APPENDICES

Two documents have been referenced with the presumption that both would be available in the Library of Mineral Resources Tasmania, but a subsequent search has shown that neither was submitted to the Department of Mines as required by the terms of Exploration Licences or similar agreements.

The first of these – dealing with the Gladstone magnetic texture – is reproduced in full while the second – which considers techniques and possibilities for gold search in northeast Tasmania – is too large to reproduce: only a summary and conclusion are given here. Much of the material has since appeared in other sources but original comments can be obtained from Leaman Geophysics.

Since one report was prepared in 1989 and the other in 1994 it is not possible to fully convert the documents or associated diagrams but the best possible reproduction is offered. It should also be noted that the diagnostic paper of Leaman (1994a) had not been released when the early interpretations were offered. This weakness does not weaken any general conclusions about properties of Mathinna Beds, which were in fact based on sampling studies as well.

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

89/7

INTERPRETATION STATUS
AIRBORNE GEOPHYSICAL SURVEYS
EL 34/86 GLADSTONE
for
Placeco Australia Pty Ltd
by
Dr D E Leaman

GLADSTN

Placeco Australia Pty Ltd acquired detailed magnetic and radiometric data in mid 1987. Details of the survey, the data sets and qualitative observations on the results were given by Leaman (1987).

An interpretation was begun in September 1987 but was halted when collapse of financial markets in October 1987 restricted funding for the project.
Much had been achieved and with new work about to recommence it was suggested that an outline of the status of that interpretation be filed for reference.

These notes recover terminal points in the interpretation completed and represent some record of what was done. Many conclusions were crystallizing and results offer encouragement that the NE gold province can be rationally evaluated and explored. Some profiles and treatments are clearly at a preliminary stage but all models offer a platform for development or launching of new work.

The profiles were selected so as to sample various aspects of the magnetic field and to test their possible relationships (See Figures 1A, 1B).

GLADW
This profile extends from the region of virtually exposed granodiorite across an area of "striped" anomalies within exposed Mathinna Beds. Figure 2A examines the subtler regional aspects of the profile to show that the gross anomaly trends are related to a moderate (non plutonic) thickness of granodiorite at acceptable contrast. Its shape must be tapered, however.
Figure 2B reviews the implications of the Mathinna Beds anomalies. It shows two things; specific units are magnetised with properties consistent with those observed around Portland Mine, and that those units are depth limited in a manner compatible with the granodiorite taper (+/- 100 to 200 m) and

virtually outcrop.

GLADS
This line through Gladstone samples various granitoids. Figure 3 shows that the eastern granodiorite is present but terminated and that a second body occurs west of Gladstone. The two are separated by a plug of tin granite whose upper surface is suggested by the termination of a Mathinna Beds member. The profile also reviews the response of a steel barn roof - several of these features were recorded in the survey.

GLADNS1
This profile (Figure 4) is parallel to strike of both Mathinna units and possible granodiorite as indicated in profiles to west and south. The granodiorite effects can be sustained by modelling but have been swamped by local 3D effects.

GLADCENT
This profile considers the implications of both the magnetised Mathinna Beds and the possibility of underlying granodiorite. It extends into the mapped metamorphic halo of the Gardens Pluton. Some twenty variations were tested but only a solution of the form of Figure 5 is satisfactory. Magnetic units are depth limited, the halo may be measurable as a non magnetic zone and the granodiorite is ubiquitous.
The model suggests a general halo effect (0.0002 cgs) up to 1000 m wide which, close to the granitoid, is destroyed. Particular susceptible lithologies within this halo are further altered, as near Portland Mine.

GLADNE
This profile reviews a number of features (Figure 6). The granodiorite is truncated by the Mt William Sheet; there is probably a non magnetic contact zone, above it some general alteration. Some extreme spikes may also reflect local skins of Tertiary basalt but all gross responses are from the granitoids and Mathinna Beds.

GLADNS2
Modelling of this profile (Figure 7) is affected by 3D effects but the truncation of granodiorite by the Rushy Lagoon Pluton is clear. The offset in position, and quiet magnetic zone, is consistent with property loss due to thermal metamorphism. The broad regional, more distant, alteration in Mathinna Beds is evident above the granodiorite to the south.

GLADG
This profile (Figure 8) is presented as an interim model. Although not refined it illustrates and repeats the features required of other profiles. Granodiorite is general as is the moderate alteration halo.

GLADB
This profile (Figure 9) demonstrates the depth limited character of the magnetic sources within the Mathinna Beds.

GLADC
This profile (Figure 10) further tests depth limitation of Mathinna Beds sources. Compare integration into metamorphic halo - Figure 5.

GLADD
Profile D (Figure 11) reinforces the conclusions evident in Figures 5 and 6.

Although this study remains incomplete the results have been summarised (Map 1 - folder) in terms of probable underlying granodiorite surface.

Several issues raised by Leaman (1987) have been resolved. The magnetic character observed is related to bulk regional metamorphism; where thermal metamorphism is extreme there is contrast loss. Some members of the Mathinna Beds have been more susceptible to low intensity alteration.
There are some absorbed relicts in the younger, more siliceous granites.
Gold-bearing sites are roughly associated with cupola-like structures and are offset by about 1 km. It is unclear how much this association reflects structural control or usage and passage of fracture-controlled fluids or is directly related to granitoid intrusion and form.

There is clearly scope for refinement. Further magnetic work should be largely three dimensional. Other methods, especially gravity, would offer improved and independent perspective on all relationships.

Notes prepared by

June 1989

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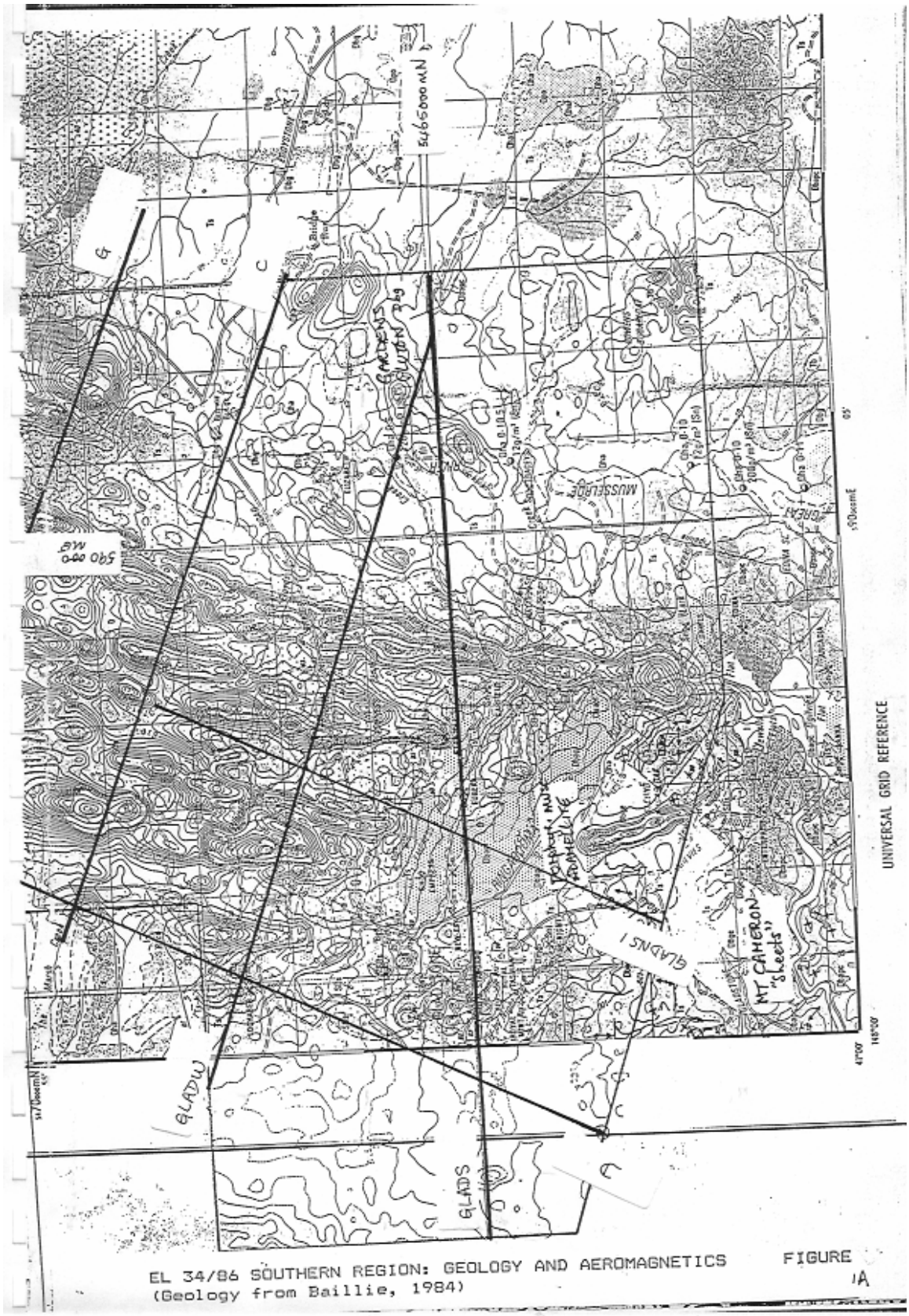
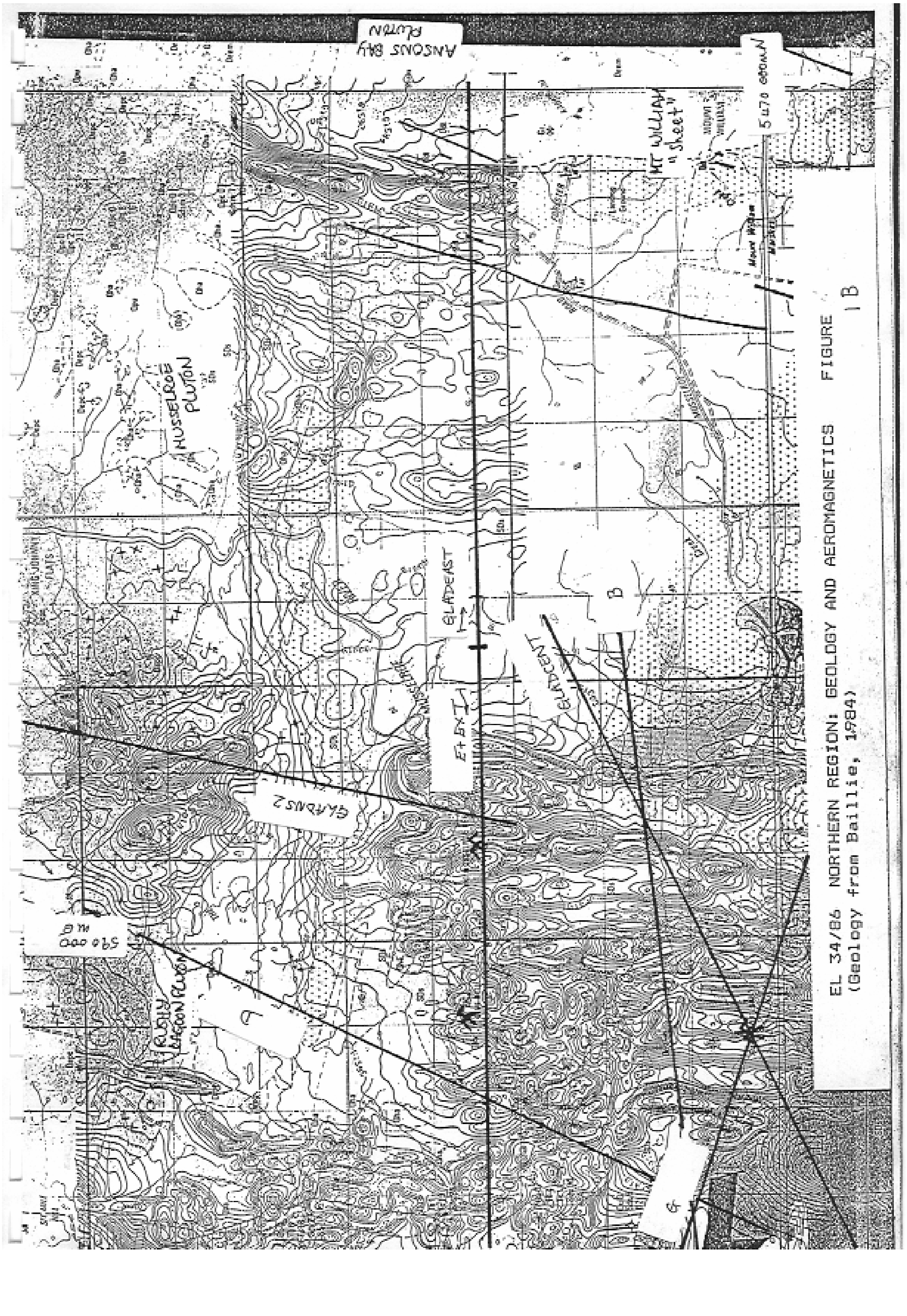
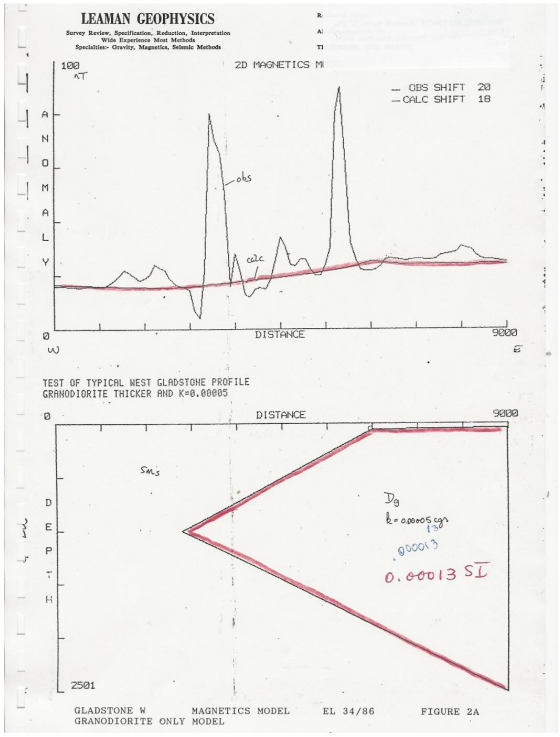
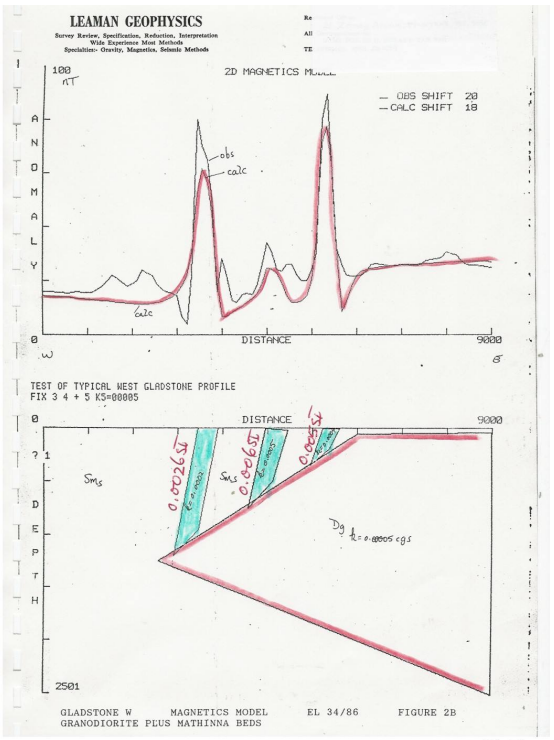


EL 34/86 SOUTHERN REGION: GEOLOGY AND AEROMAGNETICS FIGURE 1A
(Geology from Baillie, 1984)

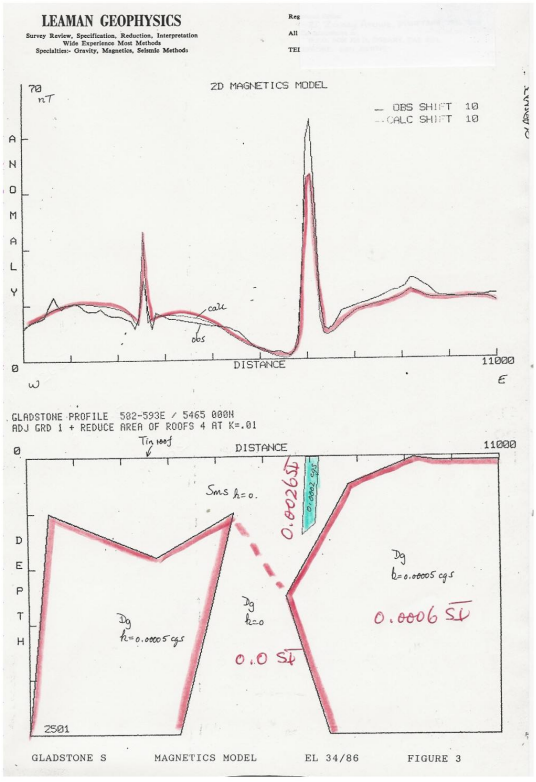


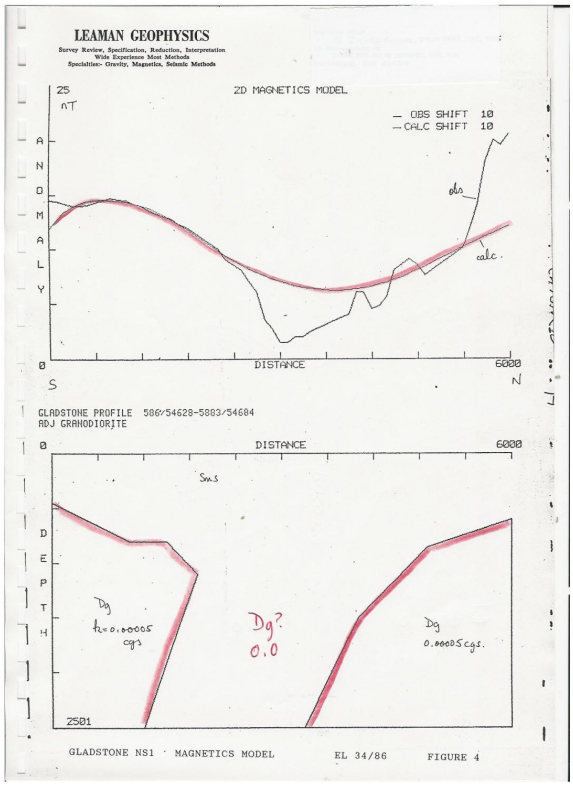
EL 34/86 NORTHERN REGION: GEOLOGY AND AEROMAGNETICS FIGURE 1B
(Geology from Baillie, 1984)



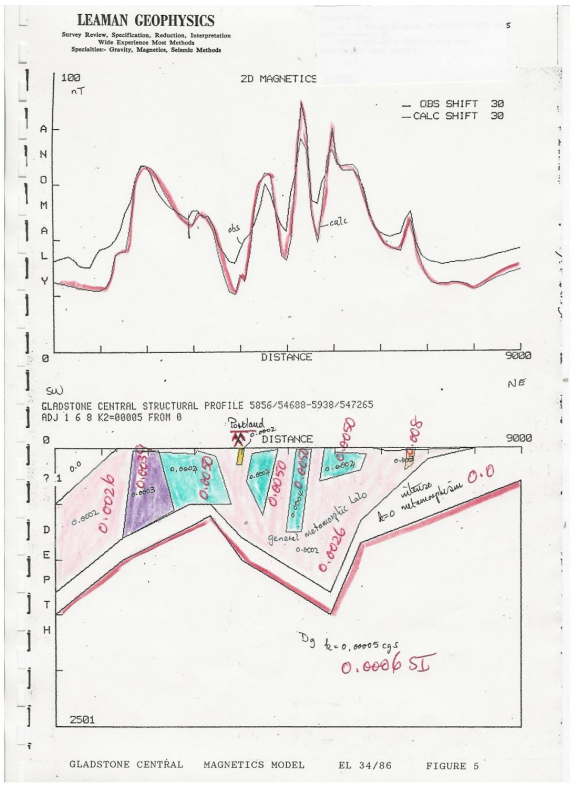


2A GLADSTONE W 2B





GLADSTONE S 3 GLADSTONE NS1 4



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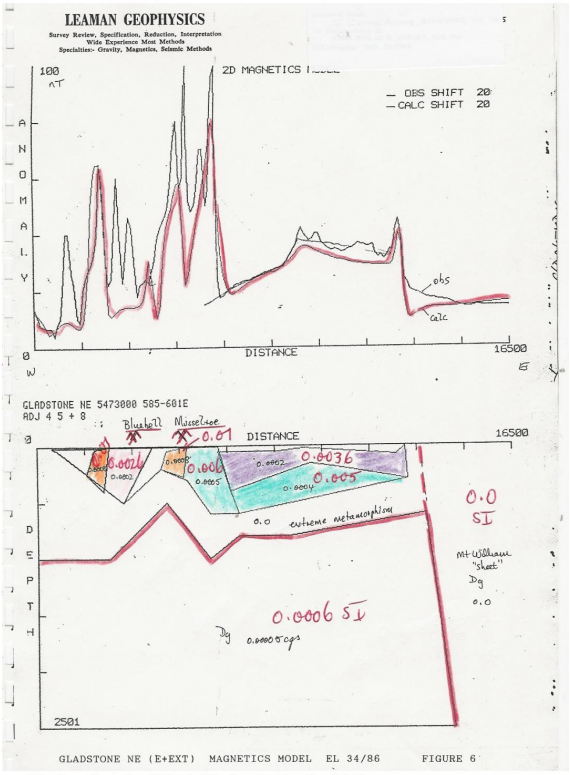

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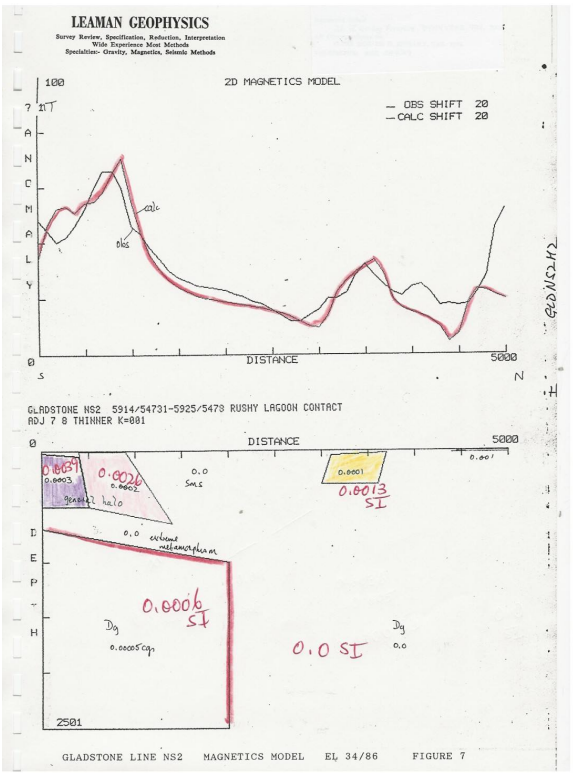

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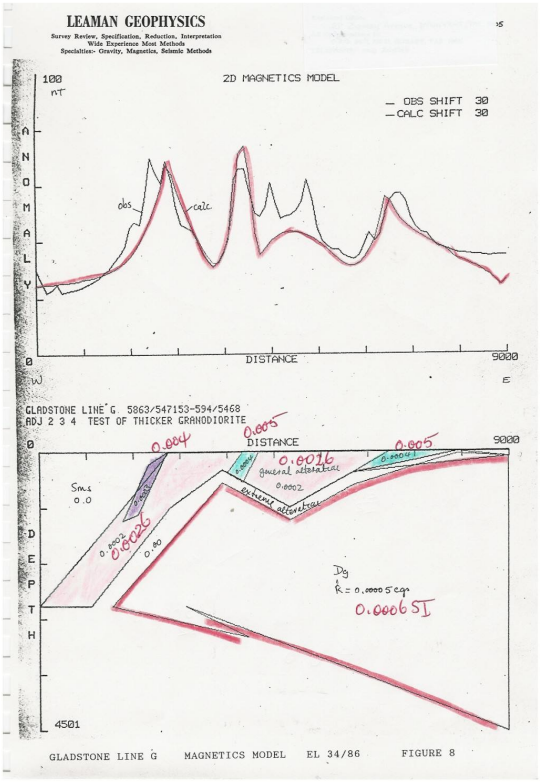

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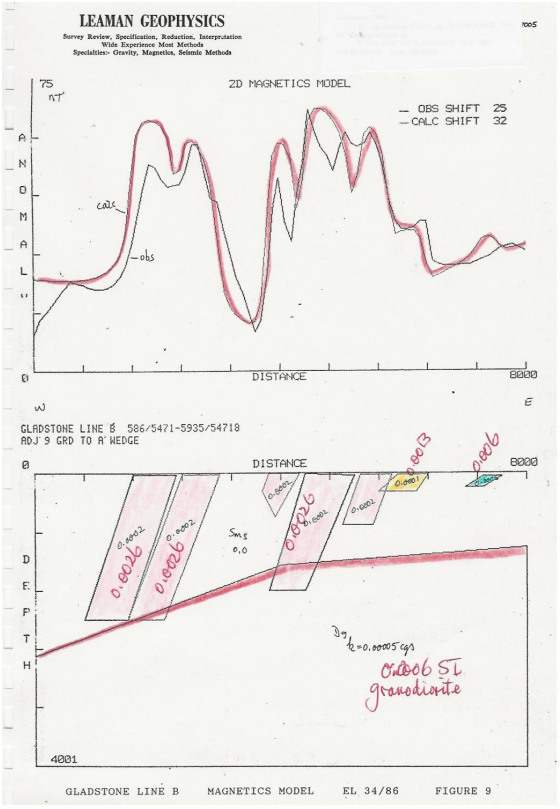

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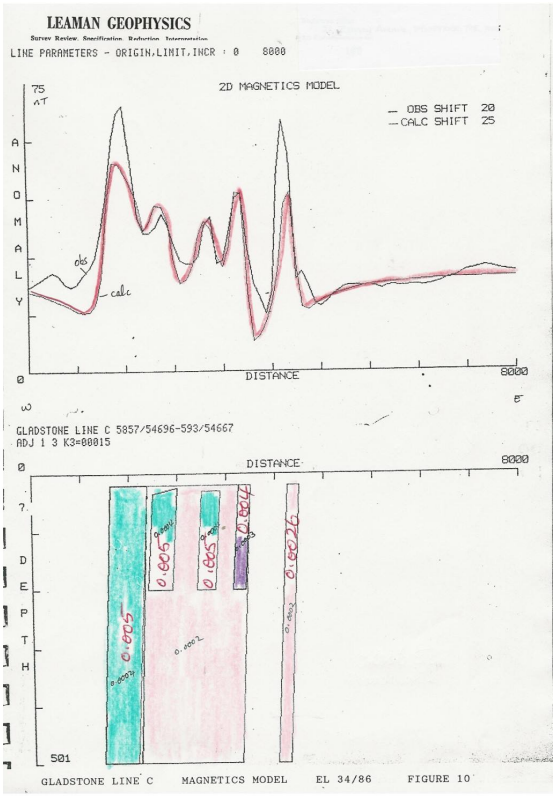

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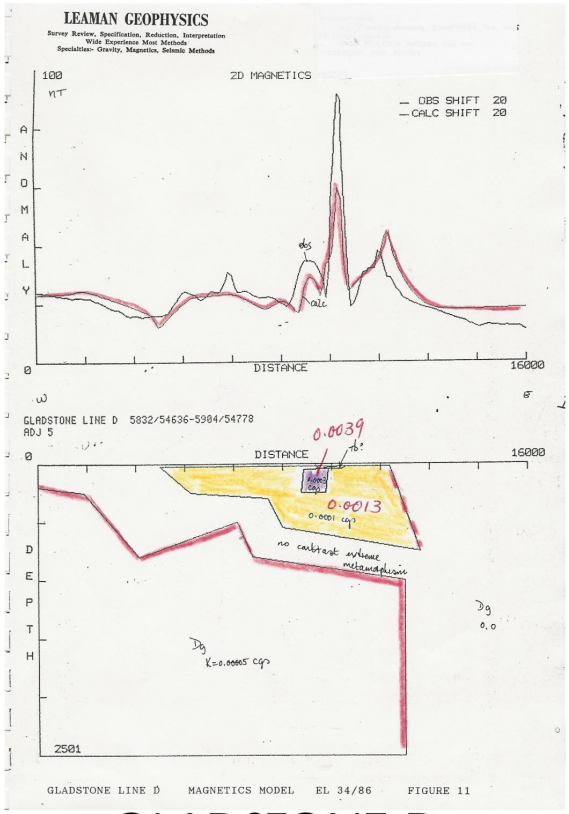

GLADSTONE D 11

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NORTH EAST TASMANIA

REVIEW
GOLD POTENTIAL
AND EXPLORATION METHODOLOGY

for
BASS MINING NL

by
D.E.Leaman

May 1994

NETGOLD

94/10

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.

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.

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.