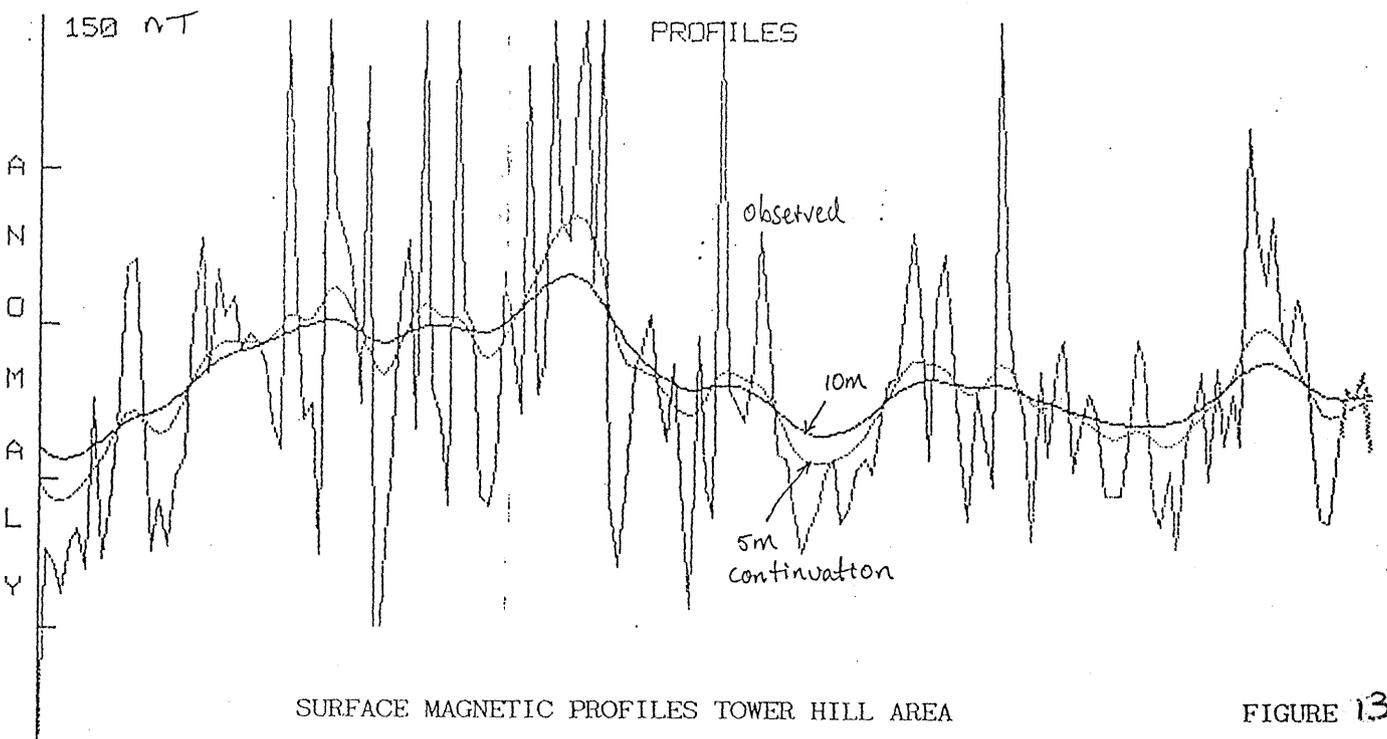
SURFACE MAGNETIC DATA SHOWING VEIN AND PROBABLE ALTERATION RESPONSES NEAR TOWER HILL MINE

1 B:THLE0000 TOWER HILL MAGNETIC SURVEY E GRID 00N 900-1200E
 2 B:C05E0000
 TOWER HILL MAGNETICS E GRID 00N 900-1200E 5M CONTINUATION
 3 B:C10E0000
 TOWER HILL MAGNETICS E GRID 00N 900-1200E 10M CONTINUATION
 ZERO SHIFT :-750

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



1 B:THLE0050 TOWER HILL MAGNETIC SURVEY E GRID 50N 900-1200E
 2 B:C05E0050
 TOWER HILL MAGNETICS E GRID 50N 900-1200E 5M CONTINUATION
 3 B:C10E0050
 TOWER HILL MAGNETICS E GRID 50N 900-1200E 10M CONTINUATION
 ZERO SHIFT :-750



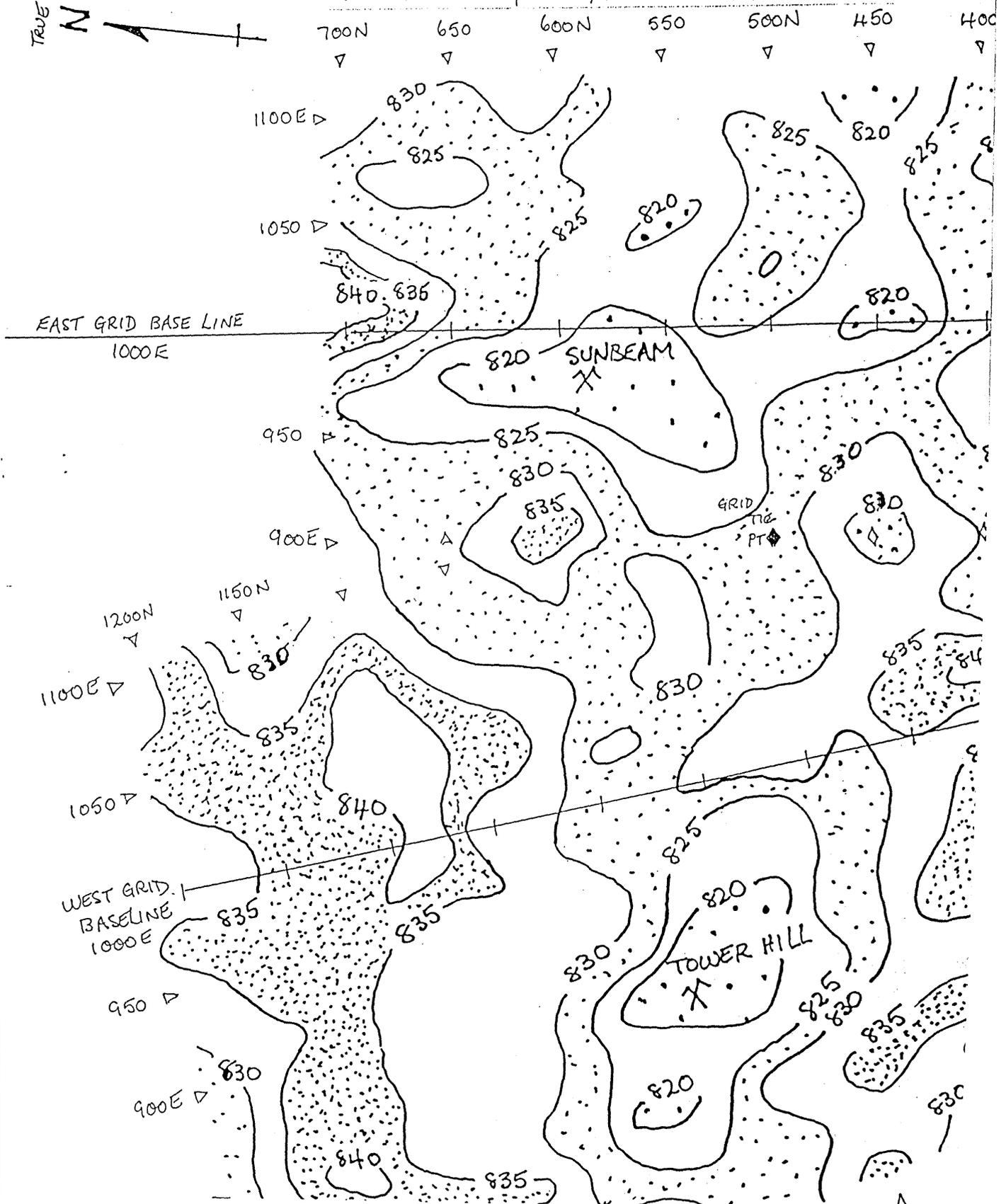
SURFACE MAGNETIC PROFILES TOWER HILL AREA

FIGURE 13

CONTOURS OF THE MAGNETIC FIELD AFTER BASE/DIURNAL AND LINE TIE
CORRECTIONS
Reliability: +/- 5 nT est.

FIGURE 114

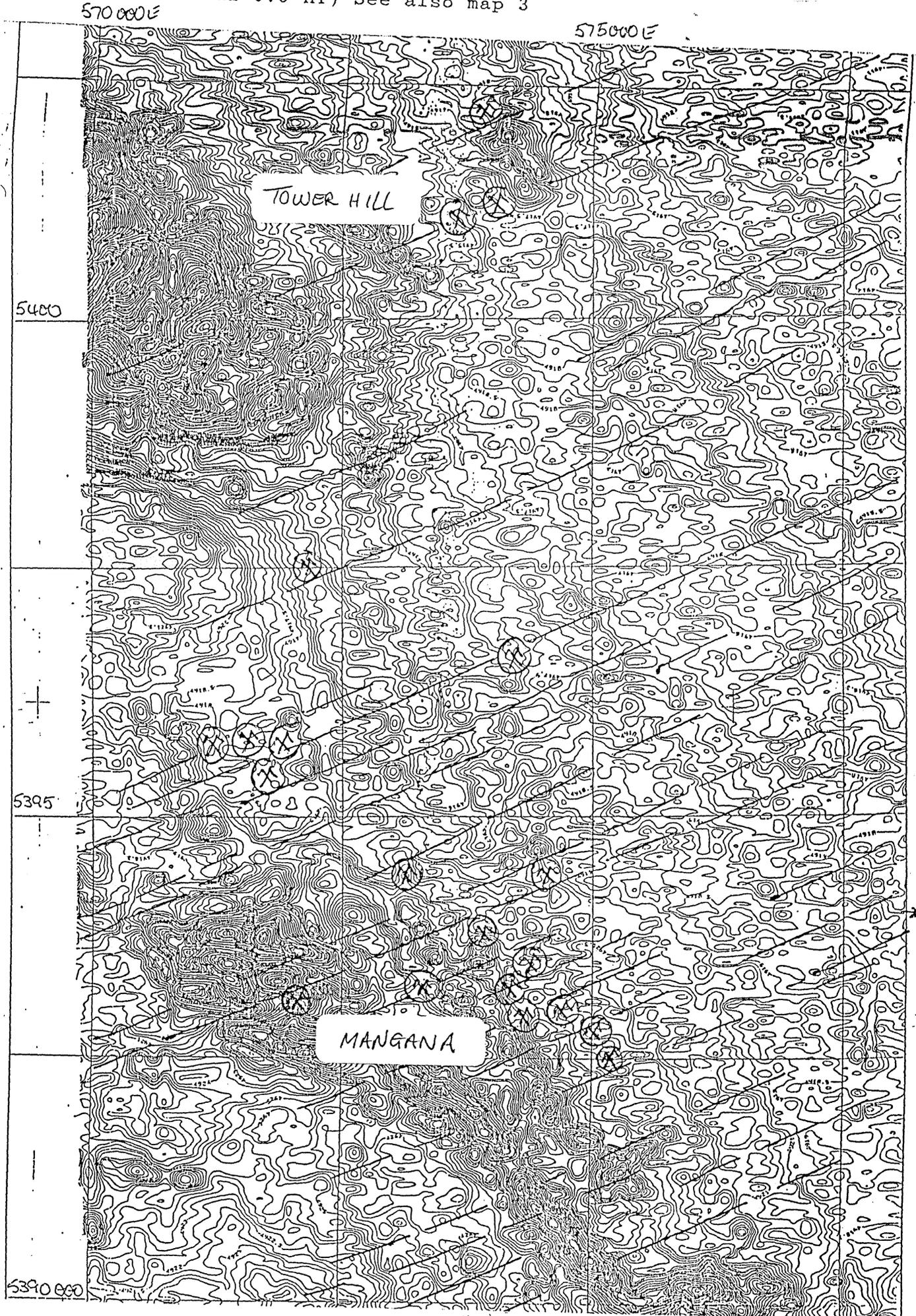
Data contoured after application of 10m upward continuation.



SURFACE MAGNETIC SURVEY TOWER HILL MINE AREA

FIGURE 114

CONTOURS OF RESIDUAL MAGNETIC FIELD (S PART)
(contour interval 0.5 nT) See also map 3

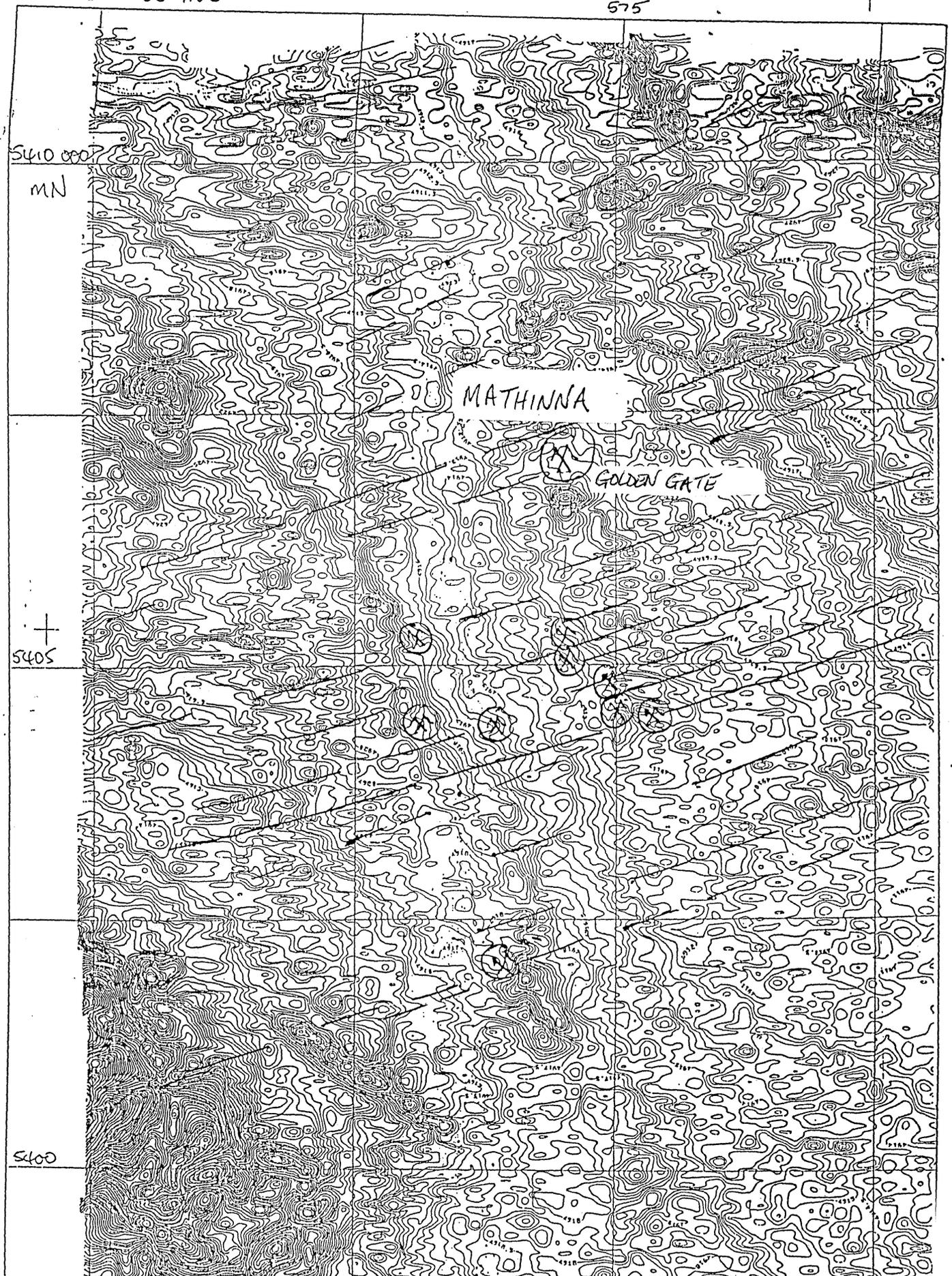


REVISED TREND INTERPRETATION OF MINERALISED SITE CONTROL AND PEGASUS
FIGURE 16

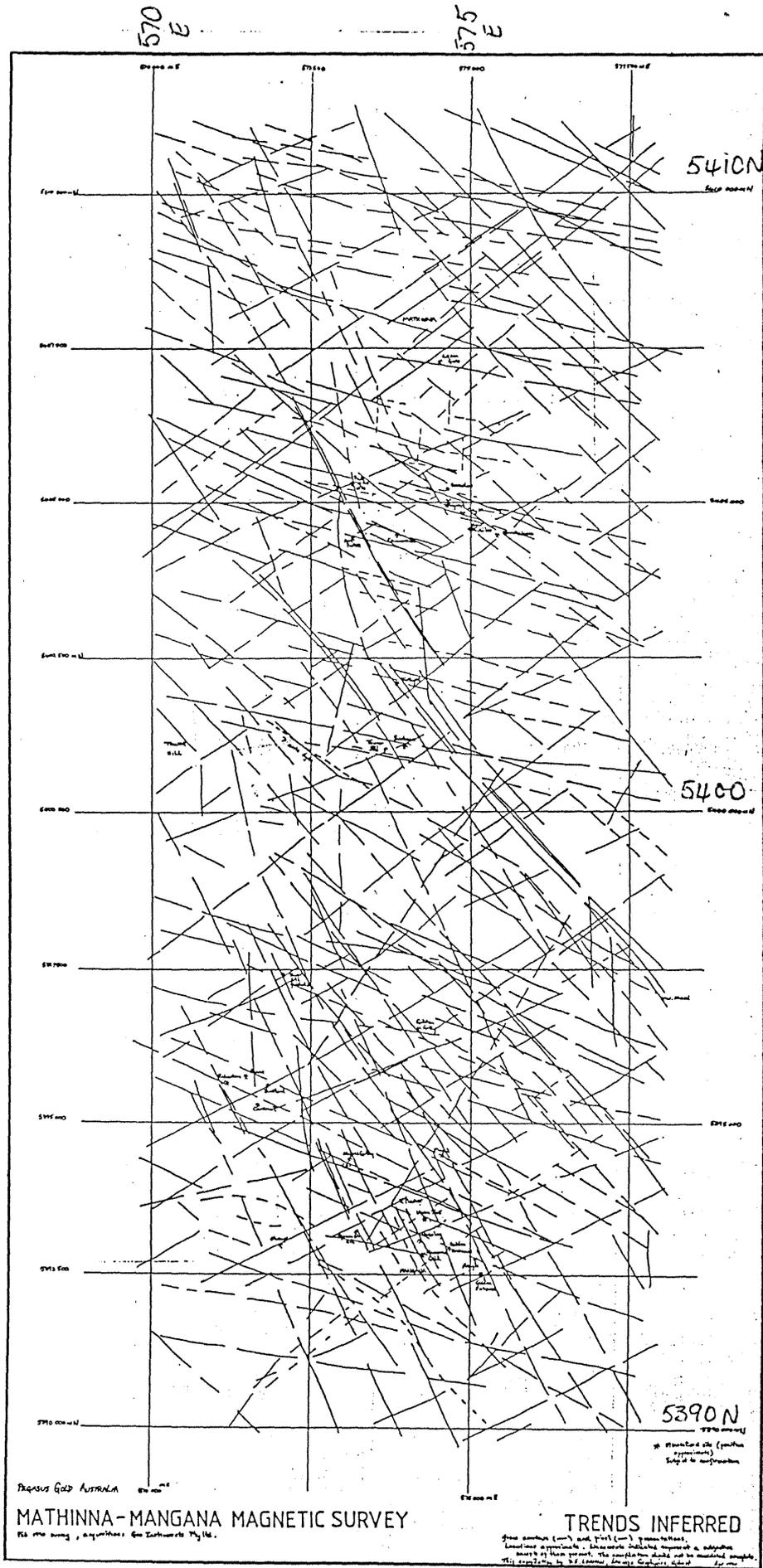
378000 E 147 59 572500 E 573000 E 147 55 577500 E

570 000 ME

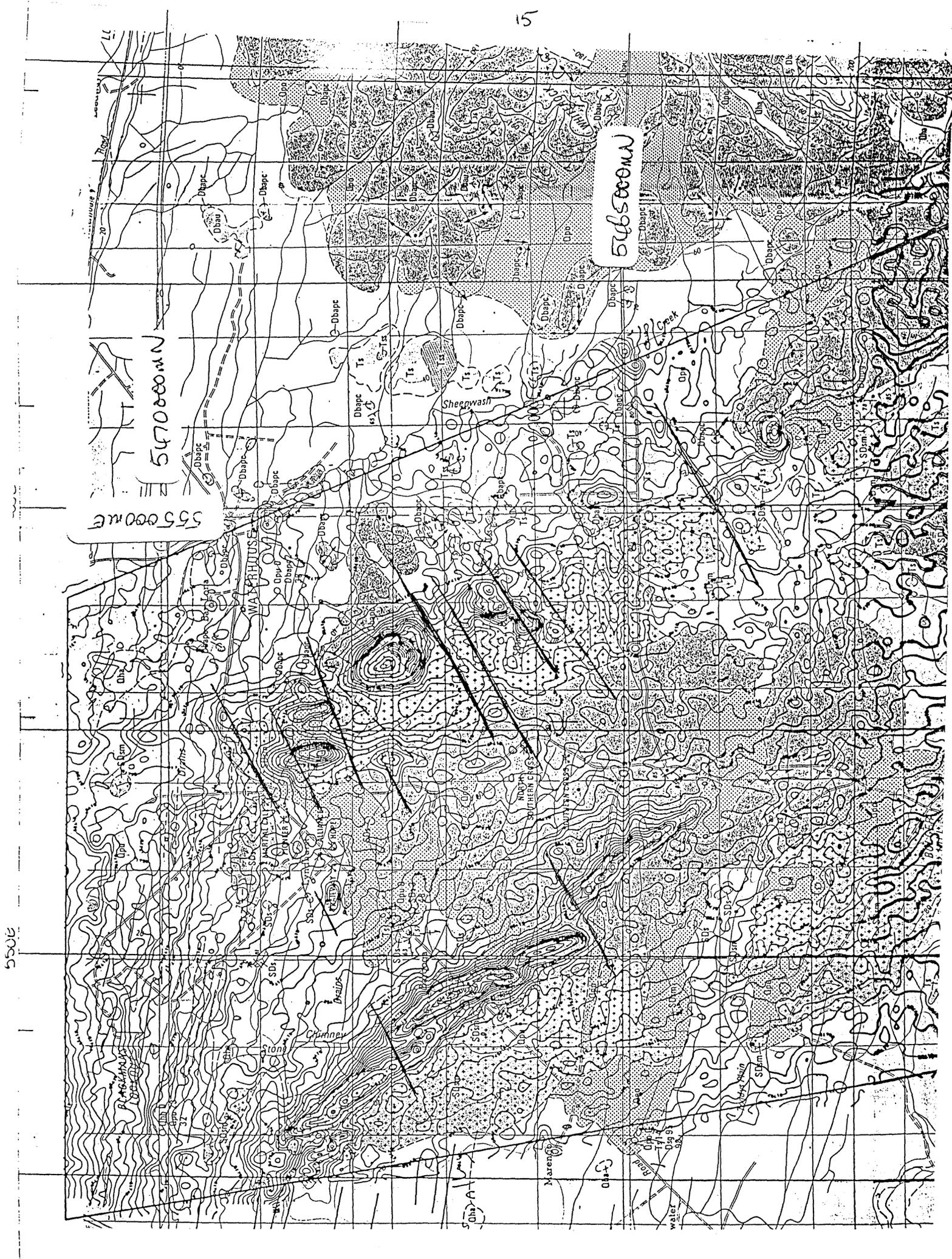
575



REVISED TREND INTERPRETATION OF MINERALISED SITE CONTROL AND PEGASUS MAGNETICS - NORTH AREA



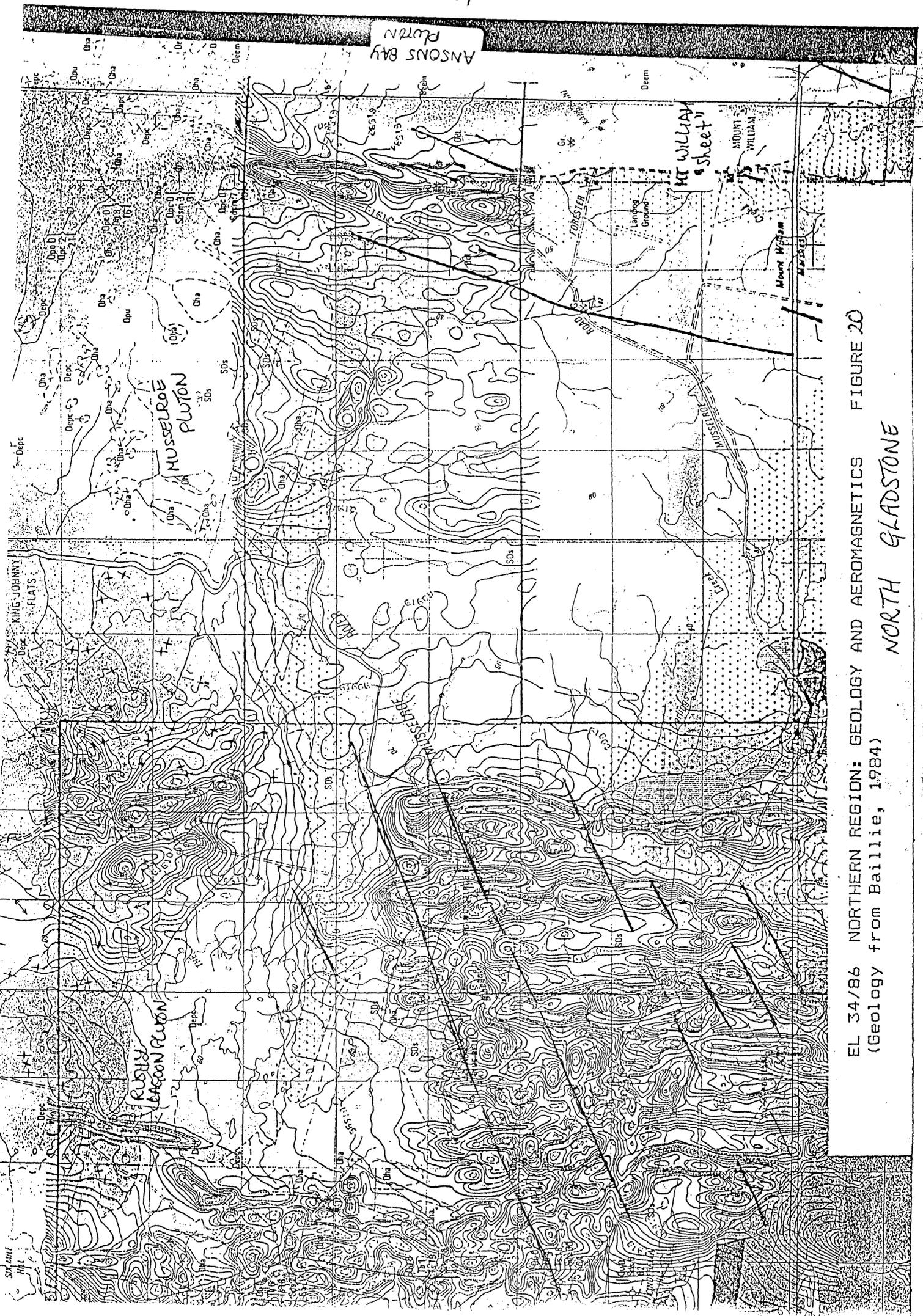
TRENDS INFERRED ORIGINALLY FOR PEGASUS SURVEY
(SEE LEAMAN, 1990)



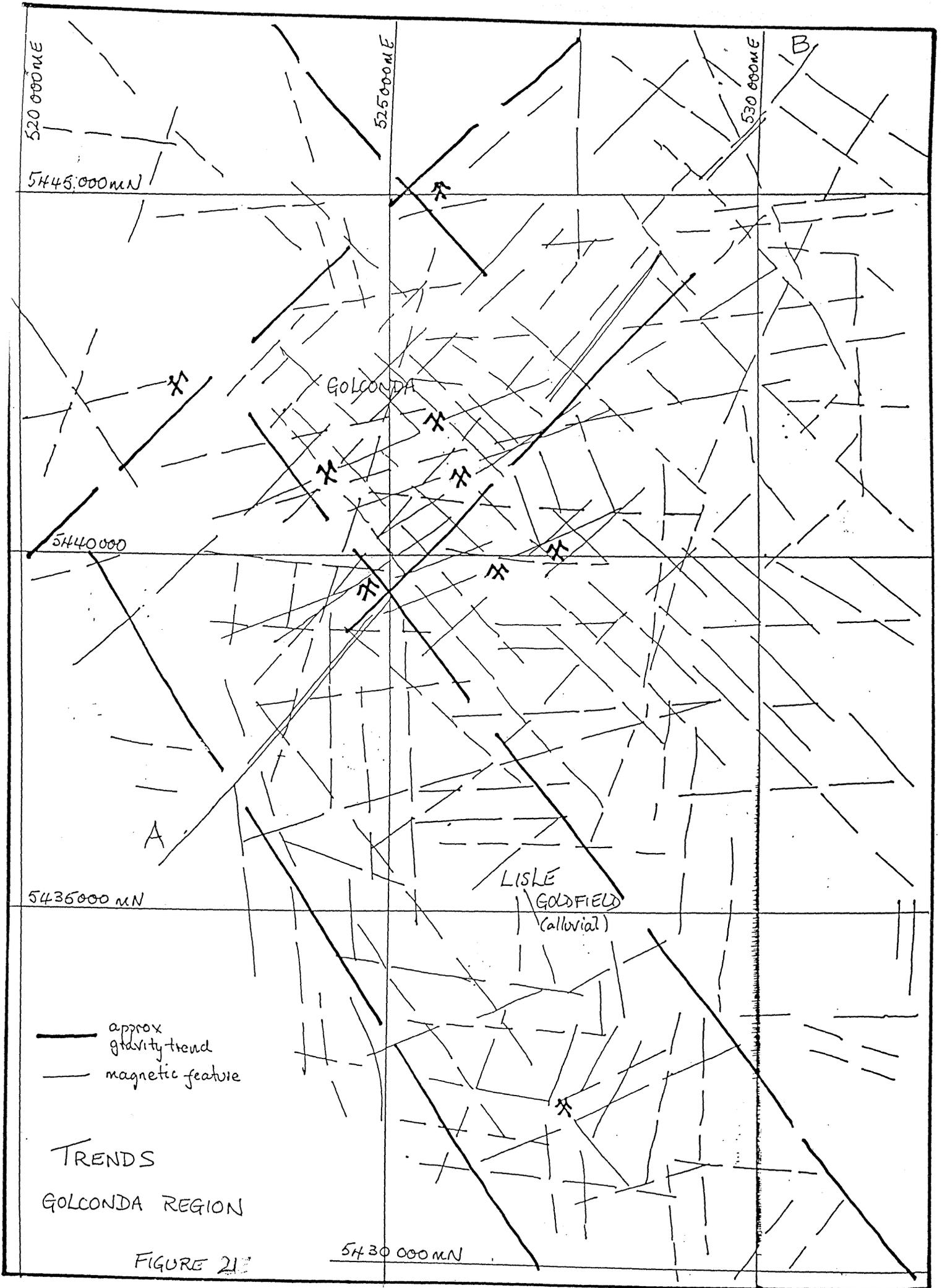
REVISED TREND INTERPRETATION IN GLADSTONE REGION

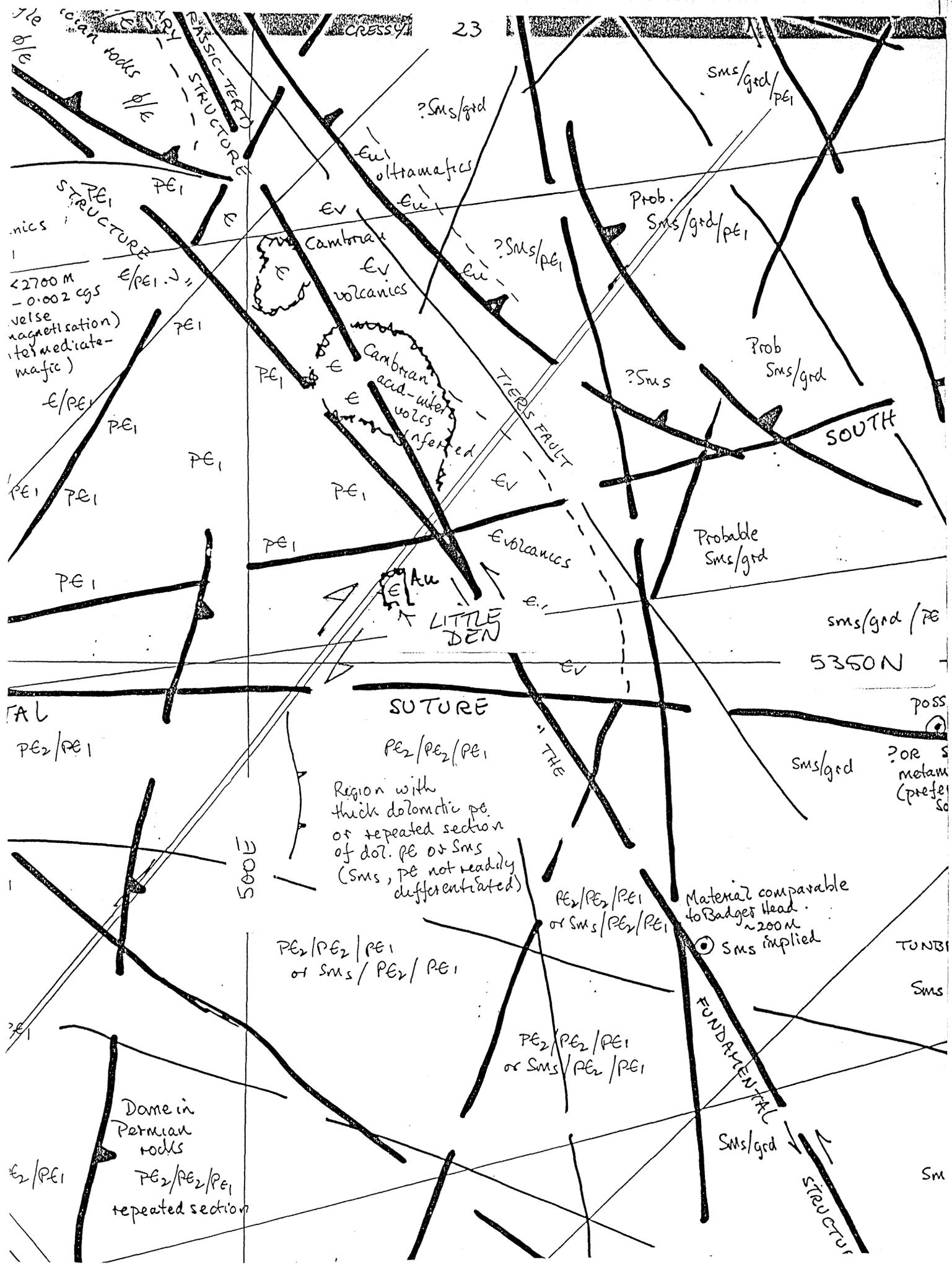
FIGURE 19

ANSONS BAY PLUTON

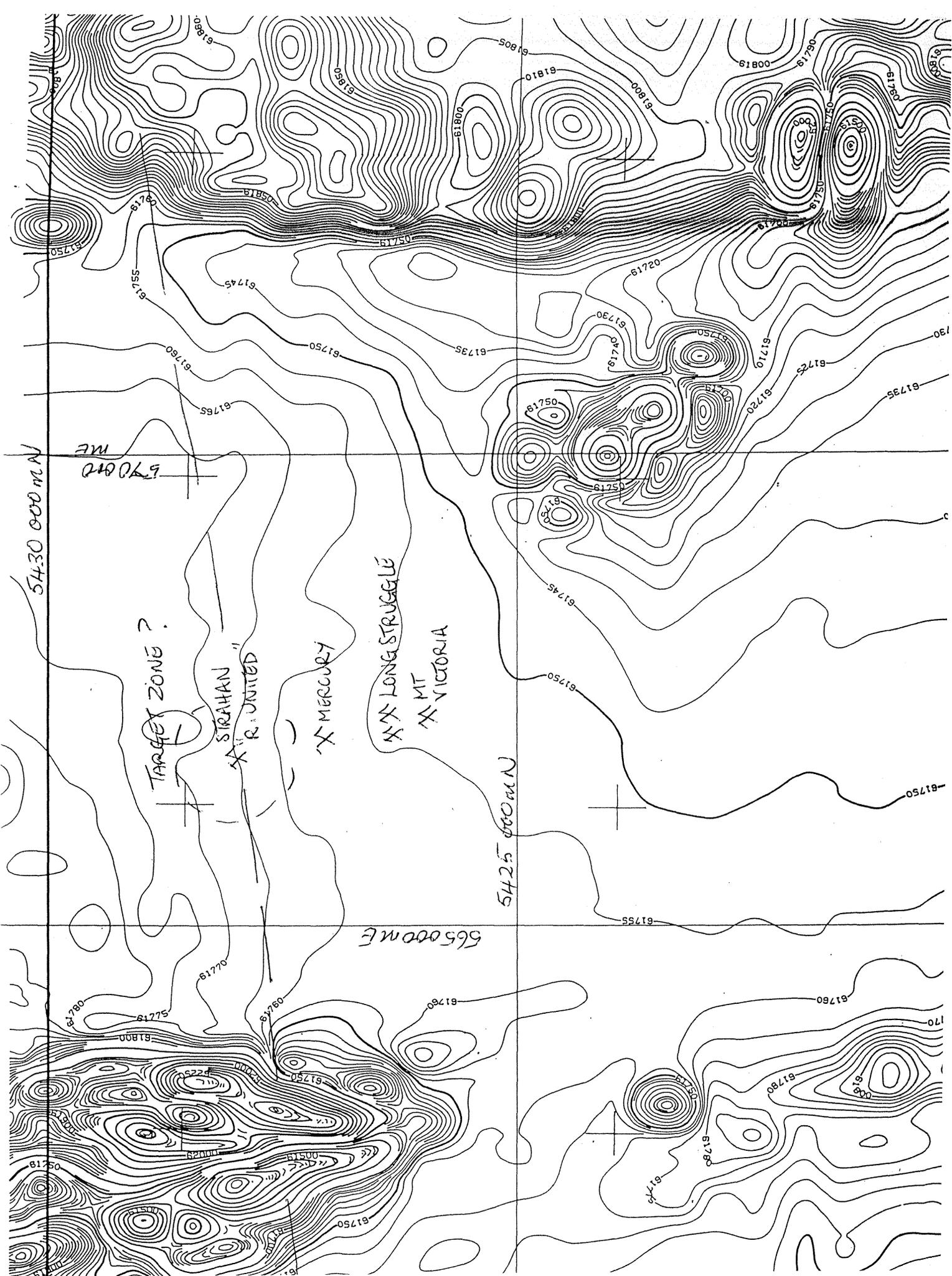


EL 34/86 NORTHERN REGION: GEOLOGY AND AEROMAGNETICS FIGURE 20
 (Geology from Baillie, 1984)
 NORTH GLADSTONE

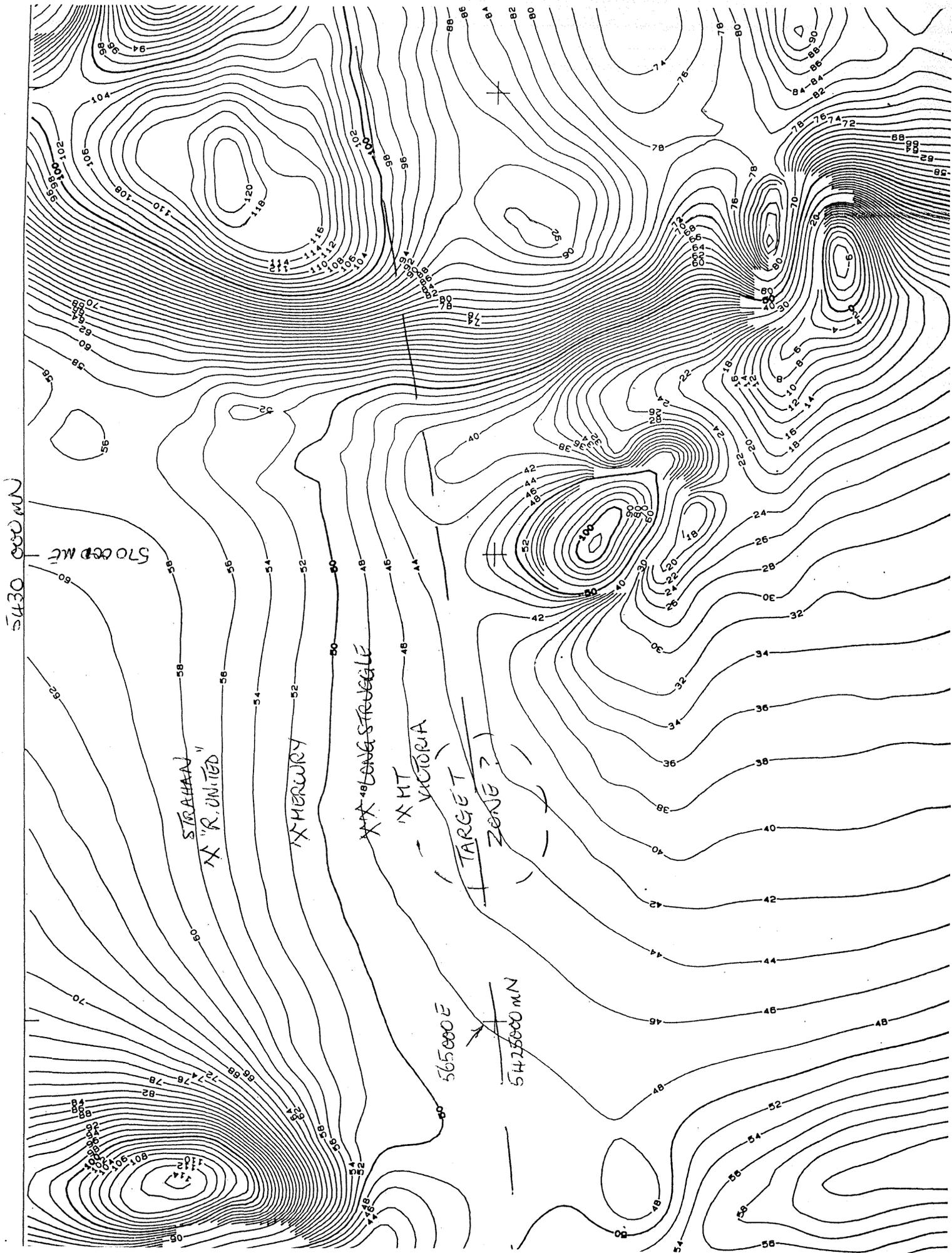




REGIONAL STRUCTURAL INTERPRETATION OF NORTHERN MIDLANDS AND SETTING OF THE LITTLE DEN GOLDFIELD
 FIGURE 23



MINES DEPARTMENT REGIONAL SURVEY ALBERTON AREA
 Variable data quality. Note location of gradient in region of
 northern mines. This must be confirmed. FIGURE 24



MINES DEPARTMENT REGIONAL SURVEY ALBERTON AREA (CORRECTED DATA)
 Data corrected to 1500 m ASL. Note diffusion of gradient and likely onset near southern mines. Differences with Figure 24 reflect the limited data coverage near edge of survey and high relief terrain.

FIGURE 25

APPENDIX 2

SUMMARY OF IDEAS

This discussion outlines ideas summarised and noted in the files of Leaman Geophysics in 1991. This material was assembled in order to assess existing data sets, and then perceived needs, and to provide material for two papers and some recommendations about a proposed NETGOLD project in NE Tasmania.

One of these papers, published in Geological Survey Bulletin 70 follows as Appendix 3.

The other was published by the Australian Society of Exploration Geophysicists in "Exploration Geophysics" vol 23, 185-190.

Recommendations which have been partly incorporated into the now released Negold package were submitted to then Deputy Director Hargreaves at his request. Unfortunately many of the incidental thoughts have been neglected or under-rated.

The Appendix provides much background material and a comprehensive outline of the development of ideas. The first insights into the significance of certain trends appears here. The main text of this report shows how much these can be revised, detailed, or rethought given the new data.

LEAMAN GEOPHYSICS

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

Registered office:

3 MALUKA STREET, BELLERIVE, TAS. 7018

All correspondence to:

GPO BOX 320 D, HOBART, TAS. 7001

Telephone: (002) 44 1233

Fax: (002) 44 6674

IDEAS

IMPLICATIONS, CONTROLS AND METHODS

by

Dr. D.E. Leaman

August 1991

NEGOLD

SUMMARY

Gold deposits in north-eastern Tasmania can be linked to particular granitoid compositions and regional and local trend patterns. Rather subdued ENE elements appear to be crucial and large deposits occur where regional and local trends of this type are superimposed. The actual details of a mineralised site are governed by local conditions including lithology changes, fold conditions and so on and are not diagnostic.

Magnetic surveys, in the form of regional and specific area surveys, seem the simplest way of locating target sites. Ground surveys can limit exploration to specific zones once the zones are established. These methods, with support from semi-regional gravity surveys can provide comprehensive structural, genetic and target evaluation and achieve site discrimination in terms of potentially economic deposits.

The work indicates that "Golden Gate" style mineralisation may be recognisable and targets near Mangana, Alberton and Walkers Flat have been identified. There are also suggestions that parts of the Lefroy and Warrentina areas contain targets but the data required to judge this are not available. Many other regions lack any data.

CONTENTS

	page
SUMMARY	
INTRODUCTION	1
GENERAL COMMENTS	2
SITE NOTES	
Mathinna - Mangana	5
Dans Rivulet	7
Golden Ridge	11
Alberton	11
Mt Horror - Warrentina	11
Lyndhurst	12
Gladstone	16
Burns Creek	19
Lisle - Golconda	19
Lefroy - Back Creek - The Glen	19
Beaconsfield	22
Little Den	22
Summation	24
EXPLORATION METHODOLOGY	25
TARGET AREAS	27
REFERENCES	28

FIGURES

1. Location map of north eastern Tasmania
2. Regional trends in Mangana-Alberton area
3. Revised trend evaluation in Mathinna (3B), Mangana (3A) areas
4. Surface magnetic data near Tower Hill Mines
5. Mineralisation and gravity gradient Warrentina
6. Trend summary Lyndhurst
7. Revised trend evaluation Lyndhurst
8. Revised trend evaluation Gladstone
9. Surface magnetic data Portland Mine, Gladstone
10. Distribution of granodiorites, Golconda
11. Trend summary, Golconda region
12. Structural synthesis, Little Den Goldfield region

INTRODUCTION

Geophysical and geological data sets in the Little Den, Gladstone, Lyndhurst, Lisle-Golconda and Mathinna regions of north east Tasmania have been examined in some detail.

The regions reviewed and general locations are shown in Figure 1.

The work has shown, as it evolved, that there are some structural patterns and possible genetic relationships common to all gold-bearing sites examined. Since so many sites, in geologically varied locations, exhibit the same, or similar, features it is reasonable to presume that such relationships might well be general.

The general features indicated include structure control (limb and axial structures), particular fracture control (ENE approx) at both local and regional scales, and a subtly magnetised early-intruded granodiorite. Most, if not all, of these factors were neither suspected nor recognised in early stages of the study but in retrospect, given hints from other areas and evolving concepts, may be defined at all sites.

This summary was prepared to unify current thinking and research about the gold-bearing areas of north eastern Tasmania and, in particular, to

- a) suggest those features which may have controlled mineralisation,
- b) identify aspects which indicate mineralised sites.
- c) specify the methods which may be used in exploration.
- d) infer the existence or otherwise of the features in zones covered by limited data sets.
- e) suggest primary targets or the means to discriminate/rate targets.
- f) suggest minimum data requirements for region or prospect review.

Each of the areas examined in some detail have been covered by at least one adequate data set now in the public domain. This summary review updates several of these evaluations in light of information gleaned from all areas.

Other areas, including Beaconsfield, Lefroy, The Glen, Burns Creek, Mt Horror, Alberton and Golden Ridge, have been briefly discussed in light of conclusions drawn or information available about them.

It is to be hoped that the data deficiencies which are universal in NE Tasmania can soon be overcome and that the proposed NETGOLD project is approved.

All basic data should be sought in the references listed.

GENERAL COMMENTS

Gold has been recovered from a large number of small to large workings in north-east Tasmania. Most occurrences are vein deposits consisting of irregular and often thin vein systems which are variable in size, continuity, orientation and grade. Many are aligned along a single NNW-trending zone about 500 m wide which extends from near Mangana to the coast at Lyndhurst. The presence of so many sites along a single axis does not mean, however, that vein systems within or along it are controlled by the regional orientation; they are virtually randomly oriented within it. Previous workers have assumed this orientation, or structure, to be ascendant but consideration of the spread of occurrences, including the significant Lisle, Lefroy and Beaconsfield workings, suggests that more than one element has controlled mineralisation. It may be observed, however, that the NNW trend of either fractures or geology may be recognised widely but never appears specific to mineralised sites.

No consistent geological or geophysical patterns have ever been recorded for Tasmania's gold deposits. Most exploration over the past century has been based on the pan or the trench, or inspection, where possible, of previous workings. The lack of obvious criteria or controls and a monotonous, repetitive host geology of Mathinna Beds has ruled against science-based exploration. The rocks, and their complex deformed structures, are not easily understood. The superposition of important mineralisation in this environment is simply frustrating.

Geochemical and geophysical methods are recent innovations in exploration programmes.

The association of gold with sulphides or arsenic has encouraged many small trials but no characteristic responses have yet been divined. Anomalies also tend to be diffuse. In addition there is no necessary basis to the assumption of arsenic as gold indicator. Previous workers, notably McIntosh Reid (1925), observed that while there is a correlation between gold content and arsenic there is a cut off and high arsenic/arsenopyrite levels are usually lacking in gold.

The suggestion by Dr. J.C. Van Moort of the Geology Department of the University of Tasmania that the nature of the magnetic properties of the quartz can be used to identify mineralised veins has yet to be proven as a cost effective and reliable method.

Geophysics has been applied even more sparingly. This reflects the assumption that no useful physical contrasts exist in the relevant materials. Quartz is notoriously difficult to identify and the Mathinna Beds host rocks have also been considered homogeneous.

These assumptions have long been known to be invalid but the province has never attracted the innovation required to apply workable exploration technologies. Leaman (1974) in the pioneering geophysical research on these rocks at Lefroy showed that self potential, thermal and piezoelectric methods can define the quartz systems (but not say whether they are mineralised) and that magnetic methods yielded some curious results only recently explained. These methods do not fall in

the "in general use" category and have not been taken up.

The evaluations leading to this summary have demonstrated the applicability of geophysical methods to exploration in this region, both in terms of geological and structural understanding and the more specific issues of mineralisation control. None of the obscure methods shown to work at prospect level have been required to achieve this.

The method now known to be the most cost effective in the development of understanding and targets is the magnetic method. The irony lies in the fact that this method has long been dismissed on the basis that none of the materials of the region is magnetic. This appraisal has always rejected the observation that the magnetic contrasts existed but were subtle. No good to high quality data was acquired until 1987 and the few surveys undertaken since have not been interpreted in any detail for various reasons - financial collapse, withdrawal etc. The surveys reflect the innovation of smaller companies.

The reviews fundamental to this summary provide the first major interpretation of these data sets now in the public domain.

Genetic relationships have also been a long-standing puzzle. Workers such as Klominsky & Groves (1970) have recognised the affinity of the gold with biotite hornblende granodiorite and implied a direct genetic relationship. While this association seems reasonable in some localities it has always been generally rejected since the important Mathinna, Mangana, Lefroy and Beaconsfield sites appear far removed from granitoids of any type.

This is another fallacy since workers since 1973 have ignored the findings of Leaman et al (1973) who suggested that granodiorite is less than 1.5 km beneath the mineralisation at Lefroy. The present research at all sites examined certainly supports a vicinity and primary association even if the granitoid is not always exposed.

This work has also exposed another problem. Regional mappers in NE Tasmania have attempted detailed subdivision of the granite and adamellite families of the two major batholiths (Scottsdale and Blue Tier) but have been prepared to lump all granodiorites into a single class. Any site tour will show that this should not be done and inferred and measured magnetic properties show that real differences may be observed. It should not, therefore, be accepted either that granodiorites are not associated with gold because they are nowhere to be seen or because there seems no reliable relationship with them. The latter condition ignores the possibility of a single family member forming the key source and control upon mineralisation and these have yet to be properly mapped and separated.

Vein orientations have also be found to be variable where recorded. Local control appear dominant, even where major regional control would be expected - as along the Mathinna to Alberton zone. Vein patterns do not appear to be systematic or significant.

Grades and vein extent also remain a crucial problem for any evaluation.

A very few mines have provided significant production; most workings

have been marginal and limited in development. This usually reflects variation in grade with depth, but may indicate under capitalisation - which was endemic when the region was in full production. Major reductions in grade, often of an order of magnitude, have been noted near the level of regional weathering or water tables. Only some sites maintain grade levels to significant depths (> 50 m) and it is these rare sites, such as the "Golden Gate" at Mathinna, or the "Tasmania" at Beaconsfield, which have produced large quantities of gold. It is clear therefore that some form of discriminator must be found which can separate the golden eggs from the chaff since all may look the same near the surface.

The aim of any exploration, then, is really to assess the identifying characteristics of such important sites and determine their presence elsewhere. Only in this way will it prove possible to rank or rate the many known small workings or new target prospects. The present work suggests that this is possible but it has not been possible previously due to ignorance and lack of research.

In this respect the Mathinna area, and the "Golden Gate" mine with its production of 7895 kg, must be used as the prototypical yardstick until a greater understanding is achieved for the entire province. It represents a large vein system in typical host materials whereas mineralisation at Beaconsfield or Lisle is atypical; there are different host and setting conditions at the former and the latter is an alluvial deposit.

Some indication of the understanding and knowledge about this important, and once highly productive, gold province can be obtained by considering the magnitude of published descriptions. The topic has rated a half page or less than two pages respectively in the 1962 and 1988 editions of the Geology of Tasmania.

SITE NOTES

1. MATHINNA-MANGANA

The Mathinna yardstick is not readily developed due to imbalances in the data available. It is possible that random vein orientations observed in the region may be irrelevant. There is also no direct association between mapped units, defined either by mapping or magnetics, and major structures even though there is a gravity and magnetic response to the axial structure of the region. Data are insufficient for unambiguous evaluation and it is possible that the NNW-trending zone represents a sheared thrust nappe system in the depressed roof of the Blue Tier Batholith and its precursor granodiorites. Only one granodiorite has been resolved with existing data but others may be present. Figure 2 shows that these are never more than 5 km from mineralised sites, laterally, and perhaps never more than 2 km vertically. These limiting conditions mean that granodiorite association probably does apply here. An improved gravity data set coupled with appropriate analysis is needed to detail this view and perhaps separate granodiorite types.

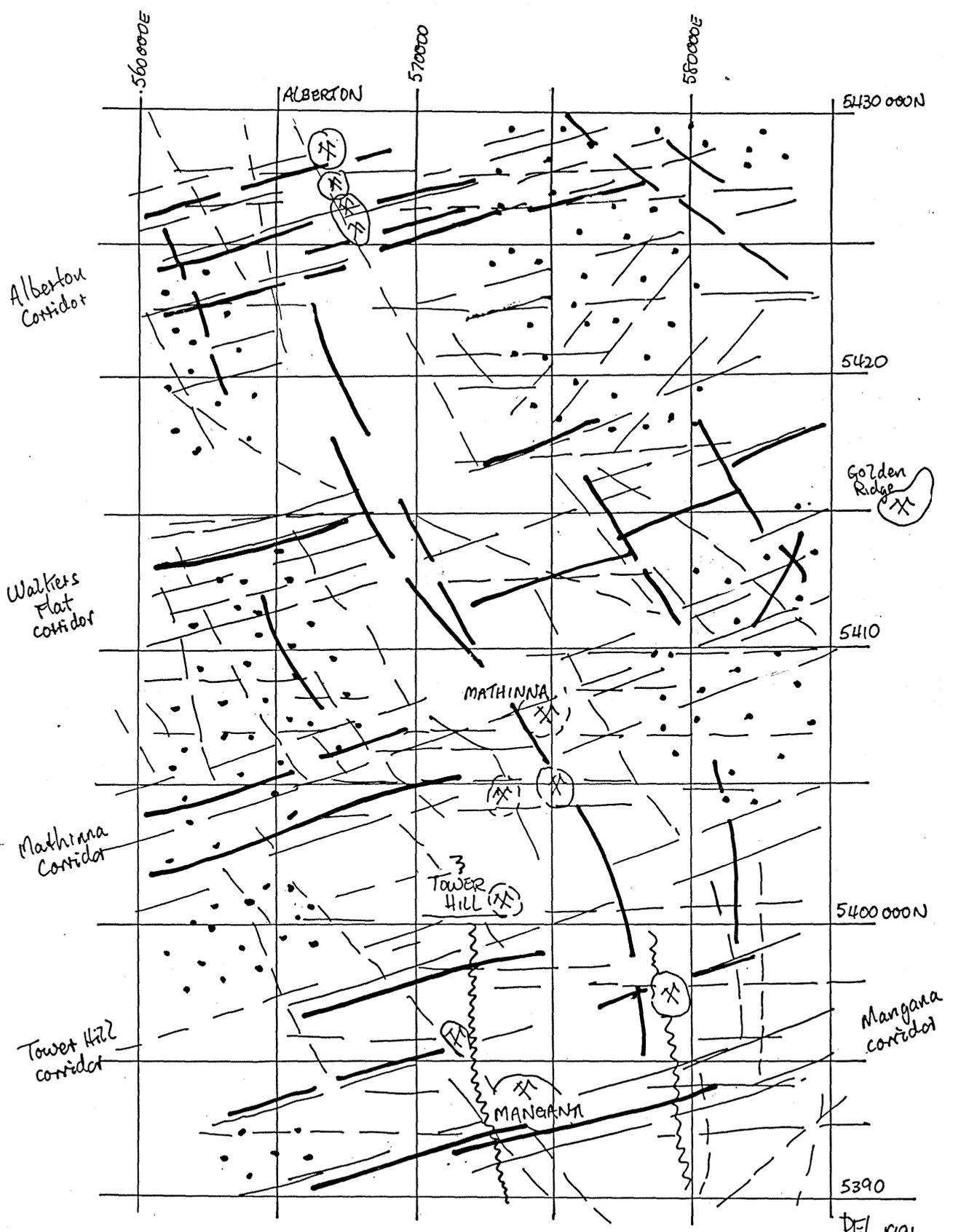
Existing gravity data south of Tower Hill does define two gradients which appear to be related to mineralisation and this suggests that improved coverage could define the extent of those features and the offsets along them. These offsets may be observed near Mangana and the pockets of mineralisation are related to these sites. Modelling has indicated that the gradients may represent the disrupted face of a nappe or the projection of the fracture face and wall of a granodiorite pluton beneath. Similar, but slightly subdued, gradients further east - beneath the Fingal group of mines - implies a genetic link. Note that none of the obvious primary magnetic or structural axes or features correlates in any way with the mineralised site groups.

While the gravity gradients can be traced southward (see Target areas) there is insufficient data north of Tower Hill to extend the inferences. I believe that a direct gravity association will be found for Mathinna once this is done.

While aeromagnetic or radiometric data of the highest quality do not reveal consistent patterns between mineralised units; mudstones and sandstones are differentiable magnetically since there is a contrast in susceptibility of at least three times, trends may be recognised which cross the stratigraphic and structural grain.

No obvious or systematic pattern can be associated with dominant NE, NW, NNW or E-W trends but the poorly defined ENE system can be linked to all known sites. This trend may be poorly defined due to its inherent subtlety or because of the bias of E-W rather than N-S flight lines. The trend can be identified in the Pegasus Mathinna survey possibly because the line balance was of the order of 3 to 1 rather than the usual 10 to 1.

The ENE trend can be identified in regional data (at all altitudes) but is there shown to be band limited (Figure 2). Acquisition of better regional coverage could be expected to improve resolution and



ENE trends emphasized
 (X) mineral fields
 ∴ granodiorite at shallow (<2 km) depth

--- low level regional air magnetics
 — high level
 ~~~ gravity gradient

Based on Mines Dept regional data. Quality limits inferences and detailed location.

REGIONAL TRENDS IN MANGANA-MATHINNA-ALBERTON AREA

FIGURE 2

correlation. Good data, as in Figure 3, can also imply regional corridor relationships. The frequency of unambiguous or indicated occurrences of ENE trend varies across the area and is by no means a general and even pattern. There is a higher frequency of the trend near Mangana but the features are subtle and lack general continuity whereas near Mathinna there is a definite narrow, well marked band with clear trend distortions away from the axis of the structure and mineralisation. These are the representations of the regional characters.

If these features are real it would be expected that they would be recorded in ground surveys. This is indeed suggested near the "Sunbeam" and "Tower Hill" Mines (Leaman, 1989, 1990). Presentation of detailed ground magnetic data is difficult since it includes spiky responses due to vein systems. It should be noted here that the vein "response" is not due to quartz, but due to oxidation and weathering along the vein walls within the host rocks. Research at Gladstone showed that the background susceptibility of host lithologies was substantially increased as the vein is approached. Veins yield an interfering double spike (see Figure 4) (Leaman, 1987)

Smoothing of the observed data, by continuation, tends to remove spike character and may either induce artifacts by aliasing or subdue the background lithological effects which clearly contribute to the pattern seen in airborne data. There is a need to reassess the manner of presentation and the various forms of presentation of ground data but it definitely reveals vein patterns and the ENE trend pattern.

#### Summary:

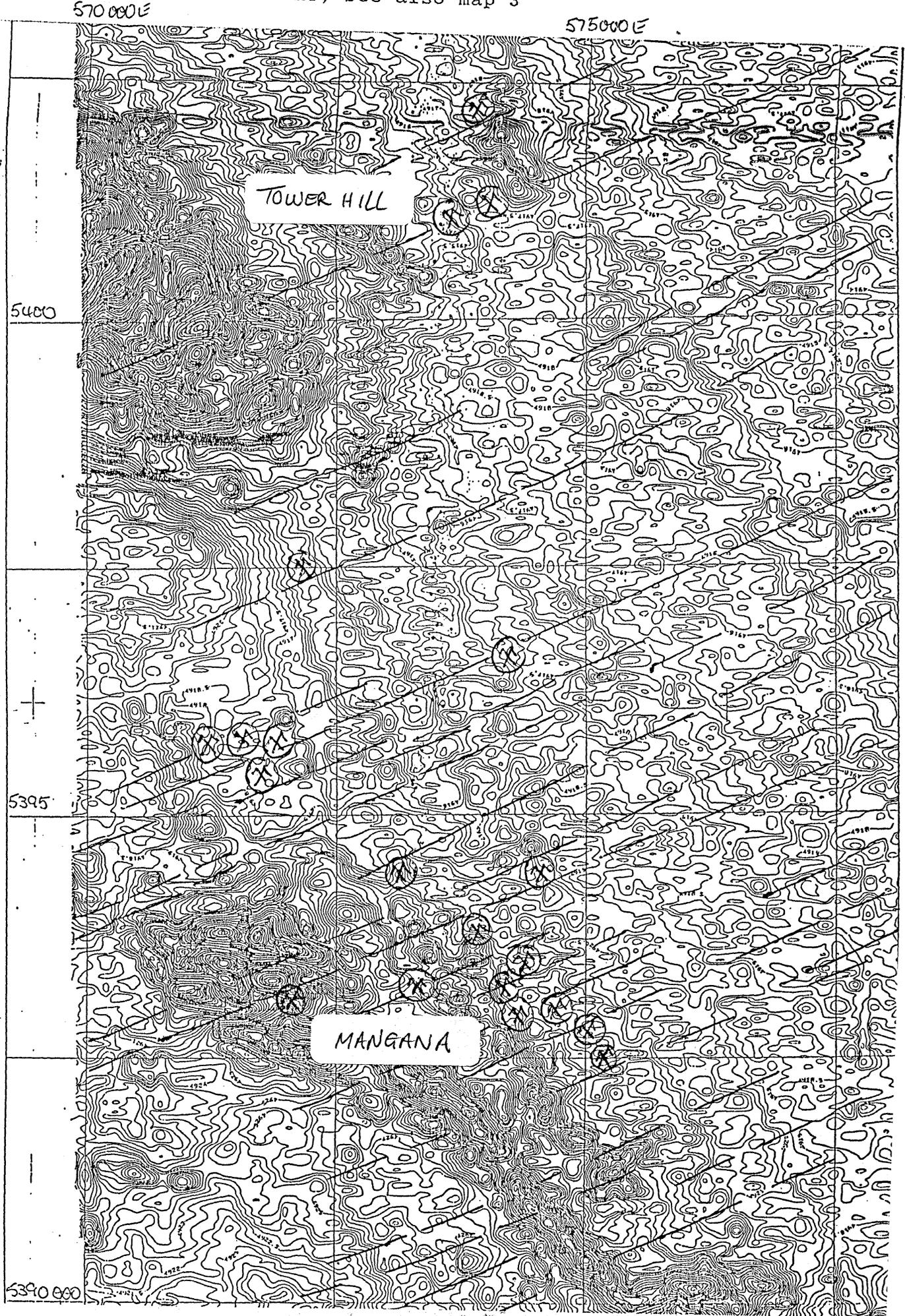
1. Magnetic, rather than radiometric, data can define units within the Mathinna Beds and suggest structural relationships.
2. Magnetic data at ground or low altitude levels can define structural trends.
3. Major mineralised sites are on or adjacent to regional ENE corridors and particular sites lie along local ENE trends. Other trends do not appear significant with the possible exception of E-W features.
4. A N-S line bias is required in surveys.
5. Gravity data may re-inforce these conclusions by defining key gradient offsets which appear to correlate with the regional magnetic corridors.
6. Granodiorites cannot be excluded from the mineralisation environment. More data are needed to define relationships.
7. Ground magnetics may define vein systems and, perhaps, host rock alteration. Several sites must be examined to demonstrate the latter association.

## 2. DANS RIVULET ZONE

The Dans Rivulet Zone extends from Mathinna toward Alberton. No detailed data have been examined, or is available, but regional data (in the conversion shown in Figure 2) indicates that two key sites may exist near Walters Flat. The sequence of known prospects and small mines in this belt cannot be correlated with current data. There are no gravity data. Granodiorites dominate the area.

CONTOURS OF RESIDUAL MAGNETIC FIELD (S PART)  
(contour interval 0.5 nT) See also map 3

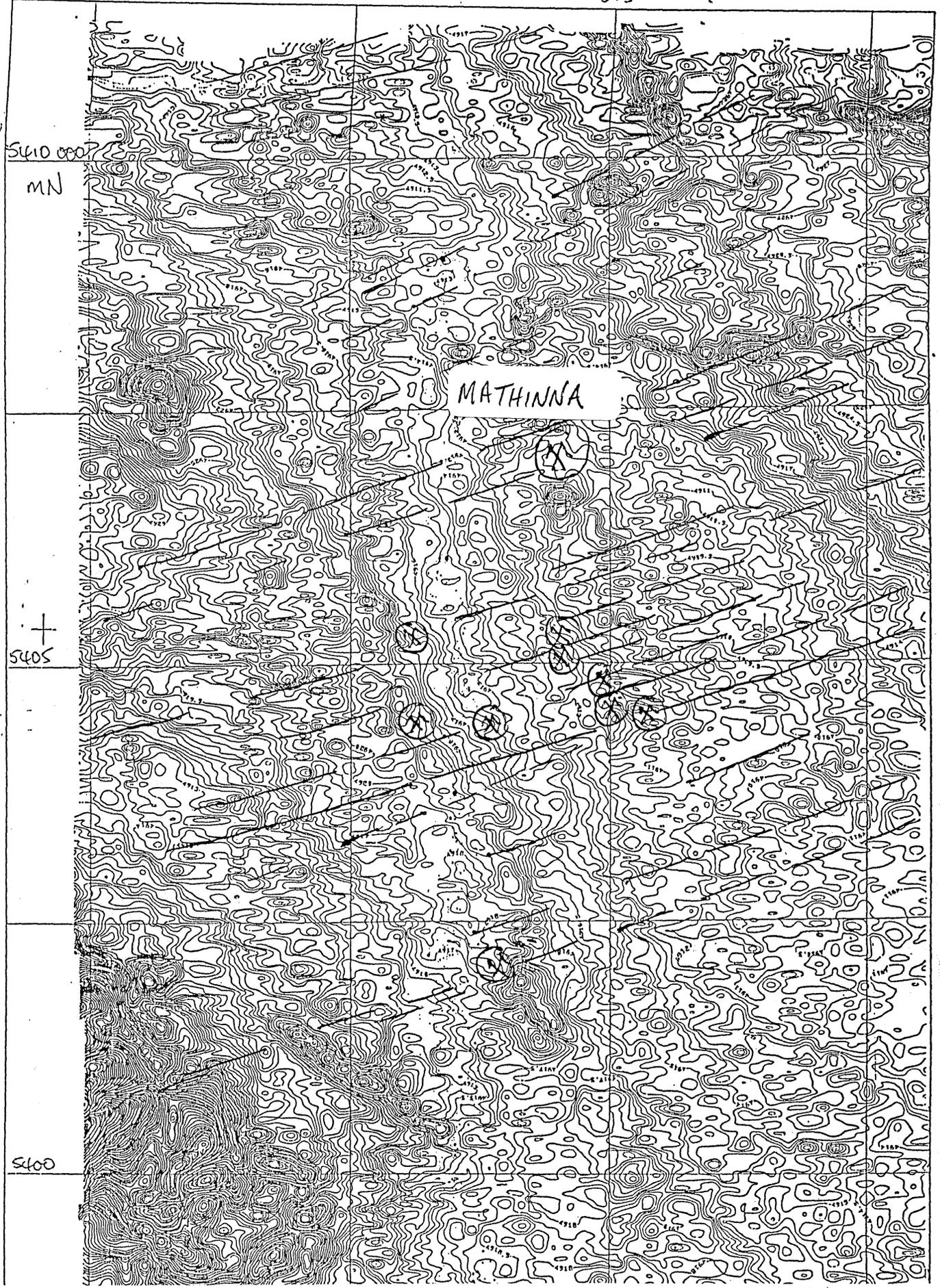
FIGURE 3A



REVISED TREND INTERPRETATION OF MINERALISED SITE CONTROL AND PEGASUS  
FIGURE 3A

570 000 ME

575

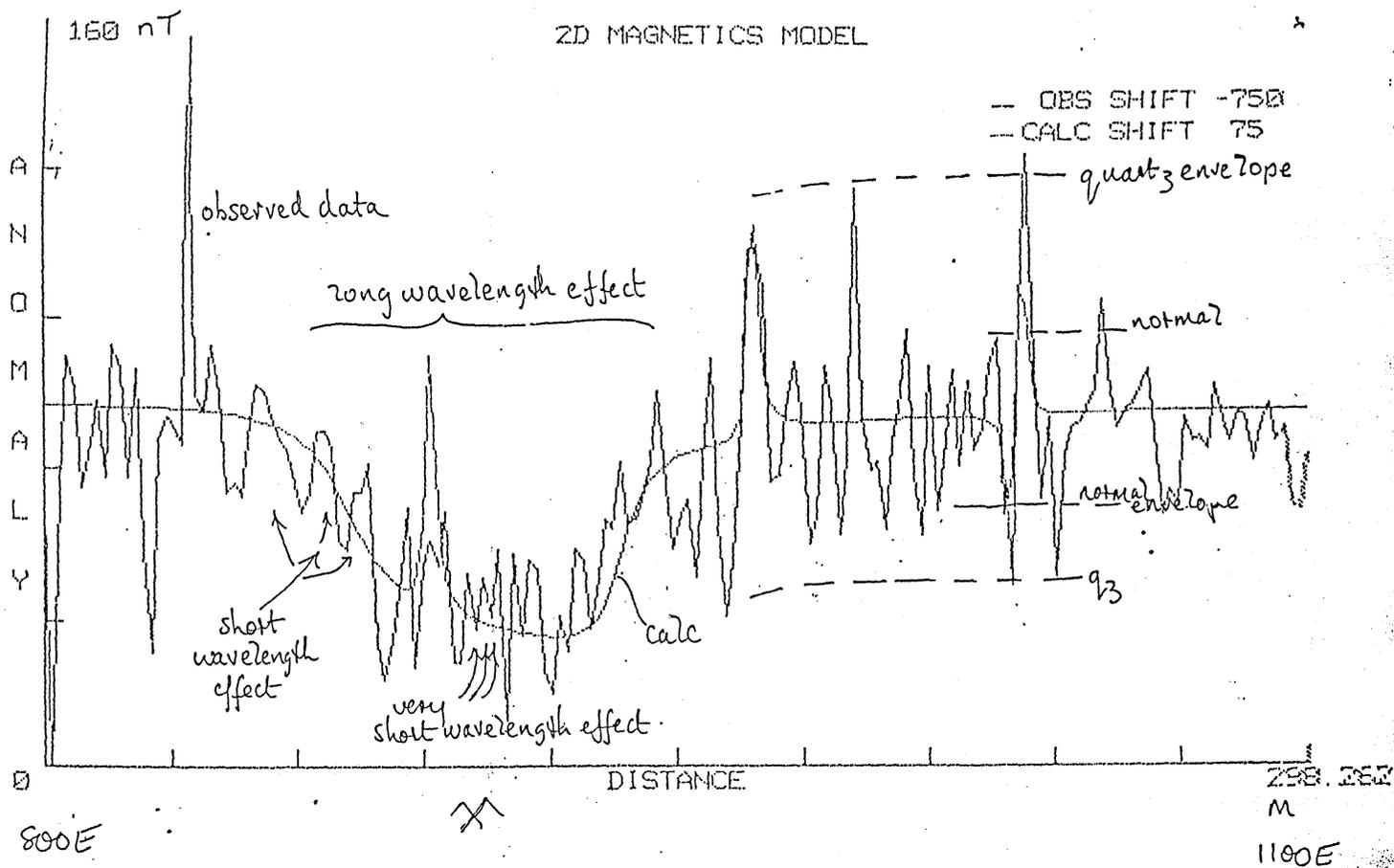


REVISED TREND INTERPRETATION OF MINERALISED SITE CONTROL AND PEGASUS MAGNETICS - NORTH AREA FIGURE 100

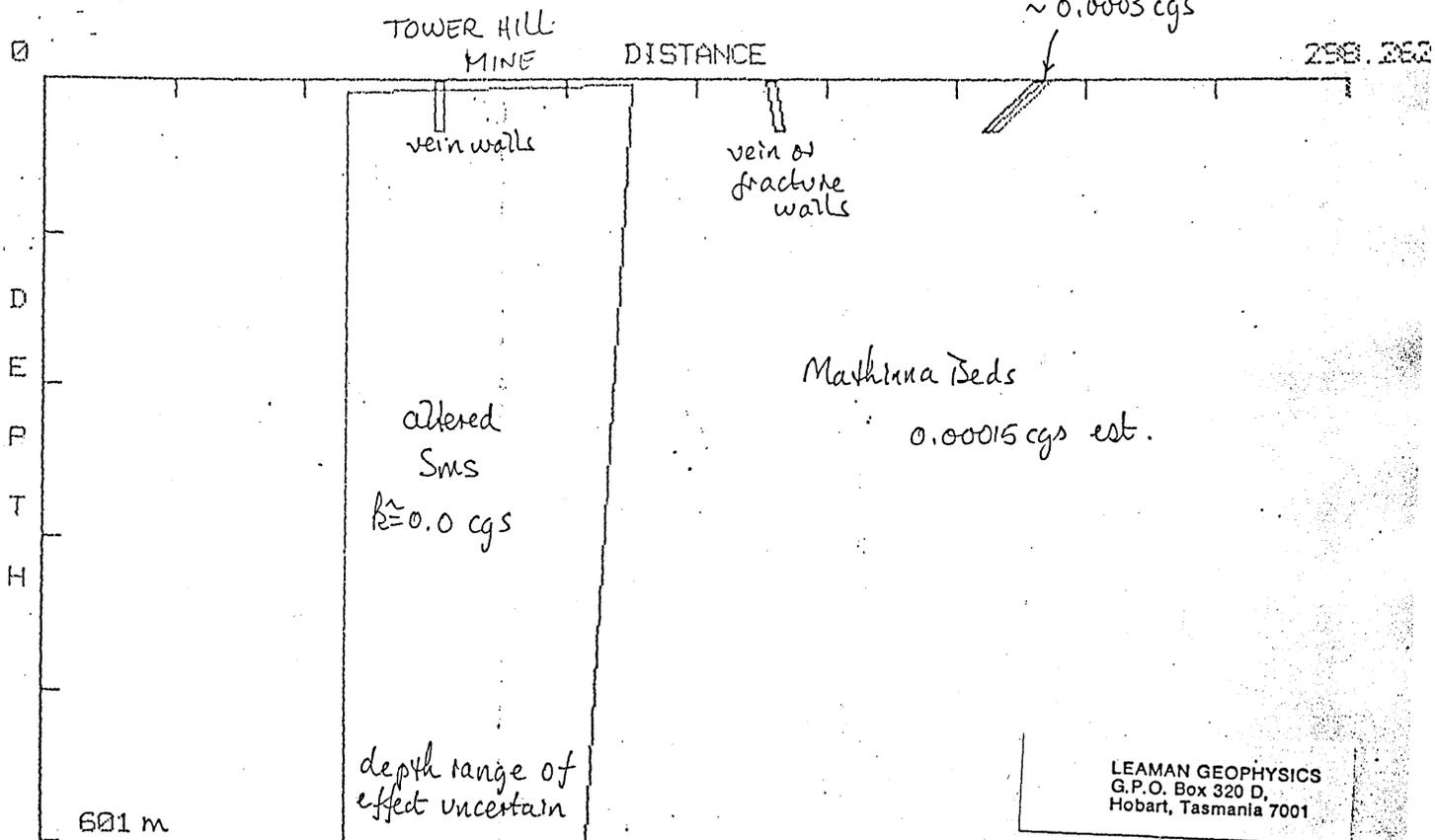
CONTOURS OF RESIDUAL MAGNETIC FIELD (N PART)

FIGURE 38

LINE PARAMETERS - ORIGIN, LIMIT, INCR : 0 300.048 1.786



TOWER HILL MAGNETICS TEST SOURCES 950N 800-1100E W GRID  
K5--00015 5/1=70/10 (DEEPER L TOP)



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

SURFACE MAGNETIC DATA SHOWING VEIN AND PROBABLE ALTERATION RESPONSES NEAR TOWER HILL MINE

FIGURE 4F

### 3. GOLDEN RIDGE

This group of prospects is marked on the eastern margin of Figure 2 and includes mines such as the "Queen of the Earth", "Golden Ridge", "Brilliant" and "Trafalgar" which are unknown quantities. These lie well clear to the Mathinna "axial zone" but may lie on the Mathinna corridor adjacent to a magnetically quiet granodiorite. Two granodiorites occur in this area; the Pyengana Pluton is strongly magnetised but the other body which has the deposits in its halo, is not. The Pyengana Pluton intrudes the mineralised granodiorite and halo and terminates gold occurrences and, I believe, geochemical indicators as well. No gravity or magnetic data are available.

The key piece of information to date: gold is associated with the low contrast granodiorite.

### 4. ALBERTON

Only regional magnetic data are available for this important and productive mine group which includes the "Mercury", "Ringarooma United" and "Mt Victoria". All lie close to the NNW-trending axial zone and a major structure as defined by magnetic gradients (E-W and/or ENE) and elements of this can be correlated with the mines. This is suggested in Figure 2 but the regional data lack definition. A very detailed ground magnetic survey of this site was completed in late 1990 using the tightest ground survey specifications known to me. Results are confidential but the Tower Hill and Portland experiences (Figures 4 and 9) would suggest considerable specific exploration value.

The Alberton mineralisation is located in rugged terrain and attempts at re-mapping by Renison Ltd while held under licence did little to clarify the structure. Previous workers, including McIntosh Reid (1925) have described the primary NNW structure as a double thrust slice.

Some other anomalies are known. Quartz porphyry dykes or sills are known in the area and are believed to assay trace gold (assay records have been mislaid?). These may be related to the roof of the batholith since it can be inferred that it may be nearby. There has been some drilling in this area but most of it, by the Mines Department, has not been reported. The reasons are unclear. One of these holes encountered what has been described by petrologists as a keratophyric lava at depth. There is clearly something very odd about this site. Or perhaps these holes have reached basement to the Mathinna Beds?

The Alberton area remains tightly held under both mining lease and exploration licence and these issues cannot be resolved.

### 11. MT HORROR-WARRENTINA

Several small mines and prospects in this region may be associated either with the main axial structure trending NNW from Mathinna or

with granodiorites intruded by the Blue Tier Batholith. No magnetic data are available but regional gravity data indicate substantial granodiorite masses nearby. Resolution is coarse. The mineralisation near Warrentina, although apparently minor, lies on a clear ENE gradient. While part of the response may be due to the Mt Paris Pluton to the south the extent of the effect and its cross cutting nature suggests a major control on both the younger pluton and mineralisation. The repetition of this important trend in this area and its association with gold mineralisation is almost certainly not a coincidence.

More data are required in this area but gravity data clearly signal a structural association with the ENE trend.

## 6. LYNDHURST

The Lyndhurst area has been modelled using Placeco data. This work identified two granodiorites; one of low magnetic contrast and another much more massive, intrusive and of higher contrast (compare situation at Golden Ridge). The roof of relatively low contrast granodiorite lies within 2 km of the surface and known mineralisation.

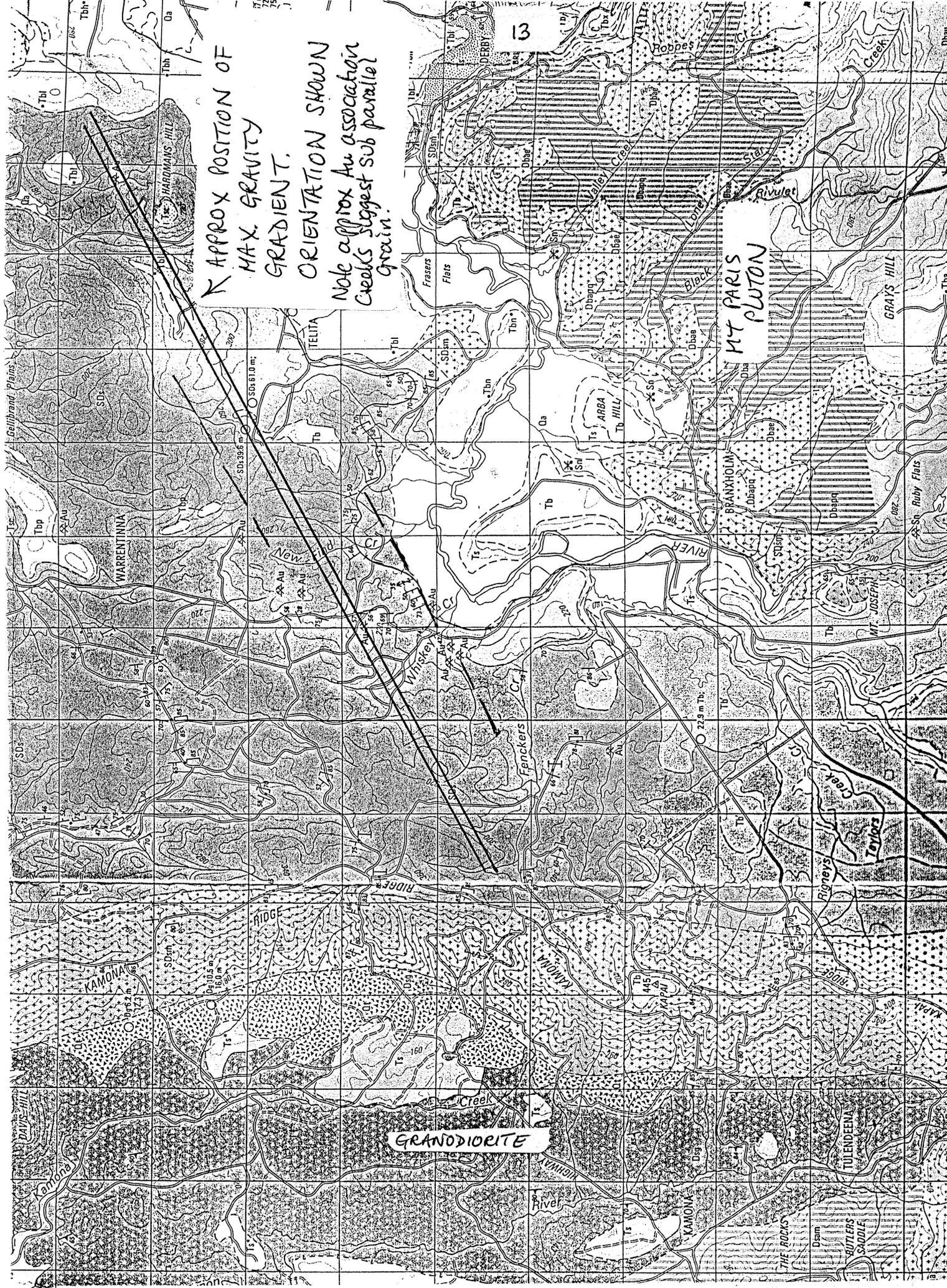
The good balance between magnetic and gravity data in this area allows some structural definition and evaluation of the composition of intrusions.

The earlier reported work indicated that mineralisation may have been related to NNW and NNE-trending intersections within the roof of the plutons (Figure 6). After appraisal of the Golconda and Mathinna-Mangana areas the magnetic data of the area were reviewed for ENE character. These elements had not been recognised previously. Such features may be found if sought. They are subtle and poorly represented due to the 10:1 E-W line bias in the survey. Such features are most clearly identified near the northern mines and the relative weighting of the features may well reflect the significance of the mineralisation.

If it is accepted that these features are present, as indicated by unit terminations, gradient distortions and similar responses within the finely contoured data, then most features are in the north of the survey but are not especially continuous. This is a very different situation to that pertaining at either Mathinna or Mangana. Some features are distinct at each of these locations and at Tower Hill whereas others produce a swarm effect. Nothing like either of these conditions occurs here and the effect is much reduced near the southern mines closer to Mt Horror.

These observations would tend to suggest that the same controls were present but that the emphatic mineralisation has not occurred here; there being no regional extent or superimposition to the control.

The study has shown that granodiorites are proximal and that the fracture and trend sets observed in association with mineralisation also occur at Lyndhurst.

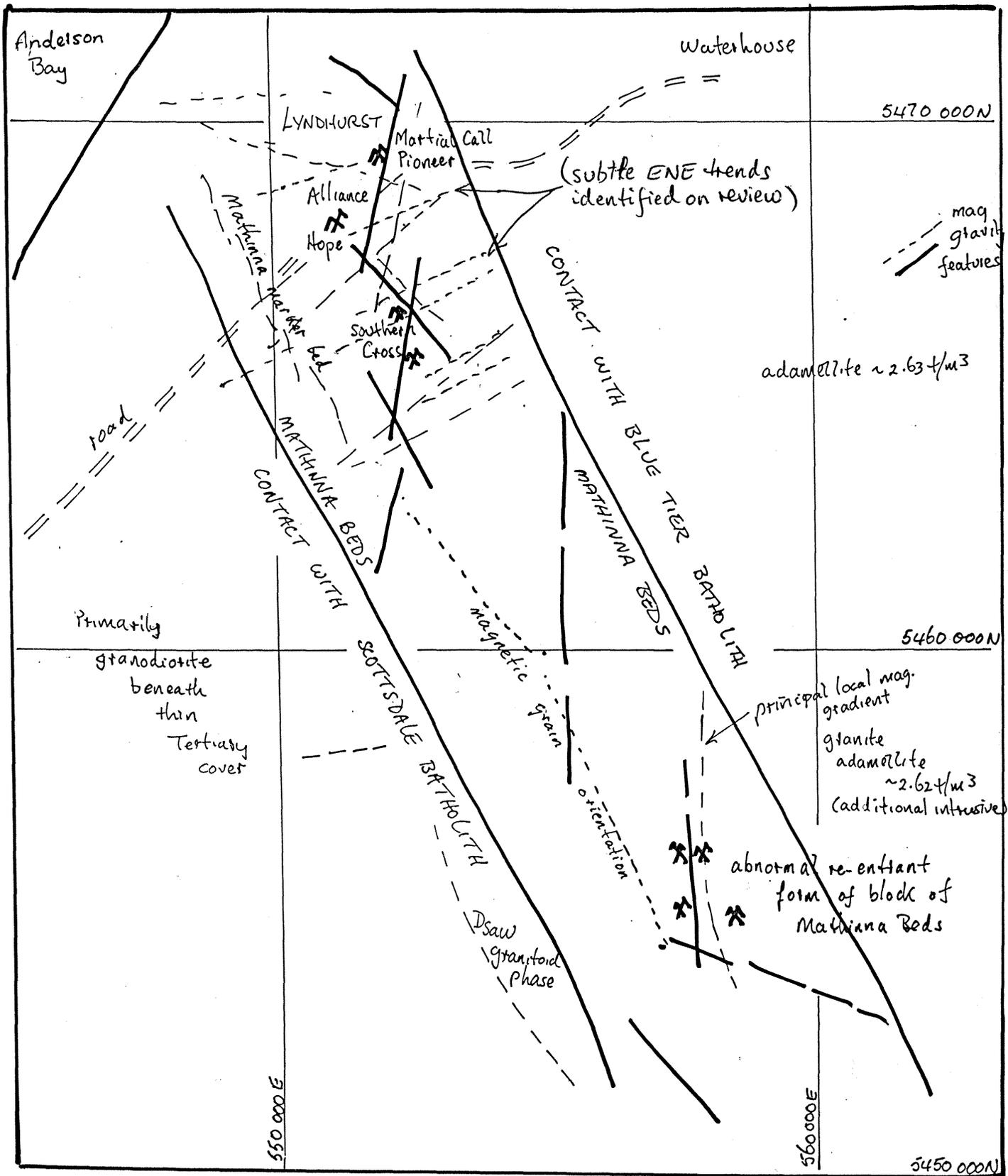


APPROX POSITION OF  
 MAX. GRAVITY  
 GRADIENT.  
 ORIENTATION SHOWN  
 Note approx Au association  
 Creaks suggest sub parallel  
 grain.

GRANODIORITE

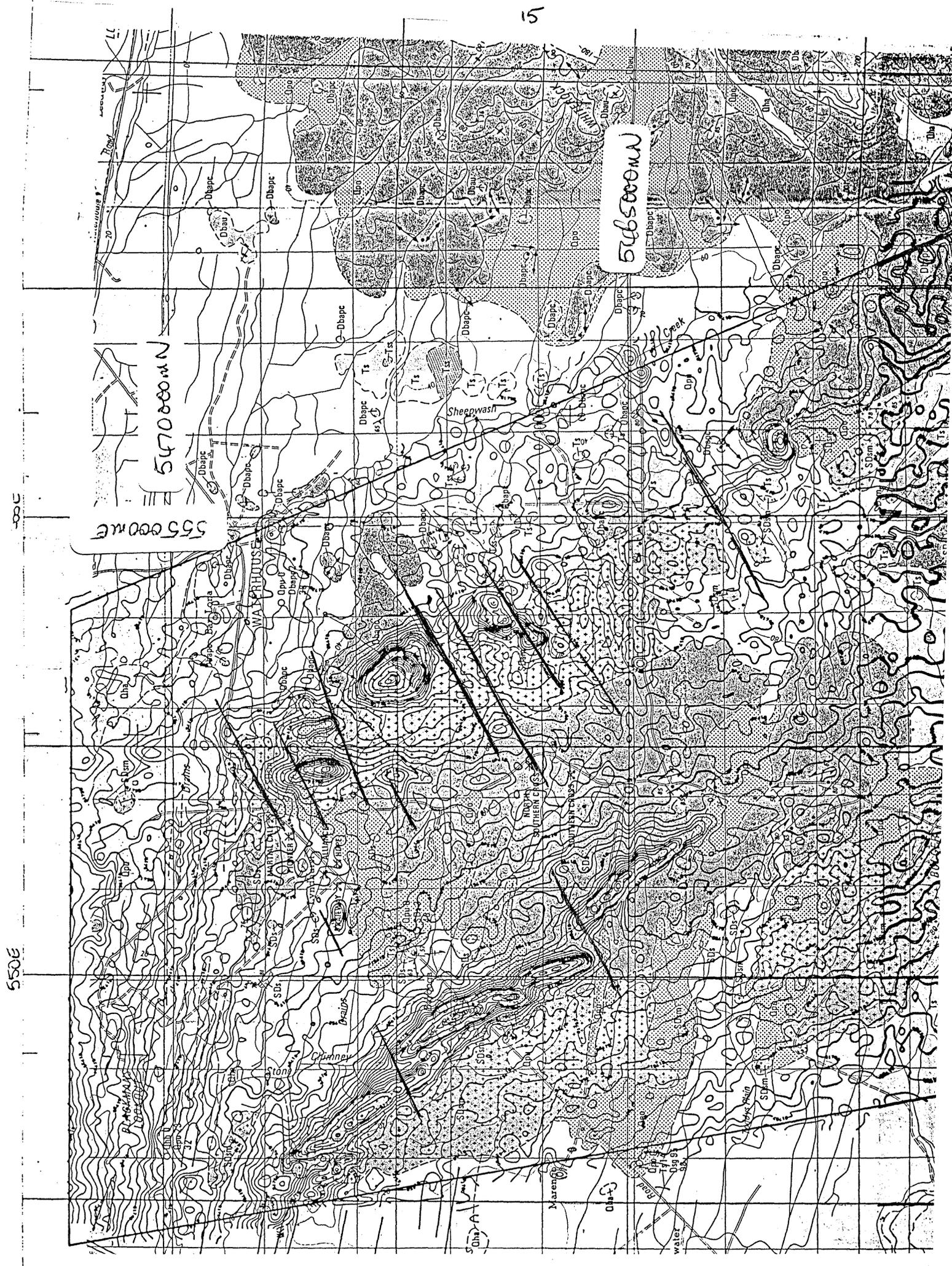
MT PARIS  
PLUTON

LOCATION OF MINERALISATION AND PRIMARY GRAVITY GRADIENT IN THE WARRENTINA AREA FIGURE 5



INTERPRETATION SUMMARY AND INDICATION OF RELATIONSHIP BETWEEN MINERALISATION AND STRUCTURE

FIGURE 6



REVISED TREND INTERPRETATION IN GLADSTONE REGION

FIGURE 7

## 7. GLADSTONE

Preliminary views by Leaman (1987) have been upgraded and the data modelled. This area has first class magnetic coverage and good gravity coverage and it was possible to establish that strong magnetic contrasts exist within the Mathinna Beds and that the units, folds and disruptions can be mapped readily. Analysis of the data also showed that granodiorites occur at shallow depth and that the roof of Mathinna Beds is never more than 2.5 km thick and that mineralised sites are much closer.

Mineralisation was shown to occur at major lithology changes within the section. This may be true elsewhere since the detailed work at both Mathinna and Mangana indicates that the deposits are near local changes in the magnetic field which can be unit related. It is thought to be the case at Alberton also.

Many strong trends were recognised in the magnetic data which were acquired using E-W flight lines. Retrospective inspection reveals that ENE trends are present and some are indicated in Figure 8. Those passing through the area of the "Musselroe Reef" and "Bluebell" have more extent than that near the "Portland" Mine but this may reflect width of survey, detail and the enclosure of the mine within a dislocated fault wedge. There is insufficient data to resolve any regional components.

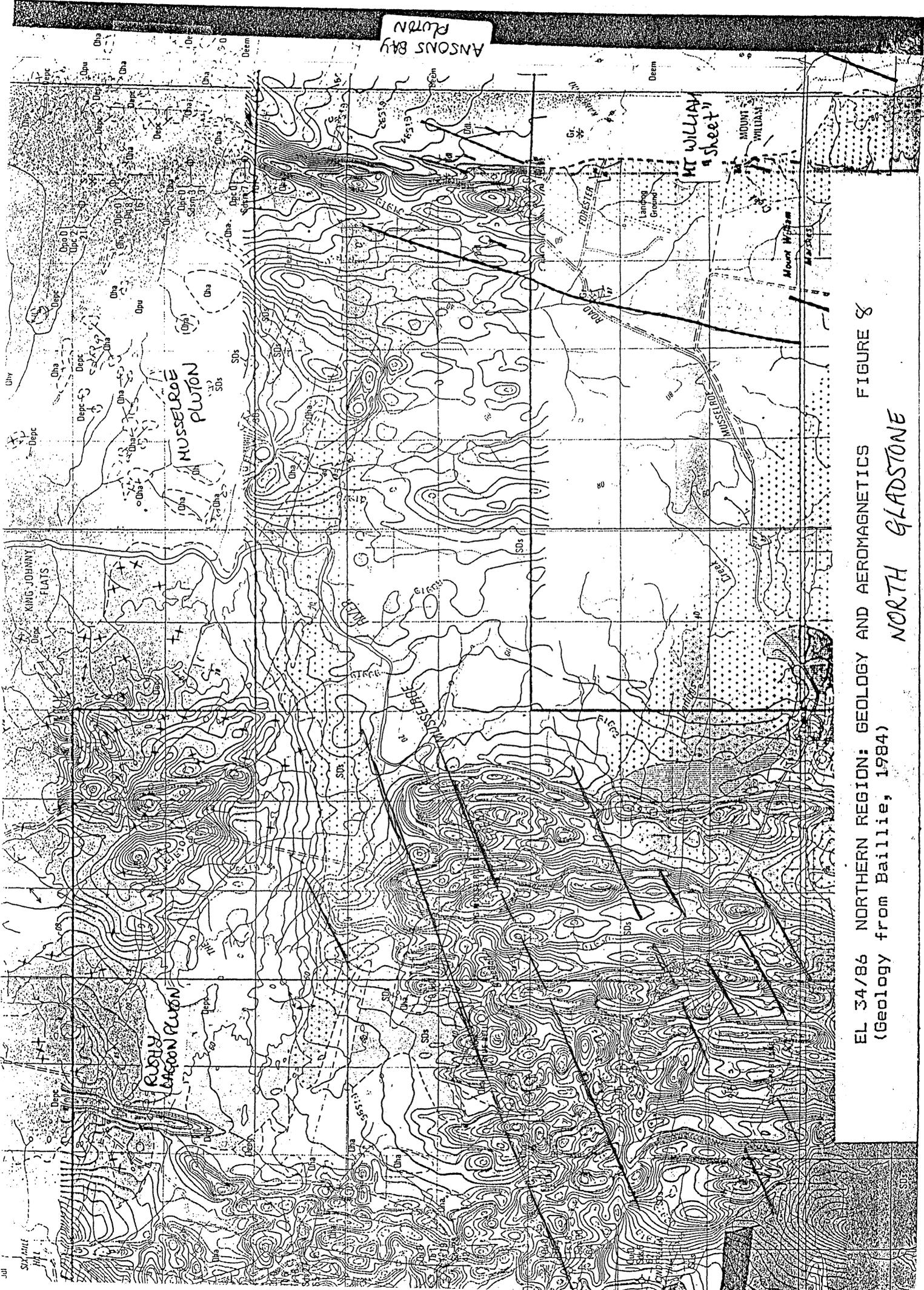
The Gladstone area contains two groups of gold producing workings; that shown in Figure 8 and another nearer the town. The latter is difficult to assess due to the complex interference due to many parts of the Blue Tier Batholith. Granodiorite extends into the area of the town, possibly from both west and east but is only patchily exposed in the region.

It was the magnetic survey of the Gladstone area which established the viability of magnetic methods in any sort of exploration in NE Tasmania. It was clear that the method could give information about the Mathinna Beds and that these units were not bland and uniform. Analysis has been able to resolve granitoid relationships as well but appraisal of these requires an accompanying gravity data set.

Surface tests were also completed around the "Portland" Mine and these demonstrated that both self potential and magnetic methods can be used to map vein margins and hence veins. Figure 9 provides an example of the lithological response - long wavelength - and vein response - spikes. Each character could be traced and was confirmed by selective excavation. The vein orientation was confirmed as being identical with that recorded deep in the shaft and drive.

### Summation:

Work in the Gladstone area has shown that low magnetic contrast granodiorite plutons underlie the mineralisation which appears to occupy tensional openings in fold limbs at ductility contrasts in the host sequence. ENE features are present. Other, imposed fractures are evident but do not appear relevant as controls, some are thrusts.



EL 34/86 NORTHERN REGION: GEOLOGY AND AEROMAGNETICS FIGURE 8  
 (Geology from Baillie, 1984)  
 NORTH GLADSTONE



## 8. BURNS CREEK

Little is known of the mineralisation in the Burns Creek area but granodiorite is exposed nearby and presumably underlies the deposit. Regional gravity data (Leaman et al, 1973) do indicate a regional ENE trend against the grain of the surrounding batholith in this area. This may be significant.

## 9. LISLE - GOLCONDA

Moderate quality magnetic data and fair gravity coverage have enabled resolution of general relationships in this area. There has been substantial production, mainly from Tertiary alluvial deposits around Lisle.

Figure 10 shows the inferred relationship between gold occurrences and granodiorite type. At least three granodiorites occur in this area and they can be discriminated by appearance, density and susceptibility. It appears that the first intruded, low density (2.70 gm/cc), low susceptibility (0.0002 cgs) has a gold halo. The others are low density and moderate susceptibility (0.0004 cgs) and high density (2.75 gm/cc est) and high contrast (0.0008). This complete association and intrusive sequence has not been confirmed elsewhere although parts of it were deduced at both Gladstone and Lyndhurst and appear to exist near Golden Ridge. In all cases the low contrast body bears the crucial relationships.

The inferred distribution of granitoid type and gold provides an excellent correlation and also explains the Lisle deposits; which were clearly derived from the mineralised halo of the "A" body.

Trend analysis in the region was the first study to suggest the role of ENE fracture systems and to indicate that local and regional components of this system occur. A correlation has been established between deposits and this relatively subtle trend orientation (Figure 11).

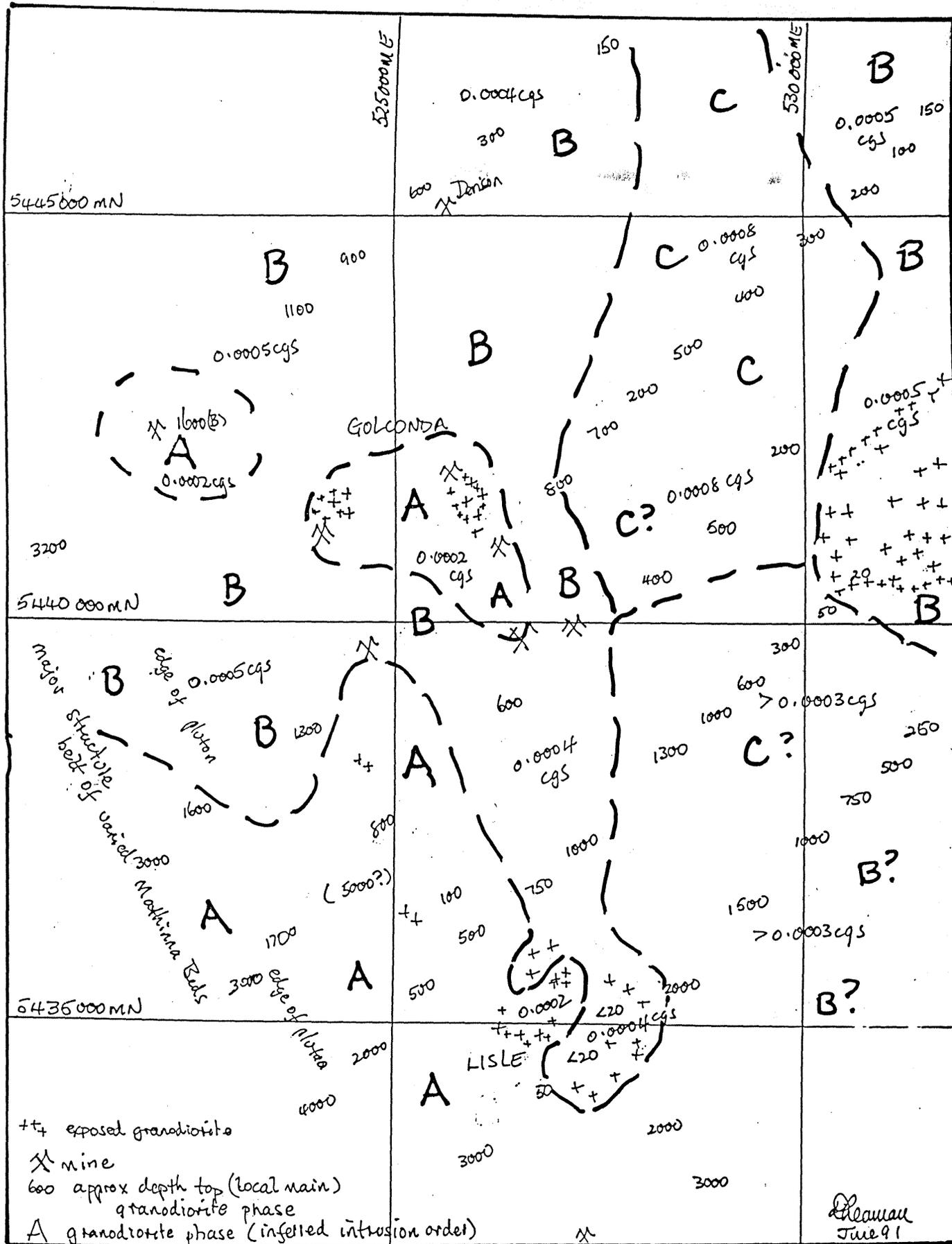
### Summation:

A positive genetic correlation is indicated between granodiorite and type of granodiorite and mineralisation. Gold mineralisation only occurs in the roof of a particular composition. This rock type has relatively low density and magnetisation properties.

Only regional and local ENE trend systems can be linked to vein deposits although other more obvious fracture patterns are evident.

## 10. LEFROY-BACK CREEK-THE GLEN GOLDFIELDS

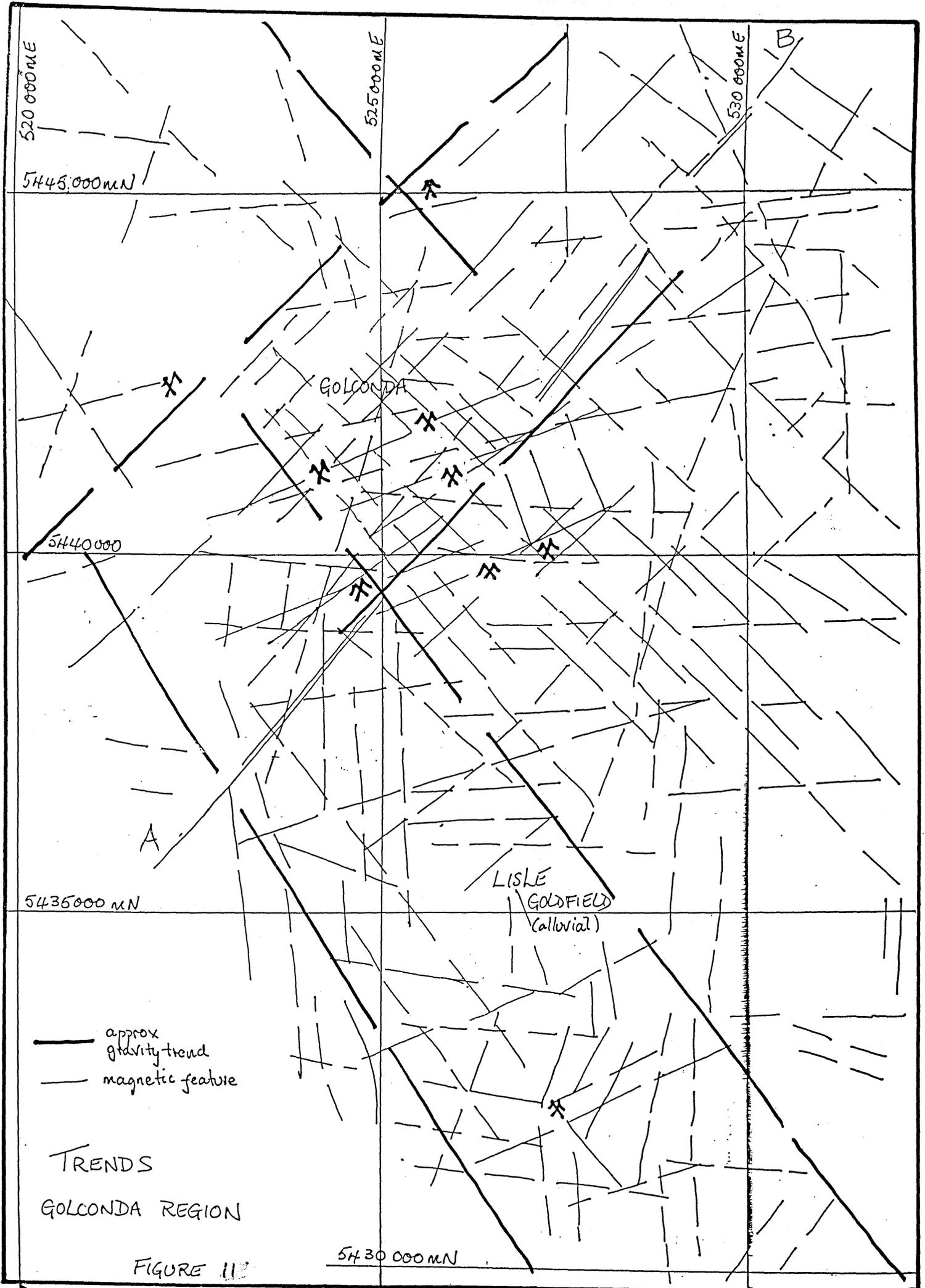
A group of goldfields in the far west of the exposed Mathinna Beds have been grouped together for discussion. No satisfactory data sets exist for any part of this region although regional gravity data is very suggestive and does indicate the presence of granodiorite at shallow depth.



INTERPRETATION SUMMARY LISLE -GOLCONDA AREA

Diagram suggests the general distribution of granodiorite types in the region and the approximate thickness of Mathinna Beds in the roof. The diagram is not the result of exhaustive or three dimensional modelling and is subject to refinement. Property sampling and classification studies are recommended.

FIGURE 10



— approx gravity trend  
- - - magnetic feature

TRENDS  
GOLCONDA REGION

FIGURE 112

5430 000 N

It is interesting to note that in this area many productive veins strike E-W or ENE and occur in a NW-NNW-trending zone about 500 m wide and 4 km long within the Mathinna Beds (Groves, 1965). The similarities with Mathinna are striking.

As is common with many other sites gold occurs with other sulphides chiefly on the reef walls and grades diminished markedly with depth (from 30 at surface to 3 g/t at 50 m). Compare this with the "Golden Gate" at Mathinna where grades were maintained at about 25 g/t throughout.

A range of geophysical methods has been tested in the area (Leaman, 1974). These showed that vein systems could be mapped with piezoelectric and thermal methods. Although some "anomalous" magnetic spikiness was observed the magnetic method was discounted. This was due to use of a low resolution magnetometer; the only unit available at the time and unsuited to the task - as it turns out.

No new data has been acquired in this area over the years and little more can be added other than to note that a pronounced ENE trend extends east from Lefroy in regional gravity data and a similar feature occurs a few kilometres to the south and may correlate with the Glen field. These are suggestive correlations from inadequate coverage.

#### 11. BEACONSFIELD

This important site is difficult to evaluate in terms of the present study. There are many differences between this site and those east of the Tamar River and the local complications of a highly varied geology and swamping effects within magnetic data have not been fully appraised. A regional ENE trend is defined east of the river at the appropriate northing and the site has only been reviewed in a regional context. Much more analysis is possible but is beyond the scope of the present summation. Gravity data coverage is quite good and the magnetic coverage is of moderate-good quality.

The gold reefs are located in Ordovician sandstones quite unlike, but perhaps contemporaneous with, the Mathinna Beds.

#### 12. LITTLE DEN

The Little Den is also different from the regular pattern east of the Tamar River. Gold is in Cambrian rocks, including volcanics, at this site.

Review has drawn attention to NE-trending shears but work at other sites suggests that the large ENE-trending regional feature may be the more significant. Figure 12 reproduces the structural diagram which indicates the relative status of this feature.

Further inspection of available data shows that the Lake River may actually follow this structure for over 4 km west from the mineralisation.



## SITE SUMMATION

The observations noted in the above discussion may be condensed into five factors.

1. A granodiorite association is definite at many sites and can be inferred (within 1.5 km) at others (including perhaps Little Den and Beaconsfield). A genetic link is implied.
2. The key granodiorite lithology forms part of a primary intrusion and possesses low density and susceptibility properties.
3. The quartz veins occupy fracture fills in the roof of this body and the essential deformations predated or were contemporaneous with the intrusion. Subsequent venation and disruption reflects the disturbance associated with intrusion of the batholith series.
4. Mineralised sites are complex but mappable units and clear disruptions of the units are not necessary elements in the process controlling venation or mineralisation. While vein systems may be locally controlled by shallow features the fundamental controls are exercised regionally or from depth. Thus a range of vein orientations is to be expected at mineralised sites. Particular sites may occur in fold limbs, axes or ductility differences in the host sequence. These are random elements.
5. Sites appear to occur at nodes along ENE or E-W trending features and intersections. Large deposits occur where local features of this trend are superimposed on regional elements. These are the non random elements.

## EXPLORATION METHODOLOGY

The summary discussion given above was not generated from application of pure structural, chemical or geological mapping or satellite information. None of these approaches has afforded any consistent or rational result for the many explorers who have used them.

While this comment is not meant to deny the importance, specific application or regional need of these methods they cannot provide the information needed to identify

- a) target zones for detailed exploration,
  - b) the means to explore within the target areas,
- since no systematic relationships have yet been recognised using them.

Geophysical methods, in particular magnetics, have. This was surprising given early thinking, research and assumptions about the geology. But there can be no question now.

The magnetic method can

- a) map lithological changes within the Mathinna Beds,
- b) map faults, thrusts, folds in Mathinna Beds,
- c) separate granodiorites or map them,
- d) map vein systems and associated alteration,
- e) define trends, both regional and local which appear relevant to exploration for gold.

Useful and important support toward (c) and (e) can be provided by semi-regional gravity coverage. It is fortunate that these are the two cheapest and most cost effective methods in the particular modes required.

Given the findings and examples of this review and its constituent studies a methodology can be prescribed for exploration of a gold-bearing province such as NE Tasmania (it would also apply to Victoria and southern NSW as well and does apply in central Queensland).

1. Regional aeromagnetic coverage of the province to establish general structural relationships. The survey should have a line spacing of no more than 500 m (N-S) with tie lines at 2000 m and be flown at a clearance of 80-100 m. Only the Mathinna Beds should be flown with excursions of no more than 5 km into batholiths in order to provide control anchorage. Granodiorites should be completely covered. The magnetometer must provide high sample rates and sensitivity.

The aim of such a survey is provision of maps of exposed and concealed granodiorites, general definition of units and structure within the Mathinna Beds and regional trend corridors. Such a survey should identify target zones for specific survey. The N-S orientation is required to ensure that the key trends are properly defined.

This approach is essential for exploration of the Horror, Lefroy, Mathinna-Alberton regions etc. Current regional data, available only for the Mathinna-Alberton region is not of desired quality.

Ideally, the entire province should be surveyed in order to integrate and appraise patterns and responses. If this is not practicable then large unitary segments of it should be surveyed.

2. Infill target zones of the order of 10 by 10 km with detailed survey. Very high resolution specification; 125 m line spacing N-S and clearance of 80 m.

It might be argued in NE Tasmania that these sites are already known - e.g., Lefroy and that the regional cover is not required. This would be a false economy since regional corridors - likely to contain large deposits, and also act as discriminators between normal, also-ran, or economic deposits would probably not be established. It is not known now. It is only the presence of a regional cover, far more extensive than the local surveys around Mathinna, which enables decisive induction in that area. That regional survey is rated only of fair quality. The coupling of first pass and refined surveys in that region allows identification of both local and corridor controls.

3. Infill regional gravity coverage to a nominal 1 km spacing within an area 20 by 20 km about the target zone. This is necessary to ensure sufficient data and to provide a structural back-up and anomaly discriminator for the magnetic surveys. The survey itself should be tightly specified but levelling by careful barometry will be adequate.
4. Recycle predliminary interpretations. Quantify structures and target options as shown in the examples in the study sequence.
5. Select areas for ground survey; a maximum of about 1 sq km is suggested. The magnetic survey should use a magnetometer with precision of 0.1 to 1 nT, and observations should be no more than one metre apart on lines with a maximum spacing of 50 m. A limit specification would be 0.01 nT, 25 m, 0.3 m spacing. The data must be fully corrected.  
Close or perspective array profile presentation may prove adequate but very light continuation filtering may be needed to contour the data.  
The objectives of the detailed survey are to define particular structures and vein orientations, and perhaps altered volumes. The latter application is still subject to further test surveys.
6. Geochemistry, mapping, trenching and drilling.

## TARGET AREAS

The present work, or available data, does suggest how areas can be ranked and targetted. This approach must be tried until or unless found wanting.

The concentration of trend features near Mangana clearly implies a major controlling corridor. Gravity offsets confirm this, as does the known mineralisation. A major magnetic corridor also appears to be present at the limit of regional coverage. This is an area worthy of examination.

Similar comments might apply to the Tower Hill and Mathinna regions, or at least westward from the known mineralisation along the defined corridors.

The structures observed near Mangana also extend south toward Tullochgorum near the Esk Highway. No gold is known from this area and the absence of magnetic data prevents any current evaluation.

Two major corridor distortions occur near Walkers Flat along the Dans Rivulet zone (see Figure 2). There is clearly scope for locating known prospects or workings in this zone and appraising them with a detailed airborne survey or ground survey. There is clearly potential for major mineralisation in this zone.

The emphatic nature of gradients in the Alberton area confirms this as a prime target. No specific data are available to refine location within the field.

No other areas can be sensibly suggested at the present time due to lack of regional or local data. Suggestions concerning the Lefroy and Warrentina areas have been made in individual discussions based on clear features in relatively poor data. These implications should be refined.

Any of the above sites could contain a "Golden Gate". Such cannot be expected of Lyndhurst or North Mt Horror, or Gladstone since the corridor overprint appears to be lacking.

Of the above areas only Alberton is tightly held at present but lateral targets may exist along the corridors - such as lead to such sites as Great Fingal or Golden Ridge. Without more data it is unclear how the Golconda area should be rated.

## REFERENCES

- Groves, D.I., 1965. Geology of the Lefroy Goldfield. Tech. Rept. Dep. Mines. Tas. 9, 59-76.
- Klominsky, J., & Groves, D.I., 1970. The contrast in granitic rock types associated with tin and gold mineralisation in Tasmania. Proc. Australas. Inst. Min.Metall. 234: 71-77.
- Leaman, D.E., 1974. Geophysics of the Lefroy Goldfield. Tech. Rept. Dep. Mines Tas. 17, 79-87.
- Leaman, D.E., 1987. Report on trial survey, Portland Mine, for Placeco by Leaman Geophysics.
- Leaman, D.E., 1989. Ground magnetic survey EL 55/83 Mangana for Pegasus by Leaman Geophysics.
- Leaman, D.E., 1990. Aeromagnetic survey EL 55/83 Mangana. Acquisition report including preliminary interpretation for Pegasus Gold Aust. by Leaman Geophysics.
- Leaman, D.E., Symonds, P.A., & Shirley, J.E., 1973. Gravity survey of the Tamar Region, northern Tasmania. Geol. Surv. Tasm. Pap. 1
- McIntosh Reid, A., 1925. The properties of the Ringarooma Gold Mining Co., Alberton, Tasmania. Unpub. Rep. Dep. Mines Tasm

# *APPENDIX 3*

PAPER PUBLISHED IN GEOLOGICAL SURVEY BULLETIN 70

This paper was presented as part of the Tasmanian government's drive for further exploration in 1992.

It represents a partial condensation of the material of Appendix 2.

It has elicited no interest or follow-up and yet many of the ideas must be tested or checked since they may lead to a breakthrough in exploration. They were not claimed to be perfect; but the issues are difficult to treat and resolve and encouraging paths should be fully evaluated.

# NORTH-EAST TASMANIA

AN INTERPRETATION OF DATA INCLUDED IN THE NETGOLD PACKAGE

BY DR. D.E. LEAMAN  
Leaman Geophysics, Hobart  
May 1994



## LEGEND

Fine lines represent geophysical trends - either gravity, magnetic or radiometric.  
Coarser lines mark the approximate location of principal gradients or changes in trend of gradients. Some show curl.  
Very heavy lines mark the limit of general or accessible exposure of gold-bearing rocks.  
Large dots mark the site of distortions in primary geophysical trends.  
Small dots mark the site of distortions in exposed formation or structure trends, including marginal form changes in plutons.  
Major goldfields identified by name and prospect symbol.  
Lettered sites indicate, additional, potential target areas.

Refer to text for details and explanation.  
Note that all boundaries and positions are approximate due to map scale and the disparate scales of the presented original data. The map should be considered a preliminary interpretation.