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ASSESSMENT OF SELECTED FEATURES IN THE 2007 MAGNETIC SURVEYS 0F NORTH EAST TASMANIA

REPORT FOR MINERAL RESOURCES TASMANIA

by

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February 2008

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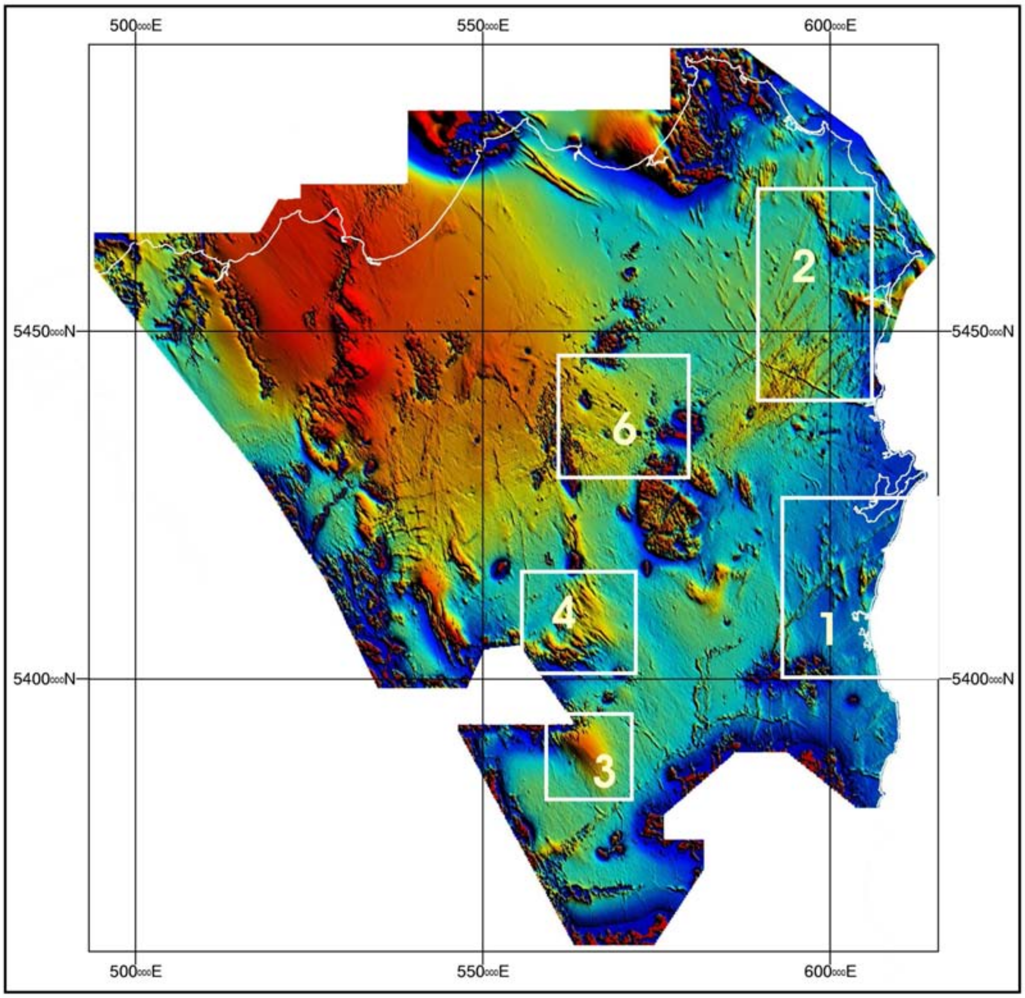


Figure 1:
Image of Total Magnetic Field Intensity in Northeast Tasmania.
(All data provided by Mineral Resources Tasmania)

The numbered areas refer to the regions and anomalies selected for assessment and described in this report.
Particular sites for selection #5 are small and distributed across areas 2 and 6, and the area between these.

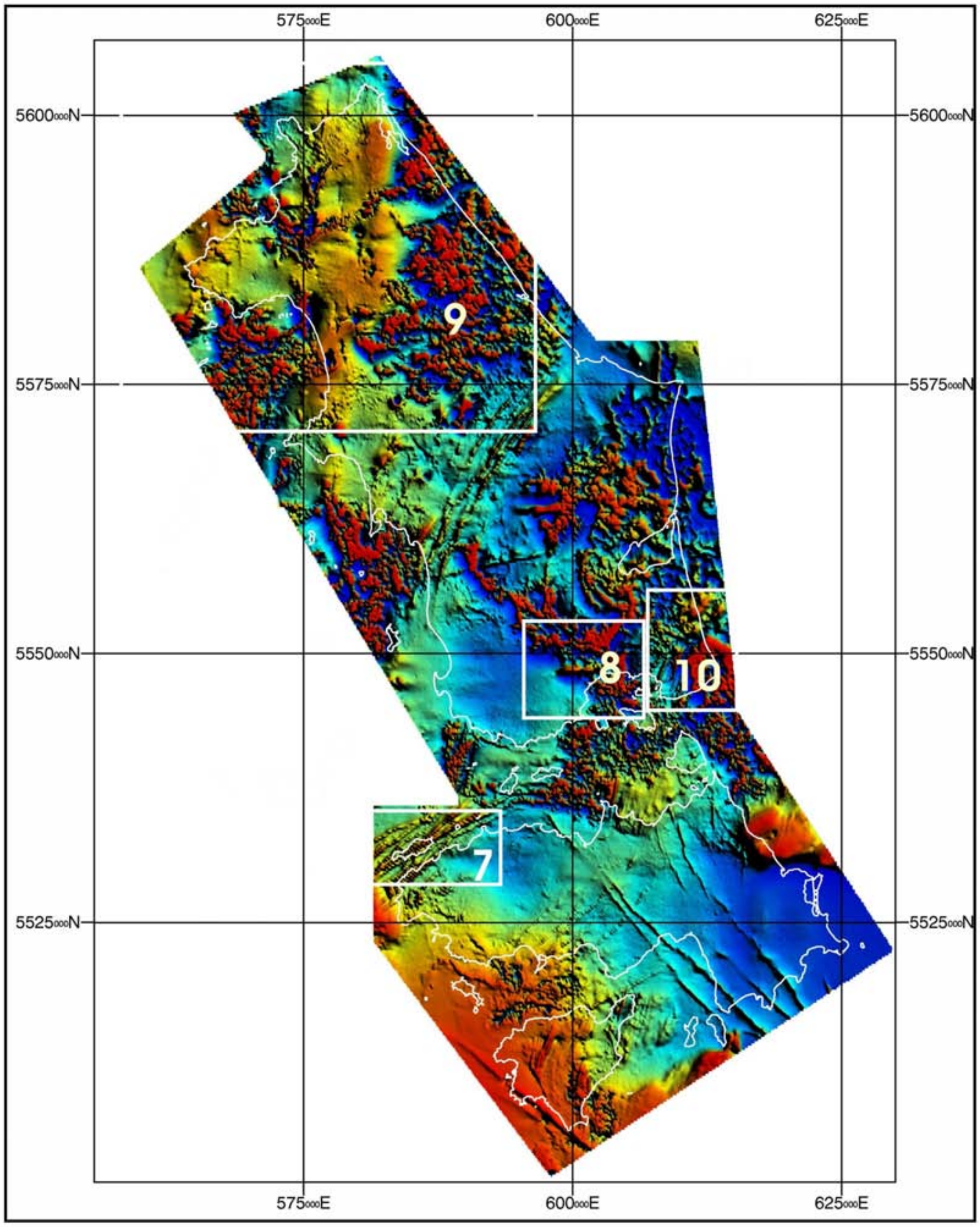


Figure 2:
Image of Total Magnetic Field Intensity in Furneaux Group, including Flinders Island. Tasmania.
(All data provided by Mineral Resources Tasmania)

The numbered areas refer to the regions and anomalies selected for assessment and described in this report.

INTRODUCTION

Regional aeromagnetic and radiometric data have been acquired by Mineral Resources Tasmania across northeast Tasmania during 2007 using a combination of fixed wing aircraft and helicopter along east-west traverses spaced 200 metres apart and with a nominal terrain clearance of about 80 m. Review of line data shows that the spacing specification was well maintained but the elevation specification of 80 m was only sustained in low relief areas and that, locally, the clearance may range from 65 to 120 m.

This report, one of three commissioned by Mineral Resources Tasmania, considers quantitatively a set of particular matters and queries raised by staff of MRT as worthy of review and explanation in order to inform users of the data and to guide future use and examination of the data.
Each topic selected, and its resolution – where possible, was intended to assist mapping, general structural understanding and, perhaps, appraisal of controls on mineralisation.
The companion reports by K. Godber and S. Webster consider aspects of regional interpretation and quantitative analysis, respectively. Consequently, most of the more regional aspects of the survey and its interpretation are – with the exception of Flinders Island – treated in those reports and only more specific issues are considered here.

The features, or areas, selected for review are shown in the compilation images of the two principal aeromagnetic surveys (Figures 1 and 2).
These are:-

1. Scamander region: presumed dyke features and the Catos Creek intrusion.

2. North east of Blue Tier: nature and properties of the dyke swarm, the source of underlying anomalies, and structural textures in Mathinna Beds near Gladstone.

3. Rossarden east: origin of the large, isolated anomaly extending south of the Ben Lomond Plateau.

4. East of Ben Lomond, Cokers Ridge: Origin of magnetic texture in Mathinna Beds exposures.

5 Possible volcanic vents.

6. Mt Paris region: origin of magnetic texture north and east of Mt Paris within both granite and intruded roof rocks.

Flinders Island.

7. Long Island: evaluation of presumed dyke features.

8. Lady Barron northwest: origin of large E-W feature.

9. Lady Barron northeast: origin of magnetic texture.

10. North Flinders region: origin of the underlying regional magnetic anomaly.

NOTES:

All grid references in this report are based on AGD66.

Several diagrams provide model interpretations.
These diagrams contain much information and some specifications are added in the margins.
The actual plots are labelled “obs” for observed data and “calc” for the modelled profile.
The vertical axes are labelled “anomaly” and “depth” and show the limiting values in nT and metres, respectively. No subdivision of these values is provided other than five equal divisions marked with ticks.
The horizontal axis is not labelled directly but represents “distance” and the length of the model in metres is shown in the bottom right hand corner of the diagram. The distance axis may be labelled in other ways, including actual coordinate locations or places.
Geological elements of the model are described in both the diagram and the associated text.
The lower right part of each diagram includes two reference values, labelled “obs shift” and “calc shift”. These values allow the reader to assess the consistency of the modelling with respect to the data set and also to establish the true reference for the residual field used to process the data provided. As explained in Leaman (1994a) these values allow full review of both the interpretation and its assumptions. For the mainland part of these surveys the residual value defined by IGRF separation or the base selection of the contractor is within about 3 nT of the true value, hence the shift is generally less than 3 nT. For the Flinders Island component of the project different base assumptions have been used and the shift difference is of the order of 80 nT. In each case the word shift means, what value must be added to achieve zero, and the difference between these shifts must be the same for interpretations of the same survey.
It will be noted that it is possible to achieve many solutions to potential field data sets but the number of possible solutions is significantly reduced by consistent application of consistent model shift relationships and the other criteria defined in Leaman (1994a). There is no infinity of solutions; there are only a few feasible in most cases.

In this report, those “solutions” which require some special shift arrangement or extreme or unjustified rock property assumptions are either not presented or are offered as rejected comparisons.

Model and data files, as subsets of observed data, have been appended to this report. These should be converted into formats required by particular modelling packages. All coordinates are referred to the origin of the profile as defined in the data header.

1. THE SCAMANDER REGION

An image (Figure 3) and contour map (Figure 4) of the area requested for examination suggests the nature of the magnetic field in the area west of Scamander and Beaumaris. This area is mineralised and has been described by Groves (1972).

The image provides an indication of the texture of the magnetic field responses in the region and the fine texture in the northern part of the selected area does not differentiate Mathinna Beds, part of the batholith or the metamorphosed halo (compare with geological map – McClenaghan *et al*, 1987 – north and west of 600 000 mE/5420 000 mN). The strong features across an axis centred about 5415 000 mN are within Mathinna Beds. These responses are very localised and a large area south of 5410 000 mN displays very low magnetic relief. The differences are quite striking. The image also displays strong transverse features, mainly trending NE-SW, which can occasionally, and very, locally be correlated with exposed (and/or mapped) dykes of dolerite.

The contour version (Figure 4) is, in many ways, much clearer with its absolute display of character and amplitude. The long linear features are much disrupted with definite offsets (see especially east and north of 602 000 mE/5418 000 mN). The much more subtle features near 602 000 mE/5406 000 mN can be assessed in context although these appear as relatively strong magnetic features in the image.

The Skyline Granodiorite

Both image and contours indicate the anomalous character of the field (and geology) in the region of the Skyline granodiorite: the rift-like axis extending north-south near 603 000 mE/5415 000 mN. Although the image suggests a change in character across the southernmost dyke crossing this zone (at 5416 000 mN) a close examination of the contours, field intensity and geological boundaries shows that the magnetic field simply maps the offsets in this intrusion and the alteration halo about the granite boundary south of St Helens. See Figure 5 for details.
The reduced magnetic field intensity near the granodiorite is not directly related to its exposure or any aspect of the mapped alteration about it. Indeed, the magnetic boundaries are either some hundreds of metres east of the granodiorite exposures, or up to a kilometre west of them. The lowest field intensity is generally, however, associated with the exposures of the granodiorite. This interesting observation suggests either that this lithology is less magnetic than normal, or some other, granodiorites, but it is certainly less magnetic than the Mathinna Beds rocks either directly adjacent to the intrusion, or beyond the immediate zone.

It may also be observed that the dyke-like features are absent within the axis occupied by the Skyline Granodiorite and associated rocks (SW of Brookes Hill), although there are steps in field intensity, and some age, origin or depth of intrusion differences must apply. Differences in sequence and age within this block of Mathinna Beds may also apply. The alignment of unit terminations, as marked by high amplitude effects, is approximately ENE-WSW and trends to both a dyke deflection (at 595 500 mE/5409 000 mN) and a kink in structure west of Catos Creek Dyke (at 593 000 mE/5408 000 mN). This trend, and character change in the field, can be best seen in contour form and the trend is replicated fragmentally further north within the granites west of St Helens. A major structure within the Mathinna Beds may be implied on this basis.

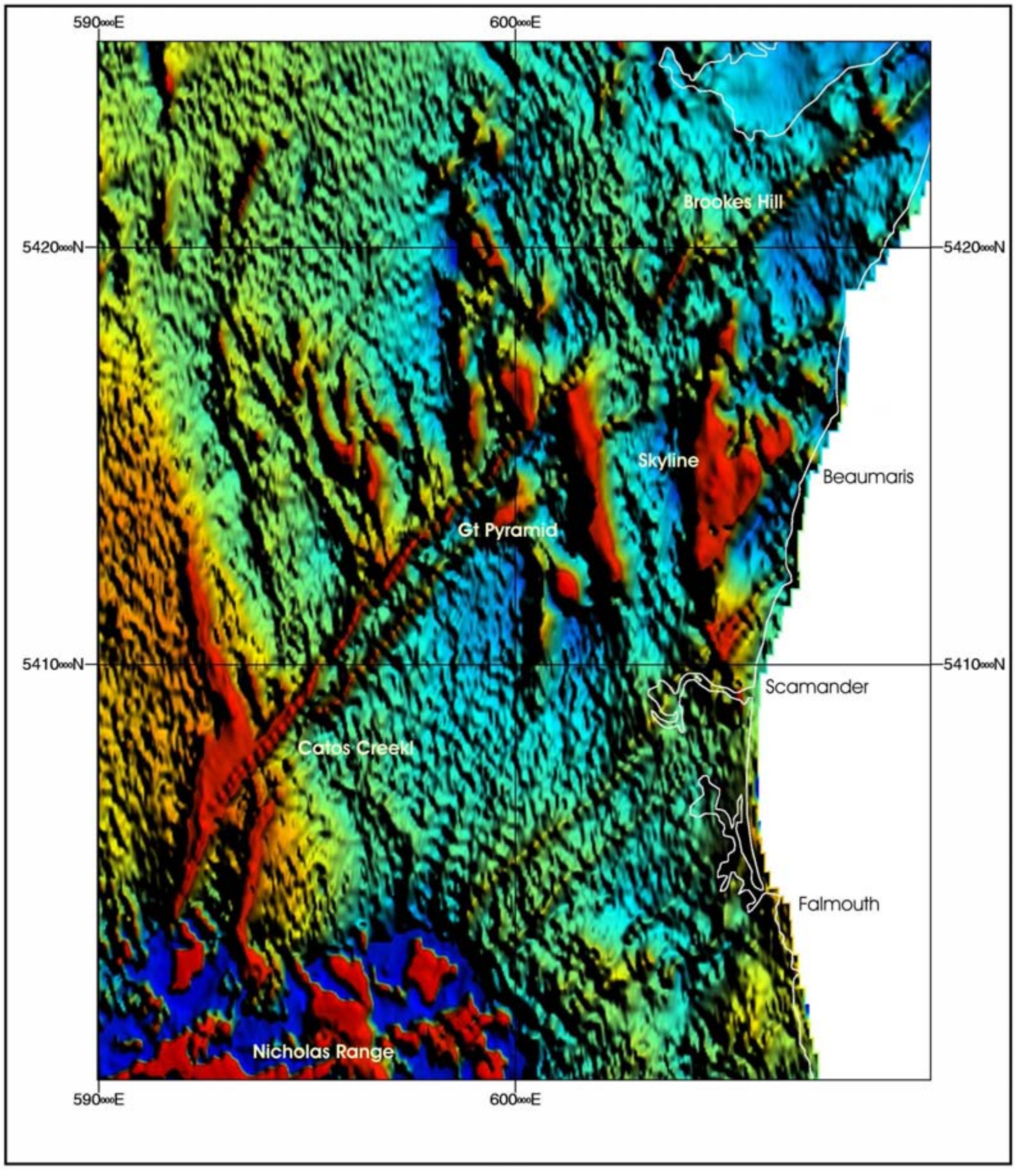


Figure 3: Image of Magnetic Field Intensity, Scamander west area.

A similar feature can be recognised in both image and contours west of Falmouth at 603 000 mE/5403 000 mN – and the more recent covering rocks of the Nicholas Range and the St Marys Porphyrite.

Mineralisation

Responses related to mineralised sites are neither systematic nor conclusive.
Magnetic character near the Scamander Mine may be due to local interference effects. A major anomaly at North Scamander is not explained. Other prospects or mines, such as Loila Tier, South Orieco, Paul Beahrs, are on the edge of a major change in

Mathinna Beds. Any response due to mineralisation at the Great Pyramid Mine has been swamped by the effect of a dolerite dyke nearby, a dyke which fully accounts for the origin of at least one transverse feature. Similar character occurs at East Pinnacle. There is no magnetic association, based on this survey, with other workings. See also Figures 5 and 6.

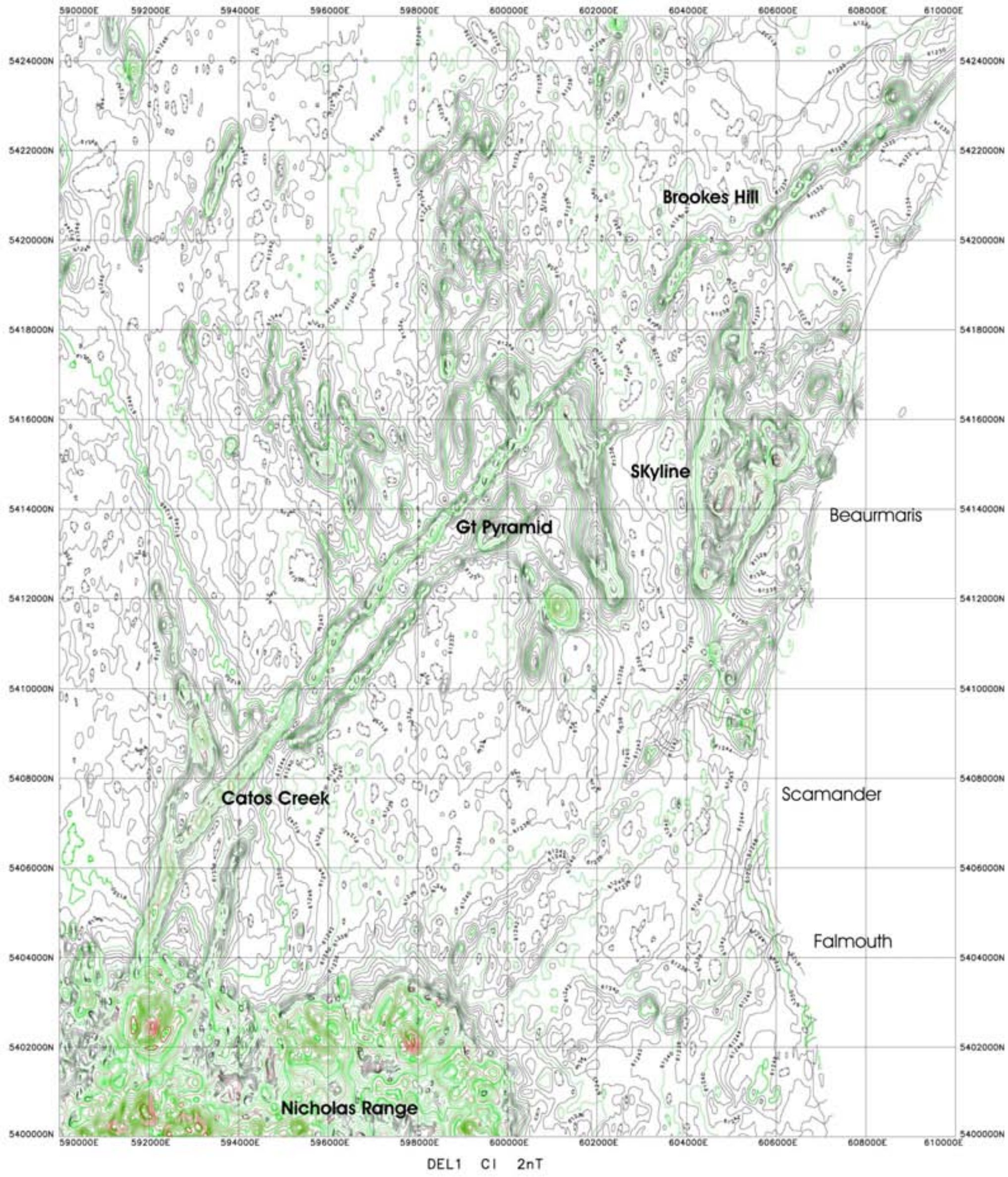


Figure 4: Contours of Magnetic Field Intensity, Scamander west area.

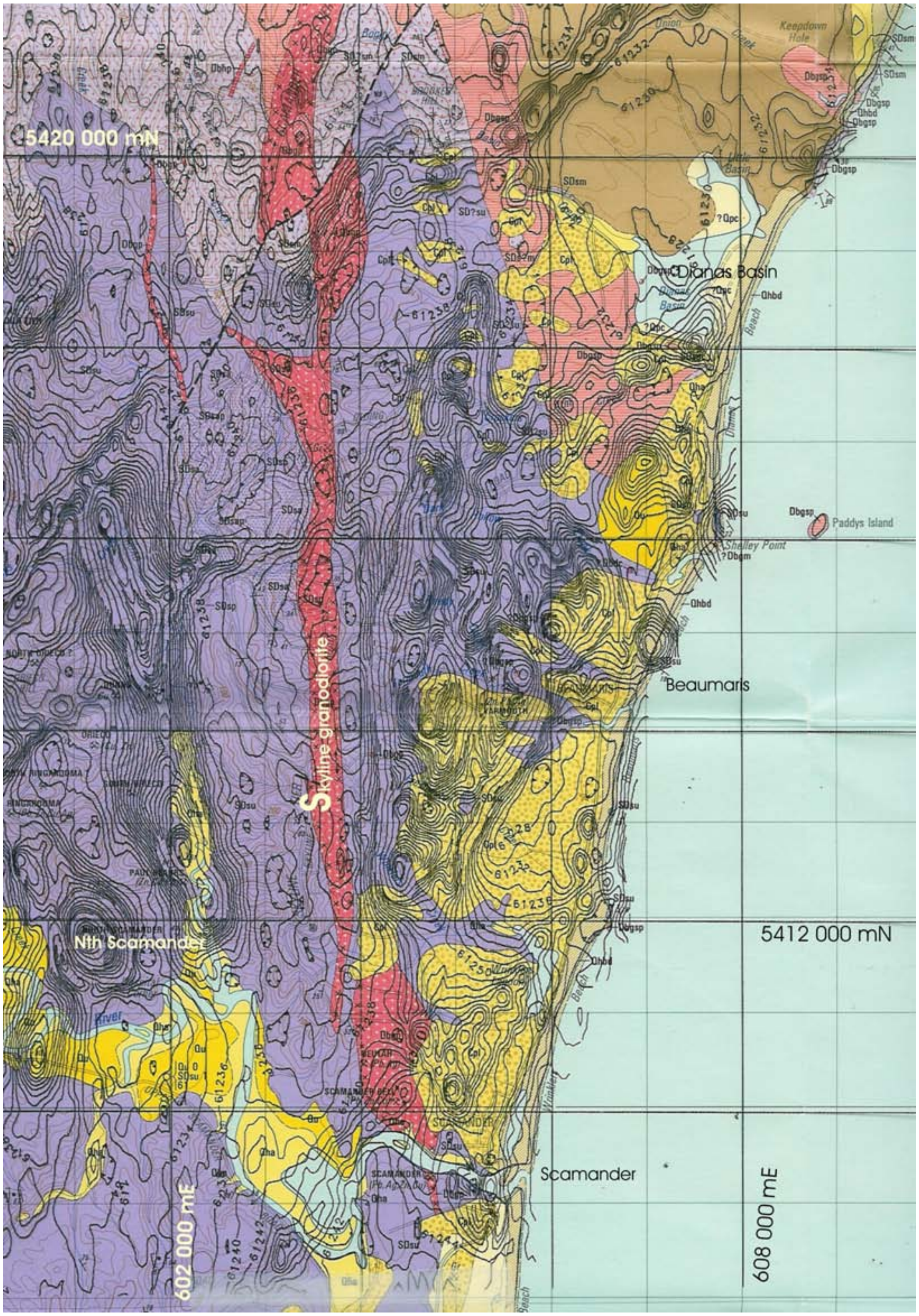


Figure 5. Magnetic field intensity and relationships to Skyline Granodiorite. The locally intense and variable nature of the field near some mineralised sites and parts of the Mathinna Beds is also evident. (Basemap: McClenaghan *et al*, 1987)

Structures near Hogans Road and Catos Creek

The structures near Hogans Road and Catos Creek Dyke are displayed in Figure 6.

The alteration west of the intrusives, which have also been faulted on their eastern face (see geological map), implies a modest dip to the west for the igneous package. It is not clear from the mapping which granitoid is responsible for the alteration, or whether all have contributed.

The distribution of transverse structures is, however, most irregular and not readily explained. The marked NE-SW features have been associated with dykes at Great Pyramid and near the coast.
The analysis below considers the probable magnetic properties of such dykes.
The southern dyke is terminated by, or at, the intersection with the granodiorite member of the sequence and its associated alteration near the faulted eastern face of the intrusion. This body does not continue, but may be restored west of the alteration – where it then trends almost north-south. There are two principal, feasible explanations for this behaviour; either thermal alteration and later weathering has destroyed the magnetic contrast, or this dyke never intruded at least one member of the intrusive package.

The northern dyke, although locally disjointed with a clear en-echelon character east of the Catos Creek intrusions, is continuous across the entire intrusive package. In contrast to its character further east within the Mathinna Beds, this continuity is emphatic. About one kilometre west of the intrusives, and contact alteration, this dyke either terminates or simply changes trend – as does the southern dyke. They remain essentially parallel.
The site of termination is complex and the magnetic field shows that an additional dyke is present, trending first north, then northeast, and then, with persistence, NNW along the approximate limit of mapped thermal alteration. The pattern of dykes poses a question: are these dykes of slightly different age with respect to one or all of the granitoid members.

A change in magnetic field intensity along the western contact of granitic rocks shows that the alteration has a slightly higher magnetic contrast – at least north of the Avenue River.

Figure 6 also shows the variable nature of magnetic responses near the old workings of the region.

Dykes

Dyke effects have been examined at various northings and locations and some examples are shown in Figures 7, 8 and 9.

In Figure 7, at 5405 000 mN, where the two dykes which cross the Catos Creek structure trend southward – and thus best meet the criteria for a reliable model using E-W data lines - an adequate solution can be obtained simply with properties expected of dolerite (upper model). The contrast for the western dyke is of the order of 0.042 SI and that of the eastern dyke about 0.019 SI.

When, however, many dykes or other structures are considered it is evident that the magnetic base level for the survey is somewhat less and that the adjustment required between observed (true residual zero) and calculated model zero should be less than 3 nT. When this condition is applied a slab of west-dipping granodiorite (0.0025 SI) is required, and which may terminate the depth extent of the dykes (lower model).

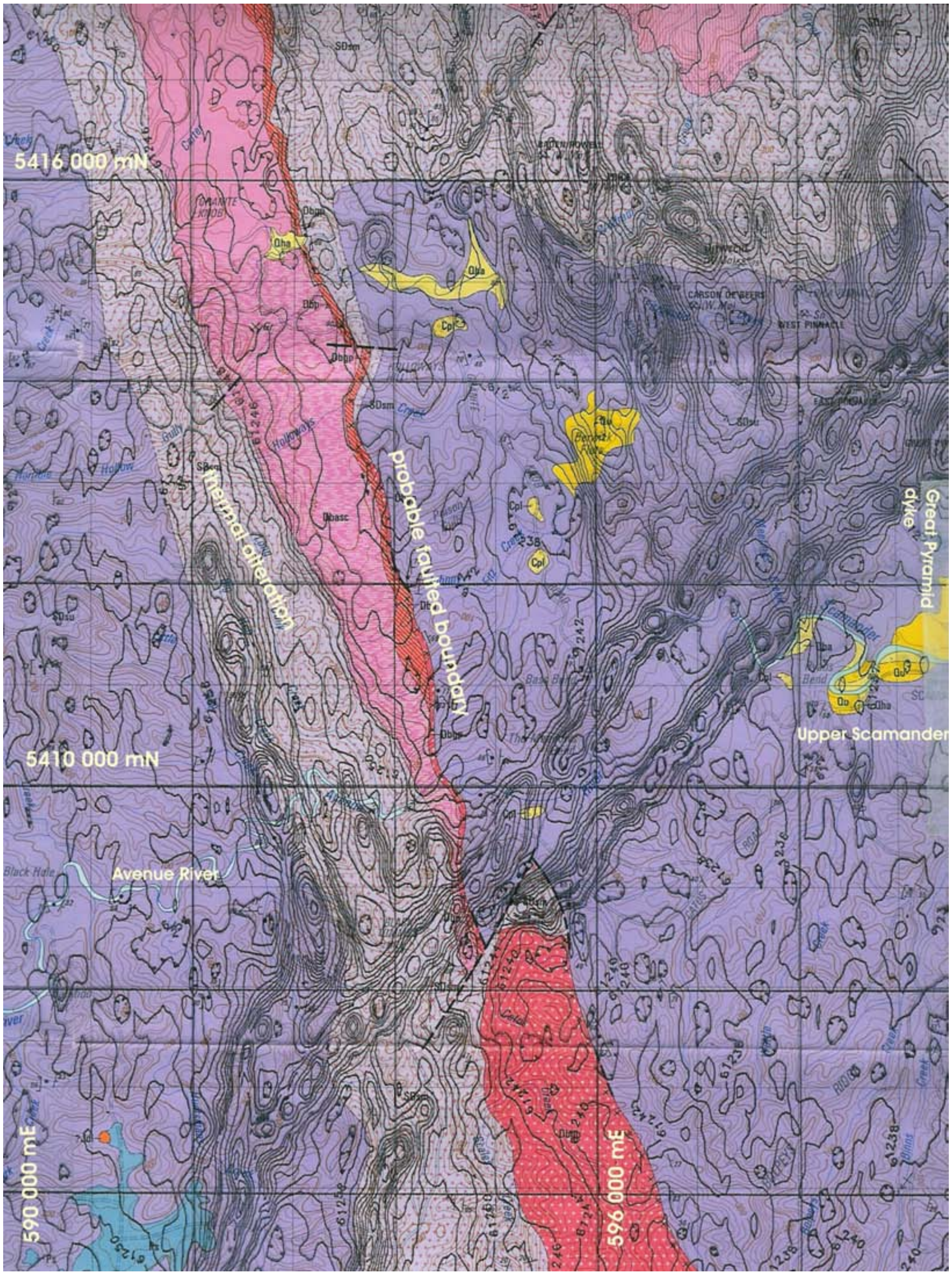


Figure 6: Structure and magnetic field intensity in the region of Catos Creek dyke. Note the different behaviour of the two dykes and the changes in trend west of the structure. (Basemap: McClenaghan *et al*, 1987)

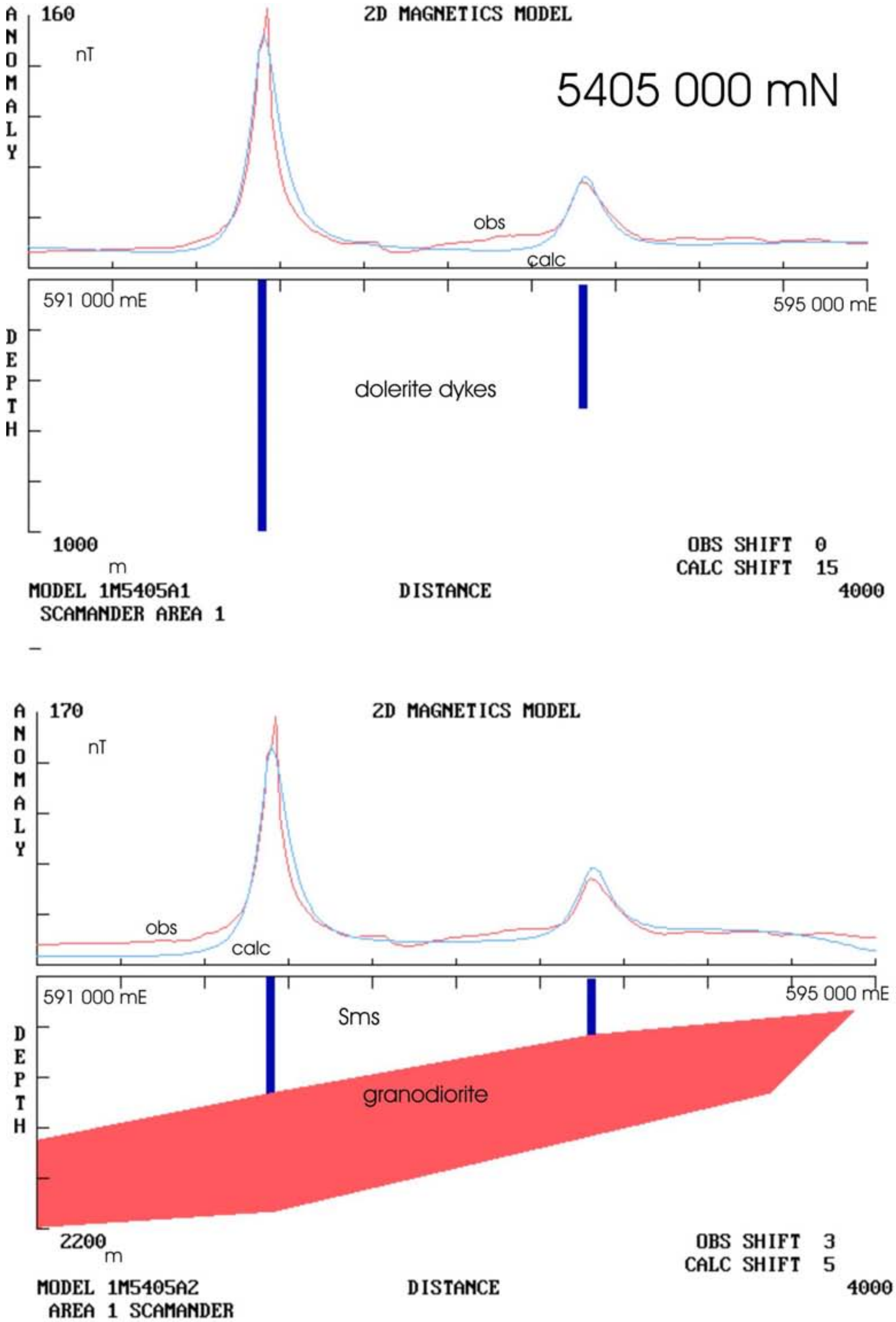


Figure 7: Models at 5405 000 mN (from 591 -595 000 mE) showing need to consider all significant contributors to the magnetic field. For full discussion of the essential criteria for reliable, consistent and comprehensive interpretation see Leaman (1994). Survey line 112891.

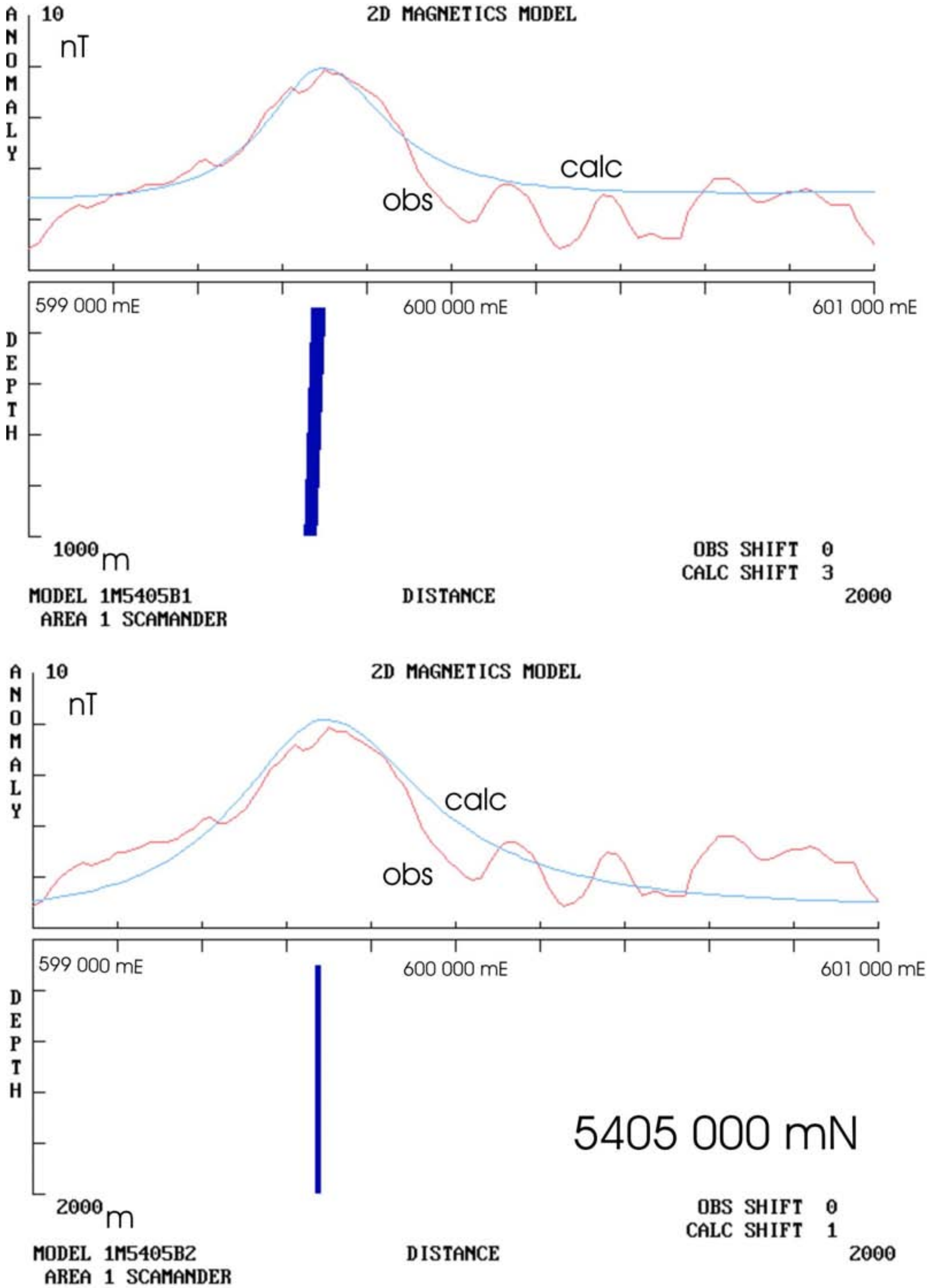


Figure 8. Interpretation of the more subtle dyke responses west of Falmouth.

A large number of dykes have been modelled.
Comparison of Figures 7 and 8 indicates some of the possible variations and issues.

As described in the second section of this report there are many reasons for variations in the responses observed from the dykes of the region. Modelling in this zone suggested a typical maximum body width of 10 to 30 metres but a depth to upper contrasting surface of nearly zero to almost 100 metres. This variation accounts for the, often, patchy nature of display given that the magnetometer is already removed by 70 to 90 metres from the land surface.

The two models in Figure 8 provide an indication of the thickness-contrast product which may apply. The upper dyke is 30 m wide, has a top surface at 100 m depth and a contrast of 0.004 SI. The lower dyke is 10 m wide, has a top surface at 200 m depth and a contrast of 0.026 SI. These calculations embody several unknowns whilst satisfying the observed profiles and more information of properties from sampling is required to resolve these issues.
The inferred values are, however, consistent with observed values for various types of mafic dykes in the region (see Section 2: Blue Tier).

Figure 9 considers the implications and requirements of the field and structure across the Skyline Granodiorite at 5414 000 mN.

The two dykes (blue) have contrasts of some 0.026 and 0.013 SI respectively (west, east) while the major magnetic variations in the region are associated with thick members of the Mathinna Beds. The granodiorite is not magnetically significant. The Mathinna units, from west to east, have contrasts of 0.0012, 0.0024, 0.003 SI respectively. A fold is implied by the eastern anomaly.

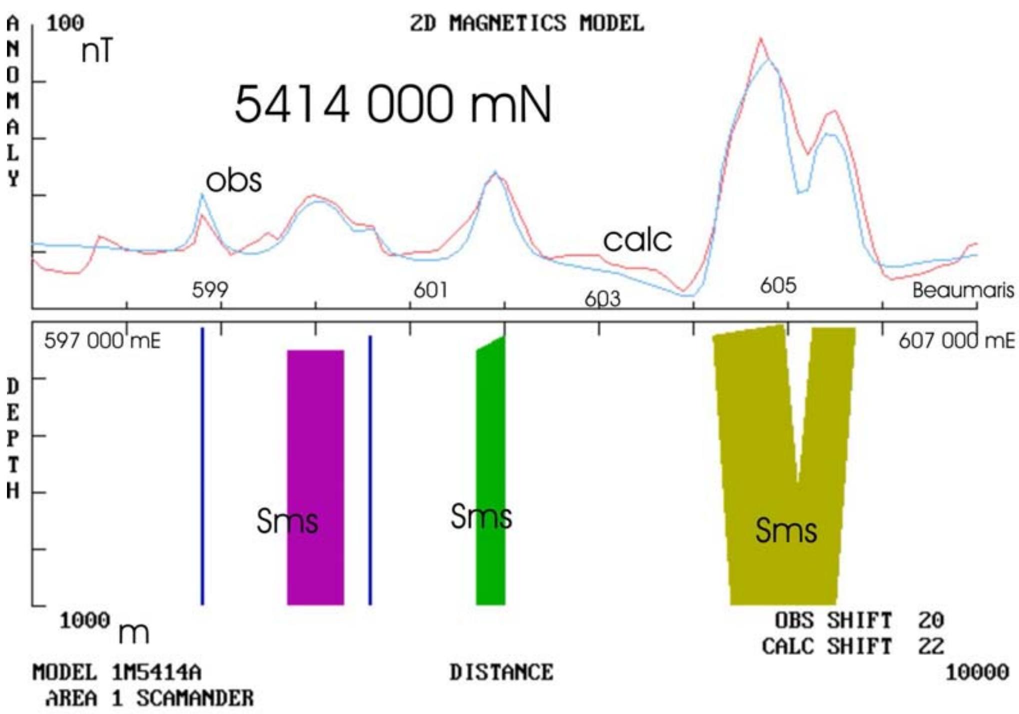


Figure 9. Regional interpretation across Skyline intrusion and intensely magnetised Mathinna Beds.

2. DYKE SWARM NORTHEAST OF BLUE TIER.

Two issues, in particular, were raised for review in this region. These were the characterisation of dolerite dykes and anomalies – and whether the magnetic responses are due to dolerite dykes; and the origin of the large but subtle underlying increase in field intensity which extends across the region from Blue Tier to the Gardens.

The nominal "dyke" effect dominates both image and contour presentations of the magnetic field (Figures 10 and 11) but only the image provides a clear indication of the underlying, but gentle, increase in the magnetic field toward the southern part of the sampled area.

The dykes:

Comparison of magnetic features with extant mapping leads to some interesting and immediate conclusions. While mapping (McClenaghan *et al*, 1983) is certainly and inevitably incomplete due to the realities of mapping (coverage, exposure, time spent), and those dykes which have been found are patchily exposed or discontinuous due to weathering or cover, there are many direct correlations between the magnetic field and some dolerite dykes. But, such correlations are not universal.

Many mapped dykes showing changes in strike (e.g., Sampsons Hill and Pretty Marsh Hill) are truly reflected and have magnetic continuations. There can be little doubt as to the origin of the magnetic responses in such cases and direct extrapolation is clearly justified.

Other dykes, especially in the area southwest of Sassafras Creek simply do not correlate with any anomaly and, even where some response is nearby, the required mapping error is too large to be an explanation. It may be concluded that many, if not most, dykes are not strongly magnetised and modelling even indicates that a few may have a reversed association indicating a reversed magnetisation. It is quite possible for induction and remanence effects to oppose and result in a material which appears virtually non magnetic. These variations might be explained by different aged members within the dyke swarm. Many of these associations can be noted in Figures 12 and 13.

It should also be noted that Cocker (1977) described two suites of dykes in the St Helens region. One, he inferred to be of Devonian (?) tholeiites, the other of possibly Cretaceous lamprophyric spessartites. Quite distinct magnetic properties could be expected and have been observed.

Some preliminary observations (Dr M McClenaghan, pers. comm.) based on site visits and sampling as a result of initial discussions and inspection of this data set may be summarized as follows. All values are of susceptibility.

Tertiary basalt.

The range of values from 79 observations at eight sites is 0.002 to 0.042 SI with a typical value of about 0.02 SI.

Dolerite (age unknown, Devonian inferred).

The range of observations from 68 observations at eight sites is 0.0005 to 0.025 SI with a representative value of the order of 0.015 SI.

Other fine-grained mafics (age unknown).
The range of 49 observations at seven sites is 0.0003 to 0.001 SI with a typical value of 0.0006 SI.
Gardens Granodiorite, by way of contrast, displays a range from 0.00004 to 0.0003 SI, typically 0.0002 SI.
These observations indicate the contrasts between mafic rocks in the region: they are distinctive.

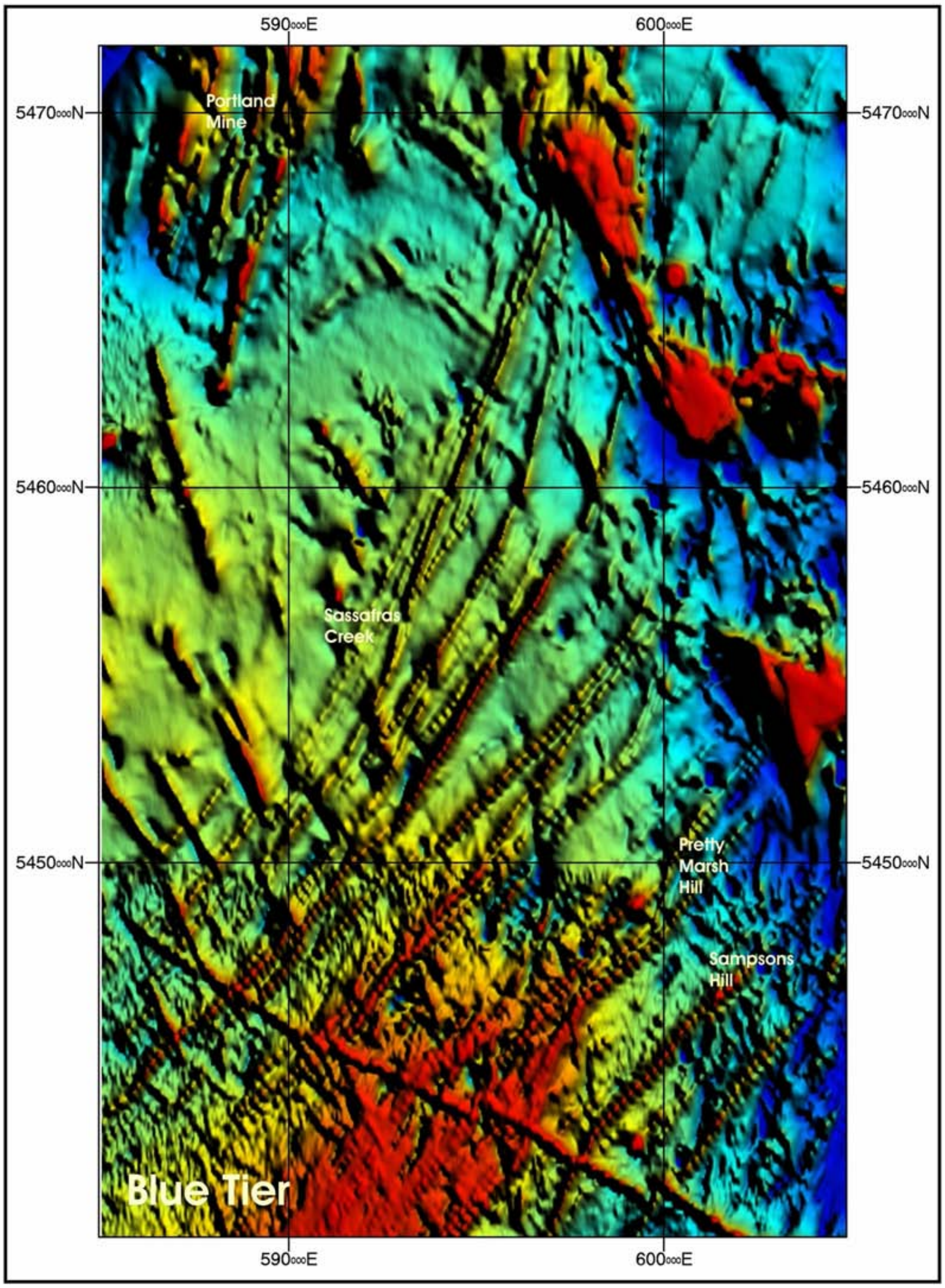


Figure 10: Image of Magnetic Field Intensity in the region northeast of Blue Tier.

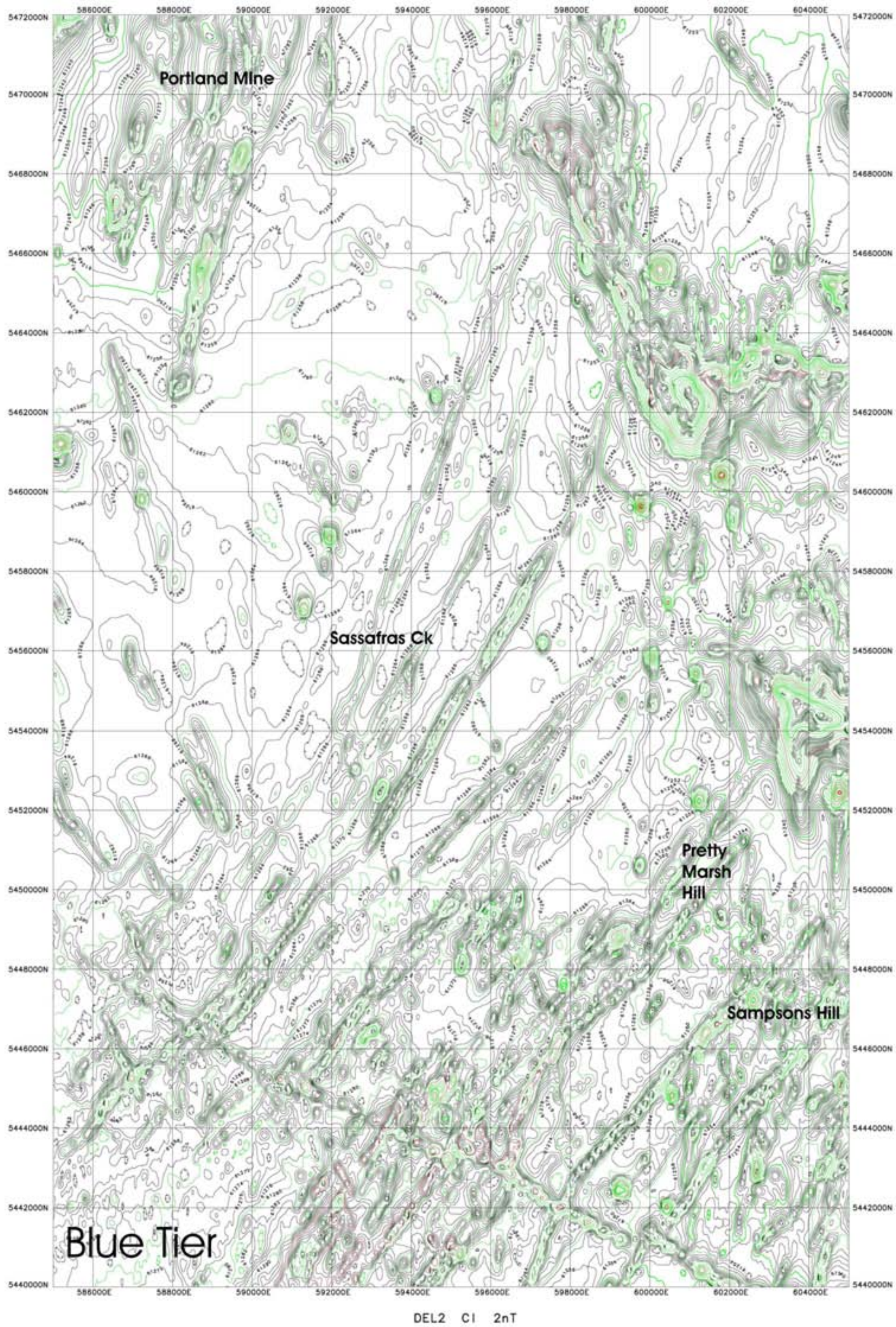


Figure 11. Contours of Magnetic Field Intensity in the region northeast of Blue Tier.

Virtually all dykes mapped, or inferred magnetically, in the Blue Tier region trend either northeast or NNE and many dykes show asymptotic changes to both trends. The trend rotates northward, to the north.

One of the most striking, and obvious, feature east of Blue Tier is that which trends approximately WNW-ESE from the south of The Gardens. This feature has all the characteristics of a dolerite dyke – yet no such material has yet been observed along its length. It dominates the southern part of the survey compilations (see Figures 10, 11 and 12).

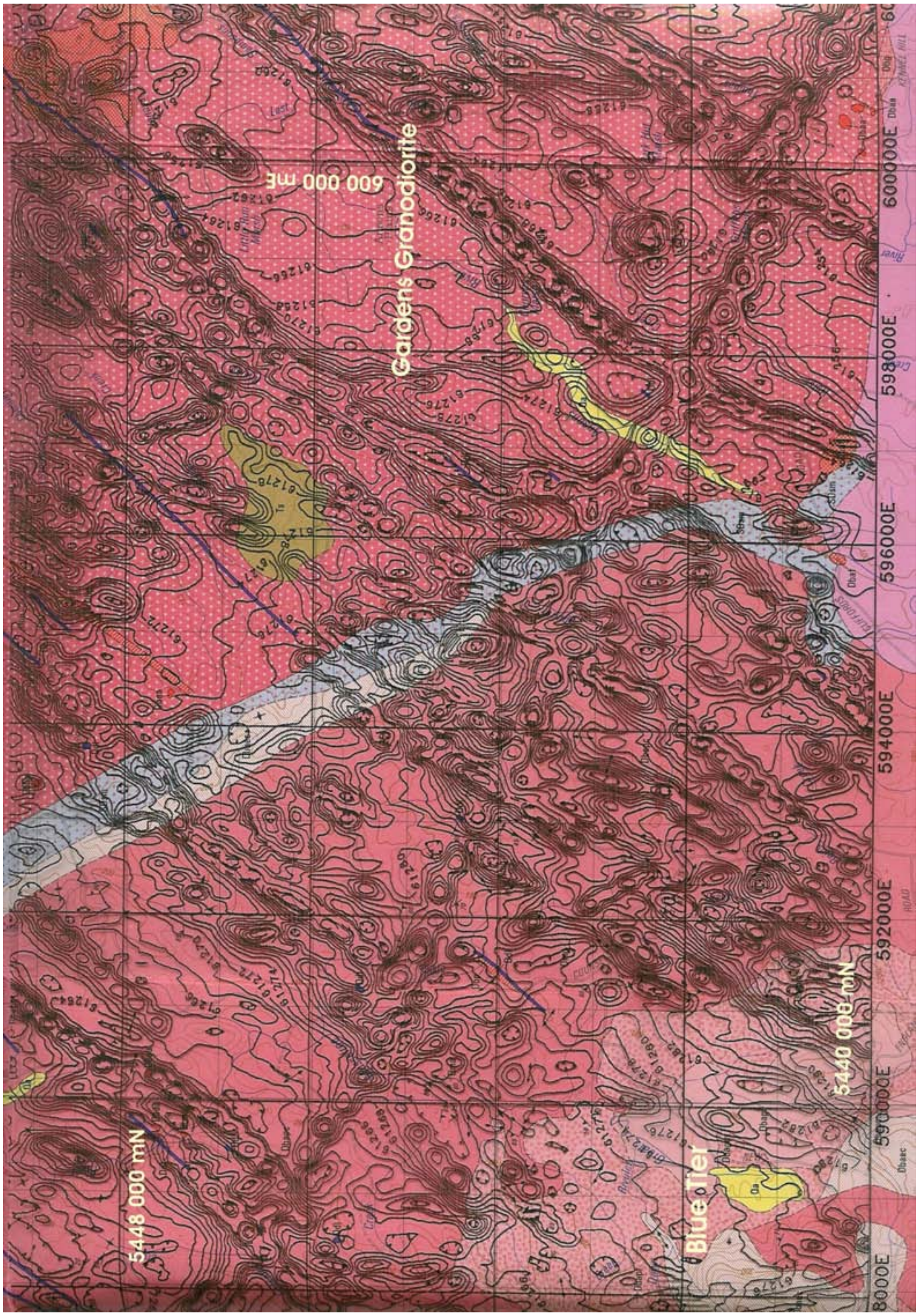


Figure 12. Detail of magnetic field and geological basemap (McClenaghan *et al*, 1983), NE of Blue Tier. Note the correlations between anomalies and mapped dykes – and the absence of such correlations in some cases.

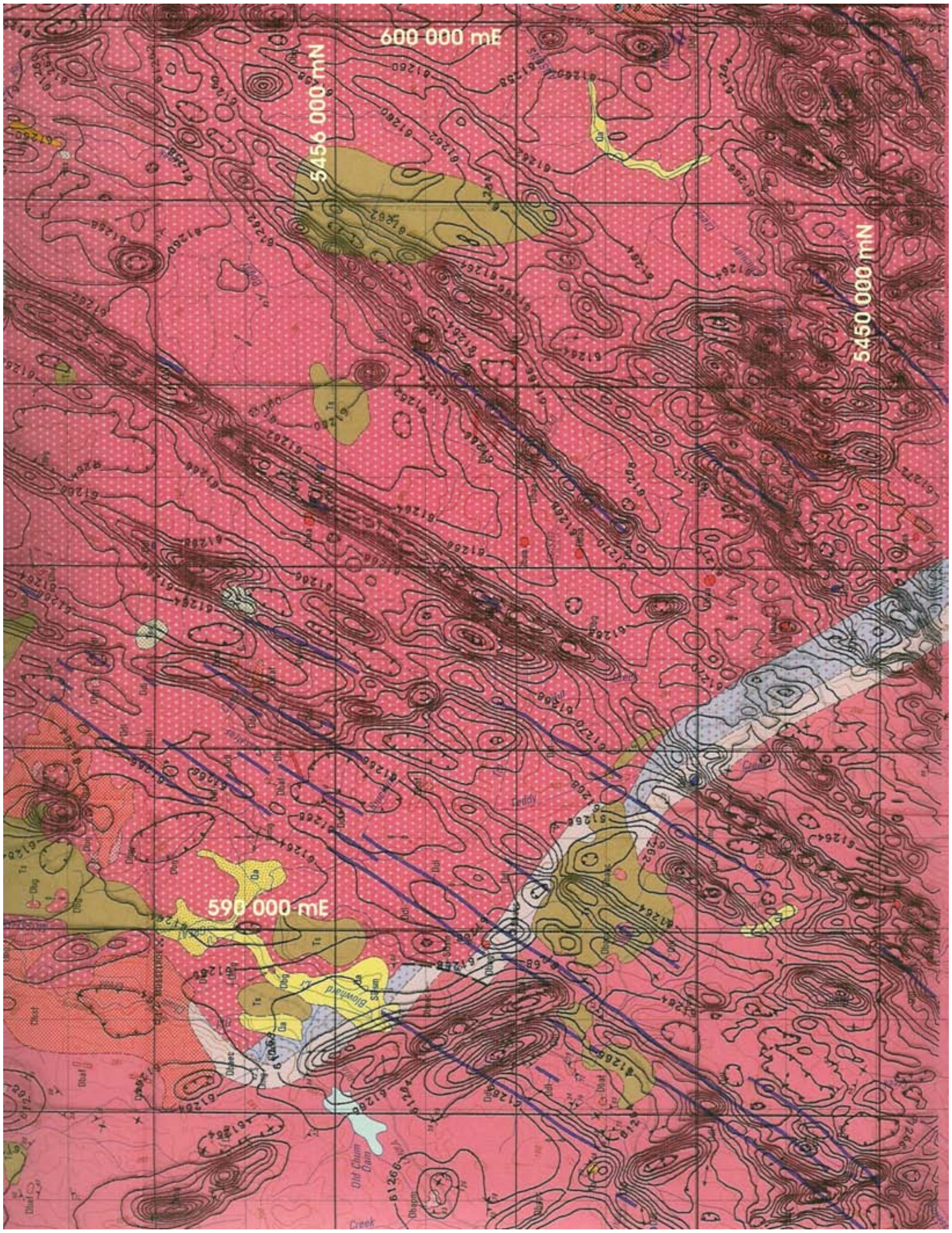


Figure 13. Detail of mapping north of Blue Tier showing the strong magnetic anomalies and the limited associations between them and mapped dykes. It is clear that many dykes are not magnetised and may be different ages.

Interpretation of dykes

Each of the possible variables – thickness, magnetic contrast, depth of weathering-burial-cover, dip and depth range – has been reviewed by modelling a large number of the observed anomalies. A sampling of models shown in the previous section (for Scamander) may be compared with the inferences made here.

Two variables have been shown to be either not critical or indeterminate: dip and depth range. The features extend several hundred metres in depth but no finer conclusion can be drawn until such time as several dykes have been located and the near surface variables (width and contrast) can be uniquely ascribed for that body. Similarly, all dips may be described as very steep to vertical.

Modelling has, of course, been restricted only to those dykes with a magnetic expression. Some of the others must be located and sampled and even surveyed with a ground magnetometer traverse.
Models are provided in Figures 14, 15 and 16.

Although the survey was flown with a terrain clearance of 70 to 100 m (normally 75 to 90 m) in this region, modelling suggests a general weathering or cover depth of between 10 and 50 m and that this weakens and breaks up the continuity of any magnetic response. This variation in depth to relatively fresh or recognisable rock may account for both the patchy surface expression and the magnetic character.

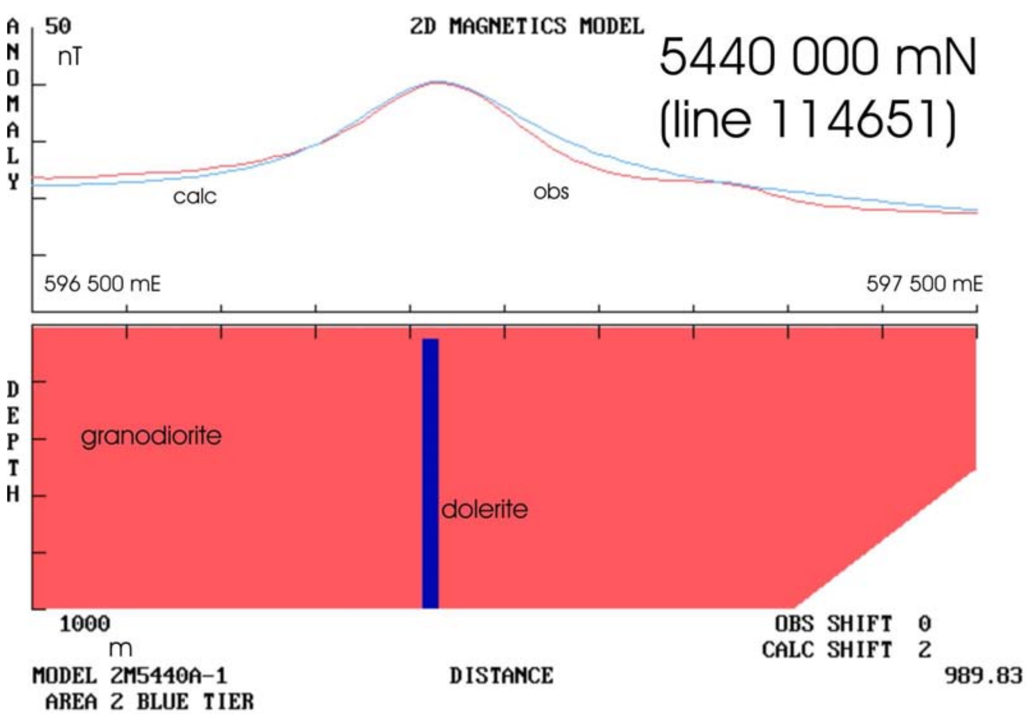
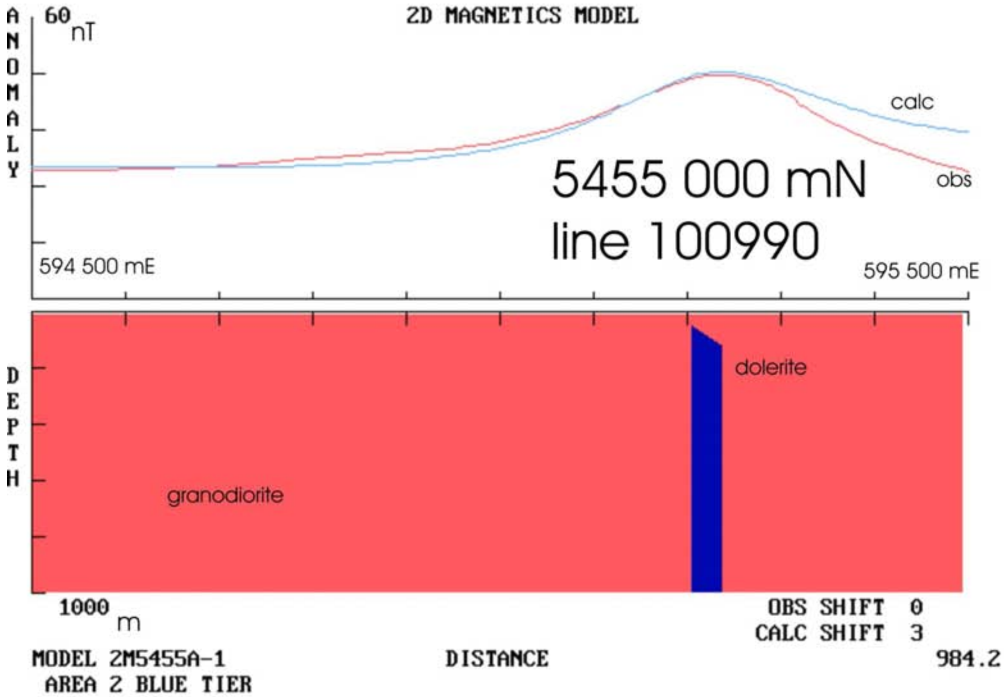


Figure 14. Magnetic model, 5440 000 mN. An adequate solution requires a dyke of 15 m thickness, dipping vertically, and a contrast of about 0.018 SI. The typical depth to magnetised (unweathered) rock is of the order of 50 m. (The corner cut-off of the granite marks the limit of the granitoid and its intrusion by another)



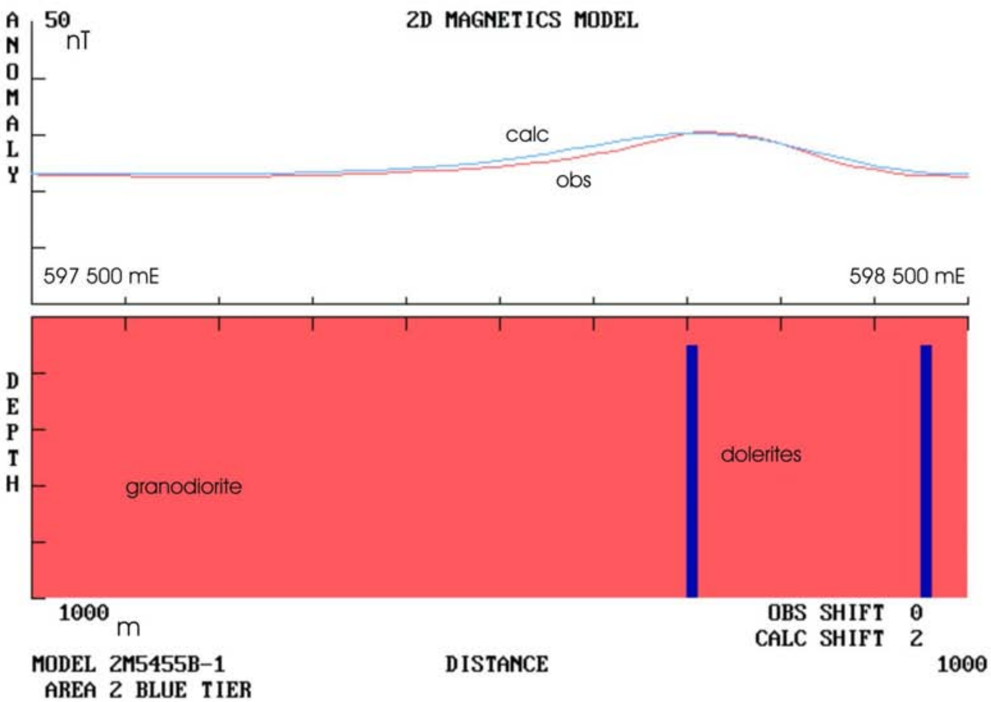


Figure 15. Examples of dykes of various thickness and contrasts which do not outcrop but which are along strike from segments which do.
Contrasts are variable: 0.013 SI (upper diagram) and 0.02 and -0.01 SI (lower diagram). The dykes in the lower diagram are 10 m thick.

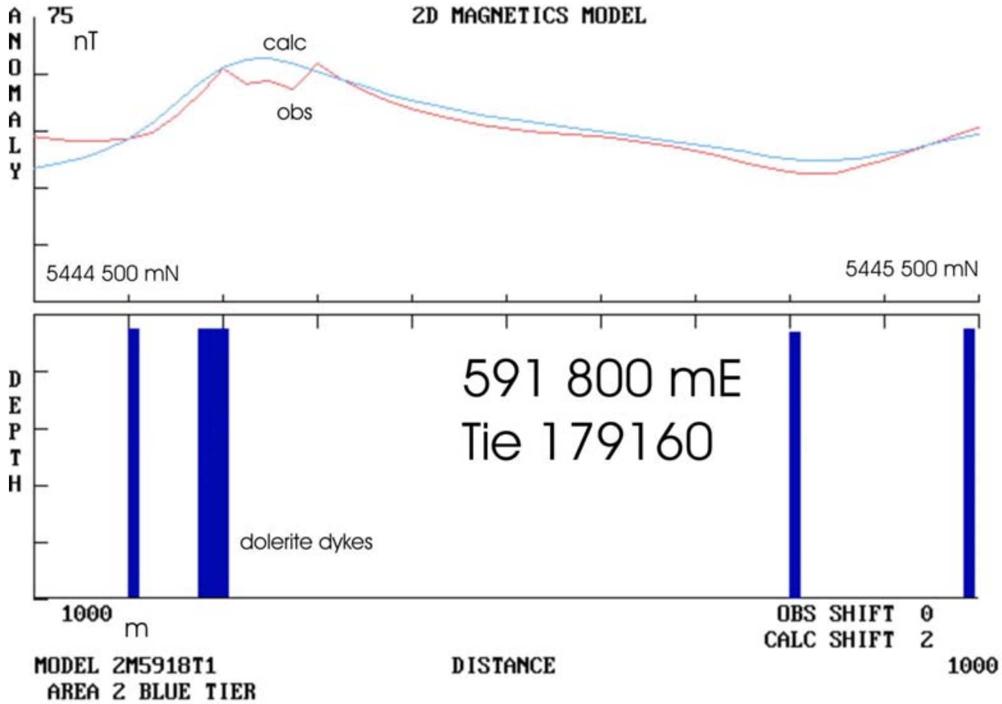


Figure 16. Dykes as seen in a N-S tie line. The thick body is the transverse structure seen in Figures 10, 11 and 12. Part of thickening effect, and broken response, is due to line orientation and is an apparent thickness (maximum 30 m). In this diagram two of the dykes are negatively magnetised (1 and 3 from left side) and contrasts and thicknesses from left are -0.007 SI, 10m; 0.015 SI, 30m; -0.007 SI, 10 m; 0.013 SI, 10 m.

The range of positive contrasts inferred from modelling of dykes is 0.001 to 0.026 SI when rated against a background of granodiorite or Mathinna Beds (max. 0.0026 SI). Those bodies with negative contrasts fall in the range -0.006 to -0.012 SI.

The transverse dyke (Figure 12) described above is anomalous in terms of the predominant magnetic grain (see Figure 10) but it is not anomalous in terms of linked disruptions and kinks in that grain. The western part of the region contains a number of features, some certainly dykes, which trend NW-SE. Most of these have limited strike length but the orientation can be recognised in isolated fragments across the entire area.

The pattern of deformation or disruption across this transverse dyke is most irregular (Figure 12). At 600 000 mE there is a dextral offset of another dyke and the transverse structure is offset sinistrally. At 598 000 mE both it, and another dyke, merely intersect with no perceptible offsets. At 596 500 mE another dyke remains continuous through its intersection but it is deformed sinistrally. At 595 000 mE there is a similar but less well defined or deformed relationship with a sinistral offset at the transverse structure. At 593 000 mE the intersection is simple but at 591 500 and 590 500 mE other dykes are terminated. At 589 000 and 588 000 mE other dykes show direct intersections but at 587 500 mE the transverse dyke splinters to yield a reduced extension and a stronger feature trending NW. No offsets are noted where non magnetic dykes intersect the main structure (as north of Blue Tier).

The significance of these variations is unknown, both in terms of age of dykes or any controlling structures or stress fields. It must be admitted that a complex stress field may have existed at time of intrusion since the now-exposed structures were once buried several kilometres and may have been at considerable depth at time of their intrusion: a time and depth which may have varied for groups of dykes.

The selvage of hornfelsed Mathinna Beds mapped between plutons (Figures 12 and 13) is recognisable magnetically as a subtly non magnetic axis trending northwest. Variations in the magnetic field are generally much wider than the mapped zone. Most magnetic dykes do not cross this zone, while all non magnetic dykes appear to. This relationship suggests that the magnetic dykes are intra plutonic and the others may be more recent – post at least one batholith stage (compare Cocker, 1977)
.
Many of these inferences must be confirmed by detailed field inspection.
Are there in fact many more exposures? Are the dolerites different – and in what way? Can they be dated? The sites of several intersections should be reviewed now that the location of these is accurately known. Ground magnetic surveys may offer the most reliable and low cost means of location and assessment.

The large regional anomaly

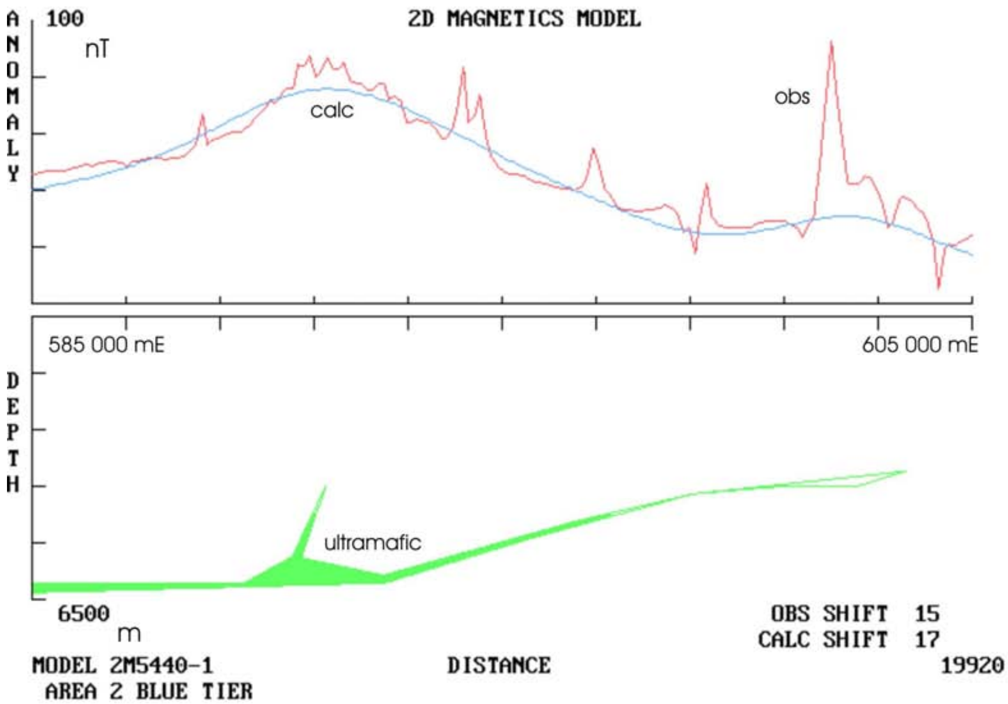
Line 5440 000 mN samples the crest of the large regional feature extending east of Blue Tier (Figures 10, 17). The intensity of the magnetic field shows a modest increase: the critical aspect is the widespread nature of the change.

Previous workers have suggested west-dipping reverse structures in this region (Keele *et al*, 1994). Comparable east-facing structures near the Tamar region involve ultramafics (see Leaman, 1992; Roach, 1994; Leaman & Webster, 2002). These are the only known materials in Tasmanian geology which possess the necessary properties able to generate long wavelength responses from sources at considerable depth. No material actually exposed in the region can account for the effect; none is widespread nor sufficiently magnetised. Local materials (granodiorite, dykes, some members of Mathinna Beds) produce the minor elements enhanced strongly in image format.

Figure 17 presents a possible solution.
The soling structures are multiple and the simplest solution is shown in the diagram. The selvage between plutons may mark the ghost of the extension of at least one of these structures and the age relationships between displacements on the thrusts, the timing of the plutons and the insertion of elements of the dyke swarm may be inferred and may be related.

Mathinna Beds texture east of Gladstone

Consideration of the magnetic character within the Mathinna Beds was requested in at least two regions (see also Cokers Ridge and Mt Paris), including the area east of Gladstone. The southern part of this zone occurs in the northwest corner of Figures 10



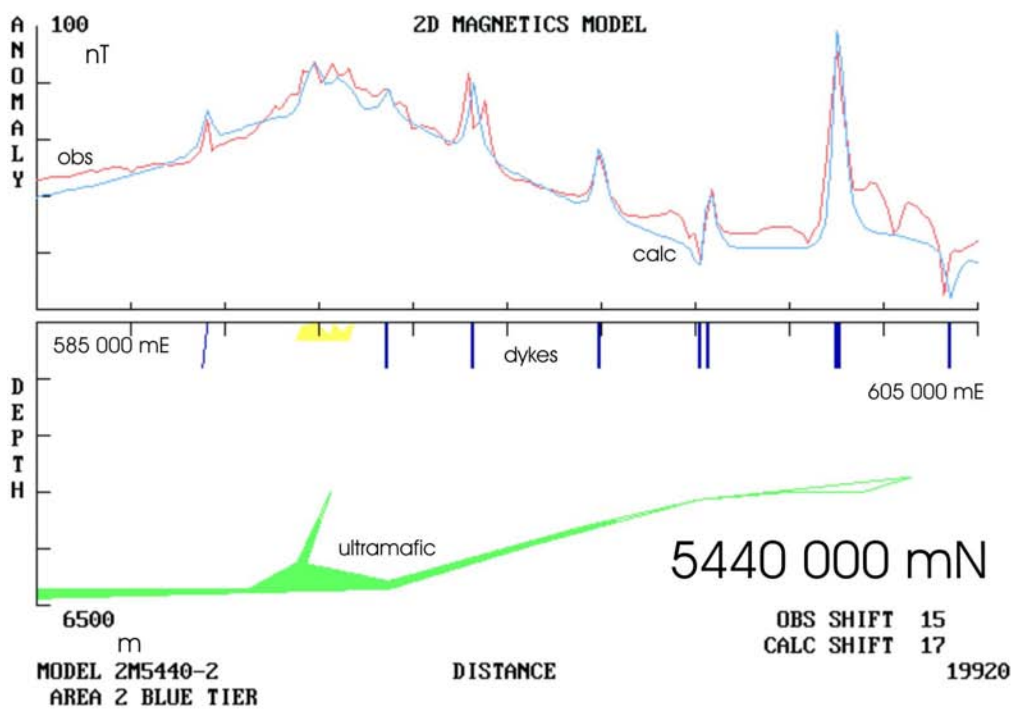


Figure 17. A possible solution for the regional anomaly in the region between Blue Tier and the coast. Local features insert noise into the profile but the entire feature is best explained by some combination of relatively shallow-dipping west facing structures which are marked with ultramafic slices.
Data line 114641.

and 11. These responses have been examined previously (e.g., Leaman, 1989, 1994b, 1994c) using data from a high resolution local aeromagnetic and ground survey. This older data, with closer line spacing and lower flight clearance, should be consulted since it is one of the few surveys of (probable) better coverage and resolution than the new survey. The model shown in Figure 18 is consistent with previous analyses and known properties.

These early surveys demonstrated that units within the Mathinna Beds are magnetised and may generate significant or apparently systematic anomaly patterns. The inferred properties were checked by sampling, mine site and drilling investigations. Those inferred properties were used in the model shown in Figure 18 and in other models in this assessment. The magnetic properties of the Mathinna Beds units rarely match the bulk contrast of the underlying granodiorite but are often about half the contrast of the intrusive (0.0006 to 0.0026 SI, v 0.0025 SI), and occasionally are more susceptible. These variations apply to the bodies in the model (left to right: 0.0012, 0.0019, 0.0014, 0.0026, 0.0005, 0.0025 SI).
This review of such variations within a regional context has not altered any conclusions offered in the exploration reports cited.

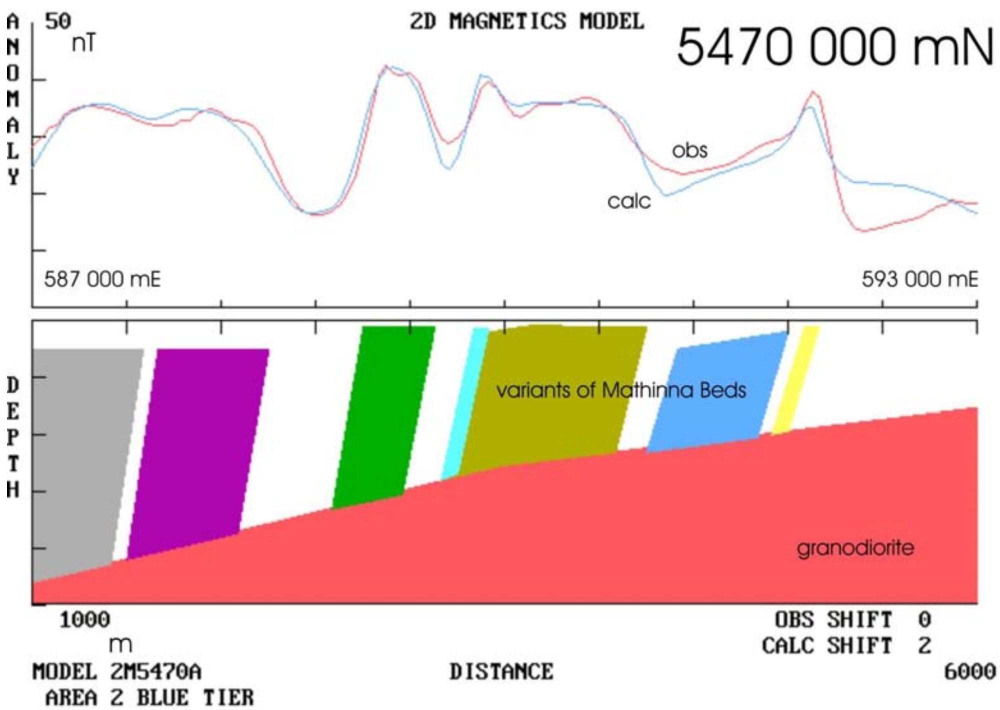


Figure 18. Modelled cross section of varied Mathinna Beds responses near the Portland Mine, east of Gladstone.
Data line 101730.

3. STRUCTURES SOUTH OF BEN LOMOND, EAST OF ROSSARDEN

A significant, isolated, long wavelength anomaly has been observed southeast of Sphinx Bluff on the Ben Lomond plateau and east of Rossarden. It is shown in Figures 19 and 20. The observed feature extends beneath the plateau and the character of the anomaly is broken up by the interference from exposed Jurassic dolerite and nearby screes. The anomaly tapers rapidly southward toward the South Esk River and Ormley. The feature has an amplitude of about 100 nT, which is large for the region, and relatively smooth gradients, which indicate a minimum depth to source of about 700 metres on the western side and more than 1000 metres on the eastern side.

Near surface features are evident but all are small scale, localised and possess a relief of little more than 10 nT. This substantial feature has not been well defined in any previous survey but it is striking and apparent in the new survey.

Some explanations have been presented for test; including one which proposes that it is the effect of a metamorphic halo about a concealed extension of the local granites.

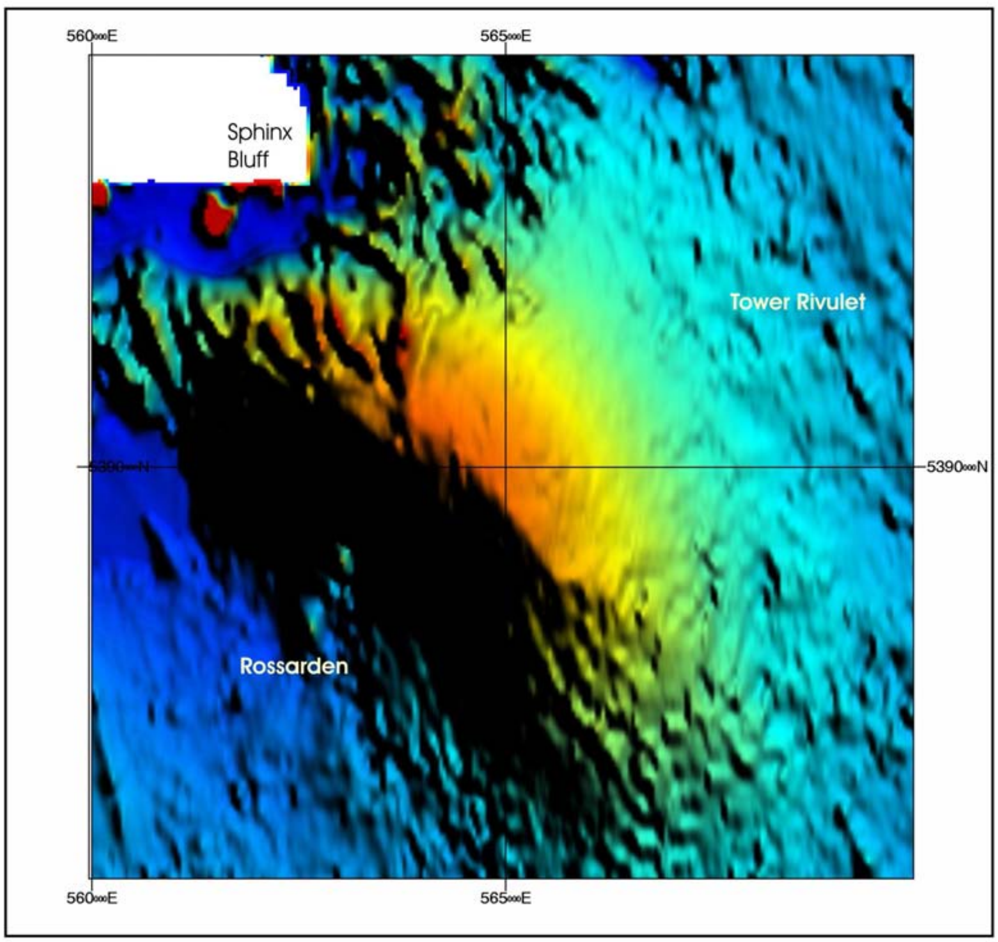


Figure 19. Image of Total Magnetic Field Intensity south of Sphinx Bluff and east of Rossarden. Note the disturbed character of the field to the northwest where scree fields interfere below the Ben Lomond plateau escarpment.

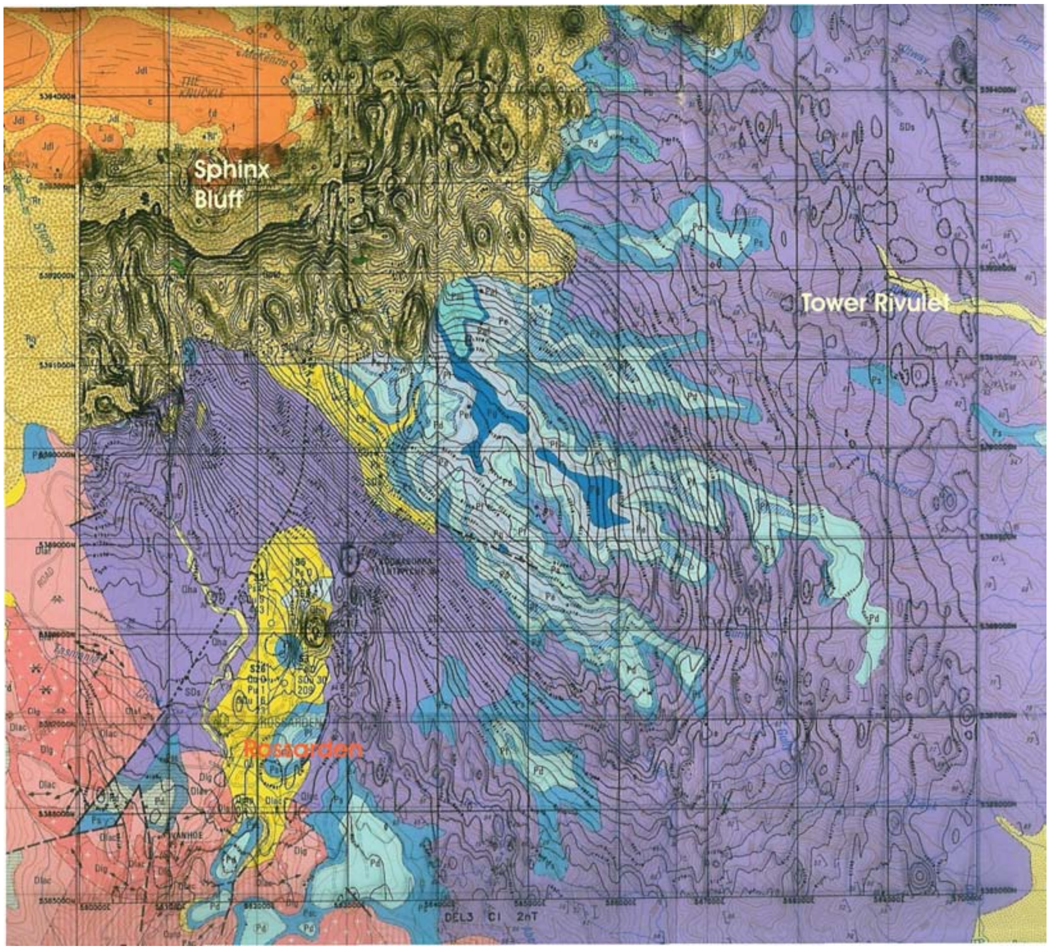


Figure 20. Magnetic anomaly and base map Ben Lomond.
Note that the feature is several kilometres removed from the mapped granite margin.

The anomaly is too broad and too large to be related to any exposed materials, including the local Mathinna Beds. The source is concealed.

There is no mapped suggestion of any thermal alteration halo east of the main granite contact near Rossarden although acceptance of the gradient depth indications could mean that any such alteration is also concealed. Most critically for the hidden cupola solution, however, is the lack of evidence in the extant gravity data. The gravity coverage east of Rossarden and east of the plateau (including on the plateau itself) is currently poor and in much the same state as defined by Leaman & Richardson (1981). The few stations that do exist lie on two traverses which cross this feature and they offer no suggestion of a significant granitic shallowing. They are not adequate, however, to completely preclude the possibility of a granodiorite presence.

The feature has been modelled in order to test various options but a halo type band source a few hundred metres thick cannot generate the effect required with contrasts and properties known to be normal elsewhere in northeast Tasmania for metamorphosed rocks.

Figure 21 offers two viable solutions using rocks and properties which may exist in the region, or which are known to outcrop nearby.

The first (upper sections) employs ultramafic slices which are known to exist west of this site (and northward toward Bass Strait – see Leaman & Webster, 2002 and Leaman, 1992 for example). The style is consistent with the structural models of Taylor (1992) and Keele *et al* (1994) in which east-facing thrusts in the western part of NE Tasmania oppose west-facing thrusts in the eastern part of the region (also see Scamander and Blue Tier discussions above).

The second (lower section) solution implies a detached and concealed, highly altered part of the Mathinna Beds. The volume is large. The general contrast required for this volume is 0.0065 SI and 0.0078 SI for the lesser facing zone. These are higher than any normal values for the Mathinna Beds but such contrasts do exist (see Cokers Ridge below).

Which solution should be preferred?

Both geological styles are either known to exist, or could exist, within the sequences exposed. The following section of this report examines magnetically extreme members of the Mathinna Beds.

It can be stated, however, that no skin effect anomaly source such as an alteration halo about a concealed pluton can generate the pattern and no such source seems justified by the depth range to top of potential sources, exposure, or limited gravity data.

The shallowness of penetration of any sliver of ultramafics may rule against this solution although, of course, such materials come to surface along the northern Tamar region.

Within the structural environment of the entire region, which includes the ultramafics, a structurally-confined section of the Mathinna Beds is possible. Magnetically equivalent portions of these rocks do appear elsewhere and such rocks may prove to be stratigraphically important.

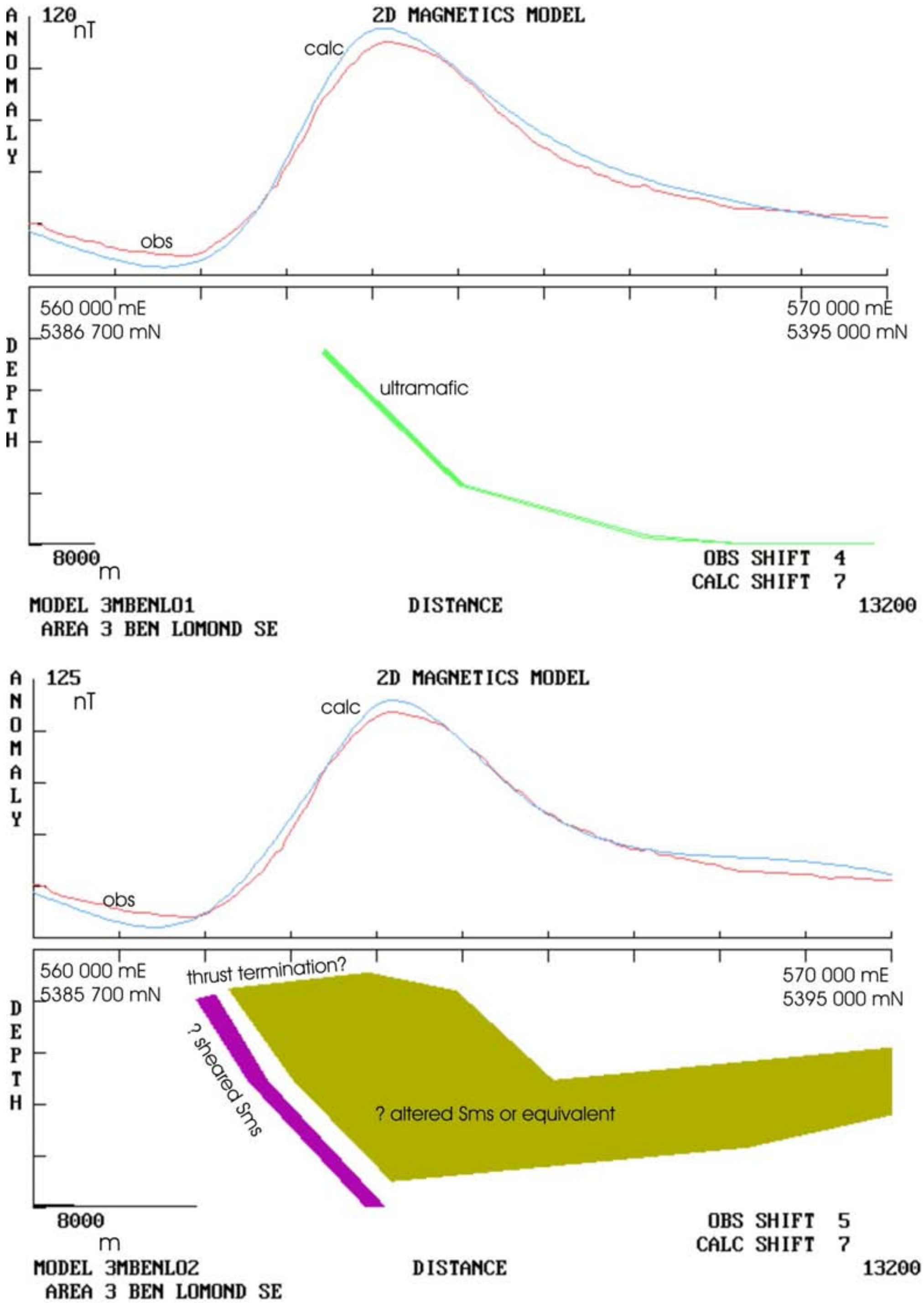


Figure 21. Possible solutions for the east Ben Lomond anomaly.
Ultramafics or structurally-confined Mathinna Beds.

4. EAST OF BEN LOMOND – COKERS RIDGE

The Mathinna Beds between Ben Lomond Plateau and Tower Hill, and south of the South Esk River present strong magnetic character. The nature of the field is both abnormal in amplitude and particularly definite in orientation – and is clearly anomalous for these rocks.

The abnormal character of the region is well displayed in the image (Figure 22). The relatively subdued magnetic field in the north west corner of the image is associated with exposed granodiorite of the Scottsdale Batholith and the first high amplitude effects south east of this are related to the limit of mapped thermal alteration (see Figure 25). With the exception of the response due to Jurassic dolerite on West Tower (far SE corner of maps) all other character is derived, apparently, from "normal" Mathinna Beds. Although trends are maintained there is a marked change in amplitude near the axis of the South Esk River west of Brooks Creek.

The available geological mapping of the region (Calver *et al*, 1988; McClenaghan *et al*, 1993) does indicate that the magnetic trends do represent real lithological or structural changes within the Mathinna Beds suite. Mapping records some differences in terms of pelitic composition or shearing. Most of this information is restricted to the Alberton map sheet (north of 5406 000 mN). Contour presentations present proper scaling of the anomalies (Figure 23) and their correlation with geological features as mapped (Figures 24 and 25).

Although gravity data are very limited there is no indication, in keeping with absence of mapped indications of shallow halo effects, of any relatively shallow granitoid beneath the anomalous region. Granodiorites might not be recognised with existing data or coverage.

The combination of extant surface mapping and gravity data implies, however, when coupled with the new magnetic data, that the 'anomalous' effect is quite local and structurally constained, and not an immediate or obvious artefact of thermal alteration. There are several grounds for this conclusion.

Review of the metamorphic halo responses elsewhere in northeast Tasmania does not indicate any consistent pattern of magnetic response for either the Mathinna Beds or its alteration zones. Indeed, there is often (usually) a loss of character rather than a gain where altered. See Scamander region, and the discussion for both Skyline intrusions and Catos Creek, this report.

There is thus little case to suggest that the strong responses seen near Cokers Ridge are due to thermal alteration, and certainly not in isolation from other factors or processes. The signature may require the presence of specific pelitic units in a particular part of an aureole, for example, although this approaches special pleading and patches of the signature do occur elsewhere (e.g., east Gladstone, section 2, this report).

Further, stratigraphic unit effects in the present situation cannot be traced in any form, even with reduced amplitude, consistently from those trends in the core anomalous zone. The image and contour presentations suggest sharp terminations of source and magnetic character, especially on the northwest and southeast faces of the anomalous block – and some structural controls are implicated.

Mapping, where lithological variations are recorded, suggests local variations in composition of the rock suite which would accord with such views.

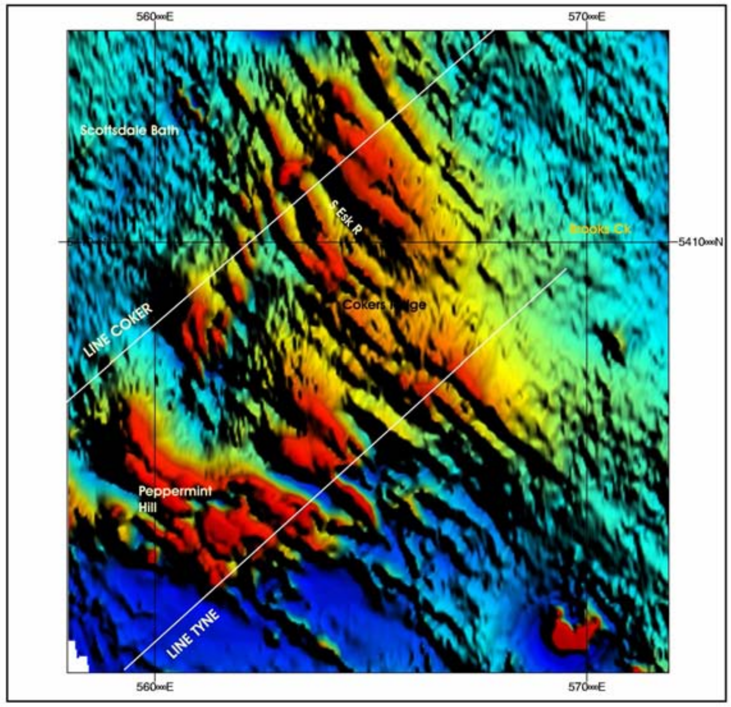


Figure 22: Image of Total Magnetic Field Intensity in region east of Ben Lomond.

Two sections were tested in order to examine the possible implications if Mathinna Beds sources are required to account for the magnetic field. Both sections are oriented approximately NE-SW so as to sample the anomaly trends reliably. The southern section, named Tyne, ends at Brooks Creek while the northern section, named Coker, samples the grain just beyond the batholith halo and examines the structure north of the South Esk River.

The modelled sections are shown in Figure 26. The location of sections is shown in Figures 22, 23, 24 and 25.

Section TYNE: Peppermint Hill to Brooks Creek.

TYNE shows that all features exemplified by character near Peppermint Hill can be directly explained by variations within the Mathinna Beds sequence. Four of the unit variations inferred possess properties considered normal for the sequence (and observed near Gladstone) and only three have raised contrasts. Two of these are not significantly higher than observed values. Two of the more anomalous units can be directly correlated with mapped pelites or extrapolations of their exposure (see Figure 25). The unusual element, therefore, is their accumulation in a restricted zone as a package – as at Gladstone – and it may well be that a particular part of the Mathinna Beds is magnetically anomalous, and that this is a primary property. It may well be age constrained. In this southern zone it is not structurally constrained within the terms of the model.

The inferred contrasts for units in the model are, from west to east, 0.0078, 0.0039, 0.004, 0.0026, 0.0013, 0.0013, 0.0013 SI respectively.

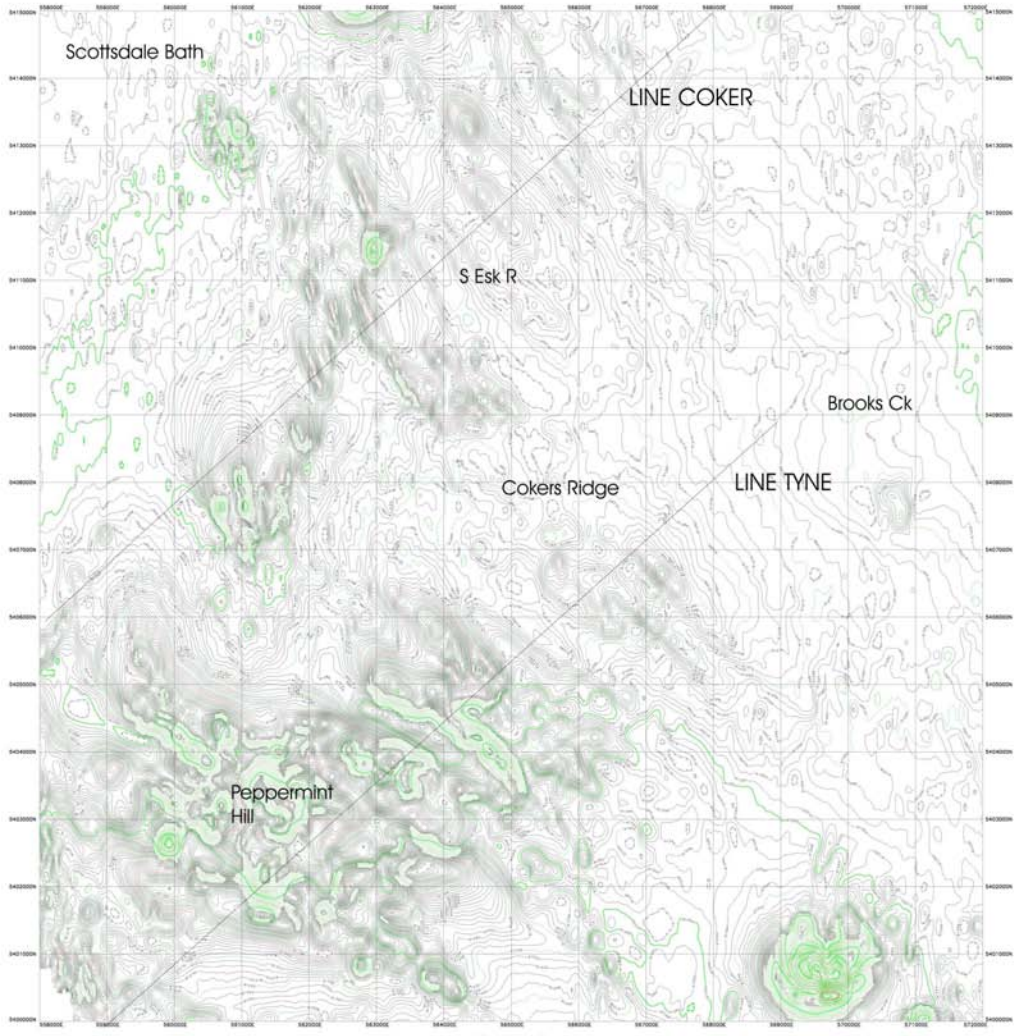


Figure 23: Contour presentation of Total Magnetic Field Intensity in region east of Ben Lomond.

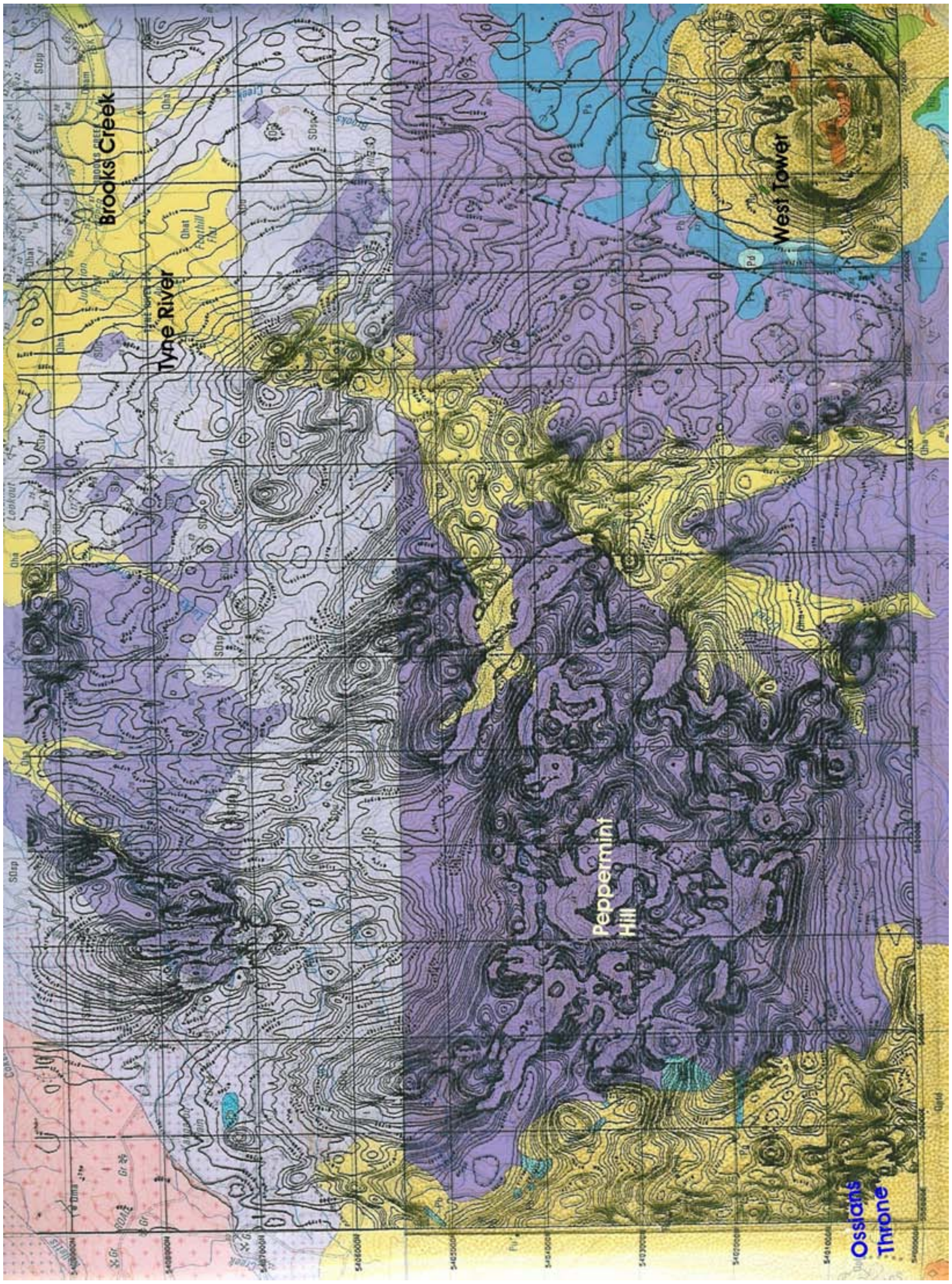


Figure 24. Mapped geology and magnetic field intensity, southern zone (Tyne).

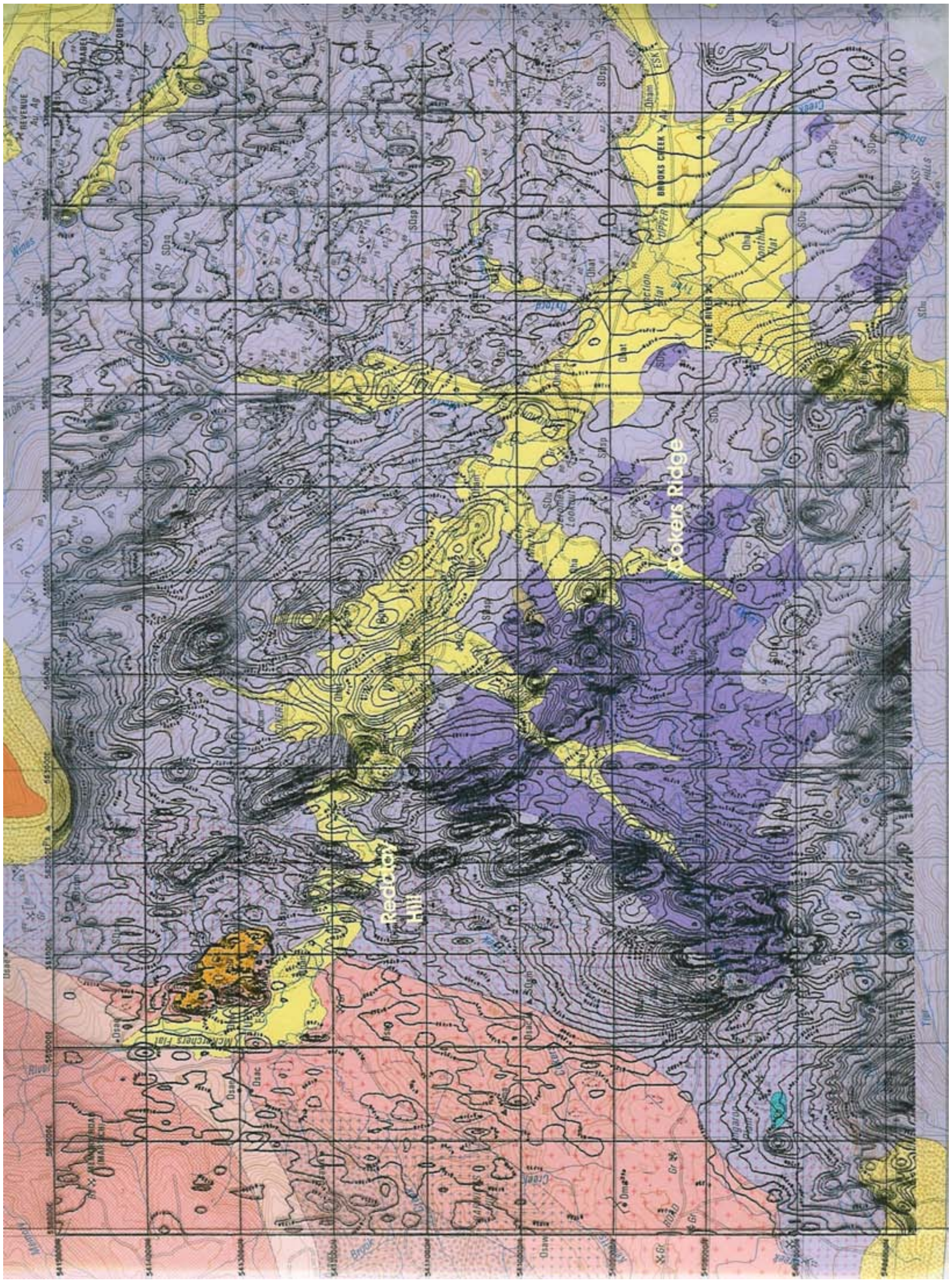


Figure 25. Mapped geology and magnetic field intensity, northern zone (Coker).

Section COKER: near batholith margin and Redclay Hill.

The section COKER, which extends across the metamorphic halo near Redclay Hill, the northern limit of mapped pelites, the valley of the South Esk River, and the hills between the South Esk River and Dans Rivulet, shows that structural limitations are involved.
The magnetic Mathinna Beds rock package is constrained southwest of the South Esk River.

The model indicates that a large block of section is pelitic with the normal magnetic properties for such material (approximately 0.0026 SI, colour yellow). Superimposed on this, as units within the basic suite, are several other variants with properties consistent with those noted further south in section TYNE.
The inferred magnetic properties for each unit, from west to east, within the pelitic package are 0.0036, 0.0049, 0.0039, 0.0065, 0.0065, 0.0065, 0.0039, 0.0058, 0.0039 SI. There is nothing in either profile to indicate any more complex constitution, such as hidden plutons or halo alteration zones.

Model COKER does, however, show that the units north of the North Esk River do not possess the same depth range and are less magnetised. Depth range is not well constrained in any modelling since much depends on realistic property assumptions and the limits gradients impose on depth to top, and width, of source. In most cases the magnetic properties are fully realised within 50 to 100 metres of the land surface.

The basic form of the magnetic field is asymmetric with a distinct reduction north of the river and this is best explained by a north dipping truncation of the main pelitic block. Units above this surface are different and cannot be projected below it within the resolution of the present modelling. The implied arrangement of units is highly suggestive of east-facing thrusting which buries the pelitic package and introduces a different suite.
Gold mineralisation at Mathinna (just east of the section TYNE but which extrapolation would suggest is north of the implied thrust) and at Tyne River and Brooks Creek (both alluvials) appears to be contained in the rock suite directly above the thrust, or have been introduced along it.

These models (like those at Gladstone – Blue Tier, above) show that useful information about the Mathinna Beds might be gleaned by close analysis of the magnetic data and that, wherever distinctive character is present, important structures might be defined.

Note that both COKER and TYNE models achieve the anomaly distribution with credible susceptibilities, but a modest total depth range – in this case 4000 metres. The 4000 m figure is not especially critical or sensitive but at least 2000 to 3000 m of vertical extent is involved. All dips have been indicated as near vertical but there are suggestions that some members dip steeply west, others steeply east. Magnetic zones of this type within the Mathinna Beds will probably repay more detailed evaluation and interpretation as comments for Section 3 of this report also note.

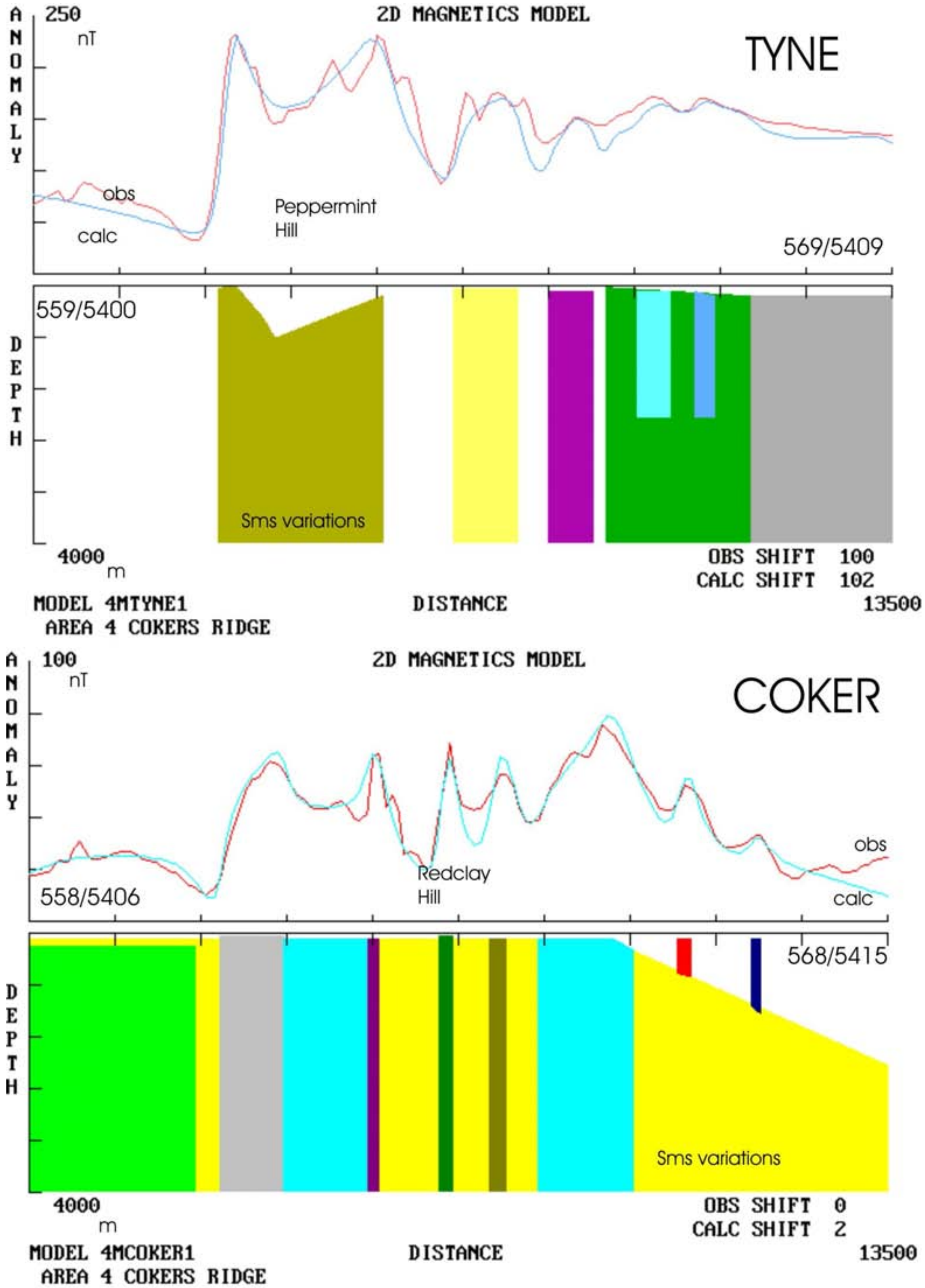


Figure 26. Modelled sections across Mathinna Beds west of Ben Lomond.

5. CONSIDERATION OF POSSIBLE VOLCANIC PLUGS

A number of point anomalies can be observed in all presentations of the magnetic field in northeast Tasmania (see for example Figures 4 and 11). These are more evident in some areas, depending on the background field and other local influences. Figure 27 presents an extreme example of an area where many such features are present.

Examination of available geological mapping reveals that some features are associated with alteration boundaries, and some focus upon them, whilst others can be associated with small exposures of Jurassic dolerite (rare) and Tertiary basalt. Most, however, cannot be correlated with any other known information and some confirmatory field work is required in these cases. Figure 27 provides an indication of these associations; one feature can be linked to Mathinna Beds alteration, and another to a mapped plug near Halfway Hill.

Some questions have been posed. Are all these effects due to volcanic plugs? What composition and properties might be involved – and hence what age? How large are the features? Are they likely to be exposed, and therefore able to be sampled?
Several features have been examined in order to offer possible answers to these questions.

Inspection of available mapping reveals that very few of the magnetic anomalies can be associated with a geological unit – but usually Tertiary basalt. This may reflect weathering, the limited traversing involved in the preparation of the maps, and perhaps the very small dimensions of the sources.

Detailed review of the actual anomalies shows that about half of the sources appear to be normally magnetised with negligible remanence, but several sources are very strongly magnetised with signatures which reflect both ancient and modern pole positions. A small subset of each category was isolated with the intention of modelling using three dimensional methods in order to extract as much information as possible and to indicate whether further examination of other sites would prove valuable.

A selection of features has been examined initially using two dimensional methods. 2D methods are faster and simpler but are clearly of dubious reliability in terms of absolute geometry and contrast when dealing with nominally cylindrical sources. Comparisons have been made to assess the degree of difference so that many evaluations can be made quickly and then either used to control a 3D interpretation, where warranted, or to suggest the scale of correction factors.

Figure 28 provides some models and profiles for features titled 5A and 5C.
These anomalies are located at 599 000 mE, 5432 400 mN and 589 600 mE, 5421 250 mN approximately. The first of these, 5A, is quite unusual in its intensity and sign and the location should be inspected. The models indicate a narrow plug extending to considerable depth – but the feature is highly magnetic at 0.26 SI and may be due to human structures. If the feature is geological and real then the lithology is most unusual and almost ultramafic, and may not be exposed since modelling indicates a

depth below surface to the magnetic contrast is of the order of 30 metres. The feature may dip steeply to the northeast. The maximum dimensions of the source are 70 m east-west and 140 m north-south with top located at 598 820 mE.

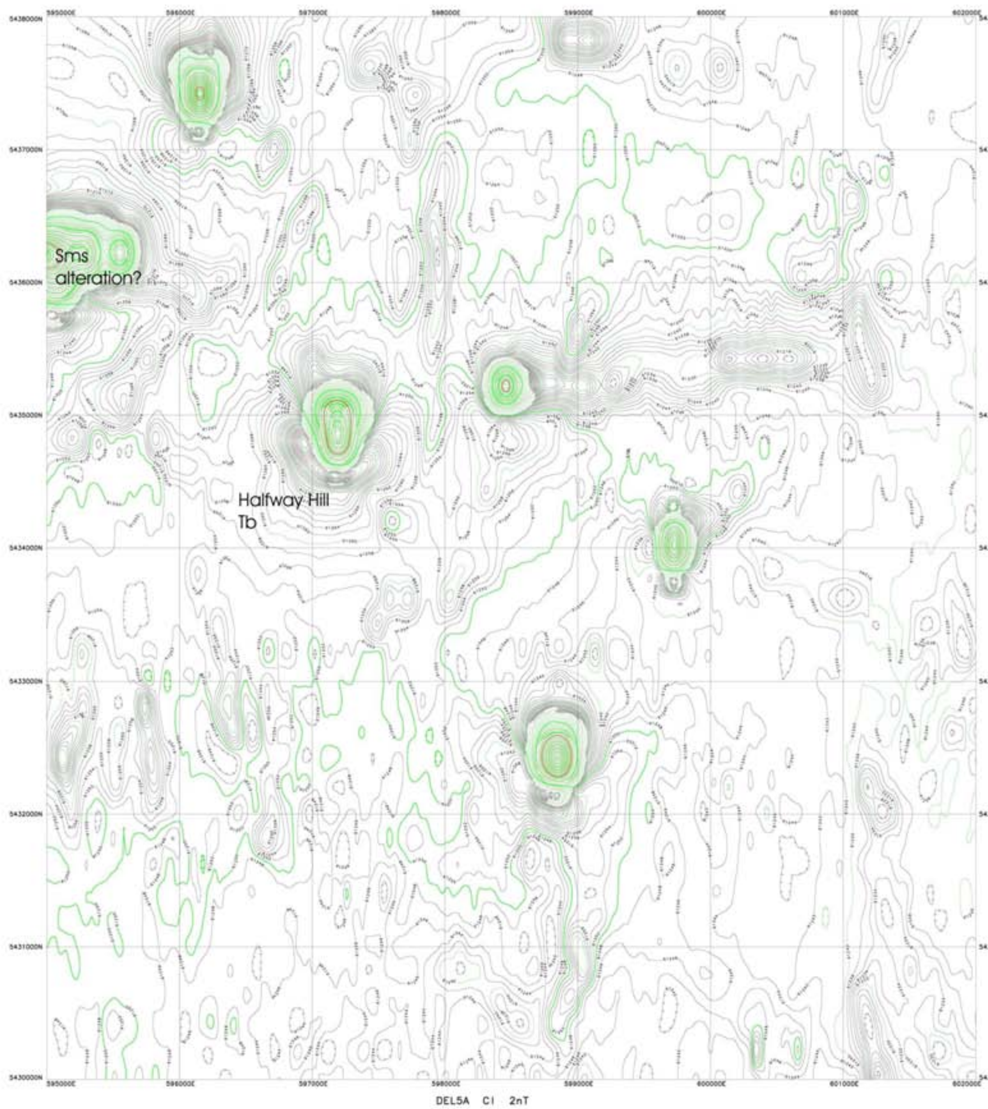


Figure 27. Point anomalies in magnetic field north of Blue Tier. The origin of most of these effects is unknown at the time of writing and ground checking is required.

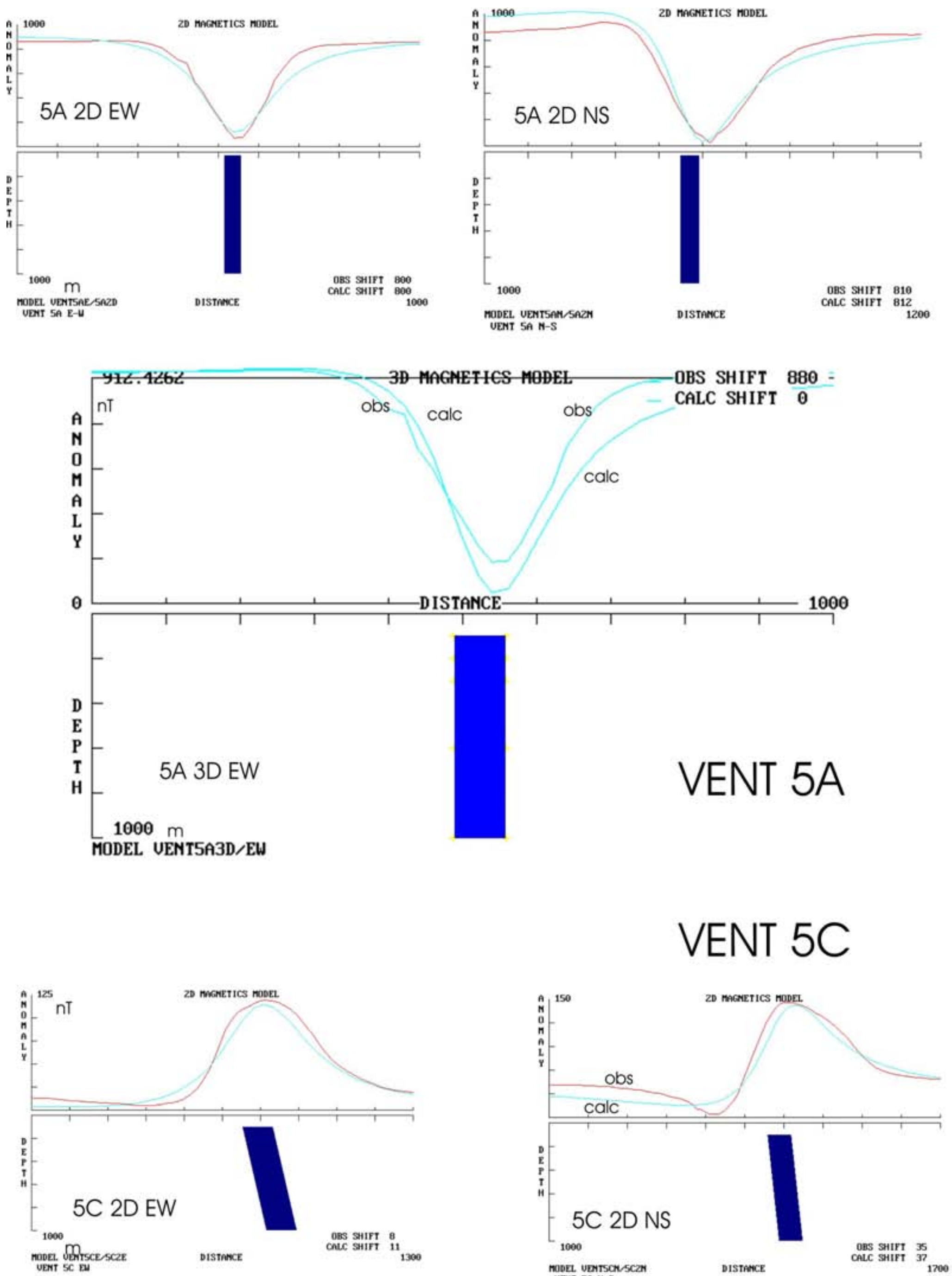


Figure 28. Comparative 2D and 3D interpretations of features 5A and 5C.

Feature 5C is much more normal and appears to dip steeply eastward and, depending on method of analysis, possesses clearly basaltic properties (0.026 to 0.05 SI). This plug may have a maximum diameter of about 50 to 75 m and is located near 589 530 mE, 5421 270 mN. As was the case with 5A, models indicate that the top of this body is concealed and may be at a depth of 50 m.

All models presented above were based on the assumption that the sources are basaltic and in plug or dyke form. It has been noted that various aspects of the anomalies are not well fitted with these presumptions – even when tested three dimensionally and with some allowance for remanent magnetisation with an orientation which might distort the effect in the manner observed for many anomalies.

Anomaly 5D (at 585 150 mE; 5461 200 mN) has been calculated with some alternative assumptions and the results are shown in Figure 29.

The models have been calculated for east-west and north-south aspects. All profiles sample the crest of the anomaly.
E1 represents an E-W profile and offers an apparently reasonable solution. The body is about 150 metres in diameter with a contrast of 0.035 SI.
D1 is a N-S profile with comparable contrast and diameter. There are serious misfits which a simple shape cannot generate.
D2 is the N-S profile in which the source has pronounced dip and is not regular in shape. This generates a better fit and might be accepted as a solution. The contrast is the same but the general width is variable.

D3, however, tests whether the assumption of plugs, or simple vents, might be invalid.

The anomaly, if due to a remnant of a flow, cannot be generated with a uniform contrast: one would not be expected in any case due to weathering and variations in flows. The solution offered, in which the bulk of the effect is produced by a massive basaltic core surrounded by an altered skin, readily accounts for the distribution and shape of the anomaly as observed, as well as its profile character.
The model does, however, indicate that the source might be as much as 100 m thick locally – at the contrasts used. The modelled contrasts are 0.055 for the flow core and 0.013 for the outer skin.

The inferred thicknesses might be reduced if it could be shown that the actual contrasts are significantly higher. Although the figure presents the solution in a slightly exaggerated version vertically the geometry and distribution of the source might allow a remnant of this vertical dimension.
This is a site which should be located, exposures inspected for evidence of vent character (ejecta, inclusions etc) and any samples found tested for magnetic properties.

The analysis of site 5D raises the entire question of the nature of the sources. The properties inferred, whether for plugs or flows, are clearly consistent with basalt and many of these sites have not been found during regional mapping. It is, however, possible that several of the magnetic features observed in this new survey represent small remnants of basalt flows.
It should not be assumed without other evidence, which will require either ground location and characterisation of contents of material or some geochemistry, that all "spot" anomalies represent plugs. Most may do, but many may not.

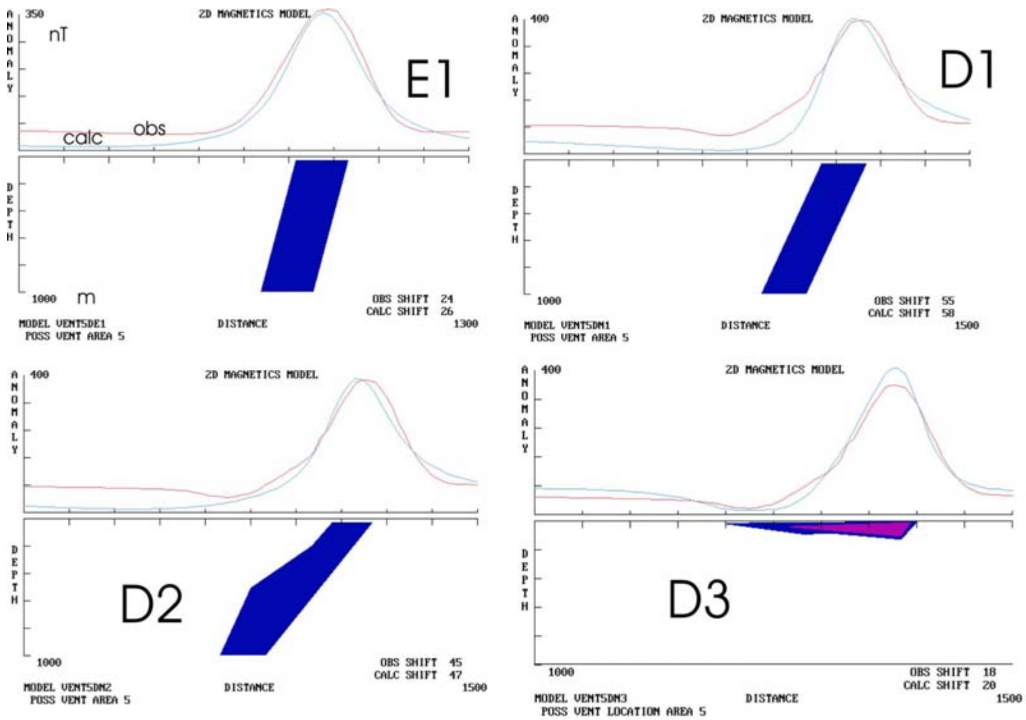


Figure 29. Tests of some variants for site 5D. These tests indicate the effect of dip or changes in thickness – if the source is plug-like – and contrasts these with the effect of a shallow remnant.

6. STRUCTURAL TEXTURE NEAR MT PARIS

Various image presentations of the magnetic survey indicate intersecting trends in the region of Mt Paris. Some forms indicate a chevron character but, as shown in Figure 30, the character is derived from two sets of features; one trending ENE and the other approximately NW. These features intersect in the region of Mt Paris and south of Mt Paris at about 570 000 mE, 5435 000 mN. No explanatory sources for these trends have been regionally mapped by Brown *et al* (1977) or McClenaghan *et al* (1993).

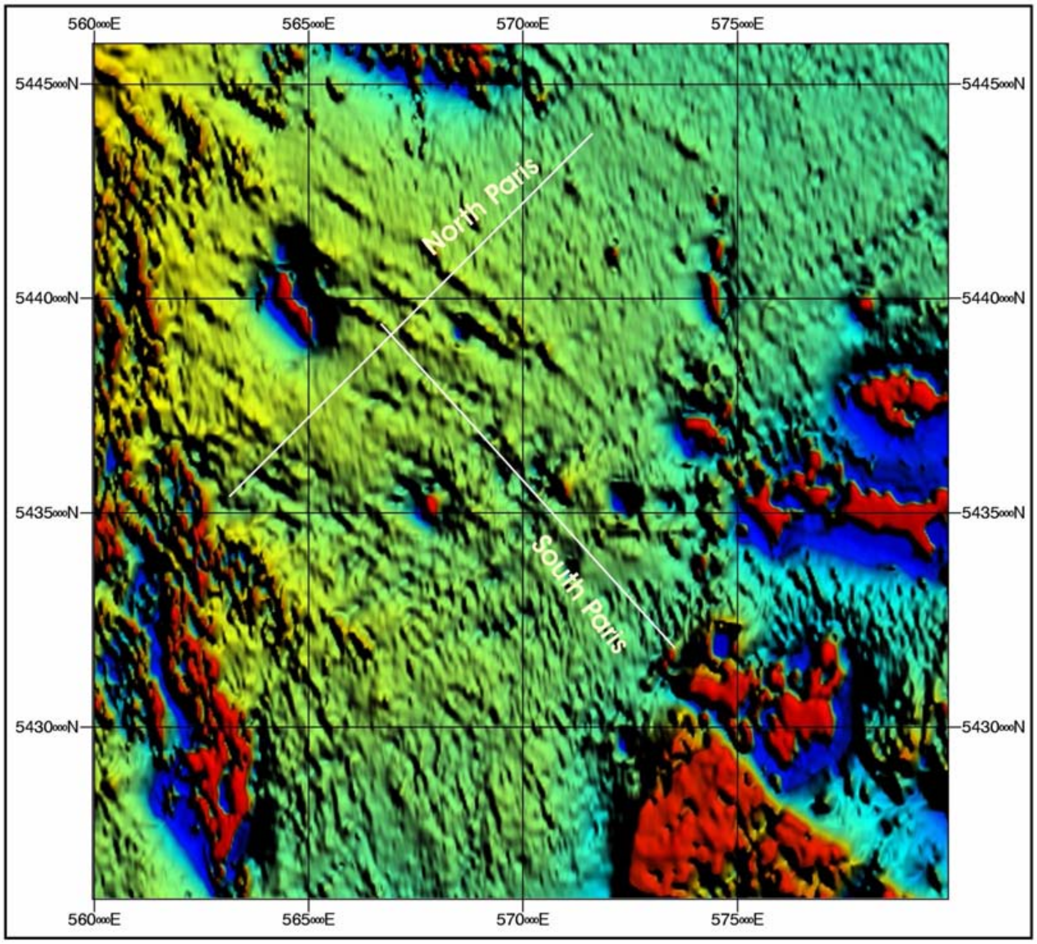
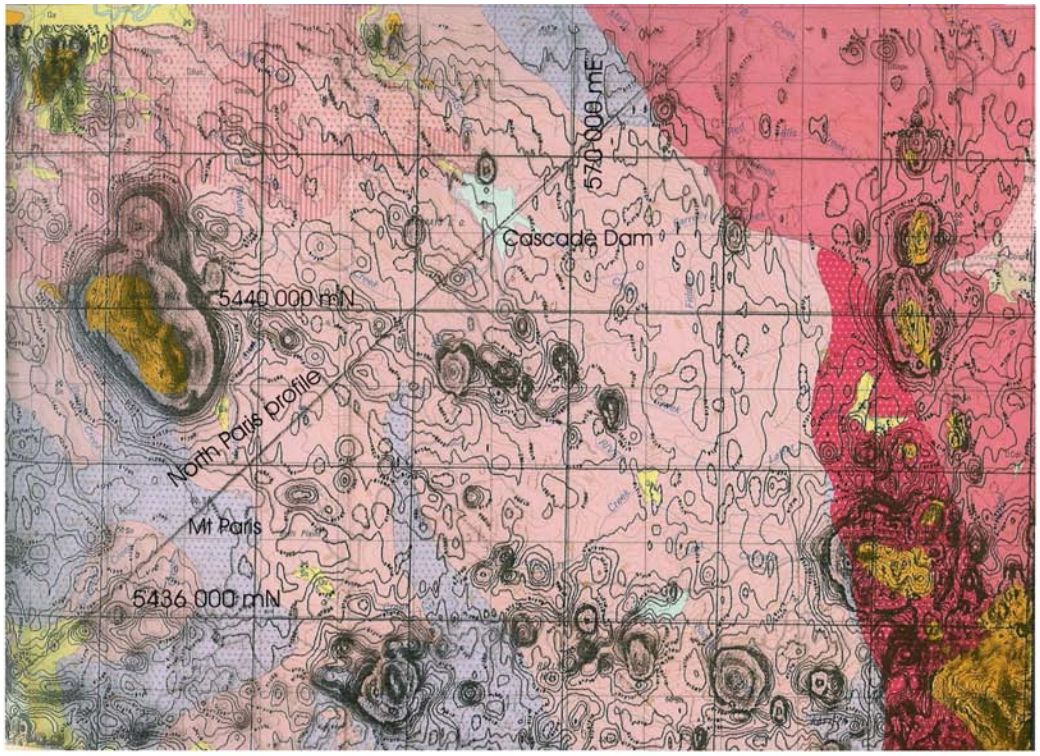


Figure 30. Image of Total Magnetic Field Intensity in the region centred on Mt Paris.

It may be observed that several elements of the drainage across the Mt Paris Pluton drains northwest but there is no obvious control for this, and no suggestion of a consistent, regional ENE pattern. It has been shown elsewhere in NE Tasmania that such trends are often, perhaps always, associated with dolerite dykes of uncertain age and relationship to the granitoids (previous sections of this report) and examination of these features was requested in order to test the possibility in this region. It should also be noted that many of the features are much muted compared to those observed in the Blue Tier area further east. Most strongly magnetic responses in Figure 30 are related to Tertiary volcanics and granodiorites in the southeast of the imaged area contribute much of the variation in the magnetic field.

Two profiles across the trends have been modelled in order to assess likely sources and contrasts. These are located, with base mapping, in Figure 31.



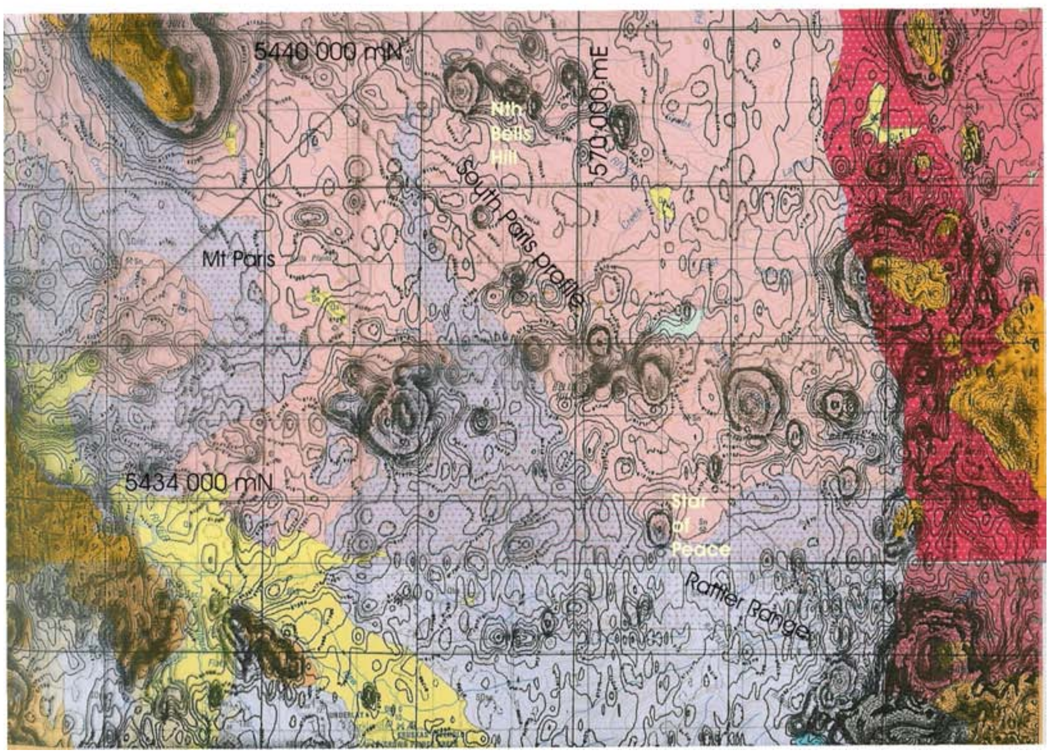


Figure 31. Location of modelled profiles in the Mt Paris region.
Line ParisN extends NE-SW in order to sample one set of structures, and line ParisS trends NW-SE in order to sample the opposing set. Both are evident in the contours but are not as readily recognised as in the image presentation. None of the features is obviously continuous across the pluton or the surrounding region.

The results of modelling the two test profiles are shown in Figure 32.

The sources represented are relatively trivial in terms of total field variations and in the context of regional magnetic fields. Inspection of the complete compilation of the survey (Figure 1, Introduction) shows that the Mt Paris region lies toward the eastern margin of a very large underlying effect. Previous work, and Webster this volume, has indicated the existence of large thrust structures which have incorporated ultramafics. Fragments of this pattern were noted in interpretations for Scamander, Blue Tier and Ben Lomond above.
Consequently, a regional assessment of the large base anomaly has been undertaken prior to detailed review of local features. This has been completed only to the level required to account for the general regional field and not to provide a detailed structural assessment of source distributions. The broad swale of anomaly evident in Figure 32 (north section) and the gross trend (south section) represent the effect of the underlying ultramafics at considerable depth.

In the northern (upper) section the principal anomalous deviations are due to a few narrow zones within the granite with low to very low magnetic contrasts (0.00065, 0.006, 0.0058 SI respectively from west to east). These are extremely subtle changes and the sources extend virtually to the land surface (certainly within 10 to 30 metres of it). Dolerite, or mafic, dykes of any sort are most unlikely to be the source of these effects: slightly oxidised alteration within the granite is much more likely.

Other alteration anomalies are evident along the western contact of the Mt Paris Pluton within the altered Mathinna Beds and some of these effects are the result of variable and sometimes negative magnetisation. The typical contrast is about 0.0013 SI and this value may be compared with the inferences about the alteration within the granite itself.

The southern (lower) section is essentially similar but with fewer intersections of intra-granite alteration zones. The implied contrast is 0.005 and 0.0065 SI respectively: comparable to determinations made for features trending normal to those intersected by this section. Both alteration zones in this section are reversely magnetised.
The granodiorite at the eastern end of the section has a normal magnetisation of about 0.0022 SI.
The altered Mathinna Beds near granitoid contacts is both normally and reversely magnetised (NW and SE end of line) with a contrast of about 0.0013 SI.

Groves (1977) and Union Corporation (1982) have described greisens in the Mt Paris Granite. Mapping and definition has been limited but the NW trend evident in the magnetics has been recognised and crudely displayed in exploration maps. Groves also noted that an ENE trend also existed in the greisens. The diffuse character of such material, and any associated fracturing and other alteration, coupled with no clear sense of magnetic contrast, the origin of magnetic properties, or width of zones, indicates that the values inferred in this report are probably maxima in terms of contrast and minima in terms of scale of source.

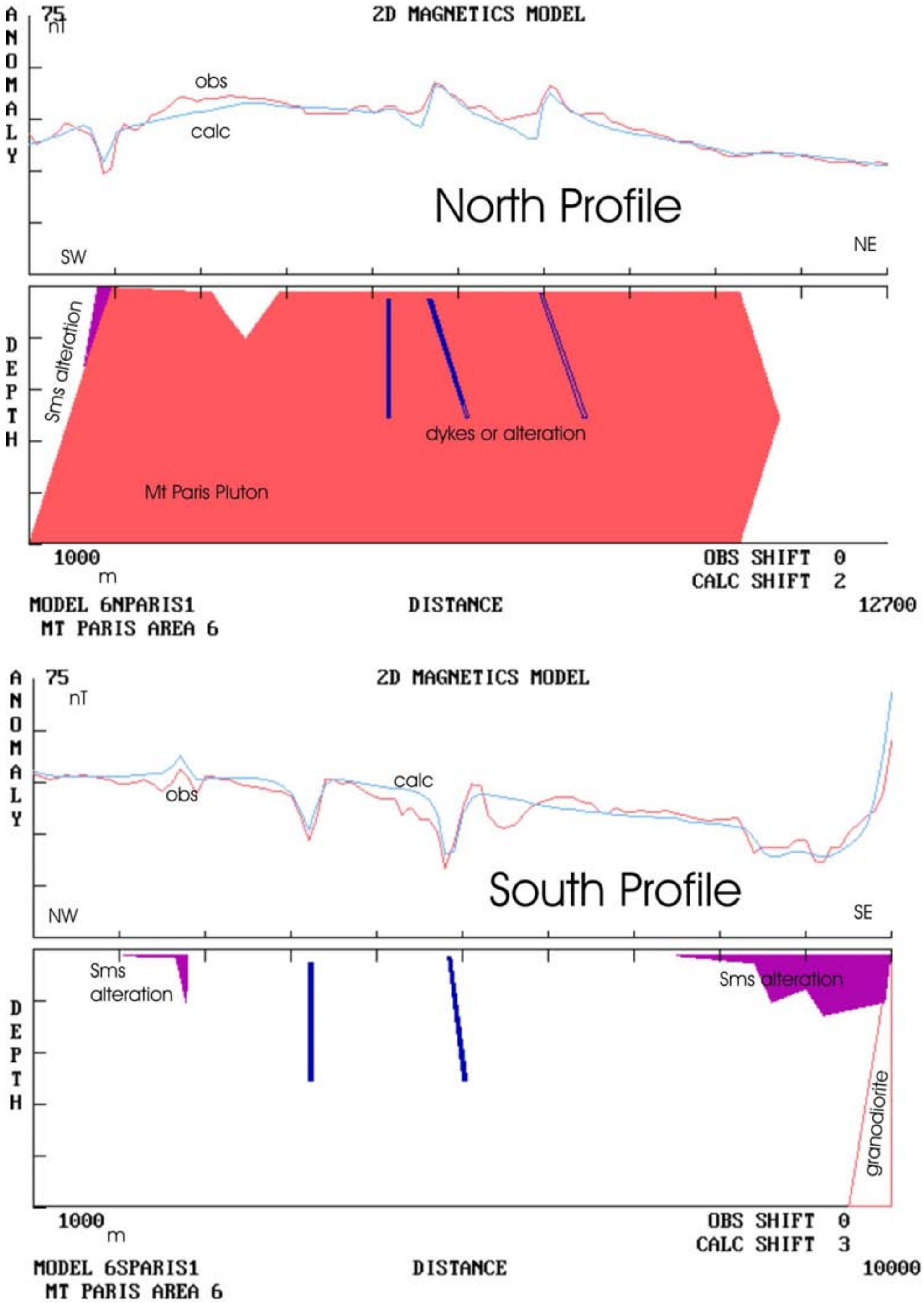


Figure 32. Interpretation of structural trends within the Mt Paris Pluton. For location of profiles see Figure 31.
Terminal coordinates of the profiles are:
North profile – 563 000 mE, 5435 000 mN to 572 000 mE, 5444 000 mN
South profile – 567 000 mE, 5439 000 mN to 574 000 mE, 5432 000 mN

7. DYKES(?) AT LONG ISLAND

Marked dyke-like character has been observed across the area around Long Island off the northwest coast of Cape Barren Island, south of Flinders Island. The nature of the features is well displayed in the image (Figure 33). The island, and the nearby coast of Cape Barren Island, possesses the same orientation as the magnetic features. Although tempting to explain all these features as dolerite or comparable dykes, few have been observed in the region and the exposure is such, at least along the coast, that such elements should have been noted if present. Cocker (1982) does note the presence of at least two dykes but does not describe their dimensions.

Analysis has been directed toward an assessment of scale, geometry, possible magnetic contrasts, and thus likely cause.

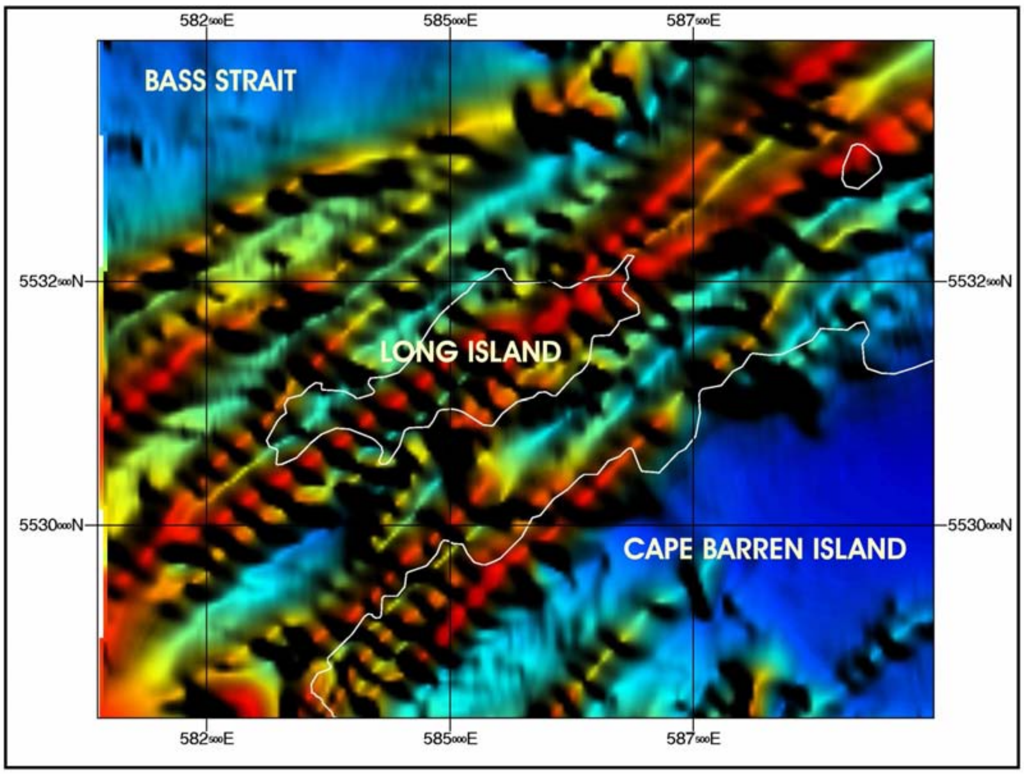


Figure 33. Image of Total Magnetic Field Intensity in the region of Long Island.

Because of the ENE to NE orientation of the structures tie line profiles have been used as the basis for interpretation (583 890 mE from 5528 to 5535 000 mN and 587 900 mE from 5531 to 5535 000 mN). Interpretations are shown in Figures 34 and 35.

The sources appear in the form of wide dykes but, as shown in Figure 34, any magnetic contrasts inferred on this basis do not support the view that the dykes are dolerite or basalt regardless of assumptions about depth to upper surface – which is clearly variable along strike.

The sources in the longer western section have width and contrasts as follows, from south to north: 230 m, 0.0013 SI; 100, 0.0026; 100, 0.0026; 100, 0.0039; 100, 0.0026;

100, 0.0026; and 70, 0.0039. The most magnetic part of the sources begins within 50 to 100 m of the surface.
Similar results apply for the shorter eastern section: 80 m, 0.0032 SI; 80, 0.0013; 300, 0.0026 and 170, 0.0026. The sources are slightly deeper in the east.

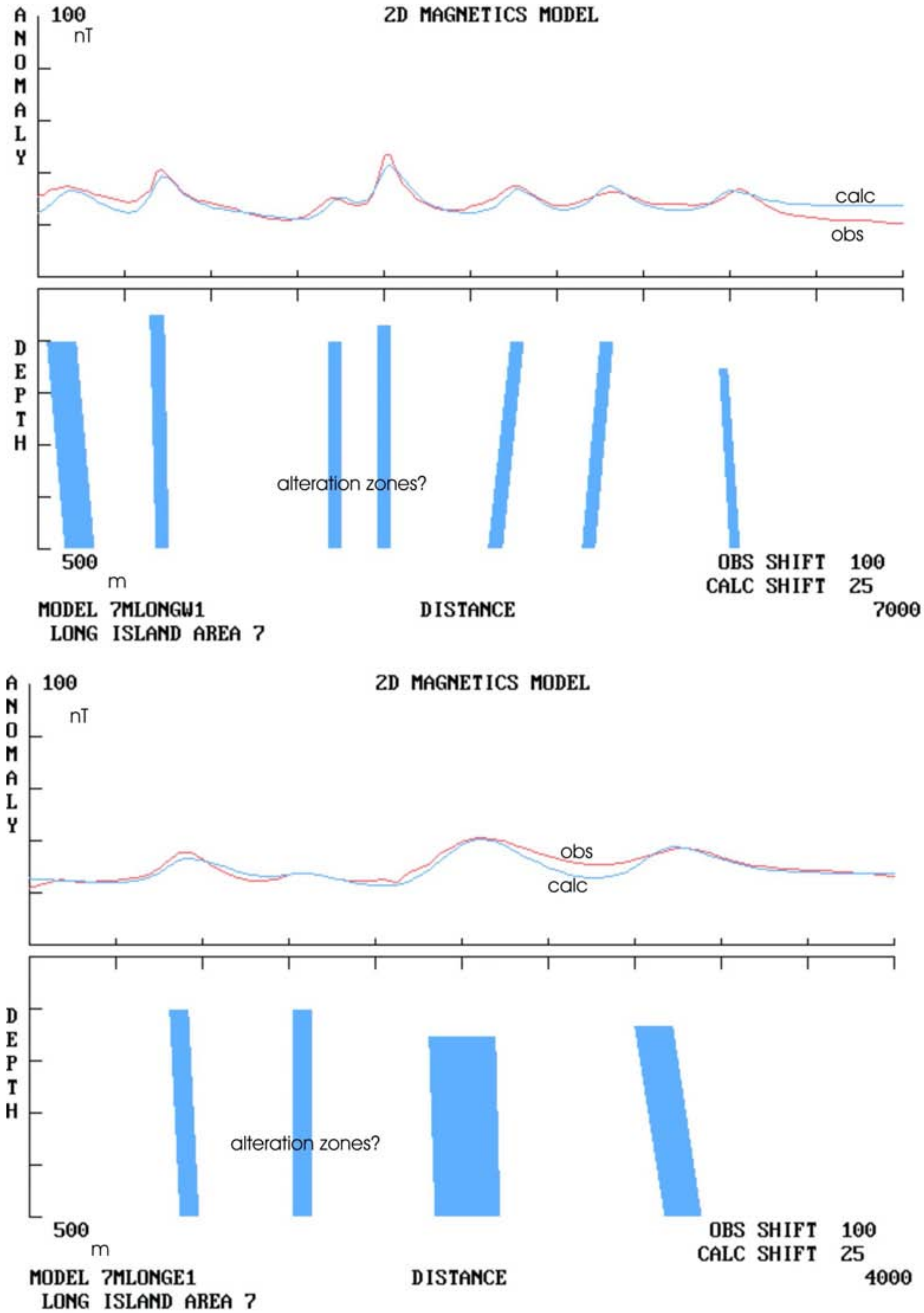
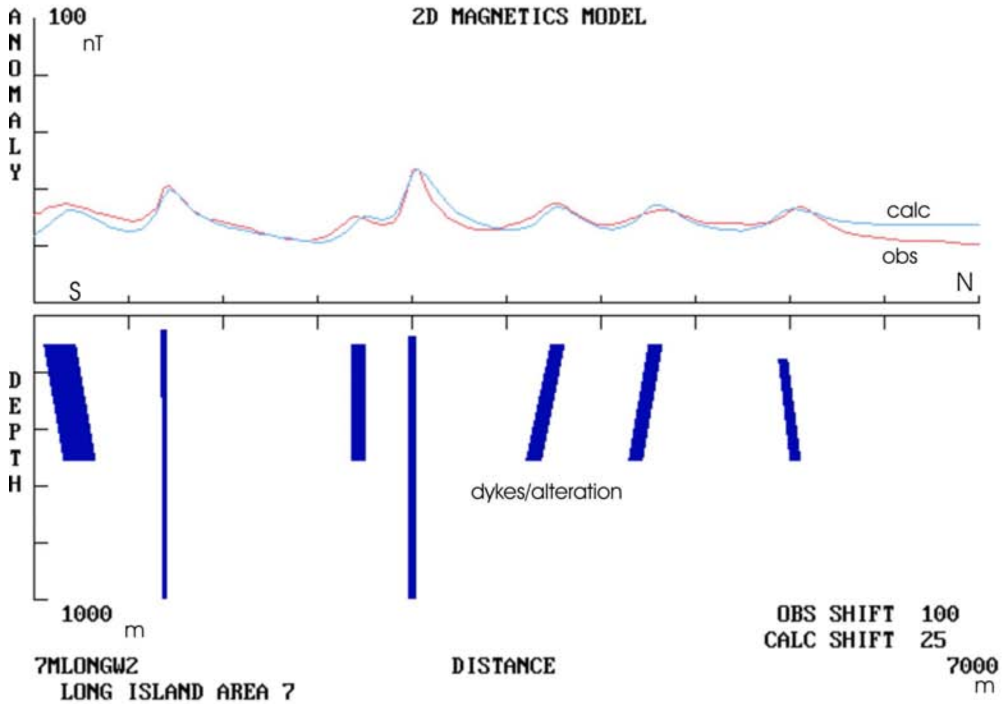


Figure 34. Interpretation of north-south profiles at 583900 and 587900 mE across Long Island.

Figure 35 presents an alternative interpretation which examines the effect of changes in depth range, width and property contrasts. The structures varied have been thinned to less than 50 m, and their depth range doubled while retaining the upper surface at the same depth. This has required an increase in contrast of about 250% to 0.0065 (from 0.0026) and 0.01 SI (from 0.0039) for the western line and 0.0054 SI (from 0.0026) for the eastern line.

All values, even those within range adjusted models, are consistent with lamprophyres rather than dolerites.

The survey, and the interpretation, indicates that there are many more of these structures than previously suspected. Some ground inspection is required to confirm the inferred properties and composition. If some of these intrusives can be located and traced and sampled, and their thickness observed, then it will be possible to revise the present interpretation and offer finer constraints on depth range and other structures which may not be exposed.



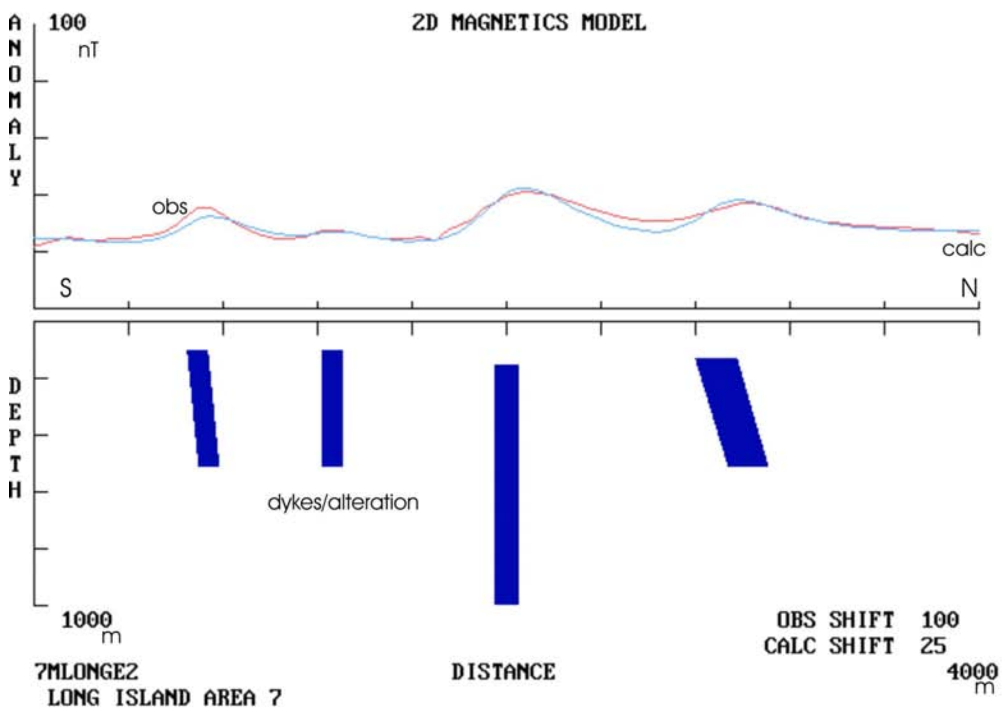


Figure 35: Interpretation of north-south profiles at 583900 and 587900 mE across Long Island.
An alternate model which allows comparison (with Figure 34) of the effect of changes in depth range, contrast and width. Only some bodies in the model have been changed in order to stress the ambiguities likely.

8. EAST-WEST ANOMALY NEAR LADY BARRON, FLINDERS ISLAND

The magnetic field is extremely variable north and east of Lady Barron and highly subdued in character across the granites of Strzelecki – as might be expected. Between these two patterns, west of the township of Lady Barron, is a strong east-west anomaly with several kilometres of easterly extension but very smooth, large or deep source character (see image, Figure 36). An examination of possible origins has been undertaken.

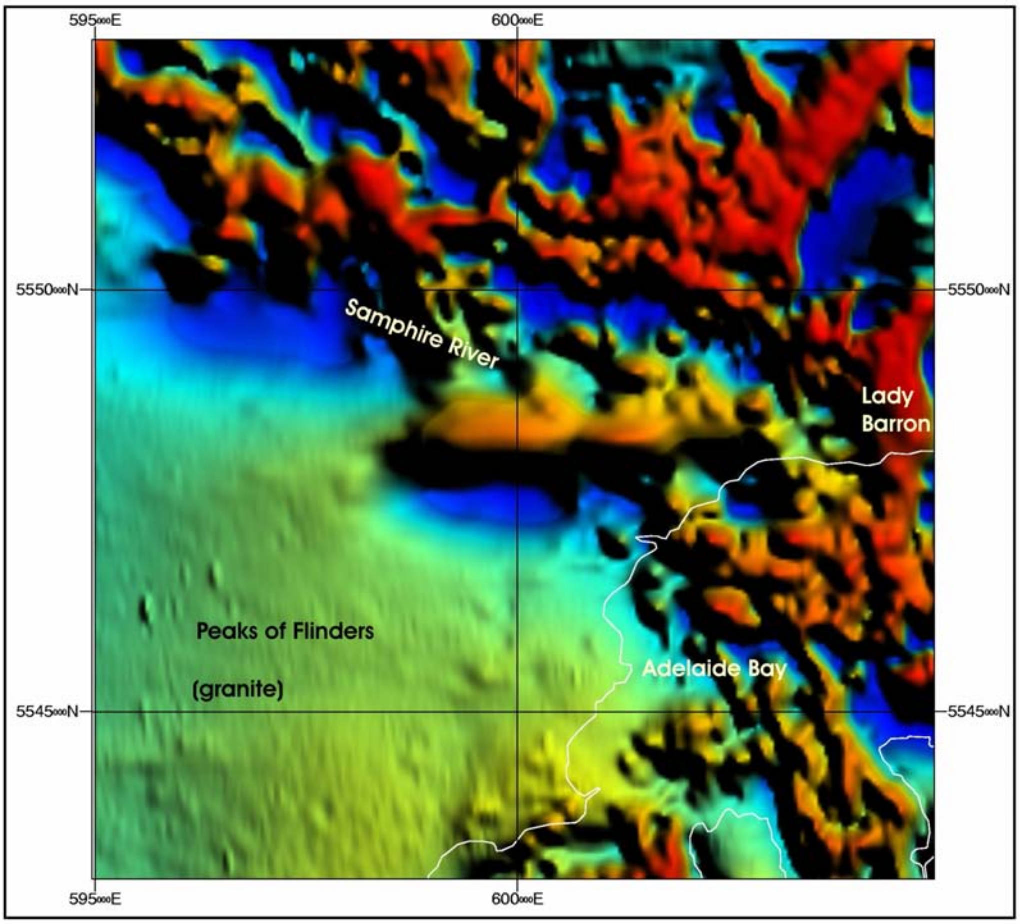


Figure 36. Image of Total Magnetic Field Intensity in the region of Lady Barron, Flinders Island. Note the contrast between the field across exposed Mathinna Beds and granite (to the west), and the effect of basalts within Tertiary sequences, often concealed by Quaternary cover. The E-W feature in the centre of the image is clearly anomalous in any of these contexts.

Available geological mapping on Flinders Island (Jennings *et al*, 1978) is of a most regional nature generally and no clear correlations can be made between mapped units and the anomalous feature. It lies very near to a cover boundary between Quaternary units and Mathinna Beds immediately east of the principal granite contact.

Three models are offered in Figure 37 which account for many of the characteristics of this anomaly. All involve basalt at shallow depth. It was determined that no deep or steeply dipping narrow source can account for the features observed.
The profile is located on tie line 190150 at 599 880 mE between 5545 000 and 5550 000 mN. Elevation variations range from 85 to 135 m (typically 95 m clearance).

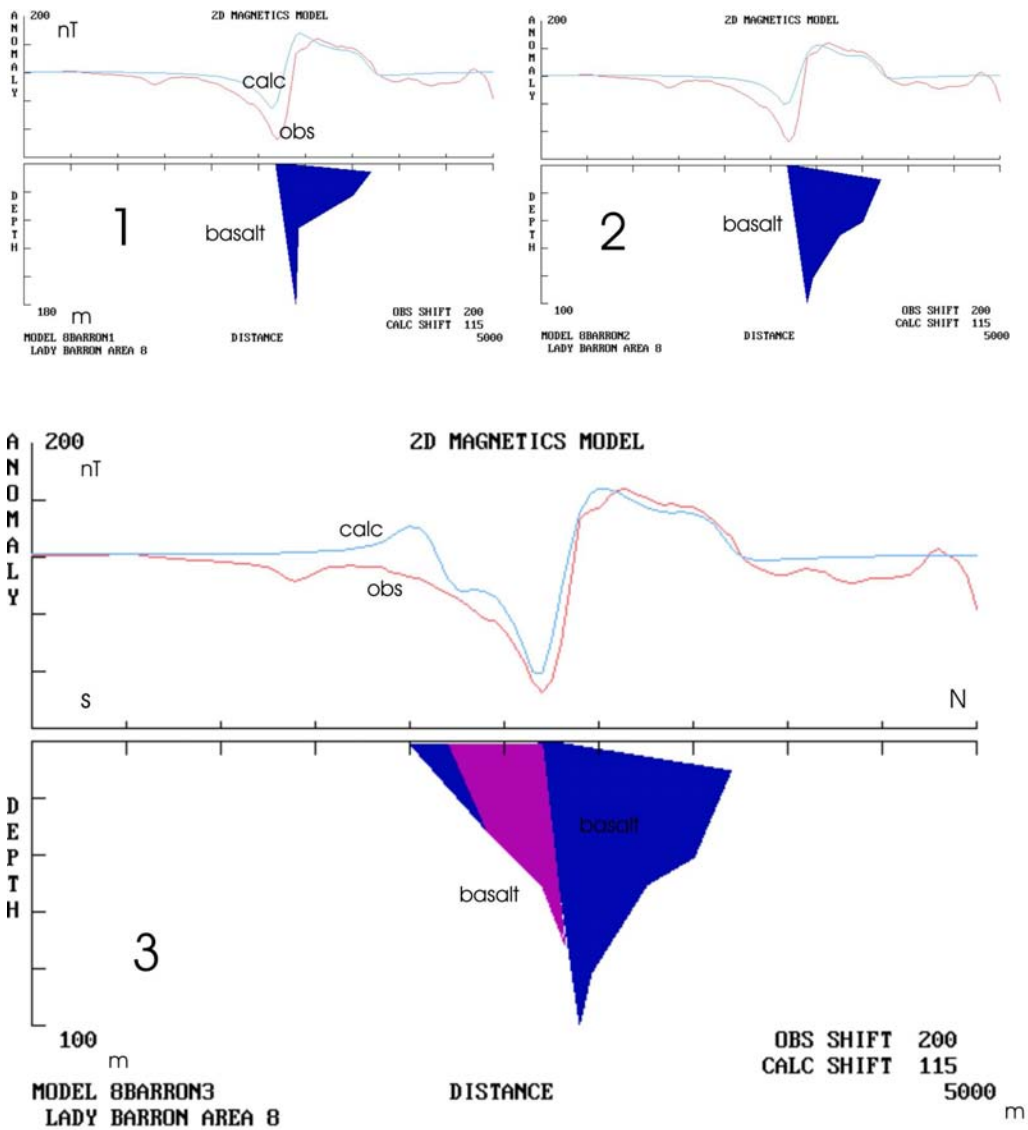


Figure 37. Interpretation of the Lady Barron anomaly.

Model 1 provides a basic outline of a basalt-filled valley (contrast 0.013 SI) and maximum thickness of about 180 metres. This solution accounts for the northern part of the anomaly but not the southern section.

Model 2 suggests some possible variations in valley profile to improve the explanation with a more credible maximum depth of 100 metres. The southern section of the anomaly is, again, not well accounted.

Model 3 provides for more reality by assuming that the basalt is magnetically variable and more extensive than either models 1 and 2 – or the present geological map – would suggest, and provides a comprehensive explanation. Part of the basalt fill appears to be reversely magnetised (-0.013 SI). Further, the model suggests that the southern limit of the fill has a normally magnetised skin. Note that these variations provide for a better general fit but create a more lumpy profile which was not observed – at this easting. Examination of the eastern section of the greater anomaly pattern, however, shows that irregular features were observed along strike at the required northing.

The anomaly is due to a thick valley fill of Tertiary basalt.

9. REGIONAL SECTIONS NORTH FLINDERS ISLAND

Three regional sections were proposed across the northern half of Flinders Island in order to suggest the origin of the various anomaly patterns and, in particular, to test if possible thrust slices containing ultramafics were responsible for the general rise in the magnetic field in the centre of the island. This can be seen in images, Figures 38 and 39.

The three sections selected are located at 5574 415, 5585 020 and 5595020 mN and termed 9FLINDA, 9FLINDB, 9FLINDC in the models below.

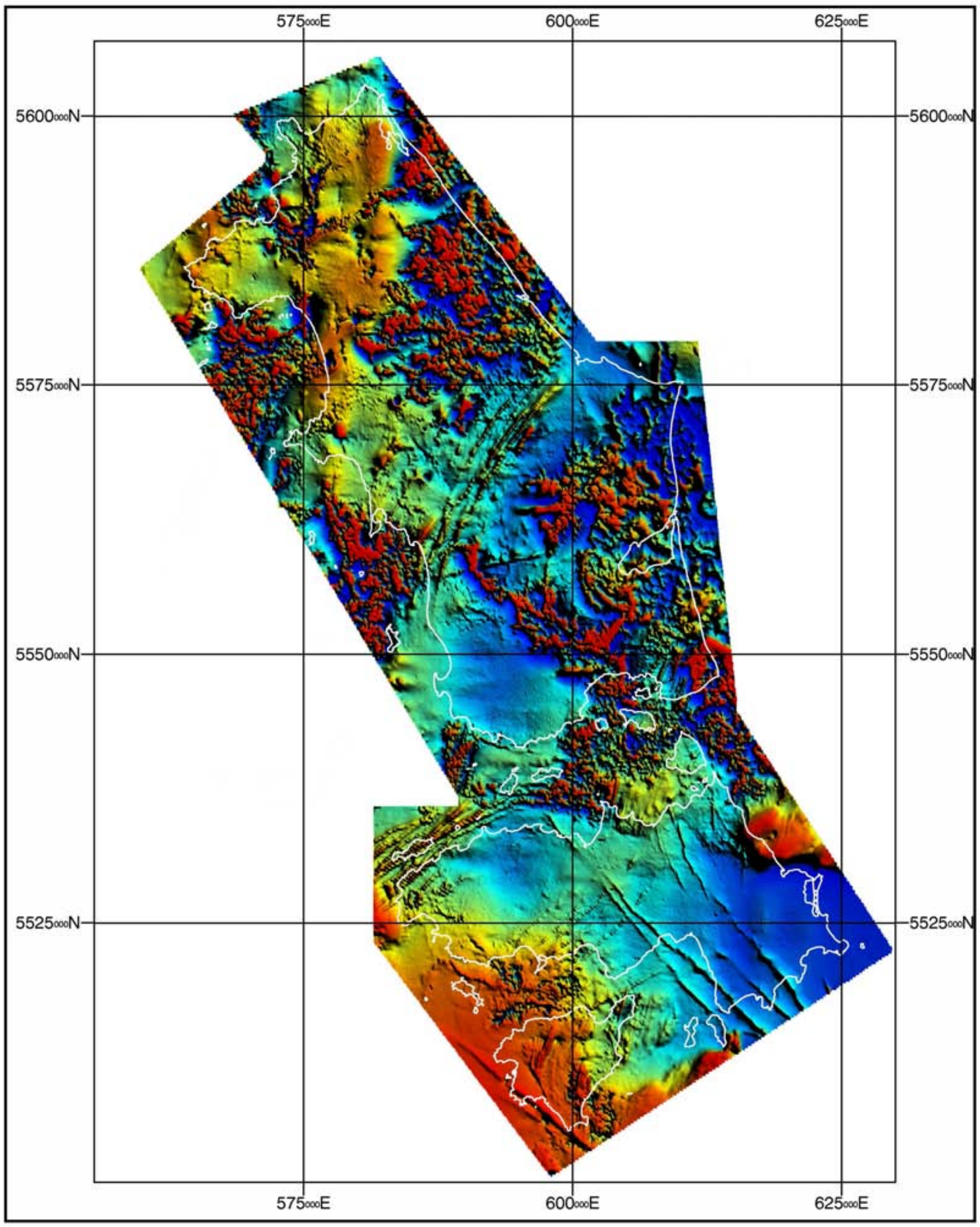


Figure 38. Image of Total Magnetic Field Intensity, Flinders Island.

The magnetic map of Flinders and surrounding islands displays many interesting features. It will be noted that the island is bisected in magnetic character by three “dykes” and that the magnetic field is generally of higher intensity to the north than the south. The northern character is not unlike the character east of Blue Tier or south of Bridport. The southern character is quite distinct. In other areas the underlying increase in field intensity has been found due to the presence of ultramafics at considerable depth and this possibility has been tested here for North Flinders Island. If the concept is supported by analysis then it would suggest that such materials are absent beneath South Flinders Island and that the small dyke group occupies a structurally important location. Previous modelling (as for Long Island) indicates that the dykes are probably not intensely magnetised and may be related to the lamprophyric set.

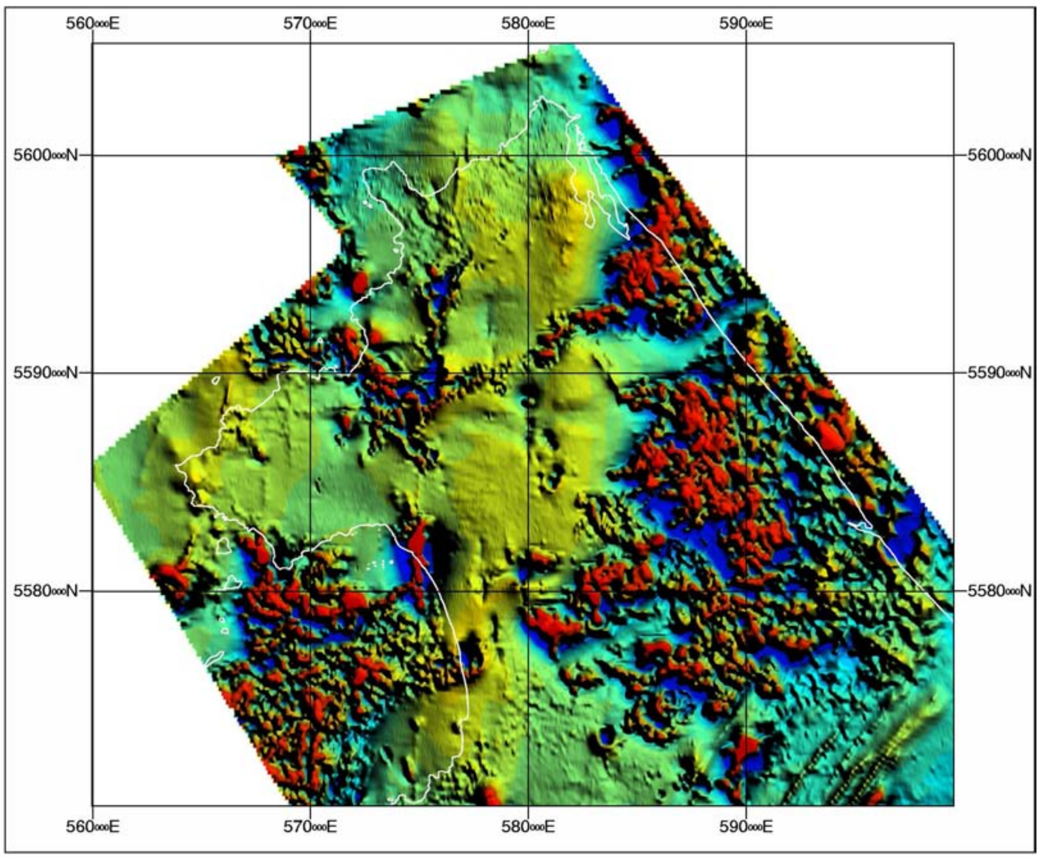


Figure 39. Image of Total Magnetic Field Intensity, Northern Flinders Island.

Much of the speckled character evident in the images can be directly correlated with the presence of Tertiary basalts, or inferences about their concealed extension. Some filled drainage systems are indicated.

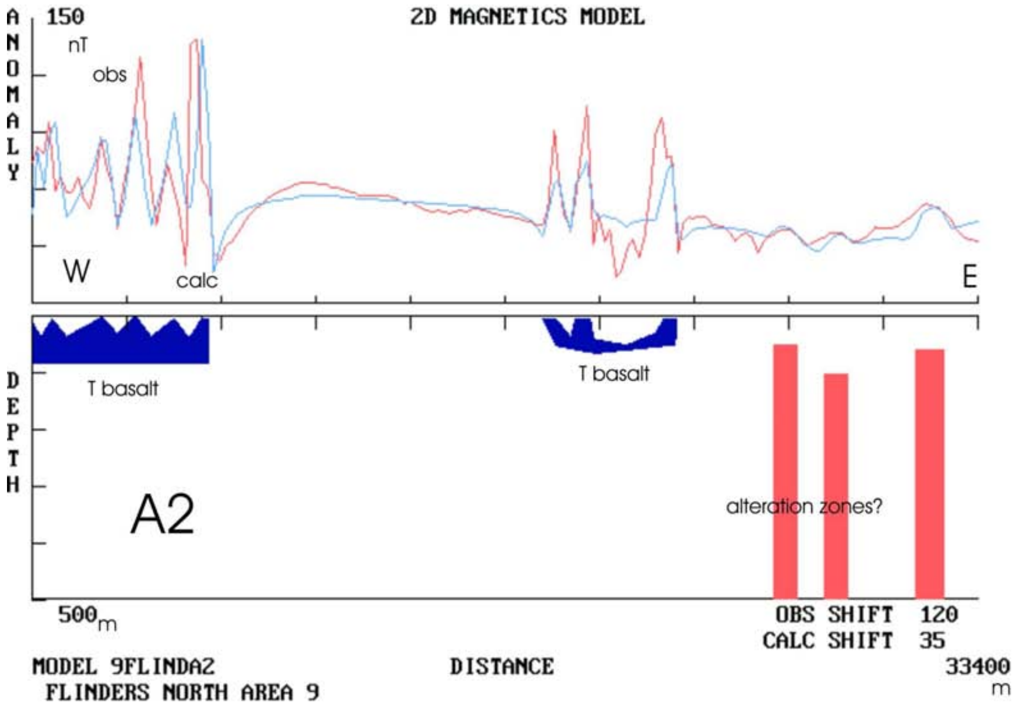
Modelling has confirmed these suggestions, and the regional character of the field is consistent with the existence of ultramafic slices at considerable depth. At least two such slices are present but the field and the interpretation of them is largely unconstrained since no surface elements are known which can limit some lateral relationships.

Models for 9FLINDA, at 5574 415 mN, (line 103670, from 566 500 mE to 599 900 mE),include the effect of a deep mafic body but the predominant features are related to basalt at very shallow, but variable, depth. No attempt has been made to fully evaluate the contrasts or thickness of basalt but it is rarely more than 50 metres thick and must outcrop (or nearly outcrop) in many locations. The average contrast of the basalt exceeds 0.013 SI.
Modelling (see Figure 40) also suggests that a suite of more subtle features is located at the eastern end of the profile. These have dyke-like anomalies of low amplitude and are probably due to felsic material or alteration zones within underlying granites. These are deeply weathered (30 to 70 metres) and have contrasts in the range 0.0013 to 0.0039 SI – as noted for similar features at Long Island.
The overall form of the magnetic profile, however, is determined by the presence of thin slices of ultramafics which dip shallowly to the east. It is not possible to reliably estimate the depth of this body.

Models for line B (line 104200, 5585 020 mN from 560 000 to 597400 mE) show the entire set of magnetic relationships (Figure 41). Version B1 shows the effect of ultramafics in isolation while the detail from B2 shows the effect of all sources. Due to the minor nature of the shallow materials and their limited depth range, model B2 shows only the shallow features and a projection of the presence of the underlying ultramafics. The implied magnetic susceptibility or contrast of the ultramafics interpreted in all three lines is in the range 0.04 to 0.16 SI. The detailed fit of the volcanic-sourced section of the profile depends on the considerable variations in depth and contrast (including weathering) within the shallowly concealed flows.
The model includes an alteration(?) zone near Cape Frankland. This may be a thick felsic dyke, or a relatively non magnetic mafic dyke - given implications at Long Island.

Models for line C (line 104700, at 5595 020 mN from 570 000 to 590 000 mE) are a limited length variation of the longer southern lines, but quite consistent with them (Figure 40). No attempt has been made to account for all the variations in the magnetic field due to the range of properties or depth to Tertiary basalts.

The models demonstrate that most of the magnetic character in the northern half of Flinders Island is due to variations in the Tertiary basalt drainage fills, but that these effects are superimposed on, and swamp, the underlying effect of east-dipping slices of structurally controlled ultramafics. The mafic rocks at depth account for the modest bulge in the intensity of the magnetic field in the region.



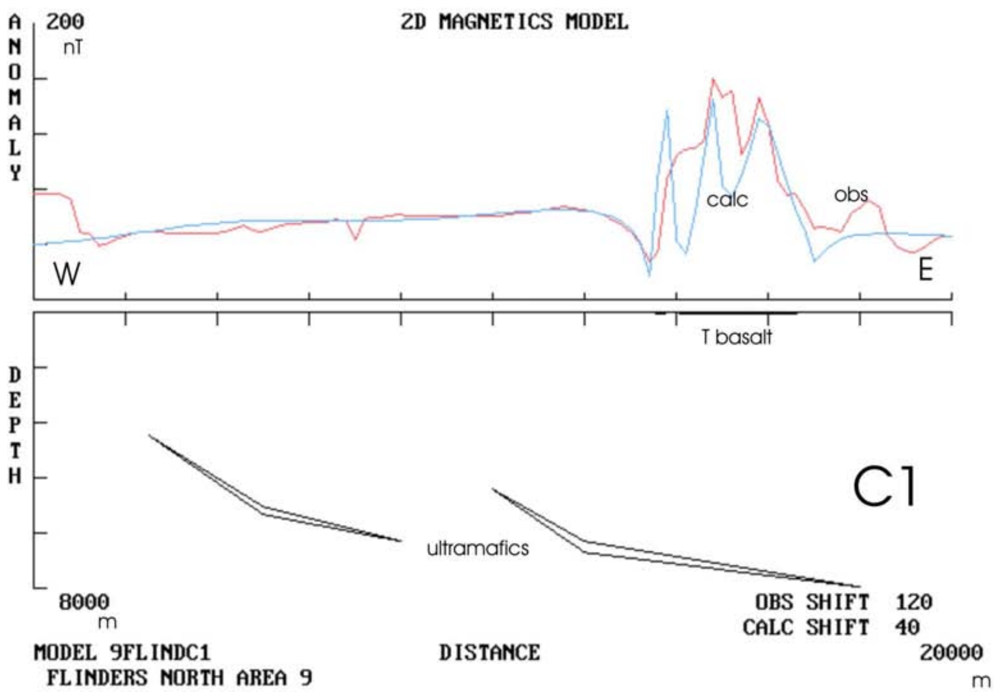


Figure 40. Models for North Flinders Island data lines 9FLINDA and C.
The models indicate the magnetic dominance of shallow Tertiary lavas but the underlying anomaly is regionally significant and requires thin slices of intensely magnetised material at depths of the order of 5 km or more.

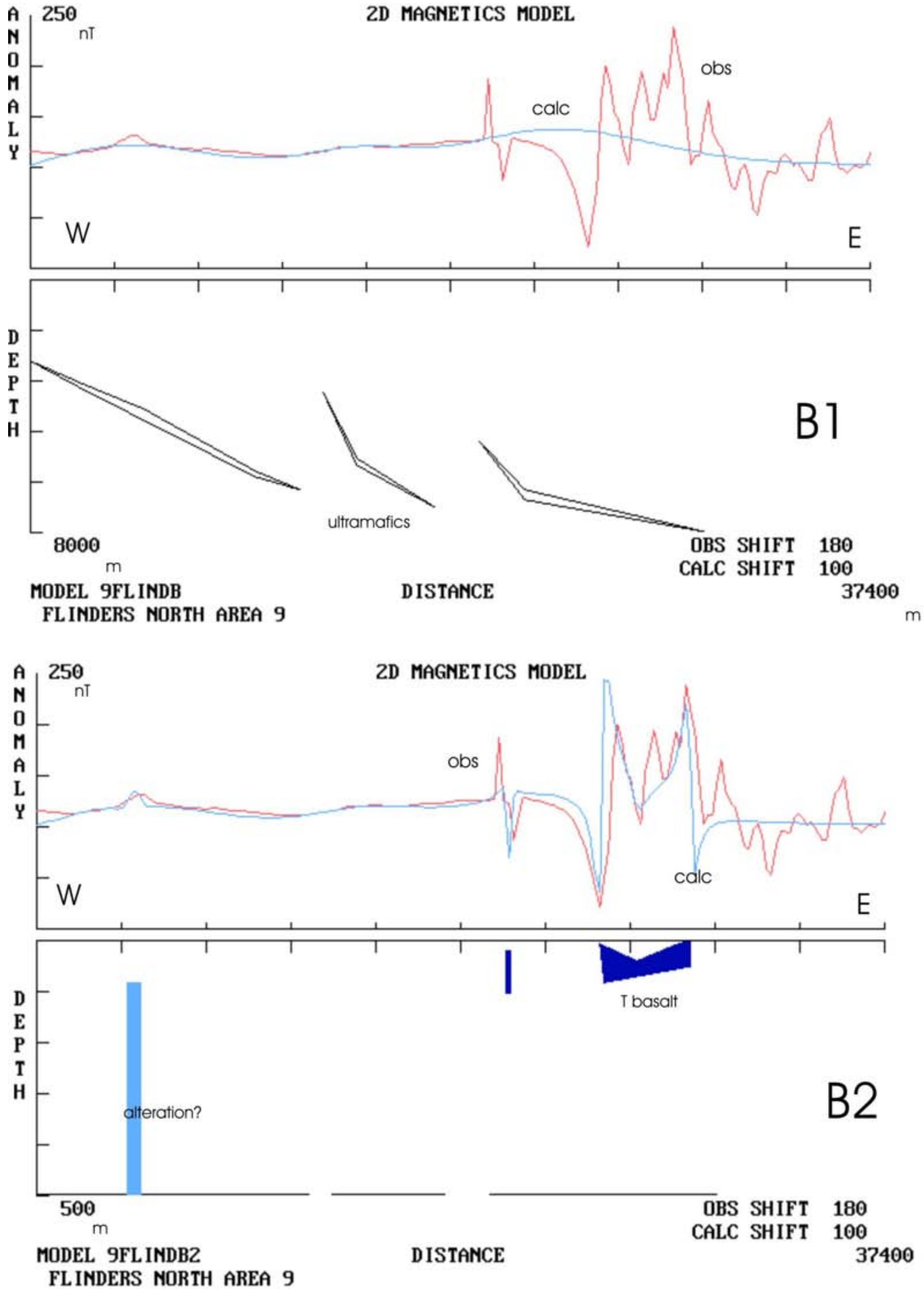


Figure 41. Models for North Flinders Island data lines 9FLINDB.
The models (shown in a regional full scale context – upper; detail of near surface portion – lower) indicate the magnetic dominance of shallow Tertiary lavas, modestly magnetised mafic dykes or altered zones near surface (lower diagram) but the underlying anomaly is regionally significant and requires thin slices of intensely magnetised material at depths of the order of 5 km or more (as shown in the upper diagram).

10. ALTERATION/DYKE? TEXTURE NORTH OF LADY BARRON

Pronounced trends have been observed in the magnetic field north and east of Lady Barron. Modelling of similar features in northeast Tasmania and on Long Island, off Cape Barren Island, has suggested that some of these may be dolerite dykes, whilst others may be felsic dykes or alteration zones. The group of structures shown in Figure 42 is relatively isolated but does present NNE trend patterns comparable to those found elsewhere.

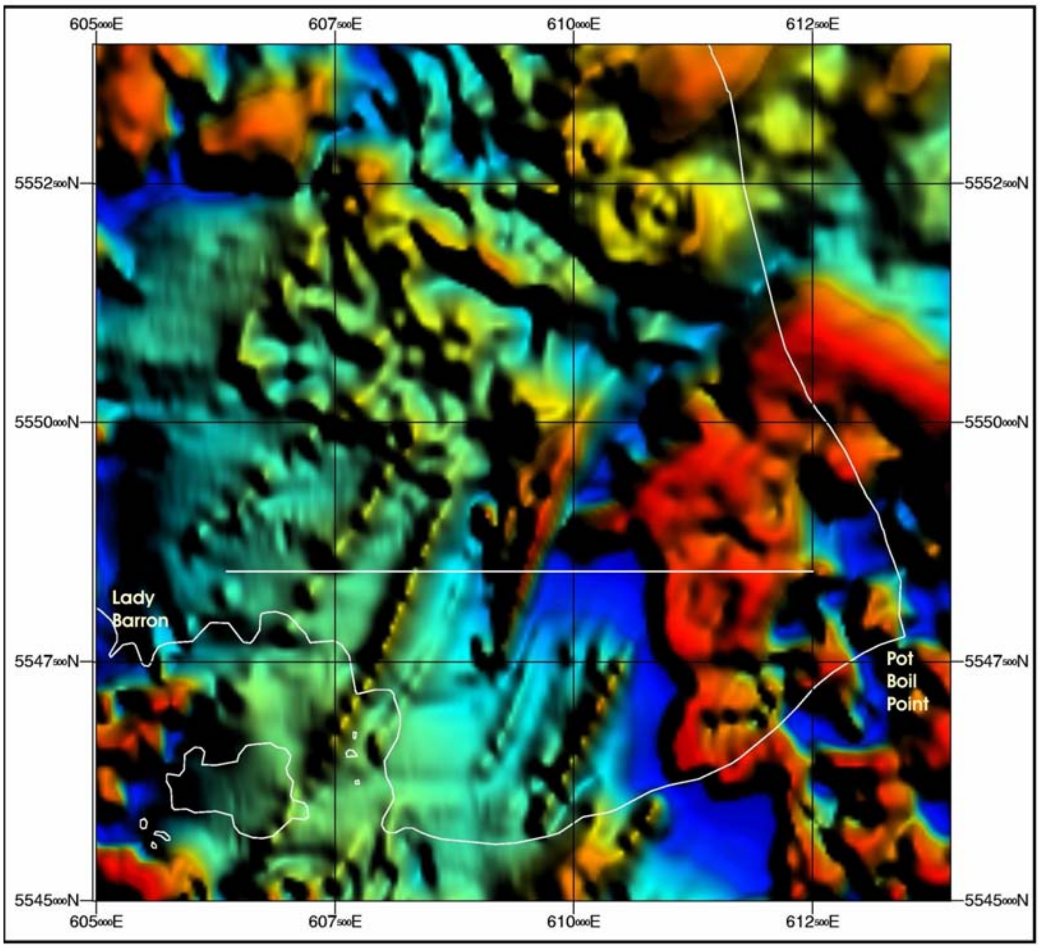


Figure 42. Image of Total Magnetic Field Intensity, northeast Lady Barron.

The dyke or alteration character has limited continuity and is lost within the disturbed magnetic field of the Tertiary volcanics in the north of the sampled area. The elevated magnetic field intensity close to Pot Boil Point is distinctive. There is evidence of the basaltic signature of the Tertiary volcanics but this is overprinted on a more regional effect. The western boundary of the change in magnetic character is marked by an elevated response consistent with boundary alteration. It is unlikely to be due to a filled channel deposit, including lavas, given the presence of volcanic patterns and a regional effect bounded by the change. The contoured version of the data (Figure 43) emphasizes the distinct character change in a manner that the image cannot.
Both types of magnetic feature have been assessed in the indicated profile.

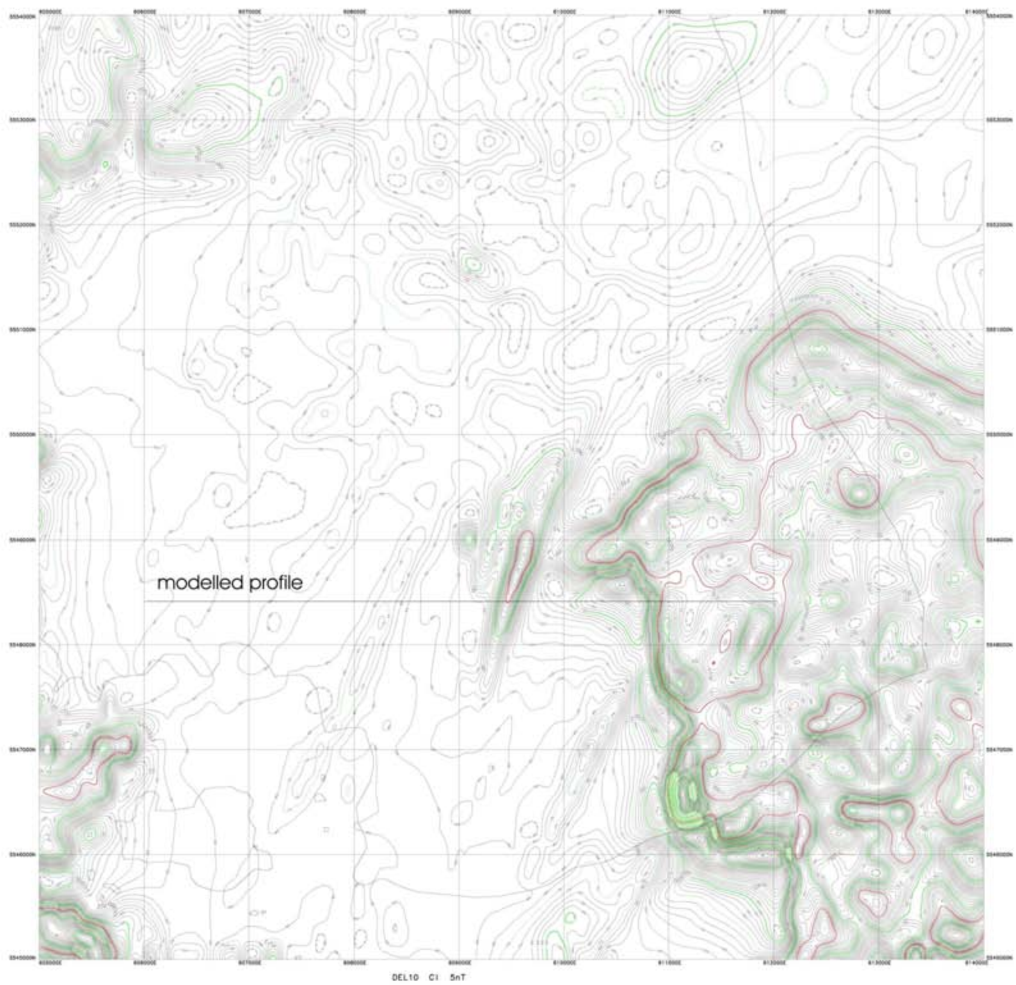


Figure 43. Contour presentation of Total Magnetic Field Intensity east of Lady Barron. The major anomaly near Pot Boil Point is evident, as is the strong gradient and anomaly ridge which forms the margin of the anomaly. This presentation places in context the character due to Tertiary volcanics, dykes, and another major regional source.

One observed profile has been modelled across these structures and the result is presented in Figure 44.

Analysis suggests that two subtly magnetised alteration zones (0.0013, 0.0025 SI) occur west of Lady Barron and that something much more magnetic (0.016 SI) occurs mid section (~609 500 mE). All features are shown in this model as the thick, low contrast solution and proportional changes similar to those defined at Long Island may be made to the interpretation. The anomaly, mid section, clearly represents a more magnetic version of the material, or has greater depth range. None of these alternatives can be separated with existing geological control but the contrasts implied, however the features are assessed, indicates a mafic composition but are likely to be lamprophyric rather than basaltic or doleritic.

East of Lady Barron there is a clear change in granite composition and a relatively magnetic granodiorite is indicated (0.006 SI). There is a marked contact zone anomaly which is in at least two parts, one very narrow and strongly magnetised (0.039 SI) and the other wider but reversely and lightly magnetised (0.004 SI). Tests of the contact suggest it dips steeply east.
The profile, coupled with the view offered by the contour presentation, shows that the eastern anomaly is not like the Tertiary channel anomalies, including basalts, seen in other models and other areas.

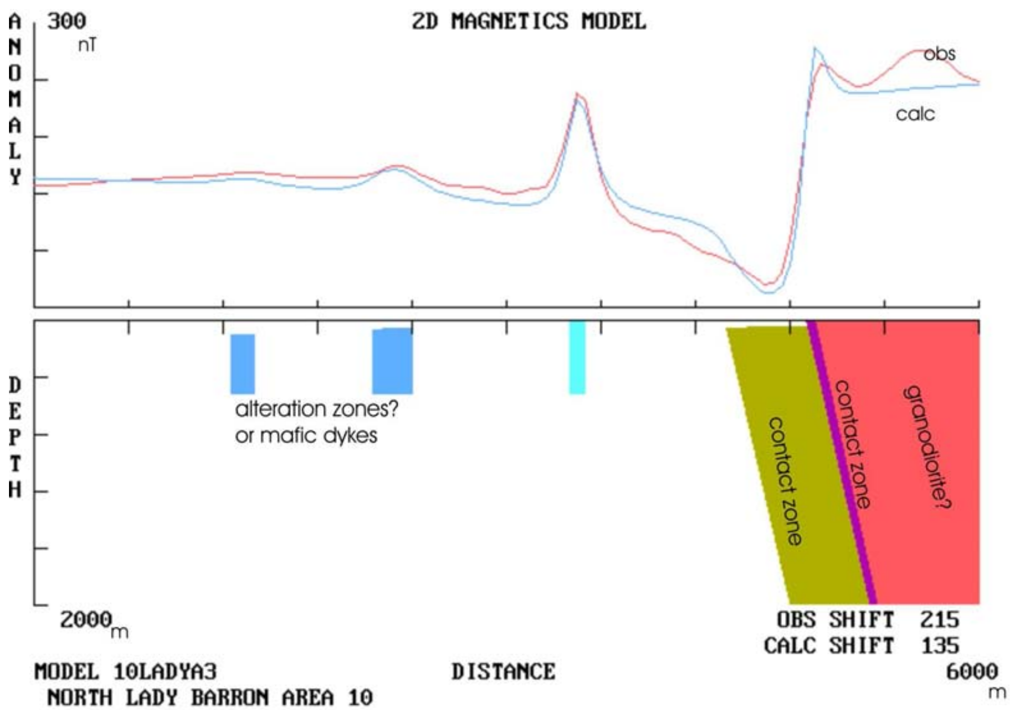


Figure 44. Models for the Lady Barron north zone of dyke-like features and the change in character of the magnetic field near Pot Boil Point..

SUMMARY

Ten regions or aspects of northeast Tasmania were selected for quantitative assessment in order to guide both the appreciation of, and further evaluation of, the 2007 Magnetic and Radiometric Survey of Northeast Tasmania.

The relative subtlety of effects and anomalies reduced many of these reviews to a few themes; such as the origin of the dyke-like features which cross the region (including Flinders Island), the possible presence of ultramafics at great depth to account for low amplitude-long wavelength features, the effect of metamorphism on the Mathinna Beds and the patchy presence of magnetic character within these units, and some isolated but distinctive features such as observed south of Ben Lomond or west of Lady Barron.

Webster (pers. comm., 2008) has considered the largest regional anomaly, located south and west of Bridport and concluded, consistent with previous interpretations, that it is due to **large slices of ultramafics**.
Other, smaller, anomalies of the same type are located near Blue Tier and on Flinders Island and have been reviewed in this report. All can only be explained by thin slices of intensely magnetised material at depths of three to six kilometres, approximately.

The large, isolated anomaly south of Ben Lomond and east of Rossarden can, similarly, accounted by a slice of comparable material, although other solutions are possible in this case which may prove both more realistic and important stratigraphically if any more detailed ground work or interpretation can be undertaken.

The slices of ultramafics which have more regional extent and which are not of ambiguous presentation, appear to splinter from a soling thrust, dip eastward near Ben Lomond and on Flinders Island, but westward near Scamander and Blue Tier. This interpretation of them confirms the inferences outlined by Keele *et al* (1994) in a conceptual structural model.

The **dyke-swarm character** evident in image presentations of the data has been reviewed carefully. In the Scamander-Blue Tier-Eddystone sub region it is clear that many of these anomalies are due to narrow dykes of dolerite, or equivalent material. Some anomalies correlate directly with known dykes, others represent continuations of limited exposures, while others may be inferred to be due to similar structures. Such dykes are typically 10 to 30 metres wide, steeply dipping and with modest magnetic properties consistent with mafic rocks. The same region, however, contains mapped dykes with no magnetic expression and it is possible that dykes are of different ages and structural origins and location. This response pattern is consistent with the observations of Cocker (1982) and more recent sampling by Dr. M. McClenaghan (pers. comm. 2008).

In other areas, such as around Flinders Island (Long Island and Lady Barron north) and in the region of Mt Paris, there are dyke-like anomalies which are not necessarily associated with strongly magetised mafic rocks. Either none are known in these areas, or the inferred properties and dimensions are not consistent with a solution such as

dolerite dykes.

In the case of Mt Paris the anomalies may be due to larger felsic dykes or alteration zones within the granitic rocks. These features, typically, exceed 100 metres in thickness and may represent greisens. Greisens have been mapped but their scale and chemical content – and its effect on magnetic properties – has never been assessed. Some research on these associations may be of economic value given the association of mineralisation with some of the greisens.

In the Bass Strait and Furneaux Group region the dyke anomalies appear to be due to modestly magnetised mafic rocks, probably lamprophyres, which may be Cretaceous in age. This appears to be the explanation at Long Island, central Flinders Island and near Lady Barron.

All dyke-type features display some variation in properties but, more critically, considerable variation in approach to surface. Their full magnetic contrast is rarely applied at depths less than 25 to 50 metres indicating the presence of substantial weathering or covering materials, effects which may well have constrained the mapping of them. Appraisal of these features leads to estimations of thickness, depth to upper surface, depth range and magnetic contrast. Regardless of assumptions there are distinct groups of materials, some definitely basaltic, others much more subtly magnetised. Complete evaluation of these features, now that many of them can be accurately located, will depend on ground observations (geological and magnetic) in order to constrain either some element of their geometry, or magnetic properties.

The region contains a large number of **isolated point anomalies** and many of these can be associated with mapped patches of Tertiary basalt. Others present no such correlation, perhaps due to the realities of regional mapping or limited exposure. While it has been suggested that these features mark the sites of volcanic vents detailed two and three dimensional review indicates that some may be vents and others may be remnants of basaltic flows. Most possess intense magnetisation with at least some component of remanence, and the magnetisation is generally variable across the location.
There is need to locate and review many of these features and note composition and properties. Dr M. McClenaghan (pers. comm.) has already, as a result of preliminary inspection of the data of this survey, found several sites and their character and content is often consistent with vents.

Parts of the Mathinna Beds also present marked magnetic character. Such sites tend to be very isolated and not predictable, but are not consistently associated with contact zones or any other obvious feature. Most appear to represent a distinctive part of the succession which is dominated by pelites and considerable lithological variability.

A zone east of Gladstone has been examined previously and there was some explanation of the variations in properties.
A more intensive effect has been observed in the present survey west of Mathinna and the rocks are far removed from granitoids- as far as can be judged with extant contact indicators and gravity data, and the implied magnetic depth ranges. Interpretation suggests, however, that a bracket of rocks may be repeated within thrust slices since the effects appear depth limited – at both top and bottom. This solution is consistent

with structural styles within the detachments known or inferred within the Mathinna Beds succession. The relatively magnetic rocks may thus represent a particular part of the succession and their presence could prove important to unravelling relationships and timing of deposition.
Dating of this unusual part of the succession, if fossils can be found, would be both interesting and important to understanding of the region.
More detailed magnetic analysis would be justified of each of the zones where the Mathinna Beds have magnetic character. It may be noted that one of the bounding blocks may lie north of the South Esk River and its eastern boundary may lie along Dan Rivulet. There is scope for much more work and it is recommended.

The full value of this survey will only be realised once a range of features and their sources have been sought on the ground and the geometric and magnetic characters observed introduced to yield a revised interpretation.

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Report submitted on behalf of Leaman Geophysics
by

Dr . D. E. Leaman
Feb 21, 2008

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.

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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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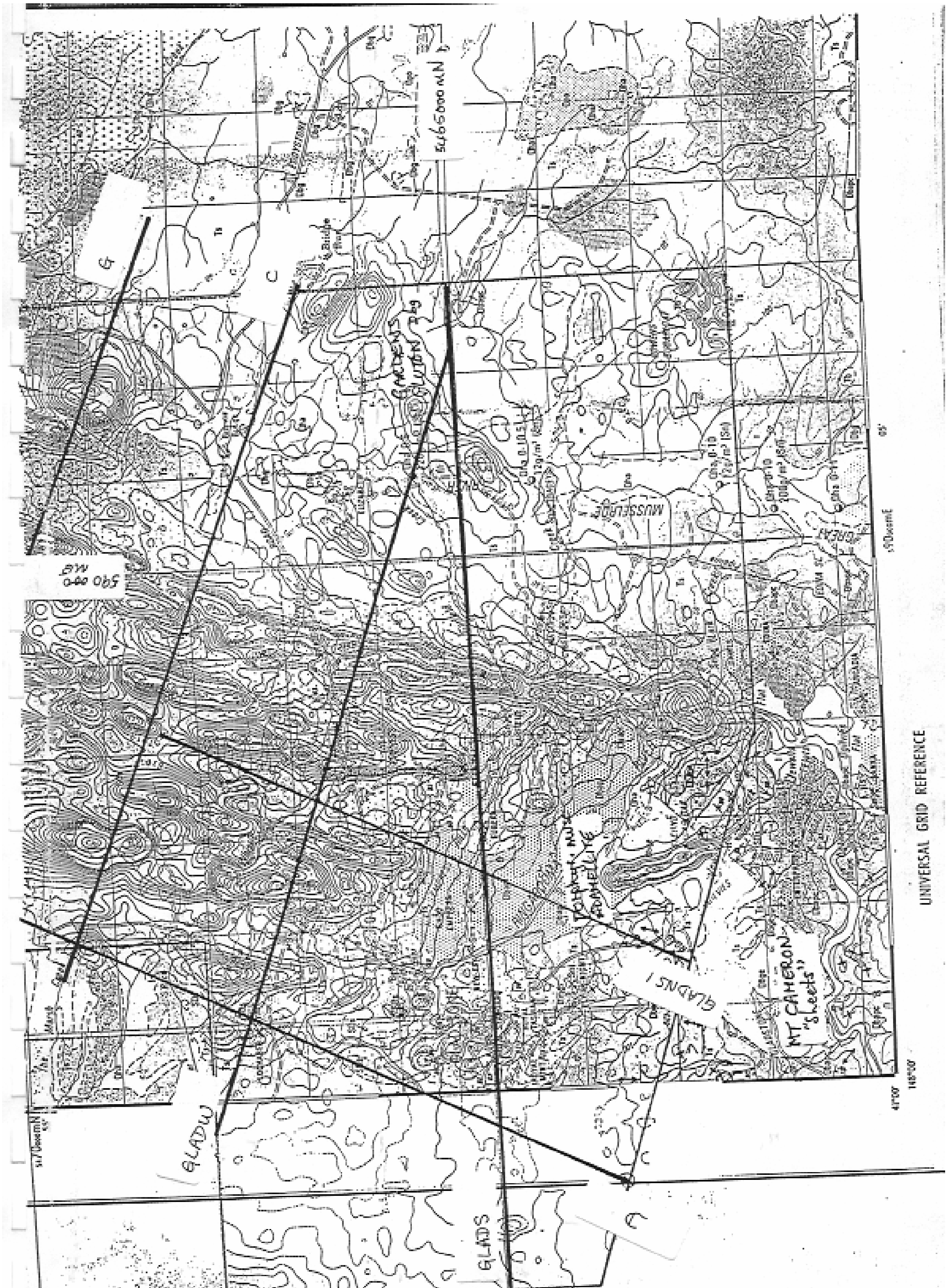
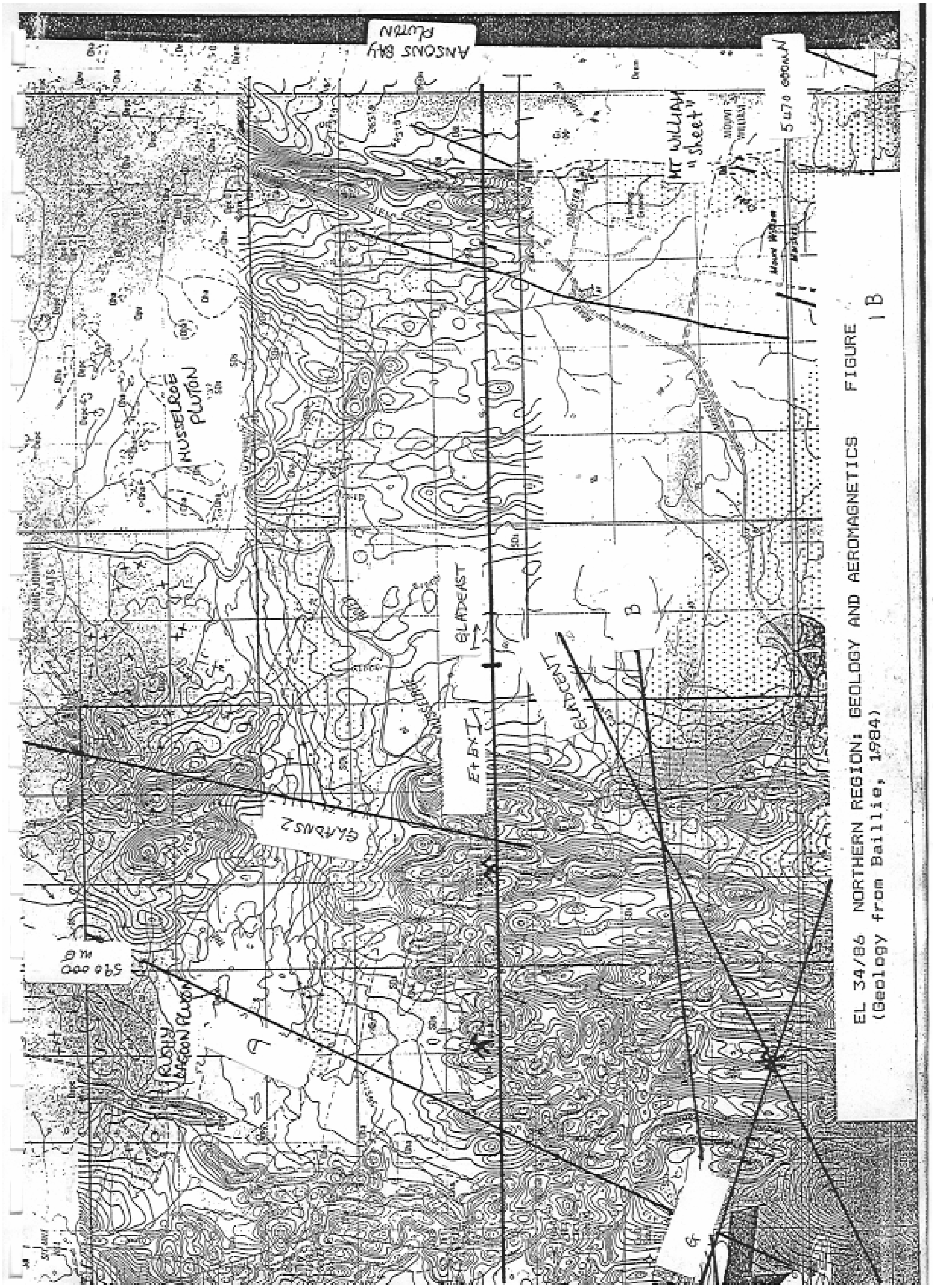
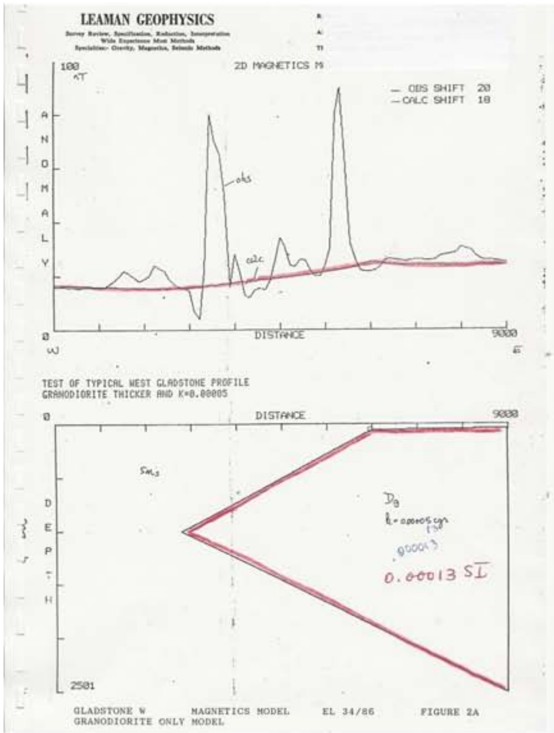
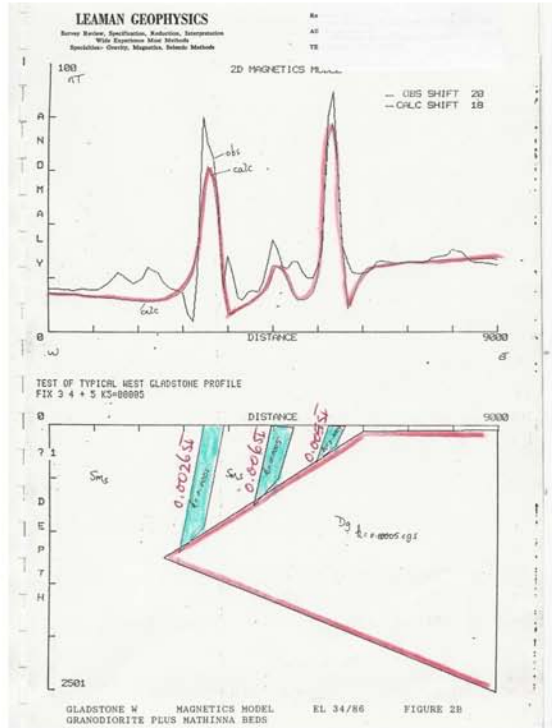


EL 34/86 SOUTHERN REGION: GEOLOGY AND AEROMAGNETICS FIGURE
(Geology from Baillie, 1984) A



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





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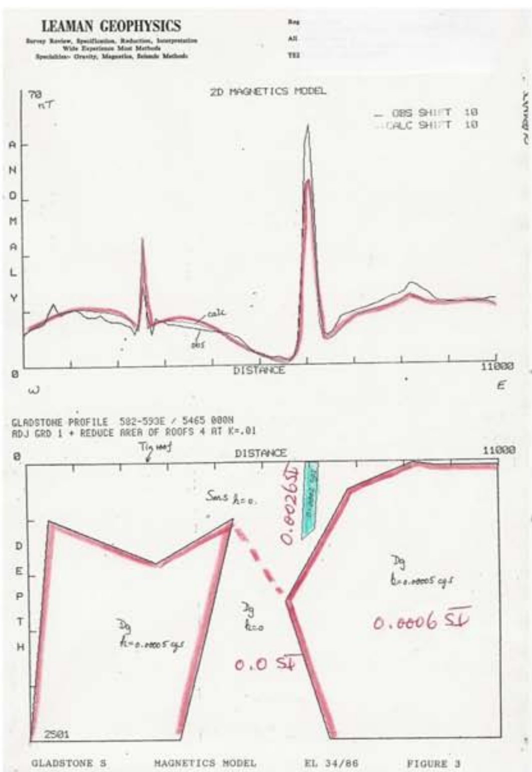
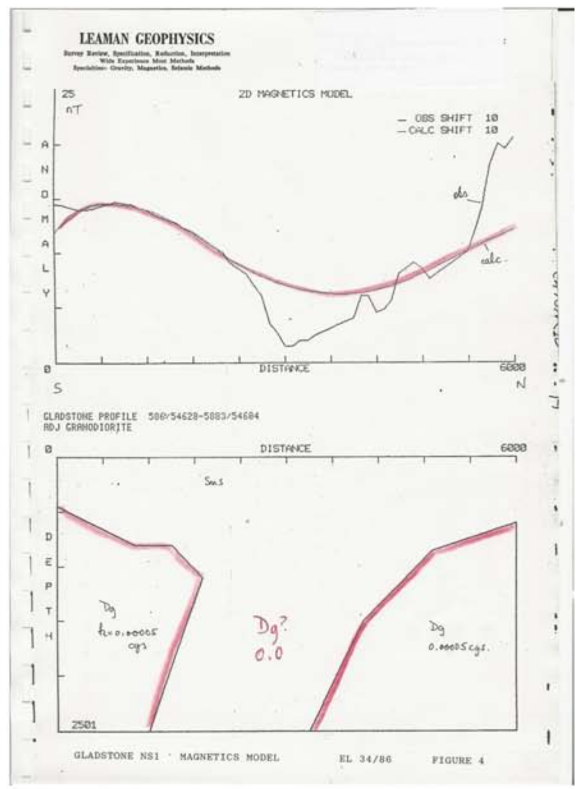
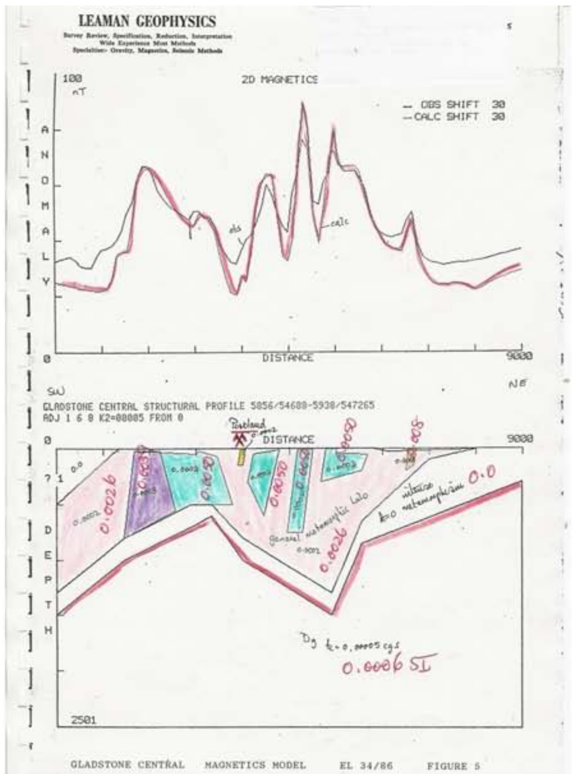




GLADSTONE S 3 GLADSTONE NS1 4



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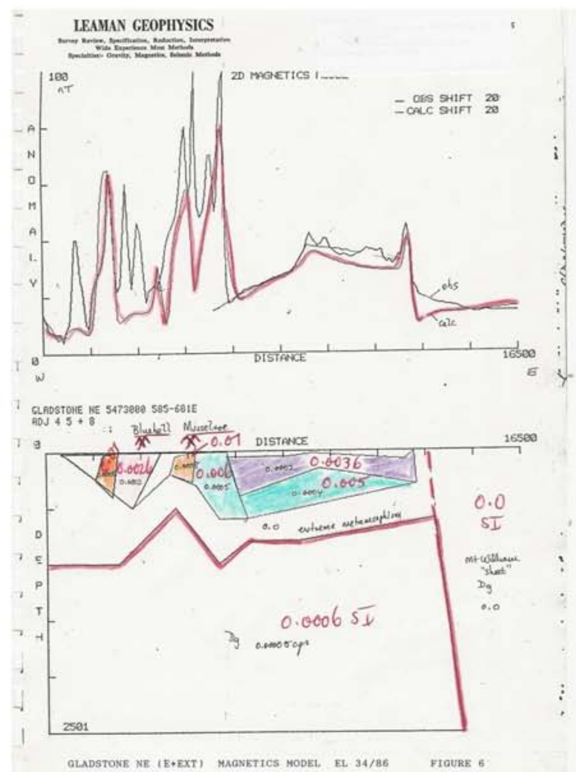

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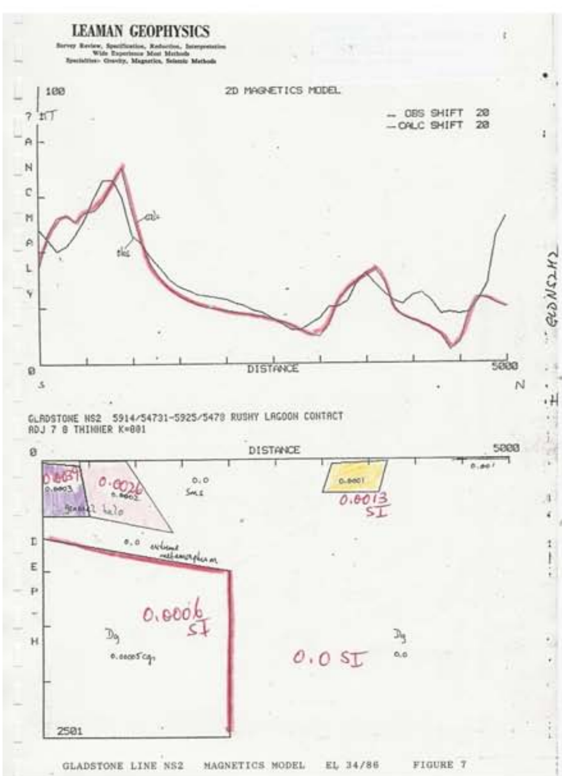

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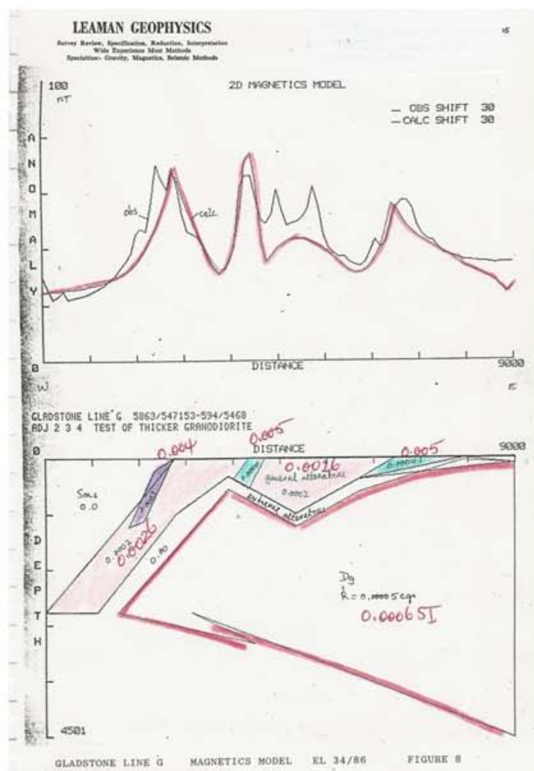

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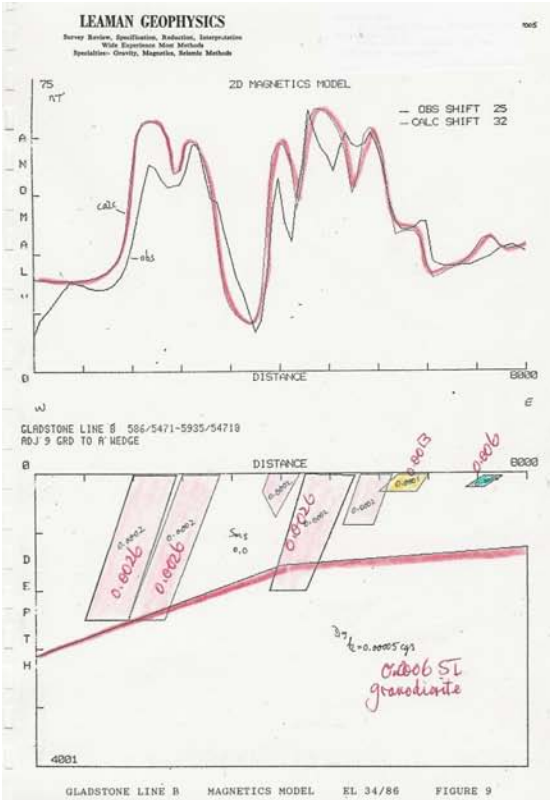

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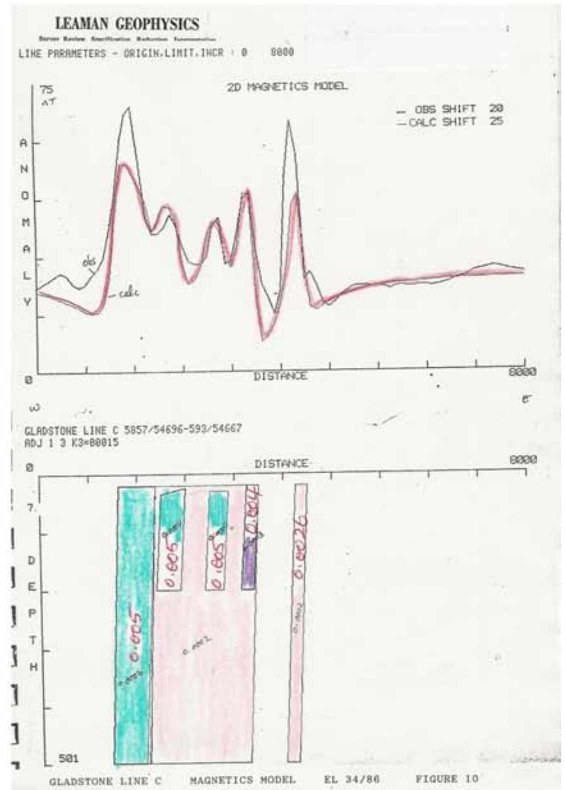

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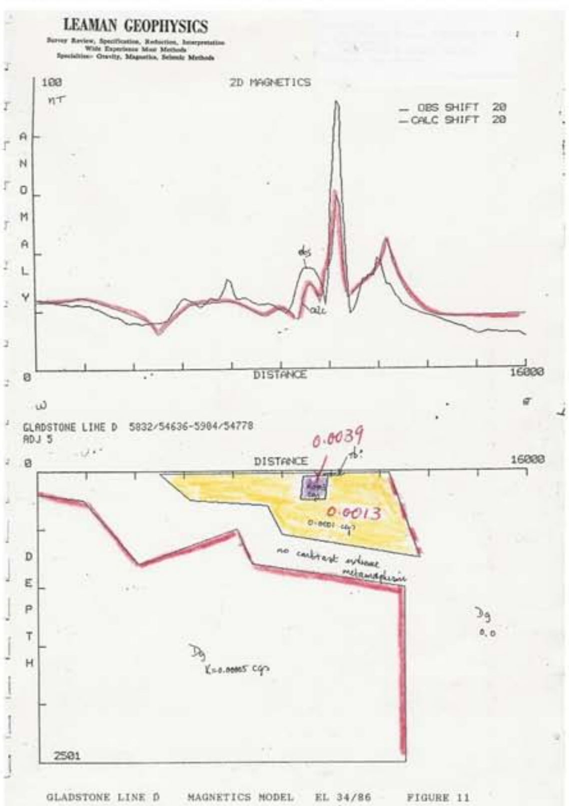

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NORTH EAST TASMANIA

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.