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DATA ENTRY

001

Project Arthur River Project DB Number _____ Date May 1990
 Prospect _____ X Ref ROCKYCAP
 Company Leaman Geophysics
 Title Geophysical - Structural Review Rocky Cape Block NW Tasmania
 Author Dr D E Leaman
 Key Words Gravity Aeromagnetics Arthur Lineament Smithton Trough ~~and~~ Thrust Faults
 Near Town Smithton Country _____ State _____ Volumes 1
 Commodities Cu Au Pb Zn Pages 74
 Amendments EL 40/89, 41/89, 42/89, 43/89, 44/89, 45/89, 46/89, 52/89, 1/90 Plans _____
 Comments 1 Comments 2 Structure Text + Text Figures

Latitude Deg 41 Min 00
 Longitude Deg 145 Min 00

MAP SHEET 1:250 000 SERIES
 Map Names _____ Map No _____
 Map1 BURNIF SK55-3
 Map2 _____
 Map3 _____

Stored At _____
 Shelves At _____

MAP SHEET 1:50 000 SERIES
 MAPS _____

Classification
 Name: MAPN03 Kind: Nonkey Type: Text Size: 8
 <edit_keys> <change> <select> <menu> <search>

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LEAMAN GEOPHYSICS

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

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

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GEOPHYSICAL - STRUCTURAL REVIEW
ROCKY CAPE BLOCK NW TASMANIA

for
GEOPEKO

by
Dr. D.E. Leaman

May 1990

TCR 91-3213

ELs 40-46/89, EL 52/89
EL 1/90

LETTER
8-1-91
REFERS

ROCKYCAP

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SUMMARY

Review of extant regional gravity and magnetic data across north western Tasmania west of Waratah and Wynyard, comprising the Rocky Cape Precambrian Block and surrounding suites and structures, has shown that the Rocky Cape Block core zone has a substantial thickness but has still been detached and displaced to the east by at least 25 km. The age of the thrust is probably post Eo-Cambrian but this is not established with certainty.

The displaced Rocky Cape Block overlies a stack of steeply dipping, and probably faulted and sheared, rocks which are dense and contiguous with the Burnie and Oonah Formations but which also include mafic and perhaps ultramafic rocks. The possible presence of the latter suggests a maximum age for the thrusting. Rocks of the type exposed in the metamorphically defined Arthur Lineament occur beneath the thrust. It seems likely that the original structural-deposition margin between Rocky Cape Group rocks and the Burnie Formation has been offset and concealed.

The rocks and sequence of the Smithton Trough have been carried east with the Rocky Cape Block motion. This folded sequence onlaps the Rocky Cape Group. There is some evidence that volcanism and centres have been controlled by major ESE-trending structures but in general the volcanism appears to have been sheet like and apparently reasonably uniform and continuous across a width of at least 40 km. The Trough section is gently folded and the zone of steepened dips south of Smithton may also be locally faulted. It is not possible to demonstrate growth faulting in this area.

The approximate NNE-trending axis and orientation of the Smithton Trough continues SW of Balfour until terminated by the Pieman Granite. The exposed Precambrian rocks which extend along the coast south from Marrawah to the granite, and inland as far as Balfour, are themselves overthrust from the west. This structure has a very shallow dip, has been folded gently, and generally buries the Trough rocks by less than 1.5 km of Rocky Cape Group rocks. It is this structure, or perhaps series of structures - if the magnetic anomalies are indicators - which disrupts the continuity of the Trough pattern and produces the "V" shape of the Trough.

The Pieman Granite has been shown to be a much larger granite body than previously thought and to extend inland as far as Balfour and Pyramid Hill. It intrudes both the Rocky Cape Block core zone and the complex overthrust Temma Block and Smithton Trough. Its presence and extent establish beyond any doubt the mobility of these supposed basement blocks. All have been detached and the latest movement may have been Devonian. The shape of the granite near Pieman Heads may also have been influenced by the dextral sense of displacement indicated along the major, old, shears which constitute part of the lineament zone and the disruption of the Burnie Formation and old margin.

Magnetic anomalies within the lineament zone, in the Burnie Formation to the east, and from sources west of it beneath the primary thrust indicate that the set of NNE to NE - trending

shears have been offset by a family of smaller dextral motions which appear to radiate from the intrusive centre of the Pieman Granite. There is also evidence for a subtle fracture grain within the eastern half of the Rocky Cape Block. This is not known from surface evidence but the magnetic texture is distinctive. The location of the Permian deposition south of Wynyard, including Jurassic intrusives, and the Guildford flood basalts of the Tertiary indicate rejuvenation of the underlying shear system.

The fault slices which have affected the Burnie Formation and which can be mapped by the effects on displacement of, or introduction of, mafic rocks are rarely more than 2 or 3 km wide but may be 20 km long. This pattern of disruption is evident across the entire area west of the Henty Fault system and its possible projection to the north coast near Penguin.

The Meredith and Husetop Granites intrude this disrupted zone and their emplacement and orientation appear to be controlled by it. Similarly the orientation of the Dolcoath and Heemskirk-Tor Granites is consistent with the tensional stress field generated by a dextral couple between the Henty or similar structure in the east and the old sheared Burnie Trough margin in the west. The second order dextral shears which fan across the area also possess this orientation (E-W to ENE) and may be more significant in terms of mineralisation and exploration.

Although the region is not known to be richly mineralised this may be an artifact of the type of mineralisation present or sought in the past.

This review has demonstrated that the tin at Balfour is related to the roof and extent of the Pieman Granite. The scale of this body must now cause some re-evaluation of the prospectivity of the area from its coastal exposure to Pyramid Hill. There are many unexplained magnetic responses and patterns in this area and the gravity data, not yet modelled to yield intrusive form, also indicate an irregular roof. The real issue now relates to host rocks and it is at Balfour where the Temma thrust has concealed dolomites in close proximity with the granite that this potential is greatest. The known copper and tin shows near Balfour are presumably fracture releases or represent mineralisation loss along perhaps the thrust surfaces. Sensible exploration can only follow definition of the granite form and possible projections of probable host units. Gravity survey infill and follow up modelling of the granite is recommended. The magnetic data should then be used to confirm and rate targets.

It has also been shown that the Meredith Granite extends into the Waratah area. Limitations in available gravity coverage restrict judgments about relationships and structures but several cupolas are indicated. Some lie concealed beneath Cambrian and Tertiary cover. Gravity survey infill is recommended.

Modelling of granite form should establish possible tin targets but also explain the nature of the Magnet Pb-Ag deposit and whether the Magnet dyke is related to the granite or the primary shear system.

It is only in the Magnet area that Pb-Zn-Ag deposits are known and there may be a specific relationship between granite fracture systems and emplacement. Host rocks may again be critical.

Copper mineralisation is known in trace or sub-economic forms across much of the region. This provides both a paradox and perhaps an opportunity. I have inferred that it has been derived from the mafic suites by a sulphide-carbonate exchange mechanism within a tensional environment. This is a variation of the Mount Isa style copper model. It would certainly explain the occurrences at Balfour, where mafic volcanics and dolomites are in virtual contact with granite and the whole system is concealed by thrusting, and along the lineament where shearing of mafic and carbonate units near possible fracture intersections, which may have carried fluids, has occurred.

Any copper deposits produced in this manner will differ from any previously sought in Tasmania. They will not be obvious and they will be concealed within purified silica and carbonate occurrences produced by the exchange. There are only two indicators; a coupled occurrence of silica and pure carbonate and a massive alteration of underlying mafic units. Ground search for the chemical indicator is recommended and if any sites are found then careful magnetic assessment should follow to estimate altered volumes. Unless these are large, several cubic kilometres, then no worthwhile deposit of this type is likely.

Exploration around Balfour should take similar forms but gravity and magnetic data must be used to define possible targets; the presence of localised, but fully concealed, alteration being the primary indicator in such situations.

An association between sheared carbonate units in contact with mafic rocks has been suggested previously within the lineament rocks. Most occurrences are, however, alluvial. It is possible to suggest on the basis of the present review that these alluvial occurrences are not random and may be associated with the primary N-S shear system or perhaps the lateral offsets. All sites should be accurately located with respect to the magnetic gradients and possible host pairings. Purified or altered carbonates may be a crucial indicator for gold as well as copper.

Gravity data indicate a large volume of mafic materials beneath the general axis of the lineament and this may provide a source for the mineralisation, or at least the exchange elements. The magnetic data indicate the location of the structures and their patterns. All strong alignments which can be associated with a fault or shear block should be ground located. Some of these lie beneath the Rocky Cape Block thrust or Permian cover.

INTRODUCTION

Geopeko hold nine exploration licences within the region N and NW of Waratah in NW Tasmania. These licences cover a very large proportion of the Precambrian Rocky Cape Block. The licences are shown in Figure 1. These are

EL 40/89 Keith River
41 Mt Bertha
42 Rapid River
43 Holder Rivulet
44 Wedge Plains
45 Savage River
46 Julius River
52 Balfour
1/90 Meunna

While the licences are centred upon the Rocky Cape Block several extend across its margins and include parts of the Smithton Trough, the Arthur Lineament and the region around Waratah. Apart from the area nearest Waratah none of the licences include zones of significant discoveries or previously worked mineralisation. Limited prospecting discoveries in earlier times has led to some exploration neglect of the area. Terrain and vegetation have not assisted. The result today is an area which is not well understood and certainly under explored.

In order to upgrade appraisal of this region Geopeko have specified the broadest possible review of extant data across this little studied region with particular emphasis toward identification of structural controls and setting.

Apart from the Waratah-Luina area, where tin mineralisation is associated with the Devonian Meredith Granite; the Heazlewood area with nickel and osmiridium associated with ultramafics; and the Magnet area where lead-silver is possibly associated with the Meredith Granite few other mineralised sites are known. The exceptions are near Balfour and Mt Holloway where copper occurs. Tin is also common at Balfour and Leaman & Richardson (1989a) have suggested that an extension of the Pieman Granite may explain this. Additional data from this area are reviewed in this report but the presence of copper is curious and anomalous and raises an important question: just what types of mineralisation could the rocks of the Rocky Cape Block conceal?

There are some other corollary questions. What is the origin of the Rocky Cape Block rocks. Are the surface materials representative and could the indicators of mineralisation be subtle and easily overlooked?

The brief for this study was consequently broad. All possible target styles have been nominated, including sedimentary hosted Pb-Zn of McArthur River type (Rocky Cape Group), Irish-style carbonate hosted Pb-Zn (Smithton Trough), shear related gold

(Arthur Lineament), volcanogenic Cu-Zn (Arthur Lineament) or carbonate replacement tin (Waratah and Balfour areas).

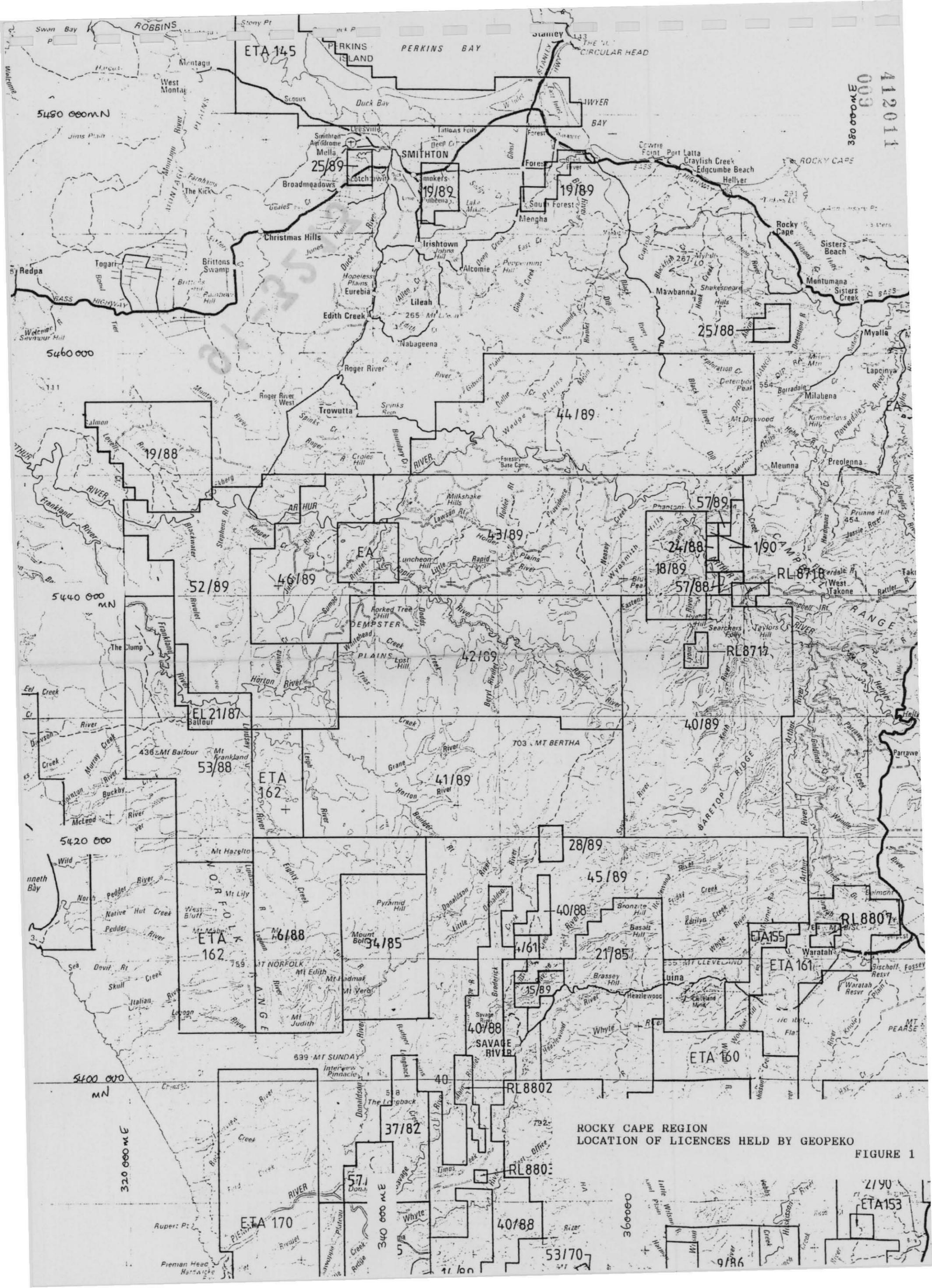
Structural definition, or assessment of controls, is crucial to delineation of anomalous areas, evaluation of what is known, and rapid exploration and reduction of exploration area. Structures which must be defined or located include features which may have been feeder zones in the late Precambrian, basin margin or growth faults, major shears and stress systems, second order tensional features related to major structures and granites or granite-related cupolas and fractures.

Some characterisation of anomalies, of the type indicated by Leaman (1986), was also sought.

The study was required to emphasize the area covered by licences but was not restricted to it where issues of regional setting or extension of structures might direct attention to other sites nearby.

This report provides a discussion of data available in the public domain and its possible structural interpretation in regional terms. Specific and more detailed follow-up studies are recommended. The analysis described represents an evolution and expansion from previous partial or regional reviews I have undertaken (Leaman, 1988a, d; Leaman, 1986b; Leaman & Richardson, 1989a). This report would not have been possible without some of the building blocks provided by this previous work.

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009
350 000 M



ROCKY CAPE REGION
LOCATION OF LICENCES HELD BY GEOPEKO
FIGURE 1

DATA

Geological

The geology of the area has been summarized by Williams & Turner (1973). More recent work by Lennox et al (1982) and unpublished mapping of the Trowutta and Corinna map sheets has not yet produced radical transformations of this basic compilation.

While the lithologies and associations of rock suites comprising the Rocky Cape Block and its fringing sequences (Smithton Trough, Burnie Formation, Arthur Lineament) have been described and some fine structure recognised the first order structural relationships have not been established and the region remains enigmatic.

I attempted to unify diverse arguments and possibilities using gravity and magnetic data (Leaman, 1988a, c). Several suggestions were made on the basis of this work.

The Smithton Trough represents a shallow tensional development on the Rocky Cape Block.

The eastern margin of the Smithton Trough is compound and possibly a growth fault.

The Arthur Lineament rocks represent a sheared, structured basin margin involving the Rocky Cape core and the Burnie-Oonah Formations.

The Temma-Balfour zone is overthrust on the Smithton Trough and Rocky Cape core sequences implying major post EoCambrian motion.

The Rocky Cape core may represent a very thick block of silicic Precambrian and be true insitu basement.

The mobile zones, flanking the core zone, have been intruded by Devonian granites and these intrusions mirror old trough axes.

There is a stack of mafic and ultramafic bodies extending east from the Arthur Lineament zone. Some are within the Burnie Formation axis.

The Lineament itself may be a compound structure with a massive sliver deeply buried by the Rocky Cape Block core zone. The implications of this inference are far reaching and affect several of the above.

These provisional conclusions illustrate the range and types of issue which must be evaluated in any study of the Rocky Cape region.

Leaman (1986a, b; 1987) has also suggested that sub E-W controls may be relevant to emplacement of mineralisation and that these reflect primitive and very deep seated crustal fractures. Mineralisation near Balfour, Interview River, Waratah and Savage River can be generally correlated with such features - either in the form of dyke orientations locally or magnetic trends. The E-W component at any site is always dominated by other more shallowly-sourced trends, strikes or formation character.

Magnetics:

Magnetic survey data have been used to appraise some of the geological possibilities listed above. Some character is obvious.

Compilations of the magnetic field are available for the entire Rocky Cape region (Leaman, 1986a; Bishop, 1987). These compatible surveys undertaken by the Tasmanian Department of Resources and Energy and the Commonwealth Bureau of Mineral Resources were flown with a nominal terrain clearance of 150 m and a line and sample spacing of 500 and 40 m respectively.

Contour presentations are shown in Figures 2A, B and images for the BMR portion are provided in Figures 3A, B and C. Both surveys have been assessed and general comments offered for the Rocky Cape area (see especially Bishop, 1987). Bishop also evaluated single profiles across the eastern margin of the Smithton Trough and the Arthur Lineament. His solutions are simple and not obviously in accord with the sectional compilation of Williams (1988) or the gravity models of Leaman (1988a).

Inspection of Figures 2 and 3 reveal some clear trends but these have not been discussed previously.

The magnetic data north of 5410 000 mN have been underutilised and the implications of this data set have not been seriously reviewed or considered. No analysis of trends, possible alteration patterns, structural continuity or inconsistencies comparable with Leaman (1986a) has been attempted for the northern data set.

Several outstanding features of the magnetic field may be recognised and must be explained. These include

The circular swells of anomaly near Montagu.

The extended sweep of anomalies from Marrawah to the Pieman River near the coast.

The belt of anomalies from Stanley to Balfour and their truncation near Balfour and division near Edith Creek.

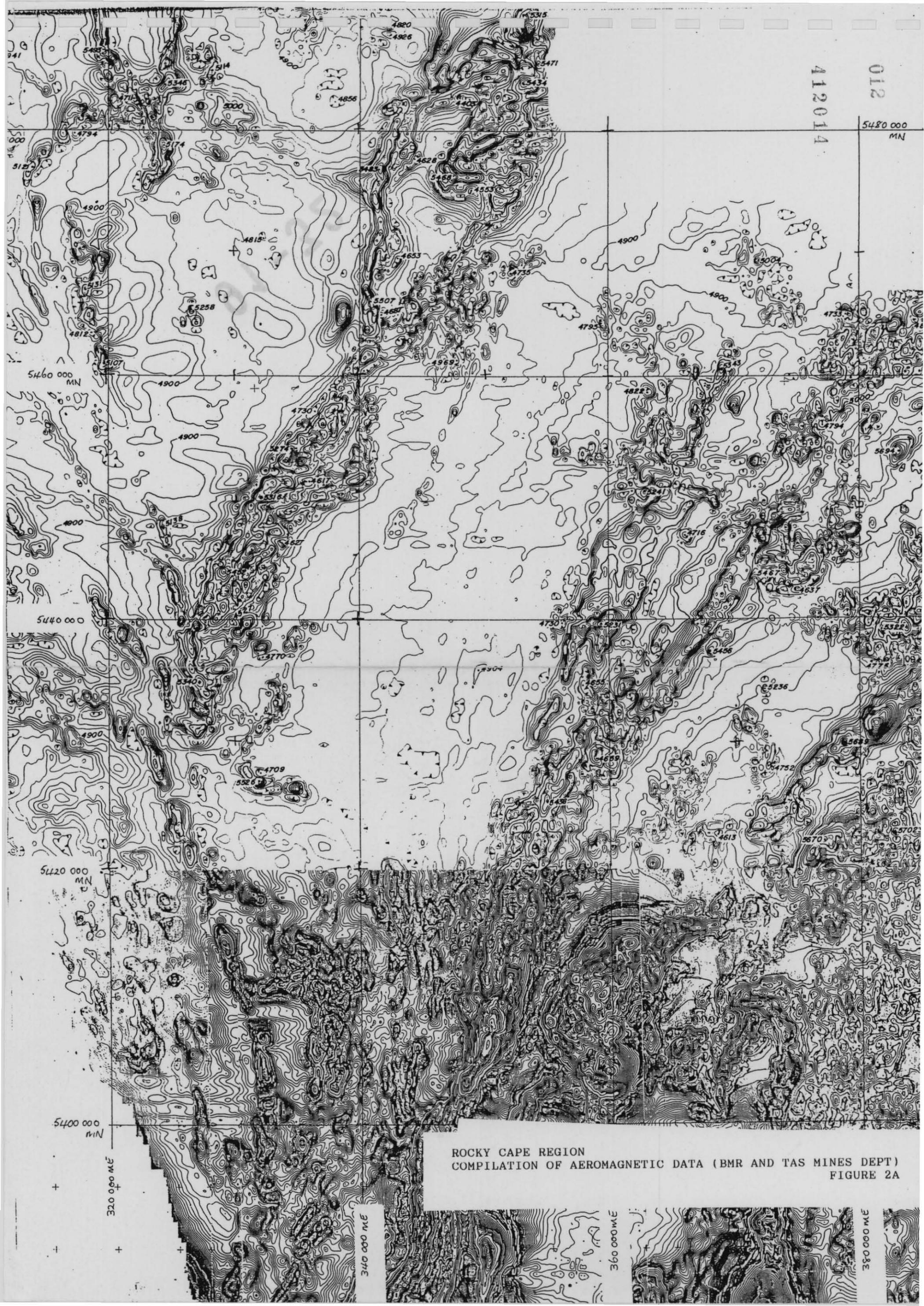
The relative barrenness of the Rocky Cape core zone and the origin of at least two subtle grains within it; one of which is offset in several places.

The variable trends along the Arthur Lineament and the loss of character south of Wynyard.

The bifurcation of Arthur Lineament anomalies near 5425 000 mN and the northerly truncation and apparent plunges of sources along it.

The origin of the gross WNW, NW and EW trends which transect the general NE-NNE grain between Smithton and Parrawe.

The Arthur Lineament style anomaly observed beneath Permian cover near Parrawe.



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012

5480 000 MN

ROCKY CAPE REGION
COMPILATION OF AEROMAGNETIC DATA (BMR AND TAS MINES DEPT)
FIGURE 2A

5420 000 MN

320 000 ME

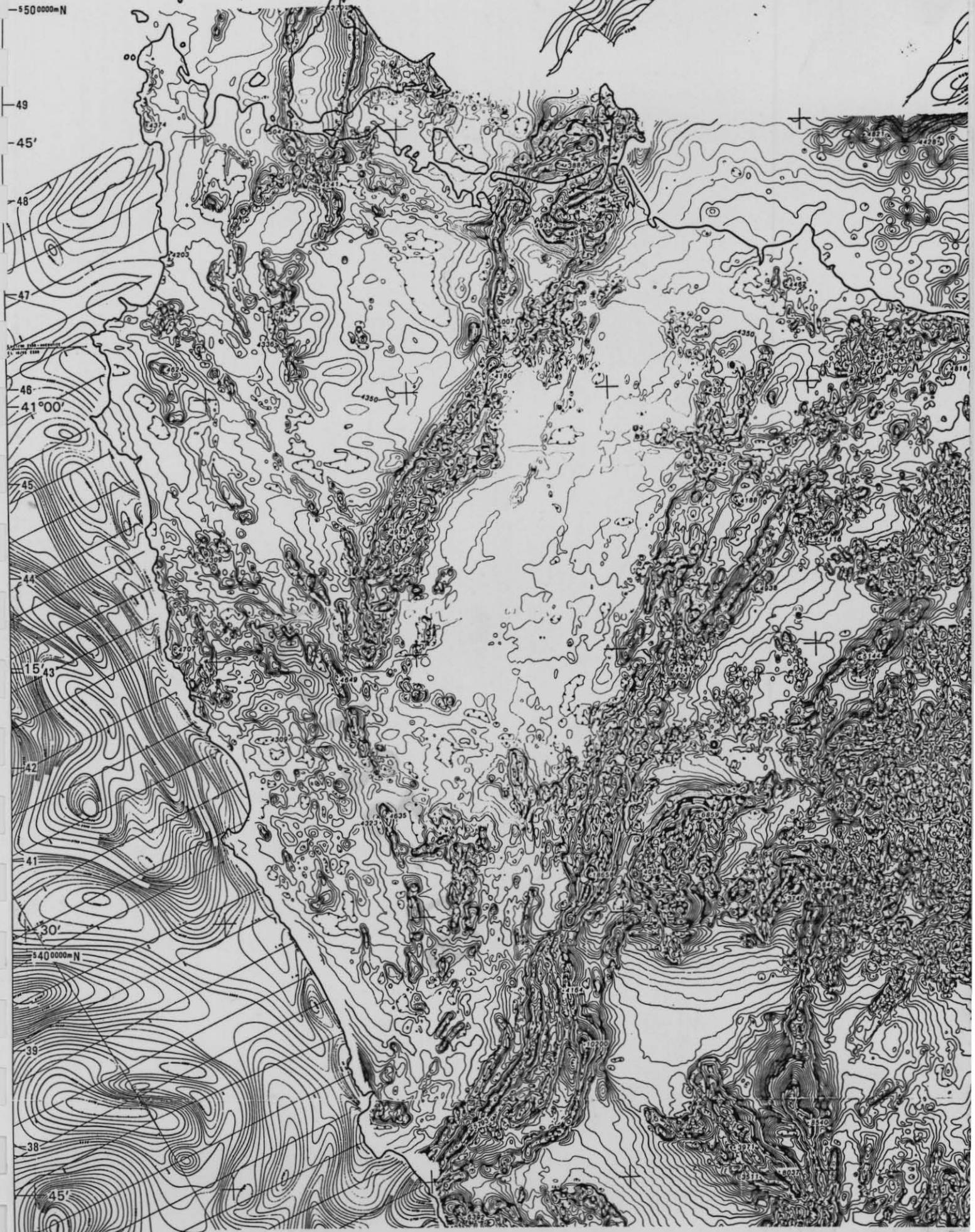
340 000 ME

360 000 ME

380 000 ME

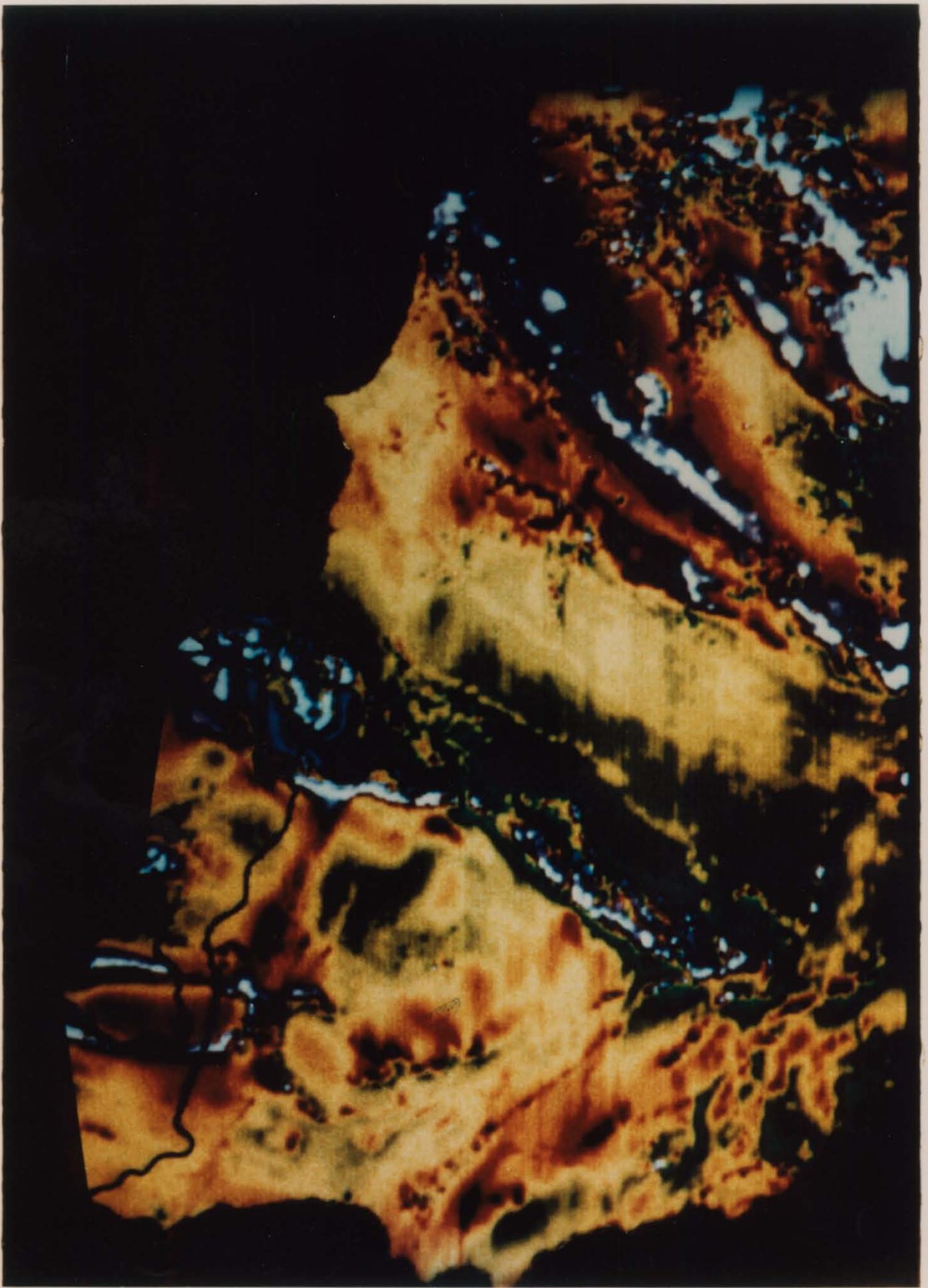
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ROCKY CAPE REGION
COMPILATION OF AEROMAGNETIC DATA USING CONSISTENT CONTOURING
(BMR AND TAS MINES DEPT DATA) FIGURE 2B

014



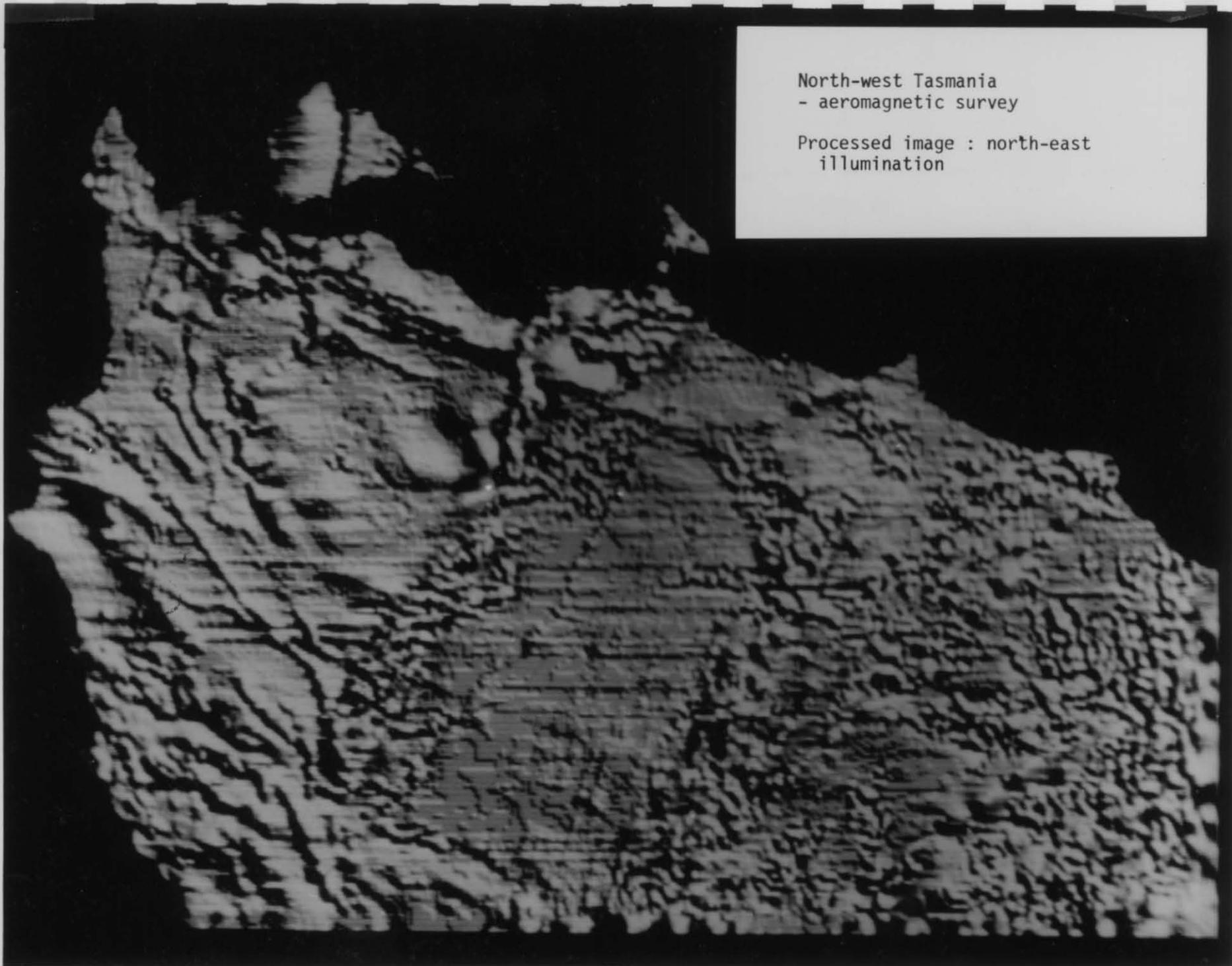
BMR data

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FIGURE 3A

North-west Tasmania
- aeromagnetic survey

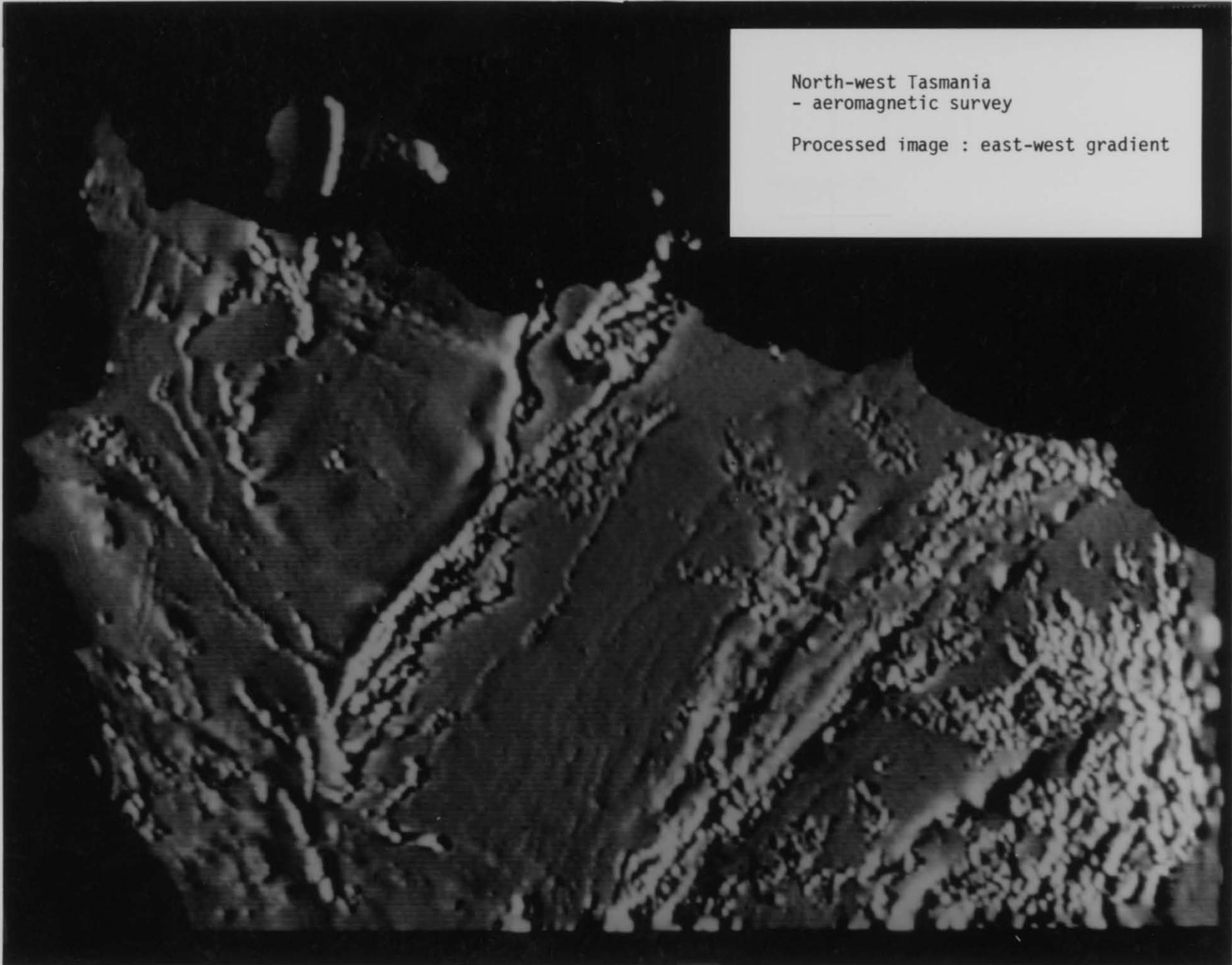
Processed image : north-east
illumination



BMR data

FIGURE 3B

412017



North-west Tasmania
- aeromagnetic survey

Processed image : east-west gradient

BMR data

FIGURE 3C

412018

Gravity:

Gravity data are available for the entire region (Tas Govt TASGRAV data base) but station density is variable with spacings ranging from 1 to 7 km. This limits resolution in some areas, especially across the core zone of the Rocky Cape Block. The observed Bouguer anomalies are distorted by coastal effects as shown by Leaman (1986b, 1988a, b). The extended analysis of Leaman (1988a) and Leaman & Richardson (1989a) was used by Leaman (1988b) to develop a geological filter for the data, extract a crustal component or its equivalent, and derive undistorted residual anomalies (Leaman & Richardson, 1989b). Residuals are presented in Figure 4.

This process does not reduce problems imposed by uneven coverage, or improve resolution, but it does simplify further analysis and properly relates and scales anomaly amplitudes and values to focus on upper crustal features.

The work reported by Leaman (1988a) and Leaman & Richardson (1989a), all of which was an essential precursor to generation of the regional-residual separation function, provided the basis for many of the geological inferences stated on page 4. The gravity data have been extensively worked in regional terms and there is no comparable magnetic analysis as yet.

Figure 4 is based on the current data base which has been expanded since late 1987 when the previous work was undertaken. This report considers data in this format, as stored in March 1990.

The principal features of the residual gravity field in NW Tasmania are

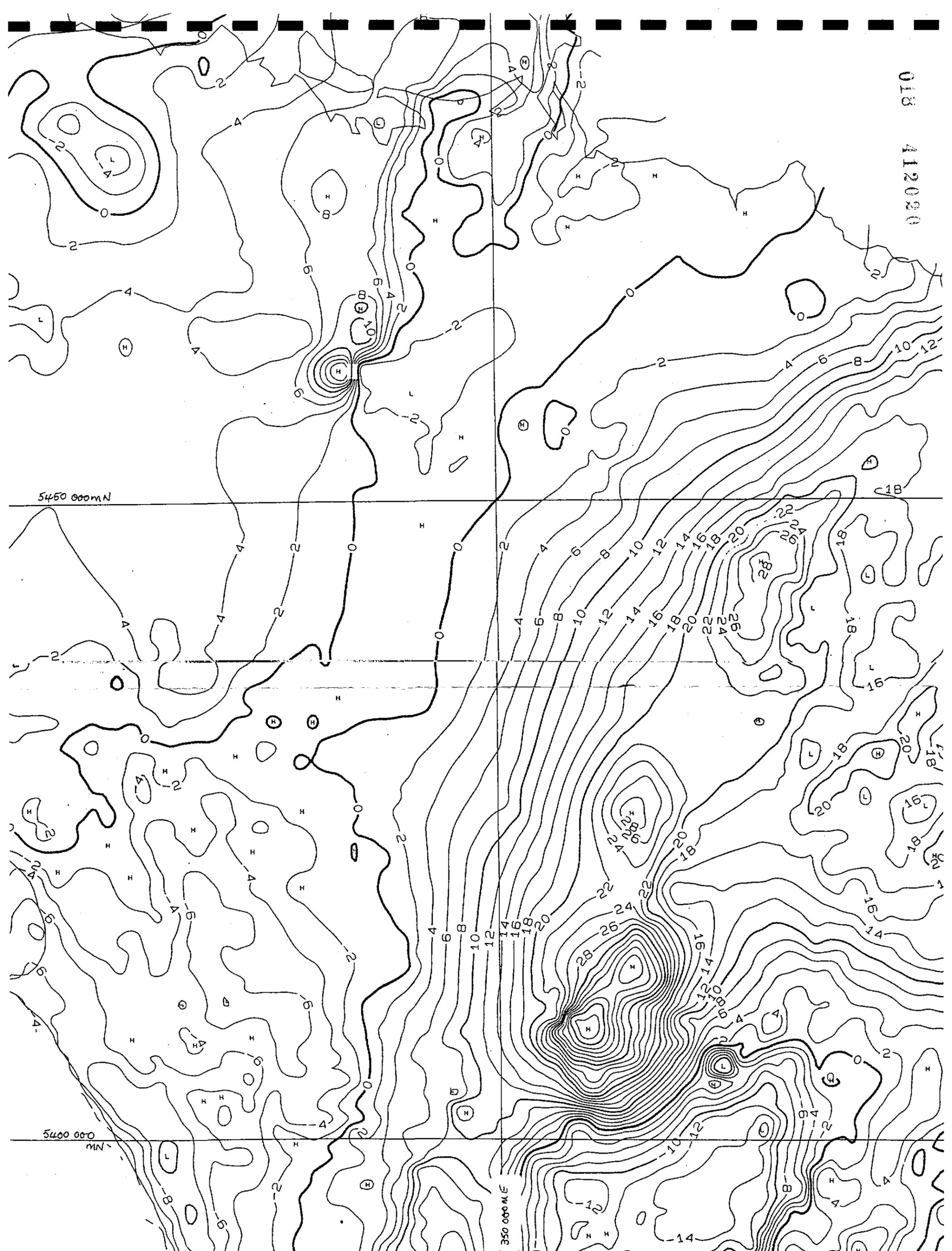
The large negative anomalies associated with Devonian granites centred on the Meredith Granite and the Three Hummock Island Granite.

Very large positive anomalies along the Arthur Lineament axis with peak effects NNE of Heazlewood. The effect is largely correlated with the Burnie Formation distribution.

There is a smaller moderate negative anomaly associated with the Pieman Granite which suggests that it may extend inland for more than 15 km.

There is a gentle trough in residual values which corresponds to the Rocky Cape Block and this is readily separated from the Smithton Trough response to the west. Peak values within the trough area occur near Smithton and Edith Creek.

The predominant trends are N-S or NE-SW although there are suggestions of other alignments (esp NW-SE).



ROCKY CAPE REGION
RESIDUAL BOUGUER ANOMALIES (density 2.67 t/cu m)
Data: TASGRAV data base (Tas Mines Dept).
Processed: Using MANTLE-88

QUALITATIVE INTERPRETATION

Each data set has been inspected for trends, response patterns, abnormal character and possible source correlations. Figures 7 and 20 summarise primary deductions about such features.

Inspection of Figures 2 and 7 will demonstrate that materials to east and west of the Rocky Cape Block core present distinctive responses and many of these are evident in the asymmetries of the gravity and magnetic maps.

Various features in Figure 2 have been labelled based on recognition in the magnetic data (Figure 5). Magnetic data have been used to locate and define particular features since this is the most highly resolving data set available. The implications of other data sets have been incorporated wherever appropriate.

Note also that the contour maps of the gravity and magnetic fields do not reveal all of the texture and character actually observed. The gradient presentation (Figure 3C) reveals many of the characters outlined in Figures 7 and 20.

DISCUSSION

Within the ROCKY CAPE BLOCK the magnetic field is generally quiet, as is the gravity field although the latter is poorly defined. Gradients stress three characteristics and these have been labelled 1, 2 and 3 in Figure 5.

Feature 1 is a discontinuous magnetic response which extends much, but not all, of the length of the Block. It is terminated to the north by feature 4 (below). At least two of the discontinuities demonstrate E-W offsets. This is important since it establishes the reality of this style of structuring in the area in a way which cannot be said to be related to data acquisition or line bias. The offsets indicate a dextral motion. There is no obvious explanation for either the magnetic unit or the offsets. Lennox et al (1982) cover a part of this feature but offer no indication of a possible source in exposure. The source is linear, presumably a formation variant, and not confused with Tertiary cover. Its extension is not wholly consistent with exposed structures. The depth to the source of this anomaly is variable and would appear to be deepest in the central portion of the block where the largest offsets are observed. The character of this feature is not consistent with a dextral offset match with the northern part of (2).

Feature 2 is a relatively subtle magnetic response but it can be traced in a broad sweep over 50 km of strike length. This sweep is not mirrored in extant surface mapping. The feature is sinistrally offset near 5470 000 mN (by feature 5 below). The orientation of this feature, north of (5), is consistent with fault and dyke grain as mapped. But the general curvature is not

ROCKY CAPE REGION
LABELLED AEROMAGNETIC ANOMALIES

020



FIGURE 5

ROCKY CAPE REGION
LABELLED RESIDUAL BOUGUER ANOMALIES

021
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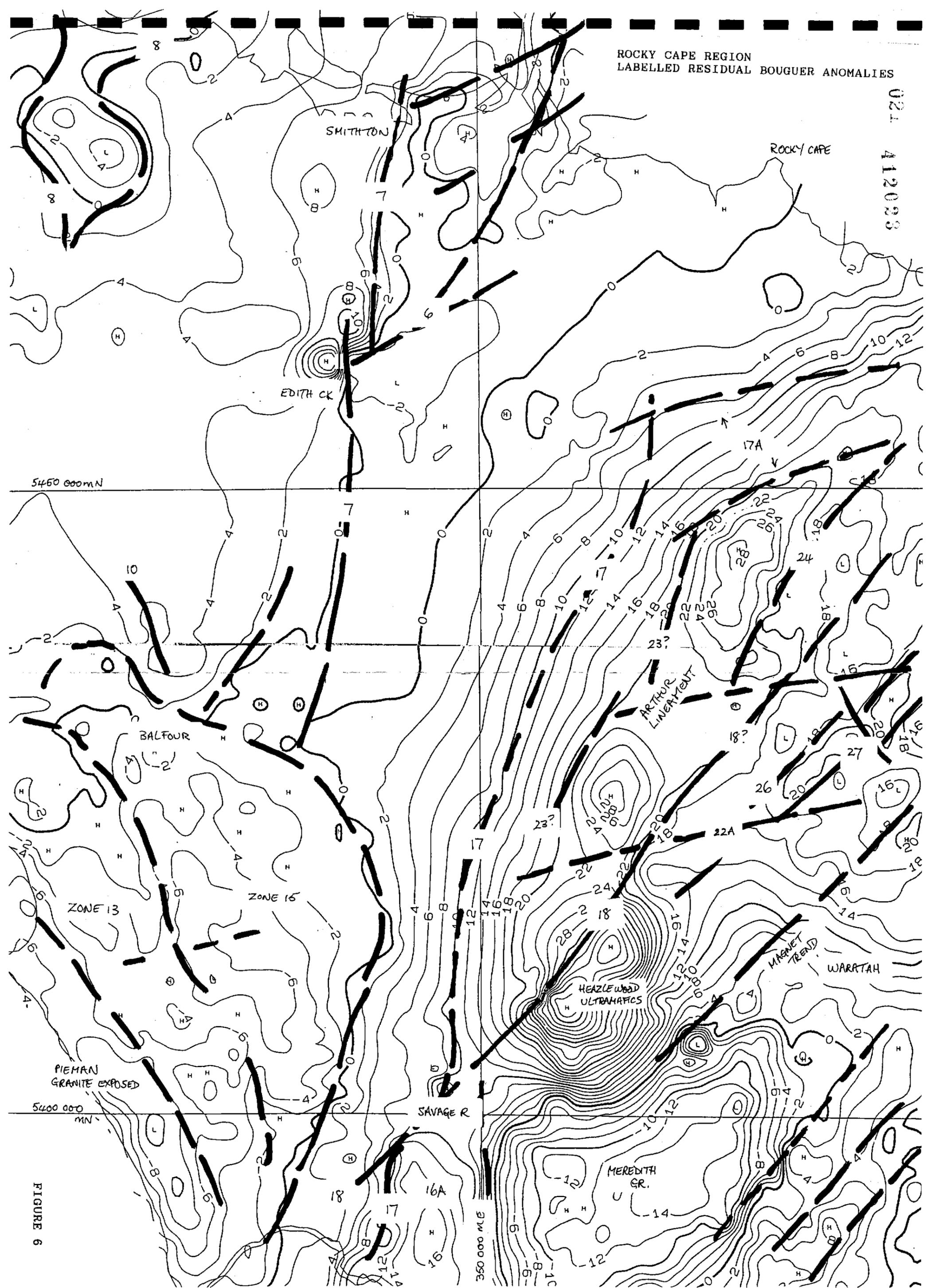


FIGURE 6

reflected by surface rocks and the subtlety of the anomaly does imply some depth of burial.

Feature 3 is very subtle but is an area of very low relief in the magnetic field. Gradients reveal a fine N-S texture which is terminated to both south and north by feature 2. No detailed mapping is available which might resolve the origin of this character.

Feature 4 is one of the most prominent elements of the magnetic field. It terminates (1) but not (2) unless it is argued that Gee's 1968 offset of 8 km to the east on (5) is translated to the northern part of (2). It can be traced in both magnetic and gravity data as far SE as Avoca in eastern Tasmania. Several other features are terminated by it and some are distorted (e.g., 6, 7 and 8 below). It is not possible to suggest a sense of motion with any certainty by the character of its intersection with (7) indicates sinistral displacement.

Feature 5 reflects a mapped structure (Gee, 1966; Lennox et al, 1982) and is recognisable in magnetic data. There is some suggestion in gravity data, upon close examination. This feature offsets (2) SINISTRALLY. Gee (1966) and Lennox et al (1982) show this as a dextral feature but Gee (1971) admits that there is no positive evidence for this sense of motion, or any other! It may be that the repeated stratigraphy may need to be rethought. He based his suggestion on the dispositions of repeated fault blocks but this is inconclusive in the exposed materials. The magnetics is definitive. Lennox et al (1982) extend this structure westward. There is no magnetic evidence for this. The structure appears, instead, to be a splay from (4). Surface evidence can be adduced to support this even though (4) is not generally reproduced by mapping. A 2 km fault segment with the orientation implied for (4) has been mapped at South Forest (see Lennox et al, 1982). Interpolation based on the magnetic data suggests how the mapped faults should be linked.

But why, if structures (4) and (5) are significant enough to offset or terminate members and structures within the Rocky Cape Block, are their exposures so poor? And why do they present different facets and behaviour upon intersection with (1) and (2)?

I suggest that the answer lies in the age of motion and origin of the individual elements. Feature (4) is through going and may be very old. It has certainly controlled some aspects of Smithton Trough deposition and subsequent structuring although it may not have moved far in these periods. Its extension to the SE has not been active since structuring and formation of the Rocky Cape core sequence. But there was later motion and this has offset (1) and (2) by movement along the splay (5). This may well be the EoCambrian element.

This means that (1) and (2) represent elements developed at different times during the formation of the Rocky Cape sequence but concomitant with it. (1) is older than (2) since it has been disrupted, presumably by the event which generated (2) and the fine texture east of it (3). It is not possible to suggest the nature of these sources by inspection.

It may be relevant to note that silica deposits occur along the length of (4) but there is no other evidence of commercial interest even though this is clearly a primary structure. Nor is there yet any evidence for mineralisation along the strike length of features (1) and (2).

Gravity data might well clarify some of these issues but the present data distribution with 11 km station spacing is quite inadequate and lacking in resolution.

Features within the general region of the SMITHTON TROUGH have been labelled 7 to 13.

Structures along the eastern side of the trough have been labelled 6 and 7 and represent two conflicting patterns or extensions within the magnetic anomalies. Much of this character has been reproduced in surface mapping and reflects the general distribution of Cambrian mafic rocks. The magnetic field, however, suggests relationships and continuity which are not obvious in other data sources.

Basaltic rocks extend N and NE from near Balfour to Roger River (6) and then N to Smithton (7) or NE to Stanley (6). The magnetic data can be considered to provide a definitive outline of the distribution of these rocks but this is not easily reconciled with simple folding or faulting. A compound structure is evident at Edith Creek (near 9). The cover of Tertiary basalt is not significant and is largely separable.

The nature of the responses suggests that the sequence is either thicker or more steeply dipping along the west face of features (6) and (7) south and north of Edith Creek respectively. The more easterly aspects of the two elements may imply more shallow dips and a greater spread of thinned volcanics. The maps of Williams & Turner (1973) and Lennox et al (1982) do suggest some systematic changes in dips.

The entire volcanic sequence is slightly magnetic, as shown by the ridge and shoulder on feature (7) between Copper Creek (541 000 mE, 5468 000 mN) and Smithton.

Gravity data broadly support these conclusions and pick out the westernmost aspects of (6) and (7) and suggest that the thickest volcanics occur west of Smithton and north of Edith Creek. Gravity data, however, do suggest that (6) extends SW beyond Balfour until the field is distorted by the Pieman Granite. Magnetic data imply termination of (6) near Balfour. The two data sets suggest that the volcanics and margin of the trough are covered by other materials (Precambrian from the west) but that the trough continues to the SW. The character of the gravity field is consistent with this view across the entire region N and W of Balfour to Cape Grim. The magnetic field is much more compatible with known surface distributions and most mapped character can be recognised and super detailed.

Feature 8 consists of two irregular rounded magnetic anomaly patterns. Each encloses a closure of Precambrian rocks and the

anomalies clearly reflect basal exposure of the volcanic sequence comparable to that at Smithton. The pattern is deformed near its intersection with (4) where a pinched effect has resulted. The general distribution of magnetic anomalies from the primary belts (6-7) to (8) suggests that the volcanic sequence occurs continuously beneath the exposed dolomites of the trough which must be Cambrian in age, or at least post volcanics. A relatively simple basin form is indicated (see also Richardson, 1987; Leaman, 1988a).

The gravity field also reflects the exposure of siliceous Precambrian cores near Montagu and indicates an increasing basin thickness to the east and south away from these cores. The entire pattern is related to the truncated rock distribution around fold cores.

Feature 9 is, however, anomalous and shows that a small, asymmetric but locally important block of isolated volcanics is concealed beneath the dolomites NW of Edith Creek. The gravity field presents a similar pattern. It may be important to note that this feature occurs close to the intersection of trends (6) and (7) and may represent a fold displacement.

Features 10 to 12, which can ultimately be traced NW to the fold patterns near Montagu and Marrawah, are associated with structures which appear to over-ride and terminate (6). This orientation is associated with copper mineralisation in the Balfour area although the magnetic features are not established as host rocks. While (10) may be a continuous feature it is possible to conceive of (10), (12) and (11) as dextral offsets of a single unit. This may be supported by correlation with the dextral offsets noted for (1).

It is notable that elements such as 10-12 and nearby features are of relatively high amplitude (comparable with 6-7) and that these imply disrupted continuation of the volcanic sequence at shallow depth. This view is indicated by the broad gravity pattern.

Magnetic texture in the coastal block of Precambrian rocks (from Pieman River-Marrawah-Balfour) may be partly ascribed to lithological changes (north of the Arthur River at 315 000 mE, 5455 000 mN and near the Interview River (14)) but the response is patchy and structurally controlled. The zone between Balfour and Temma is more magnetically anomalous than the zones to north or south. Only some of the spottier character can be ascribed to Tertiary basalt. Most features are sourced at moderate depths (av. 1 km or more).

The residual gravity pattern inland from the Pieman Granite at Sandy Cape suggests that the relatively quiet magnetic zone (13) may be due to underlying granite whereas the central zone overlies remnants of the Smithton Trough. The more intense magnetic anomalies which ring (13) may be marginal responses. The intensity of the gravity anomalies is not consistent with a large pluton composed entirely of adamellite and a compound intrusion is indicated with a younger, fracture-controlled

adamellitic phase exposed. The anomaly patterns suggest the presence of local spines.

The relatively low contrast anomalies may imply low contrasts between the granite and country rocks and that the predominantly siliceous nature of both has resulted in small variations. This possibility must be contrasted with the entire pattern along the core zone, which does indicate low density rocks (see also Leaman, 1988a), and the effect of high density rocks eastward from the western side of the Arthur Lineament (as far as the Cradle Mt Block and the Eldon Range).

Crossed grain effects persist across the belt S and SW of Balfour leaving little doubt that structural discontinuities of major proportions occur between the Pieman-Temma Precambrian rocks and those of the Rocky Cape Block.

Zone 15 consists of an extension of the Rocky Cape core but which, magnetically, is much more disturbed.

Figure 2B presents an integrated compilation which places the zones in proportion even though Figure 2A makes them appear distinctive. The difference reflects the contour interval employed. Figure 5 also shows how (11) is more extensive and occurs near a major lithological junction.

The northern limit of zone 15 is an arcuate belt of subtle anomalies extending ESE and SE from Balfour toward Savage River. The southern and western limit is anomaly belt (11) and the alignment of intense anomalies along the Arthur Lineament. Many orientations and extensions are evident. Many anomalies appear to be associated with mapped or inferred dykes but close examination of the entire Rocky Cape Block from the Pieman River to Bass Strait has shown that these rocks produce either no response or very small responses and that many of the anomaly orientations in (15) are not consistent with them - even when grouped. It may be that more detailed surveys will display more direct association, or that such surveys will indicate which of them is different - that may be much more important. Present data virtually ignores them.

Anomaly 15A is wholly out of character in that it spills E-W from (11) to an anomalous patch. Various trends are evident in the Mt Holloway area and some are indicated in Figures 5 and 7. Zone 15 is clearly not a normal part of the Rocky Cape Block.

Zones 13 and 15, with junction line 11, are mirrored in gravity data although resolution is much poorer. (11) is marked by a pinching and extension of the anomalies and a large curved eastward embayment corresponds with (15). The "flat" field of the Rocky Cape core then extends NNE. The identification of these characters in the more coarsely defined gravity field implies major structural controls or source volumes are involved.

Both data sets unambiguously pick out the southern part of the ARTHUR LINEAMENT with its sweep from NE to N from the coast toward Savage River (16A), the neck near Savage River, and the

broad sweep toward Bass Strait at Table Cape (16B). While both sets concur on the Lineament south of Savage River they differ markedly north of Savage River. Only the gravity data define a continuous sweep of structure; the magnetic data are more fragmented.

Both data sets define a western limit for the zone and place it identically (17). This marks the boundary between Lineament suites and the Rocky Cape Block. In terms of properties; dense rocks versus low density rocks, mixed magnetic properties versus non magnetic rocks, east versus west.

It seems probable that the gravity field has integrated the general property changes across the Lineament, as well as the effects of any slices or blocks which compose it whether they be exposed or concealed. The magnetic field, based on more resolving data and also more sensitive to local property changes, may well define the detailed composition of materials and structures within the Lineament. Primary inspection of both sets would suggest that the Lineament is not a simple feature, nor a single structure. It is compound, and disrupted, and consists of several disparate elements. These are disposed at a range of depths. No previous work has been reported which bears on these issues and only Leaman (1988a) has attempted a gross examination of relationships prior to the present analysis.

An array of structural alignments can be observed in magnetic data (observed and processed) along the Lineament. Most generate splinter effects on the eastern side. These have been labelled 18-27.

Feature 18 passes through Savage River and its extensions to NE and SW are obvious. A dextral shear is indicated on this structure which may be the Savage River Fault. This structure may also fault part of the Bald Hill complex and extend to (26) near Parrawe, or it may splinter into (19) and actually terminate exposure of the ultramafic complex. The ultramafics and their boundaries are faulted but mapping control is poor.

027

Feature (19) may be a splay from a major shear, as noted above. Its alignment can be traced as far as Table Cape.

Feature (20) is another shear across the "Lineament". It is virtually parallel to (18). Possible anomaly displacements may be noted from the Interview River region, where appropriate fault orientations have been mapped (see Williams & Turner, 1973). The NE extension of this feature is unclear in either magnetic or gravity data sets although the gravity data indicate that it may cross the coast near Somerset.

Feature (21) is comparable with (20) and may reach the coast near Wynyard. It delimits a major segment of the Lineament zone near Peaked Hill and marks the SE aspect of a pronounced magnetic anomaly which trends more NNE than (21). Possible dextral offsets of about 5 km could be assigned to structures of this type if the linkages shown in Figure 5 are valid (see also 23 and 24).

Several other structures intersect the lineament axis near (21). Some large near E-W structures are indicated (22-22A).

Features (23) - (24) and (17) - (25) define two NNE-trending anomalies. The former lies within the "mapped" zone of the lineament; the latter lies within the area of normal Rocky Cape Group (including the Cowrie Siltstone)! No slice extends west of (17).

Both (23)-(24) and (17)-(25) are truncated near 5450 000 mN. The gravity field reflects this in a smoothed way; the gradients of the lineament are pulled west of the exposed axis toward 360 000 mE, 5460 000 mN and then sweep E-W to Wynyard. Magnetic data simply indicate truncation and eastward offset. (23)-(24) is marked by significant, localised gravity and magnetic responses.

Feature (26)-(27), near Parrawe, displays similar properties. This anomalous block feature is totally concealed by Permian cover but its characteristics are identical to (23)-(24). It is also of similar size. But it is within the normal Burnie Formation, or what has been presumed to be normal Burnie Formation. Unless the rocks of the Burnie Formation extend westward into the Lineament zone and then extend beneath the Rocky Cape Block. This can only be a structural relationship, not a stratigraphic one since the Burnie Formation rocks are younger and onlap.

It is clear from the cursory discussion provided here for the principal features that the Lineament zone is compound and dextrally deformed by a series of large shears. All the shear blocks are limited in some way and none are large. All blocks which can be traced west of the presumed western limit of the Lineament zone, as mapped and understood at present, are terminated near (17). The entire pattern would seem to be consistent with a Rocky Cape Block which is overthrust across a sheared portion of the original Burnie Formation-Rocky Cape series junction.

This issue is so important that some quantitative analysis was directed toward its resolution (below).

If, however, the regional character of both gravity and magnetic fields is inspected it is tempting to suggest that the belt of shears extends at least as far east as the eastern faces of the Heemskirk and Meredith Granites and perhaps the eastern face of the Housetop Granite near Penguin. East of this limit SE and ESE trends are dominant whereas in this region they are pervasive but secondary (see Figure 7). I infer from this that the primary grain of northern Tasmania is of this SE or ESE style but that it is locally overprinted by a strong NE-trending dextral shear system. The so-called Arthur Lineament is but part of this where most of the effect has been concentrated.

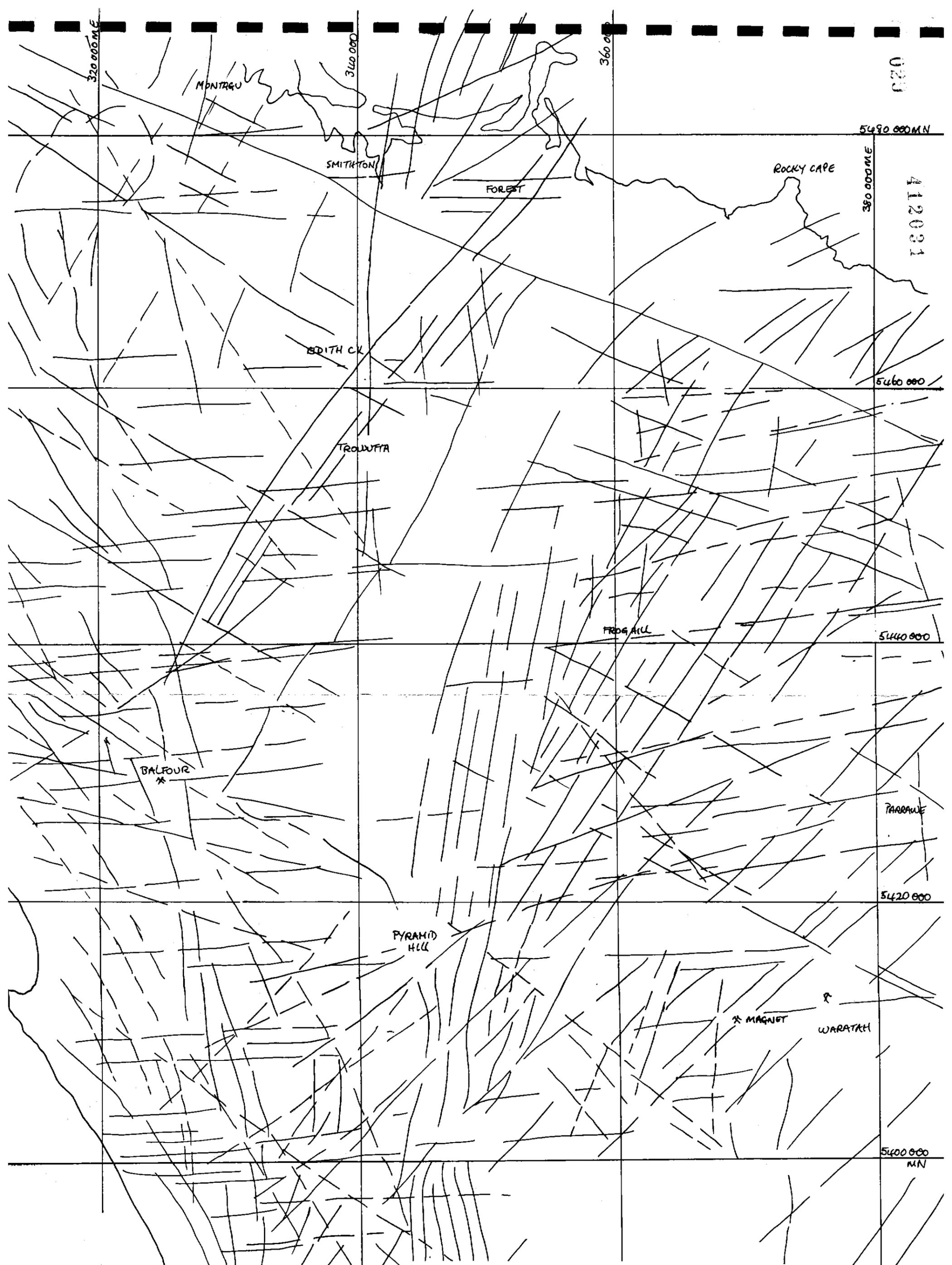
Rejuvenation of such a system also accounts for the localisation of the Wynyard-Hellyer Permian deposition, the dolerite feeders within it and the Tertiary flood basalts of the Guildford area. This zone has remained unstable. The original deformations may well date from the Penguin Orogeny.

The re-activation of this stress field could also explain the curious fracture system imaged in the Rocky Cape Block (zone 3 in Figure 5). The orientation of this fracture field is seen to be critically located when the entire fracture set is assembled (see Figure 7). The distinctive character of the fracture systems on either side of the Rocky Cape Block is also emphasised in Figure 7. The crucial hinge position is magnetic anomaly 2 and magnetic zone 3 with the ultimate change at (17). The general alignment of these features (near N-S) indicates a fundamental suture which has now been largely fragmented eastward and concealed by block movement from the west. The fracture field would indicate that part of it remains in the deep crust.

Rocks of the entire Lineament zone, and east of it, are very dense (>2.75 t/cu m) and contrast strongly with other Precambrian rocks to west or east of Burnie. Many units are magnetic.

Leaman (1988a) termed this entire belt the Burnie-Oonah Trough and this may remain a valid definition. But it is massively sheared at an acute angle to the axis of deposition. The western margin is inferred to be represented by feature (2) or (3). Qualitative inspection cannot determine the precise nature of the junction between the Burnie-Oonah Formations and the Rocky Cape core but Williams (1988) indicates overturning and faulting in the general area (by long section) and something of this type is essential to concealment of the most northerly magnetic slice (near Mersey Plains 17-25) by the Rocky Cape rocks.

It may also be noted that the Magnet dykes and mineralisation appear to occupy members of this shear system and the Henty Fault may mark the eastern side of the entire shear package. The great arc of ultramafics from the Huskisson structure to Zeehan is consistent with this concept and the block and grain character recognised north of Waratah can also be found in the



023

412031

5490 000 MN

380 000 ME

5460 000

5440 000

5420 000

5400 000 MN

ROCKY CAPE REGION
PRESENTATION OF INFERRED TRENDS IN MAGNETIC AND GRAVITY DATA
FIGURE 7

D40

region west of Mt Charter from the Meredith Granite to the region beneath the Guildford flood basalts. Each block varies in length up to about 15 km but is rarely more than 2 or 3 km wide (compare 26-27). A similar feature may be represented by the Bulgobac-Pinnacles anomaly. Many of these blocks must incorporate mafic or ultramafic materials; and/or enrichments in iron oxides but oxide sources cannot provide a general explanation.

The Donaldson and Pieman Faults of Turner (1988) may be reconsidered in light of this discussion and may be compounds of features (17), (18) and (26) and the dolerite dykes may represent tensional fillings on subsequent movements.

Many elements of the entire structure set are reflected in the distribution of Tertiary accumulations and preserved topography. It is clear that all structures are pre-Devonian, some are Cambrian and many are at least vintages of Precambrian. Most have been rejuvenated.

QUANTITATIVE INTERPRETATION

INTRODUCTION

The descriptive interpretation offered above has raised a number of issues not previously recognised nor assessed.

Several aspects of the regional structure requiring further evaluation include

- 1 The nature and attitude of the fault/shear slices within and east of the Arthur Lineament zone.
- 2 The nature of the eastern and western limits of the sheared belt and the structural relationships between the Rocky Cape Group and the Burnie Formation.
- 3 The extent of the Pieman Granite.
- 4 The northeastern extension of the Meredith Granite.
- 5 Whether the Smithton Trough extends south of Balfour and if so what is the probable relationship between it and the Precambrian rocks to the west of Balfour.
- 6 The particular character of structures marginal to the Smithton Trough.
- 7 The origin of the internal banding within the Rocky Cape Group core block.

The treatment provided here is the minimum refinement of previous work necessary to establish a firm conclusion but it is not necessarily sufficient to detail specific structures. In several instances this is beyond the resolution of the available data.

THE ROCKY CAPE CORE BLOCK AND ITS MARGINS

Several regional magnetic profiles were modelled using the available, but usually sketchy, geological control.

The longest of these is shown in Figure 8. Profile M1 extends from Roger River within the Smithton Trough sequence to the southern end of the Valentines Peak ridge. It samples all the characteristics of the Rocky Cape Block (features 6, 1, 2, 3, 17) and the presumed sheared zone (25, 23, 24, 26, 27) and some un-labelled trends (Figure 7).

The solution presented is definitive in style.

Several aspects may be commented.

Background levels in the field can be established approximately by anomaly forms within the Smithton Trough and across the Rocky Cape Block. These suggest that the textured zone (3) reflects material which is either slightly magnetic or it

disguises magnetic material. The anomaly step observed at (2) demonstrates this. The rocks to the NW are non magnetic, or less magnetic overall, than those to the east. Anomaly (2) thus marks a critical junction in the block. Feature (1), by contrast, is much more localised and probably sourced by a discrete alteration structure (no dykes or similar sources are feasible). Feature (2) is a step feature indicating either a fault or bulk contrast change. The latter option is preferred. It is subtle.

The volcanics of the Smithton Trough are not sensibly sampled by this profile but a steep fold limb is indicated (see also Figures 12 to 19).

The strong magnetic character toward the centre and east of the profile is seen to be isolated and significant. Each anomaly is relatively narrow. Each source (only three are shown in this version) must dip steeply. Dips are not precisely determined at the scale of this diagram which also has considerable vertical exaggeration but these must exceed 45 to 60 degrees. There is a suggestion that dips are to the east, east of the lineament and to the west, west of it (see clarification of Figure 9) Each slice has considerable depth extent but only those near the Lineament, or beneath the Permian cover, reach within 500 m of the surface. The important feature (17-25) lies at some 2000 m depth. The relationship between the upper terminations of these slices and the general requirement of non magnetic Rocky Cape Group rocks above them implies a thrust structure. The average dip of such a surface is about 15 degrees and is comparable with the thrusts inferred by Leaman (1986a, 1988a) and mapped by McClenaghan & Findlay (1989) on the Cape Sorell peninsula south of Macquarie Harbour.

The structure proposed could well explain the disruptions and overturning, and loss of continuity, indicated by Williams (1988) in long section.

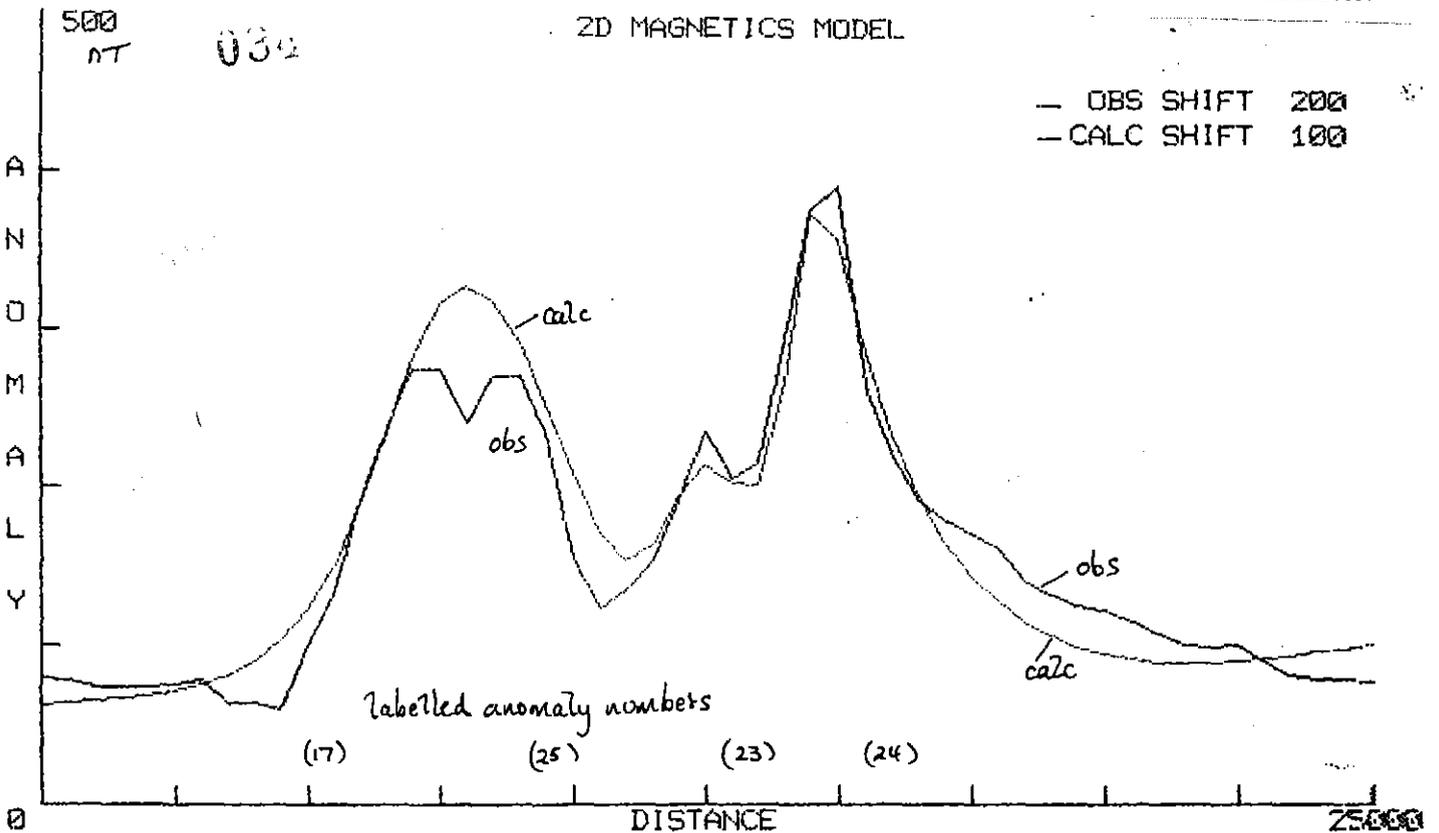
Other possible slices may be inferred at the eastern end of the profile. Only one of these has been modelled but the effect of Tertiary basalt cover has been suggested. This type of source is quite unable to generate the extended, high amplitude features observed. At least four other slices are indicated.

This magnetic section has also been considered in detail with particular reference to the zones near anomalies 17, 23, 24 (Figure 9) and 26-27 (Figure 10). In each case an optimum sub profile has been selected.

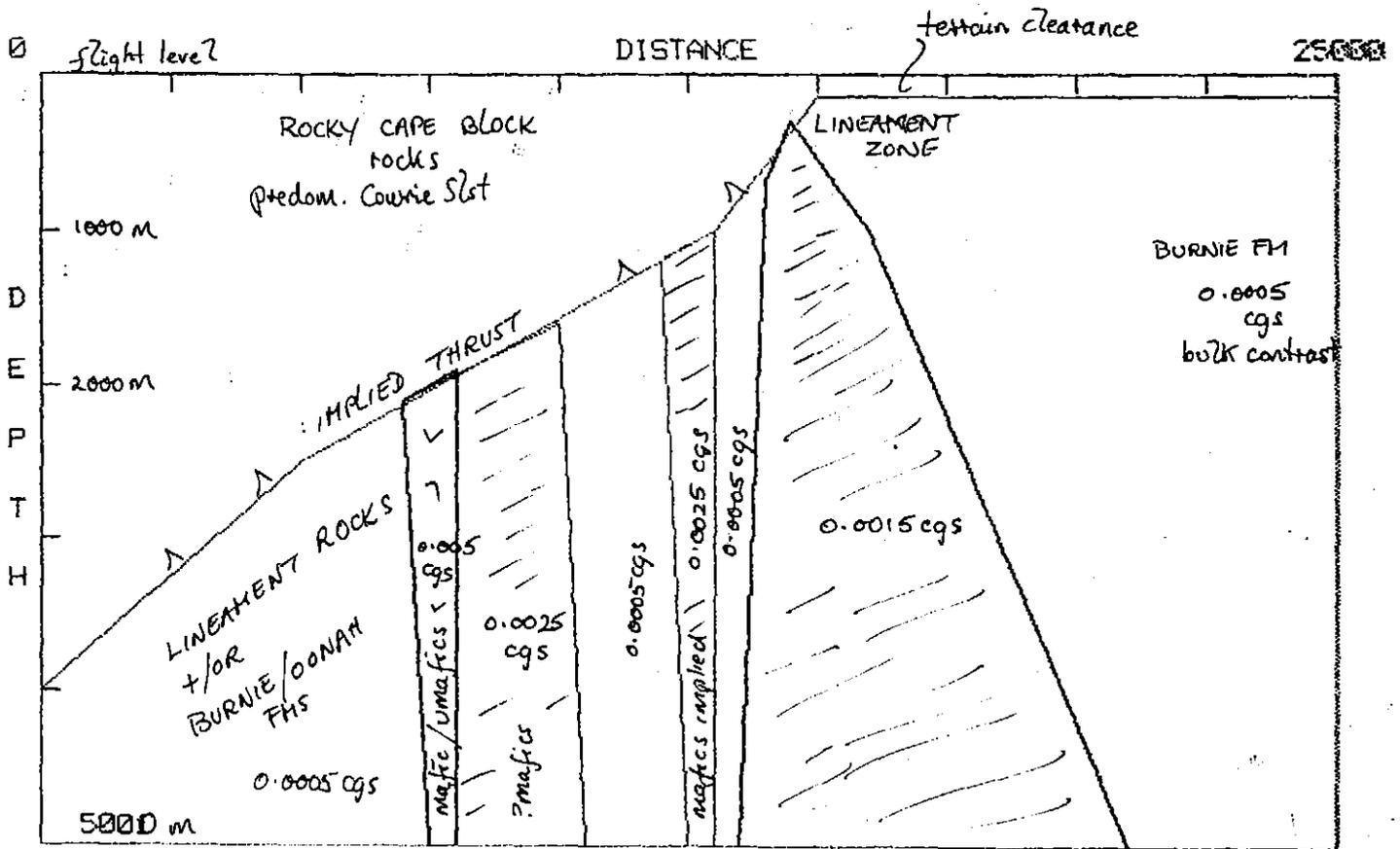
Figure 9 clarifies Figure 8. It confirms it in detail and shows that several elements are compound. The contrasts inferred imply mafic rocks in many of the slices and some must include ultramafics.

The generally easterly dip of the principal lithology or slice near the Lineament is confirmed but all other aspects must dip more steeply - but to the east. Westerly dips do not readily satisfy the observed field although it should be noted that any contribution from remanent magnetisation may vary this model.

2D MAGNETICS MODEL



353E 5445N NW
ROCKY CAPE M3 SEGMENT M1
25000 M 3745E 5415N SE



ROCKY CAPE BLOCK ARTHUR LINEAMENT MAGNETICS MODEL

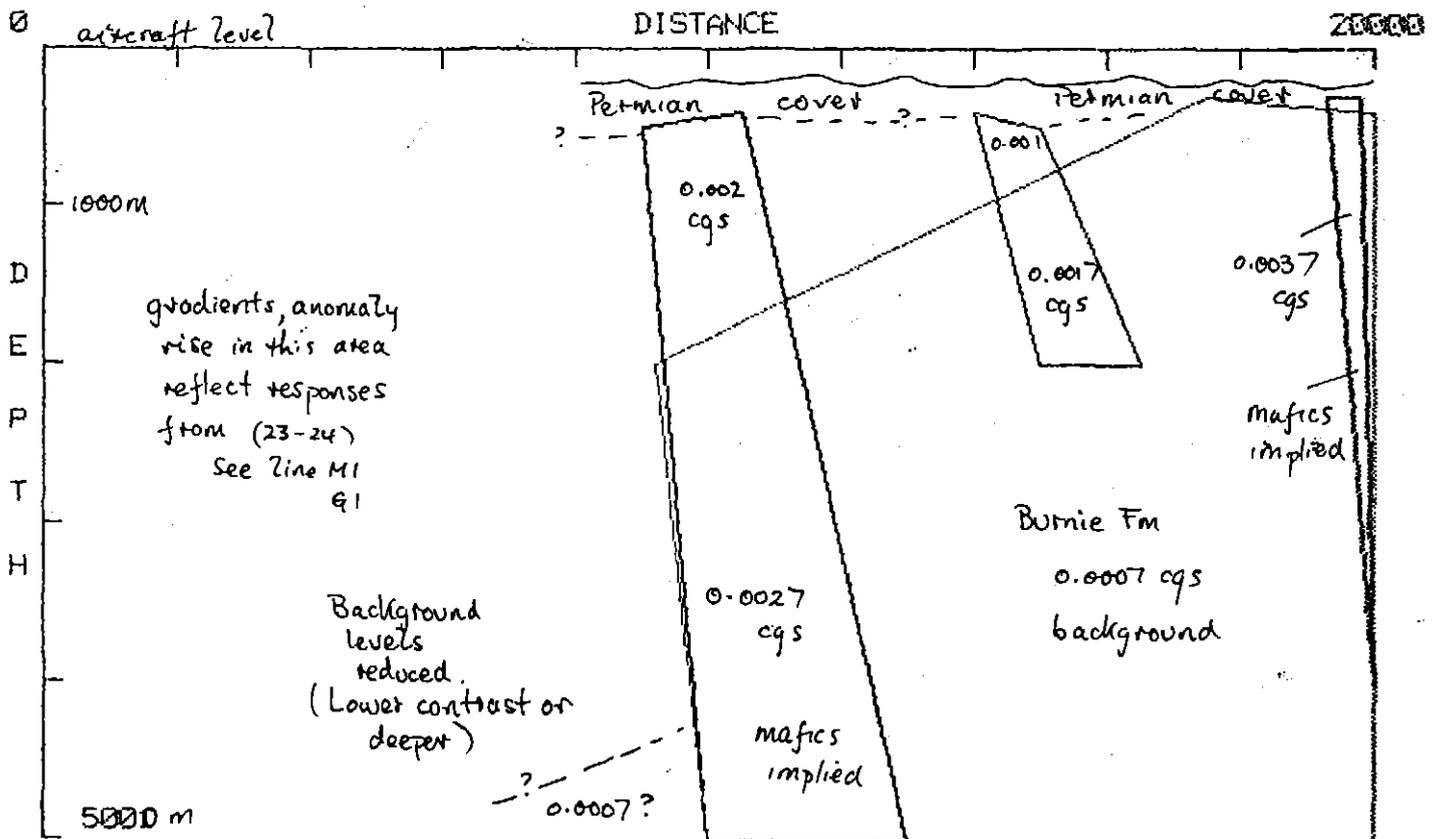
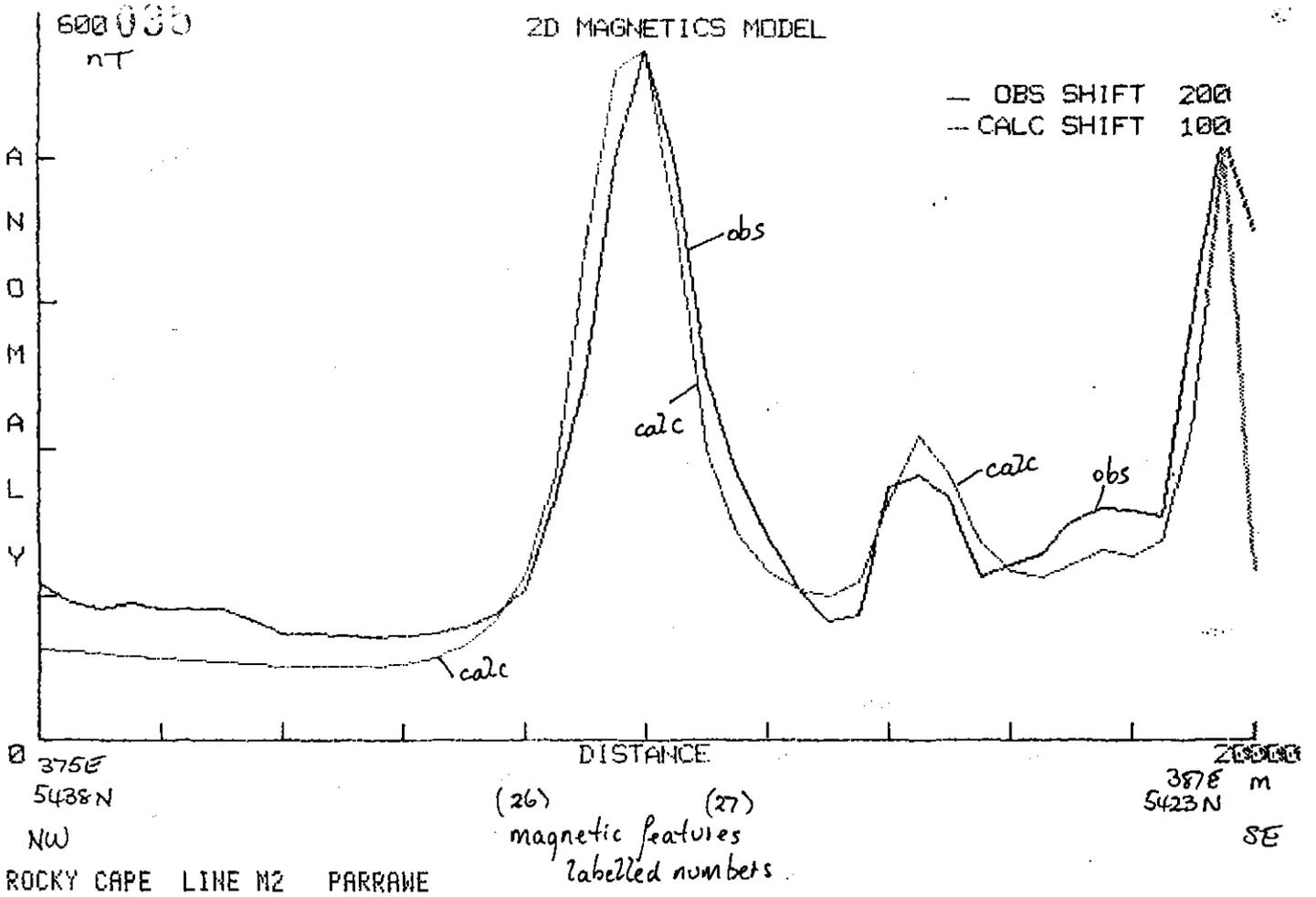
FIGURE 9

INTENSITY INCLINATION DECLINATION OBS LEVEL LINE DIRECTION
 61000.0 -71.0 14.0 0.0 142.0

412037
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 G.P.O. Box 320 D,
 Hobart, Tasmania 7001

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



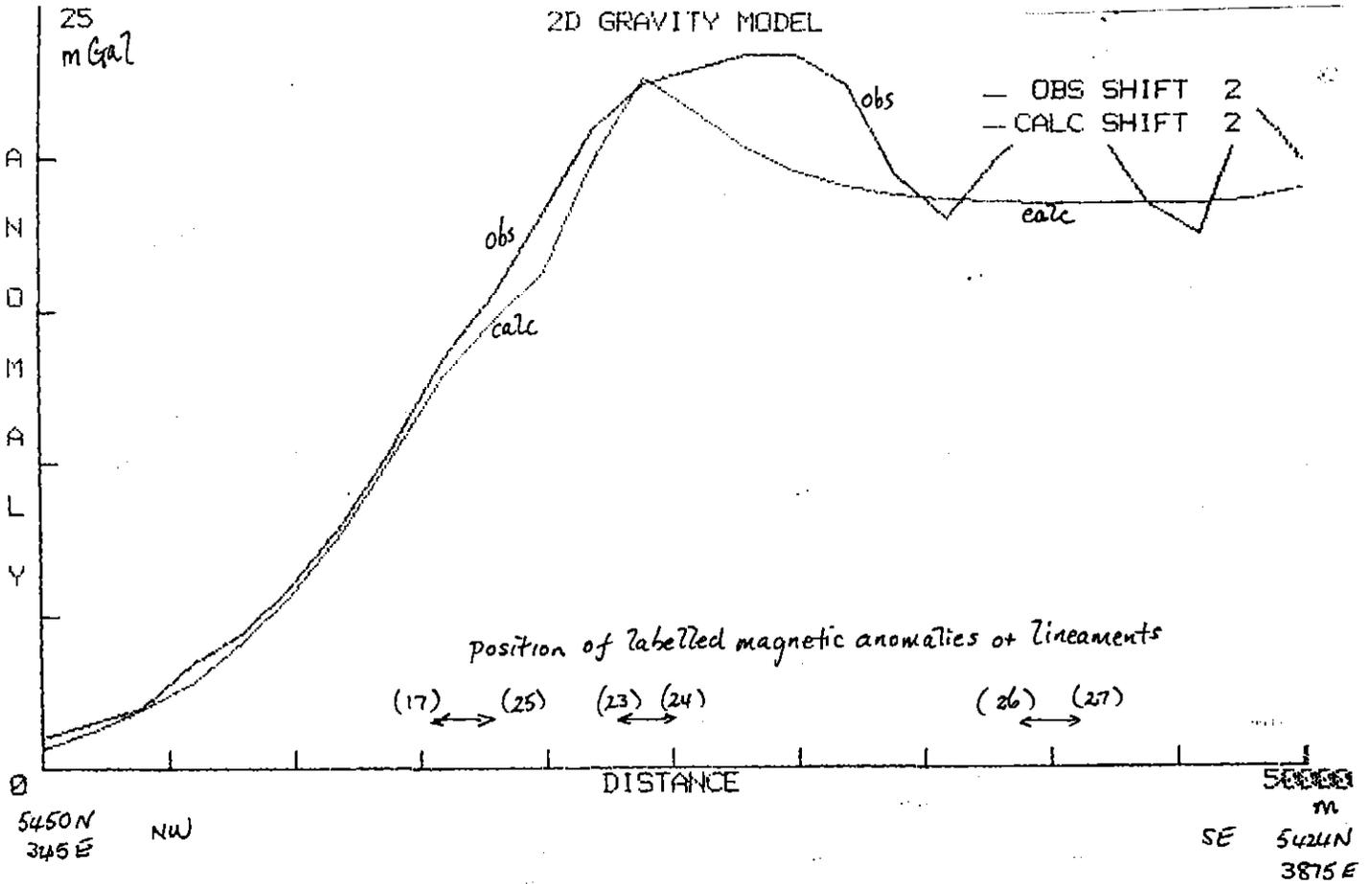
ROCKY CAPE BLOCK

PARRAWE MAGNETIC ANOMALY

FIGURE 10

036

2D GRAVITY MODEL



ROCKY CAPE G1 REFER M1

Model R

Flag Hill

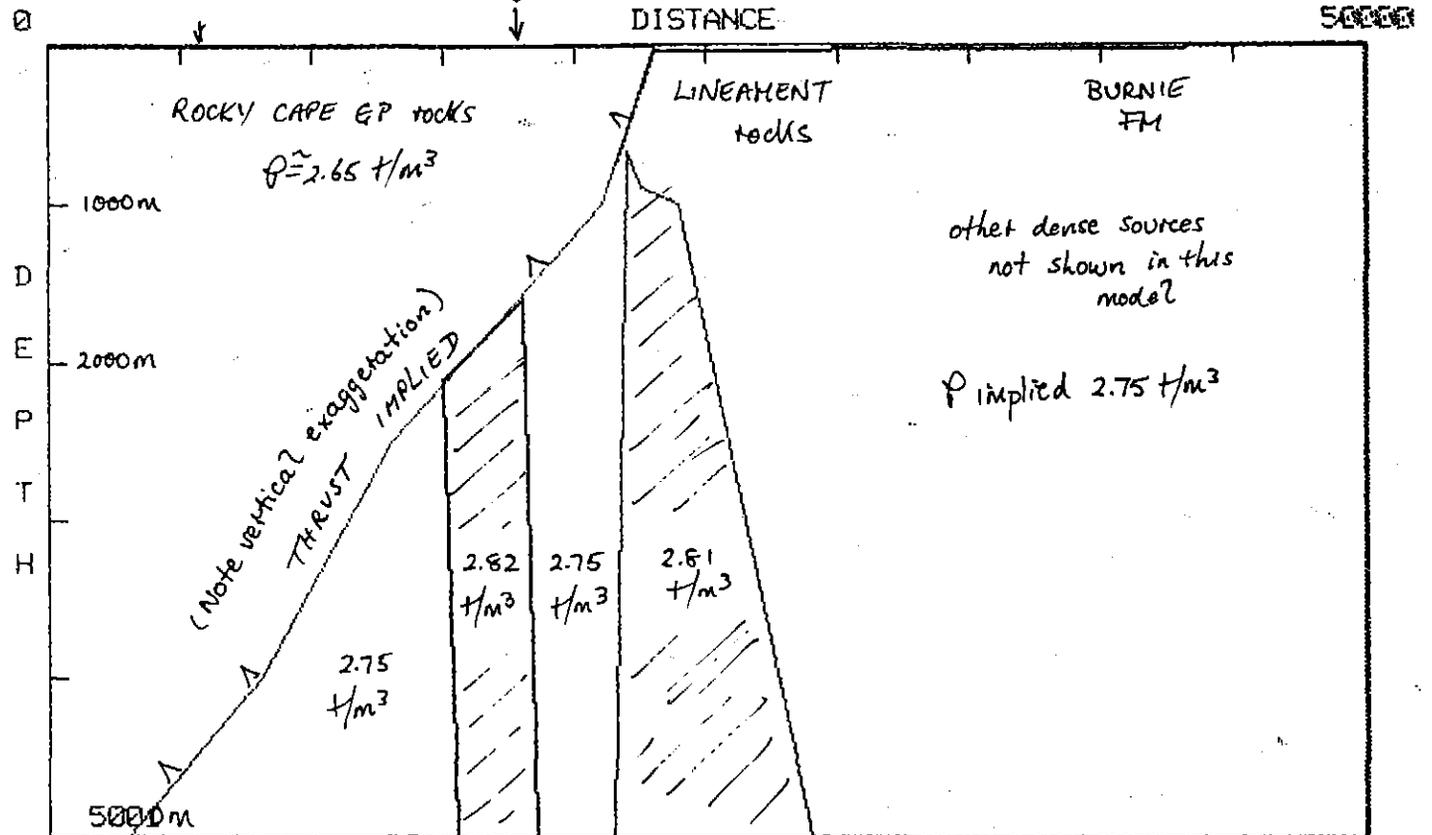


Figure 10 considers the largest and most isolated anomaly which is not affected by interference effects due to basalt cover. This feature was modelled in Figure 8. The more detailed view confirms the general style, attitude and contrast of that solution. Detailed examination also indicates that a large part of the Burnie Formation is slightly magnetic and that the interface between magnetic and less magnetic rocks may be offset by the more intense anomaly slices. Steep easterly dips are essential to any profile fit. Mafic sources are indicated.

It should also be commented here that consistent matching of the observed profiles requires a profile match shift, or base shift, of 100 nT.

The gross forms and attitudes modelled and inferred from the magnetic data are comparable to those suggested by Leaman (1986b) for the Tyennan basement overthrust south of Macquarie Harbour on the eastern side of the Mt Read Volcanics. Much of the crust is involved in such movements.

Gravity data have been interpreted previously in a regional sense (Leaman, 1988a, Leaman & Richardson, 1989a) and the solutions proposed suggested that the Burnie-Oonah Trough/Rocky Cape Group contact was systematic and dipped steeply east. Any mafic slices identified were also thought to do the same. Review of the magnetic models shows that most of these elements are represented. Most features do dip steeply east. Most of those sources are magnetic, mafic and probably dense. This poses a question. Did the original very coarse modelling resolve only the primary attitude between dense rocks (to the east of the Lineament) and less dense rocks (to the west)?

Gravity data in this area are patchy and the coverage leaves much to be desired. All previous sections and models were reviewed (see Leaman & Richardson, 1989a) in light of the magnetic models.

It was found that the general conclusion was indeed sound but, in terms of the specific attitude of the Rocky Cape Group - Lineament contact zone, a regional easterly dip cannot be sustained. Figure 11 demonstrates the required relationship. Its style was based on the magnetic models but in practice there is no other way to account for the general gradients east of feature (23) given the surface disposition of the Rocky Cape Group and Lineament rocks. The present data do not allow a vertical or east dip for the junction between the two rock suites on a crustal scale.

Profile G1 was drawn along the same section as M1 (Figure 8) and it samples several critical anomaly elements. The problem of the dip of the junction cannot be resolved with present data at the northing of Savage River, but the solution offered in Figure 11 becomes far less ambiguous as the north coast is approached. It is beyond debate at 5460 000 mN.

The sections show that rocks east of the Lineament are dense and slightly magnetic. Those to the west are less dense and highly siliceous. A bulk density of about 2.65 t/cu m is implied for

the Rocky Cape Group Block and this value must apply to a thick vertical section - i.e., most of the crust. The relationship between the suites of rocks present, however, is more complicated and the Rocky Cape Block must overlie portion of the denser suite in the region of the Lineament. Low angle, whole crustal involvement, thrusting is implied. The structure must dip west.

The available magnetic data may yield further information about the structures within the area of exposed Burnie Formation, the Lineament and beneath the eastern part of the Rocky Cape Block but such analysis is beyond the brief of the present regional setting study. The entire evaluation would benefit from some infill of the gravity data base west of the Lineament.

The age of the structuring is not readily determined. The impressed fracture system indicated by magnetic features (2) and (3) could have been produced during Carboniferous, Jurassic or Tertiary rejuvenations of minor dimension along the shear system. It was clearly active at these times.

If the sense of the shear couples is considered it is also possible to explain the sub E-W orientation of the major granites in W and NW Tasmania east of the western limit of the Arthur Lineament metamorphic zone. If this association has validity then it means that the couples were active during the Devonian. This would be expected, in any event, if the structures were older.

The mafic and ultramafic suites which are clearly embedded either in the Lineament, or the adjacent Burnie Formation, may be stratigraphically related to other units in these suites or be structurally introduced. There is evidence for both (See Turner, 1988). Since Cambrian or Early Cambrian suites are embedded in some exposures, e.g., north of Waratah, and these can be traced into the slice structures suggested then many of the shears or faults are at least Cambrian in age. It is probable that some date from the Penguin Orogeny. None of these historical elements assist evaluation of the age of displacement of the Rocky Cape Block other than that it must be (probably) post Eo-Cambrian. The carriage of the Smithton Trough materials is circumstantial evidence for this although the Trough could have developed after displacement.

The calculations do show that the estimates of block width based on inspection of the data set are generally reliable in those areas free of interference effects due to Tertiary basalt. Basalt-covered areas can only be assessed by some processing and modelling. More extensive modelling is required to reliably assess dips of the bounding faults and blocks.

THE PIEMAN GRANITE

Leaman & Richardson (1989a) assessed gravity data available in late 1987 and defined a model for the Pieman Granite. This suggested that the eastern face of the granite dipped steeply and that the exposed contact near the coast represented the virtual limit of the body. A possible dextral offset of this contact was implied near the Pieman River. Most of the granite was thought to lie offshore and to extend across the continental shelf beneath Recent and Tertiary cover.

Figure 4 is based on the current data base which has been substantially augmented in the region south of Balfour. The extensive spread of negative residuals suggests that the granite is far more extensive than previously thought. Negative residuals can only be generated by the Mantle-88 process where a significant portion of the crust possesses a bulk density less than the normal crustal density or Bouguer assumption (2.67 t/cu m). In Tasmania, this is only possible where post Carboniferous cover is thickened or where major plutons are present. The only unambiguous condition is the latter.

Precambrian rocks are exposed across zones (13) and (15) (Figures 5, 6) and significant negative effects in such zones imply extensive granite. The anomalies may be compared with the general values across the entire Rocky Cape block. These rarely exceed -2 mGal and, as shown in Figure 11, this reflects a bulk upper crustal density of 2.65 t/cu m - a value quite consistent with the rocks present. Values of -6 to -8 mGal, or -12 mGal above the coastal granite exposures, imply much lower densities - of the order of 2.60 - 2.62 t/cu m. This range is typical for West Tasmanian granite-adamellite.

The relatively subtle character of the anomalies suggests that the granite is shallowly buried and also offers only a marginal contrast with the intruded rocks (siliceous Precambrian). Much larger anomalies are generated by the Meredith and Dolcoath Granites, for example, because these intrude much denser suites (Cambrian and Burnie-Oonah Formations averaging 2.75 t/cu m) and consequently present high contrasts.

These inferences have been tested by primary and relatively simple modelling. Some examples are shown in Figures 12, 17 and 18. These present some aspects of profiles across the northern segment of the pluton and shown that its roof occurs at 2 to 4 km depth across wide areas. The peak negative effects reflect spines and roof crests and the granite may reach close to the surface locally. Some suggestions are shown in Figure 20 but a full analysis has not been undertaken. At least one such spine occurs in the Balfour area (Figures 12 and 18). The models demonstrate the reality of low contrasts (approx -.03 t/cu m).

This preliminary work establishes the extent of this granite and shows that 3D modelling could define its detailed form. Some additional data is required SE of Balfour.

THE SMITHTON TROUGH

Inspection of the data sets, above, has suggested that the rocks of the Smithton Trough onlap the Rocky Cape Group and that the spread of magnetic anomalies reflects the cover of volcanic members. The anomaly distribution implied that the volcanic members were universal and possibly fairly uniform in thickness based on comparison of characters near features (6-7-8, Figure 5). The spread of effect east of (6) was thought due to shallowing of dips to the east and thus presentation of a greater cross sectional area.

Some of these possibilities have been tested.

Figure 13 suggests the character and source of anomalies across the belt of anomalies south of Trowutta. Magnetic character is discrete and related to individual units within the volcanics. These units are not thick nor especially continuous. The effect of several such units, when disposed sub horizontally as within the lower parts of the trough, is to impart a modest bulk contrast to the entire sequence and some loss of discrimination. Similar character can be recognised near Trowutta (Figure 14) but the magnetic units are locally thickened. This model suggests the changes in dips inferred by inspection. Neither model (Figures 13 and 14) is able to separate the fault and fold components of the steeply dipping section. The distribution could be produced by pure folding or simple displacement even though a fault is shown in basemapping. I do not believe this to be proven since it depends on interpretation of the age and relationship of the dolomites to the west and these could well overlie the volcanics in normal stratigraphic relationships. There is no evidence for abnormal accumulations or growth faulting in these models.

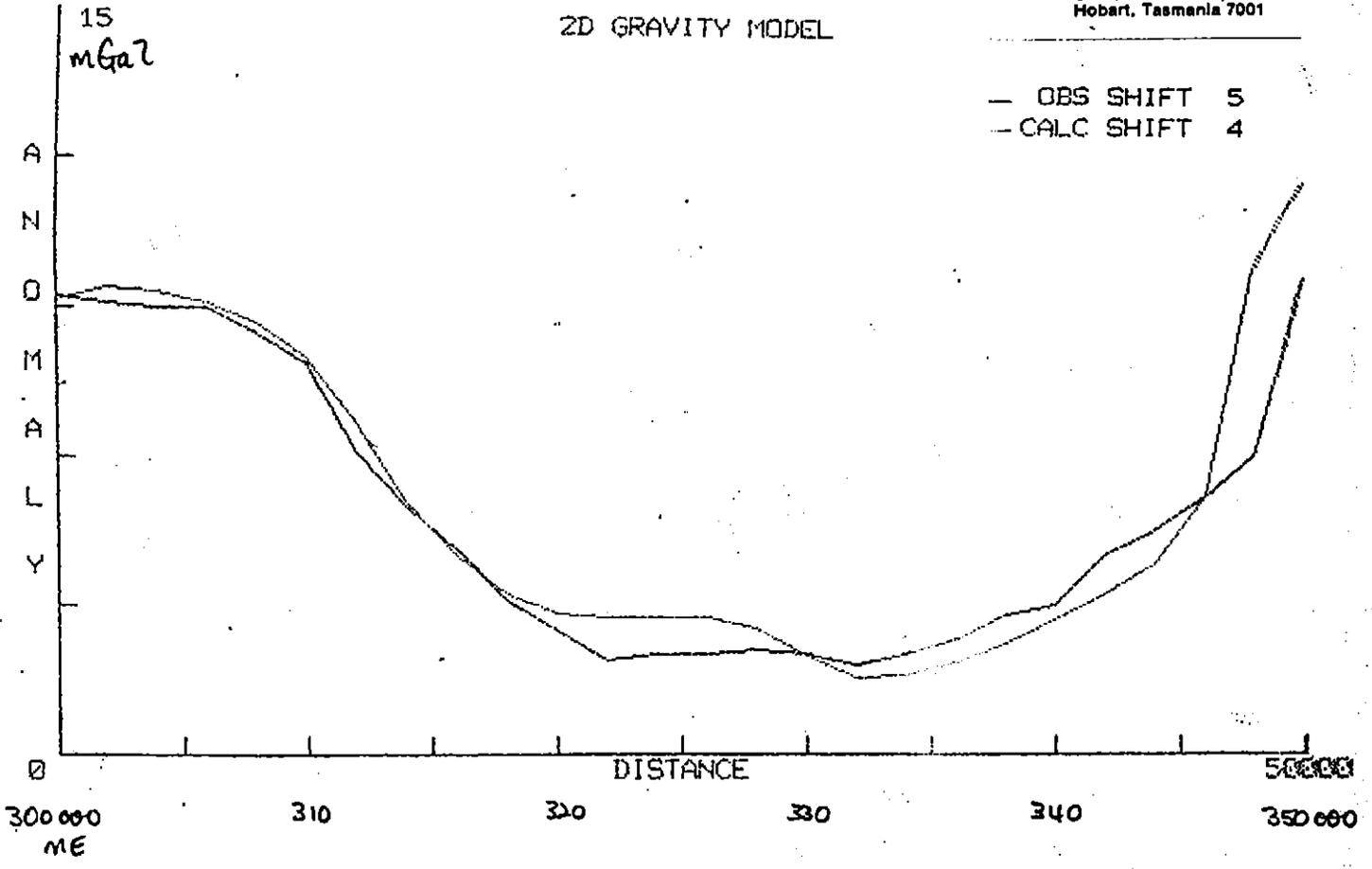
The only evidence for faulting, or at least complexity of the steeply dipping limb, occurs near Edith Creek. The gravity - magnetic feature (9) can only result from repetition of the steep limb or a local source centre. Further mapping is advised in this area.

There is considerable scope for super detailing the nature of the volcanic units using the magnetic data. Unfortunately the gravity coverage north of Balfour is poor and only gross and quite simple models can be tested. Two are shown in Figures 15 and 16. Figure 16 presents an oblique profile through the eastern side of the trough and part of the Rocky Cape Block. All dips are apparent but the model requires a lateral contribution from the concealed dense units beneath the Rocky Cape rocks (see pages 25-32. This aspect can not place them sensibly.

Figure 15 suggests the nature of the trough section and general structural forms. Many of the density elements have been bulked since the model was intended to define the scale of the Precambrian elements. It does, however, suggest the primary synclinal form of the trough.

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

2D GRAVITY MODEL



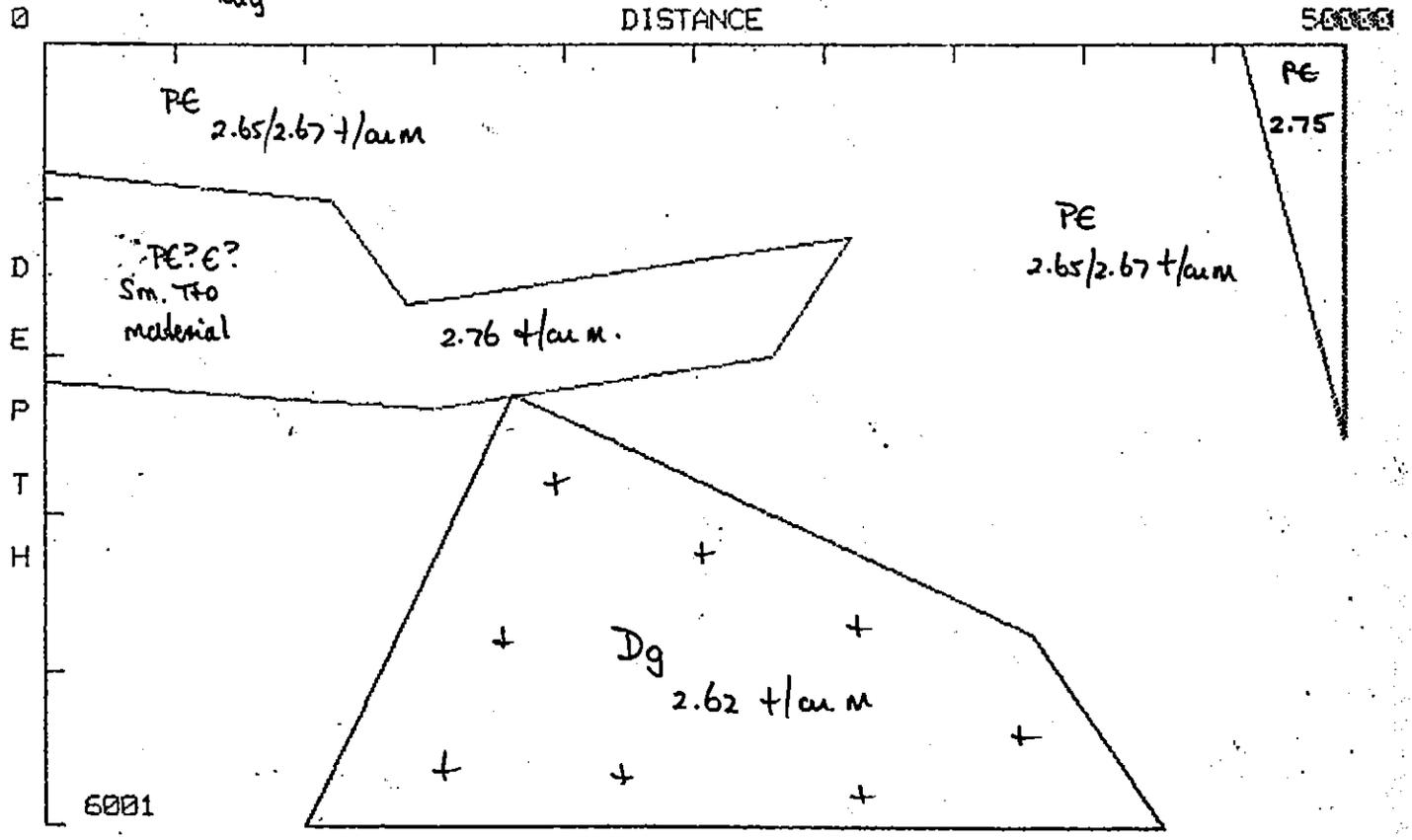
BALFOUR-TROMUTTA LINE 5430N 300-350E

(Tenna) Hazard Bay

Balfour

Hutton R

Beryl Pt.



BALFOUR REGION. GRAVITY INTERPRETATION 5430 000 MN
FIGURE 12

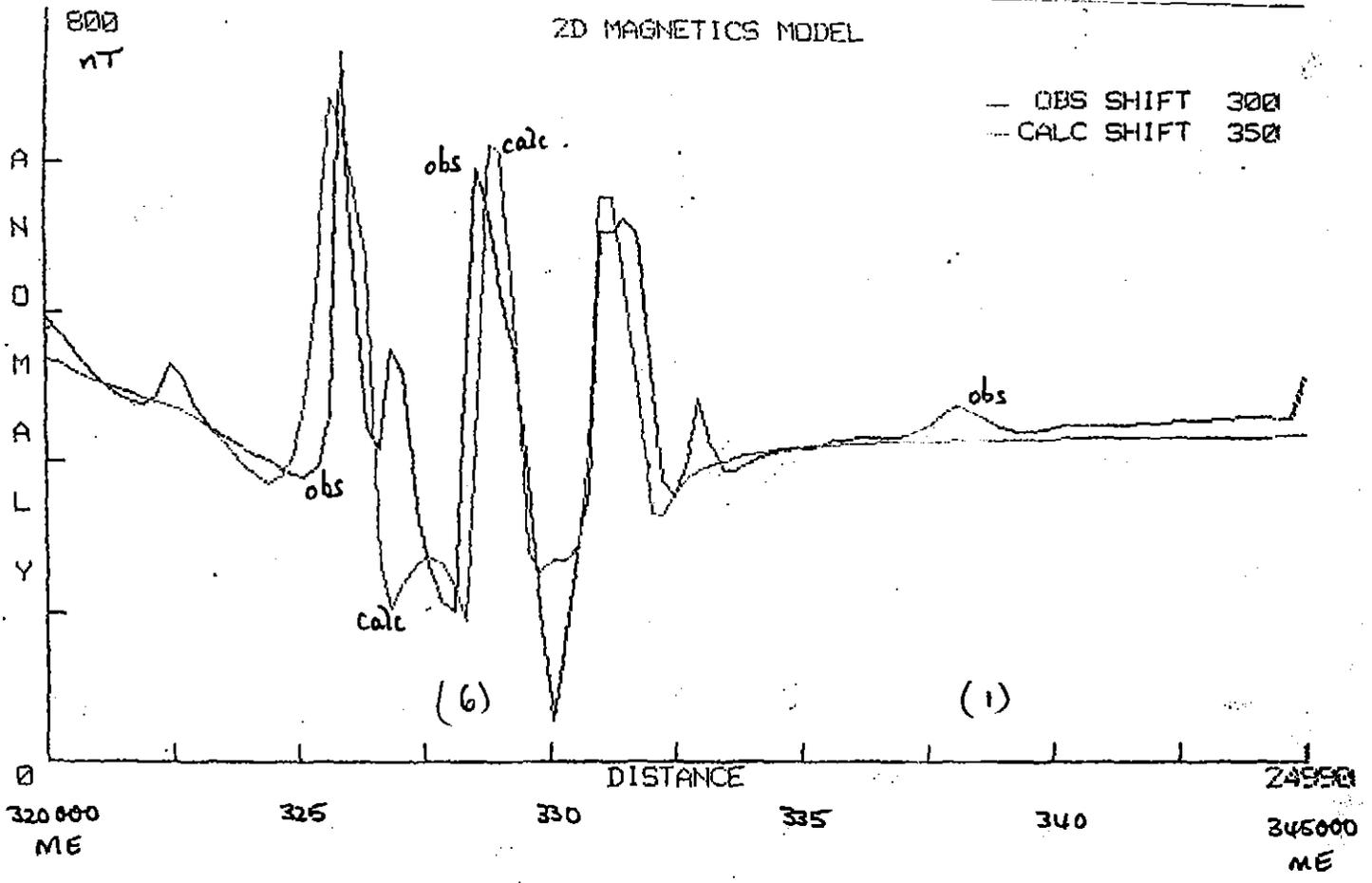
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412044

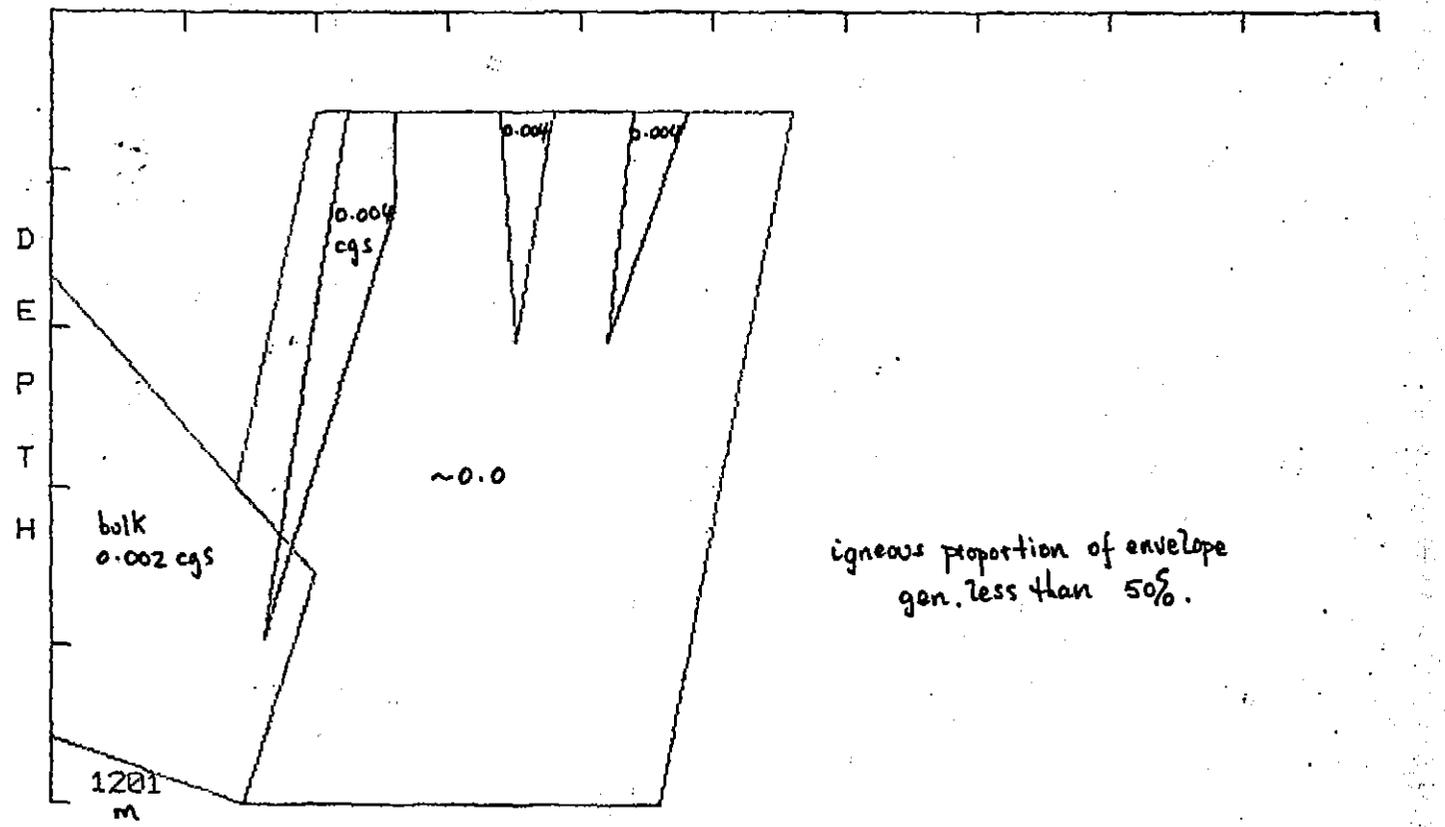
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042



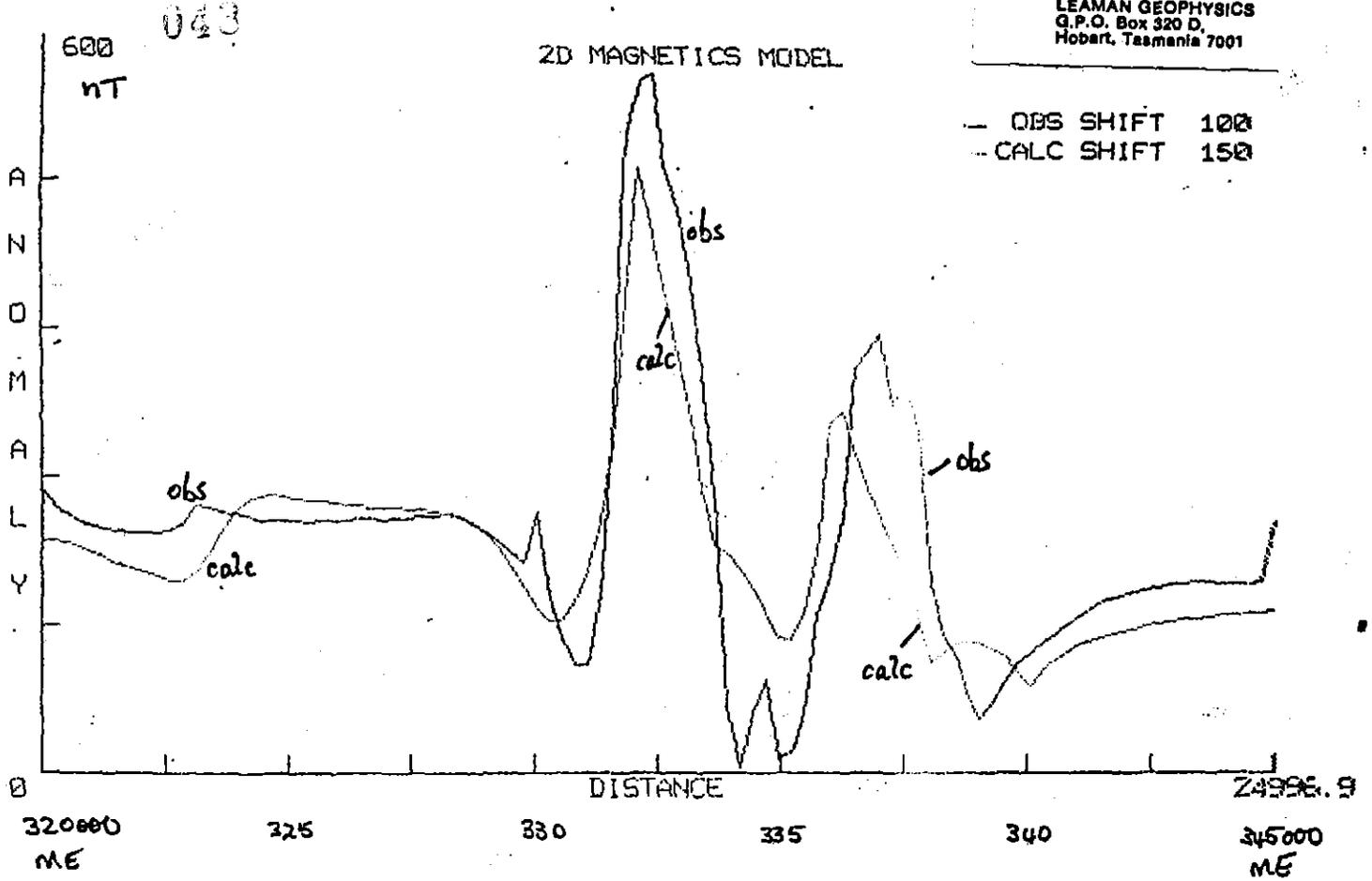
BALFOUR-TROWUTTA BMR2730 5440N 320-345E
 6/2=14000/150 /6=3500/720
 Blackwater Julius R Forked Tree Hill
 0 DISTANCE 24990



BALFOUR NORTH REGION MAGNETIC INTERPRETATION 5440 000 MN
 FIGURE 13

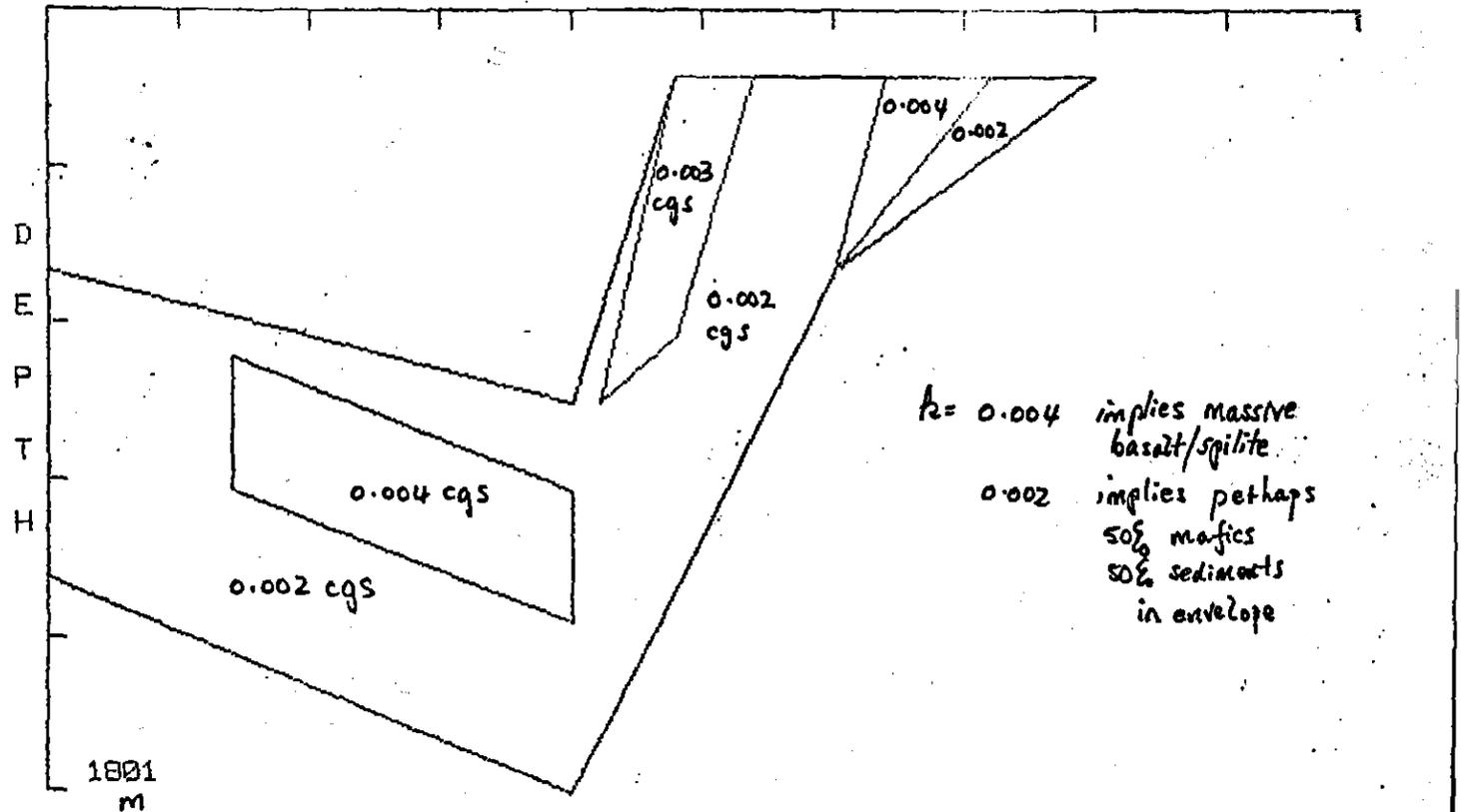
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Hobart, Tasmania 7001



BALFOUR-TROWUTTA BMR 2540 5450N 320-345E

0 Lovells R. Ekberg CR S.Trowutta Arthur R 24996.9



TROWUTTA SOUTH REGION MAGNETIC INTERPRETATION 5450 000 MN
FIGURE 14

044

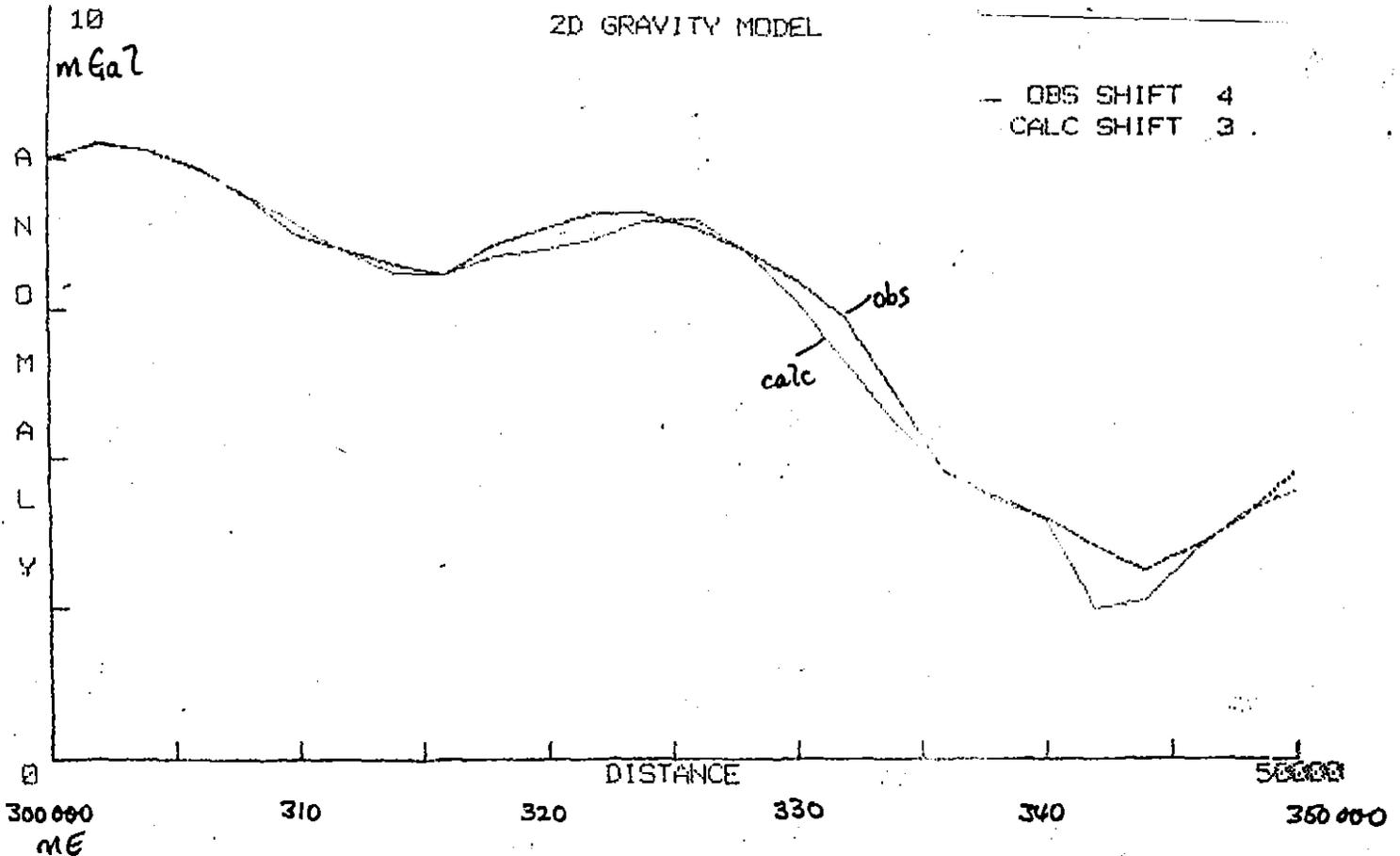
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412046

LINE PARAMETERS - ORIGIN, LIMIT, INCR : 0 50000

2000

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BALFOUR-TROWUTTA 5450N 300-350E



PE
2.65/2.67 t/cm

E
2.72 t/cm

E_v?
2.83 t/cm

PE
2.67/2.68 t/cm

2.75-2.77 t/cm
dolomite
volcanics + sed
dolomite

PE? E?
Sm. Tro material

PE 2.65/2.67 t/cm

PE

LINE PARAMETERS - ORIGIN, LIMIT, INCR :

39

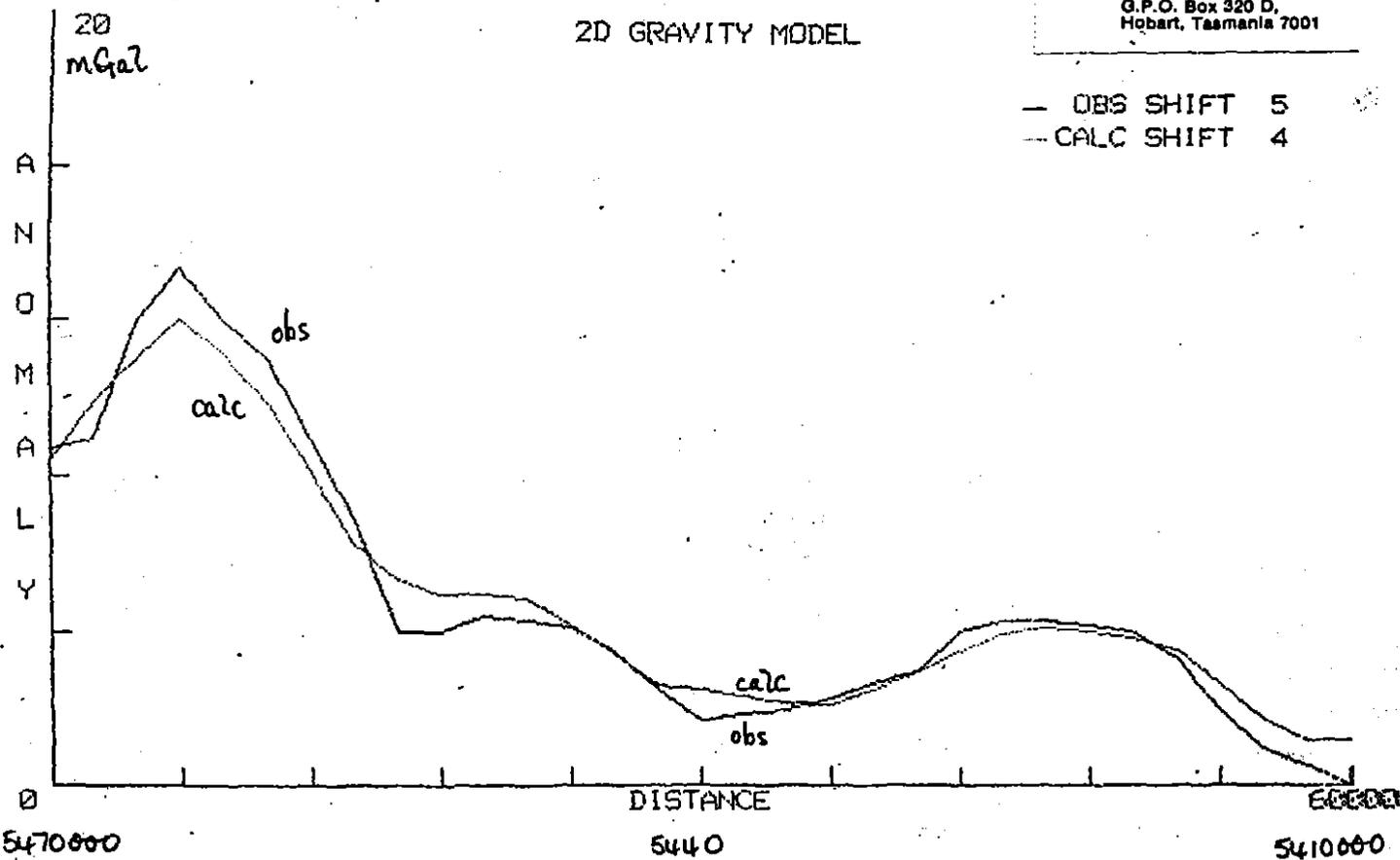
2000

412047

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Hobart, Tasmania 7001

045

2D GRAVITY MODEL



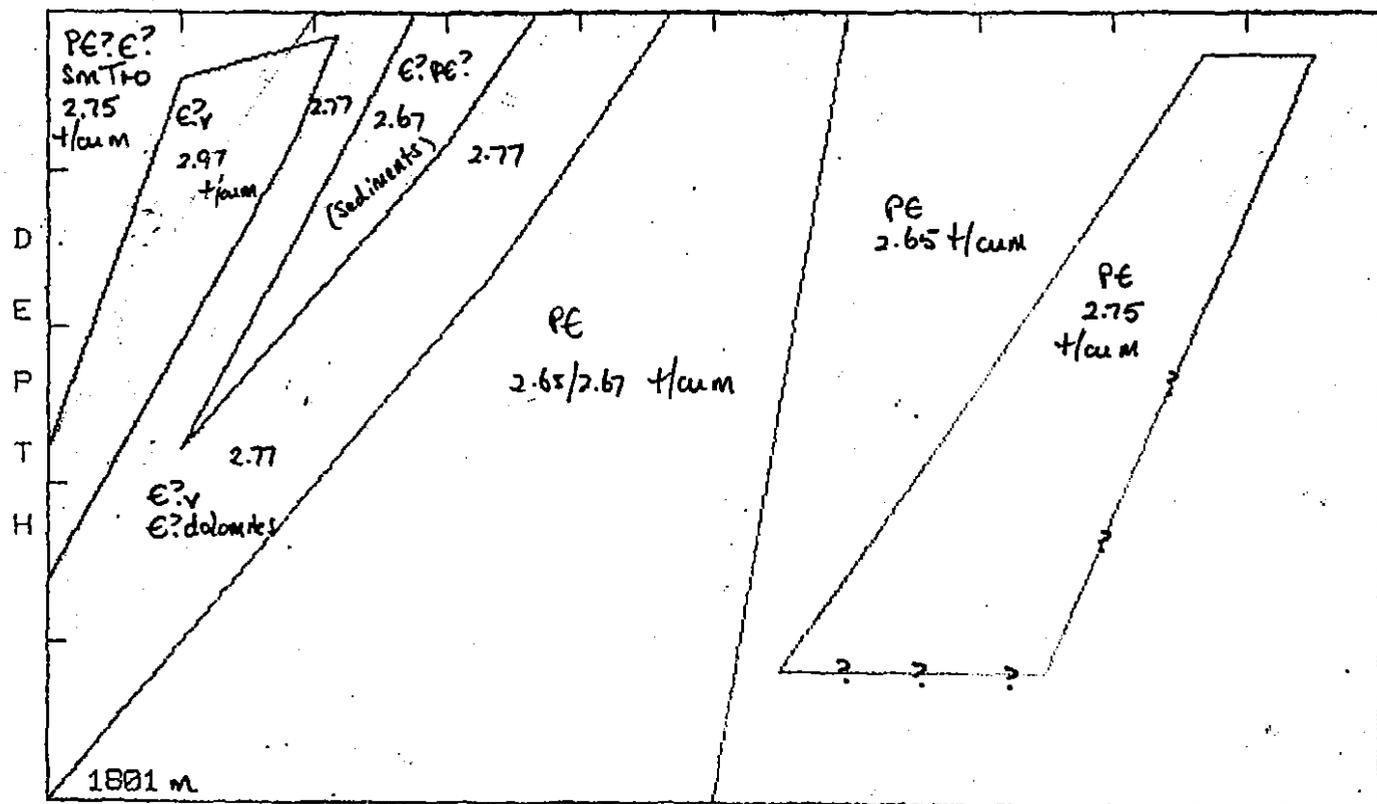
BALFOUR-TROWUTTA LINE 340E 5470-5410N

Edith Roger Trowutta
ck R

Forked
Tree Hill

Horton
R

DISTANCE 540000

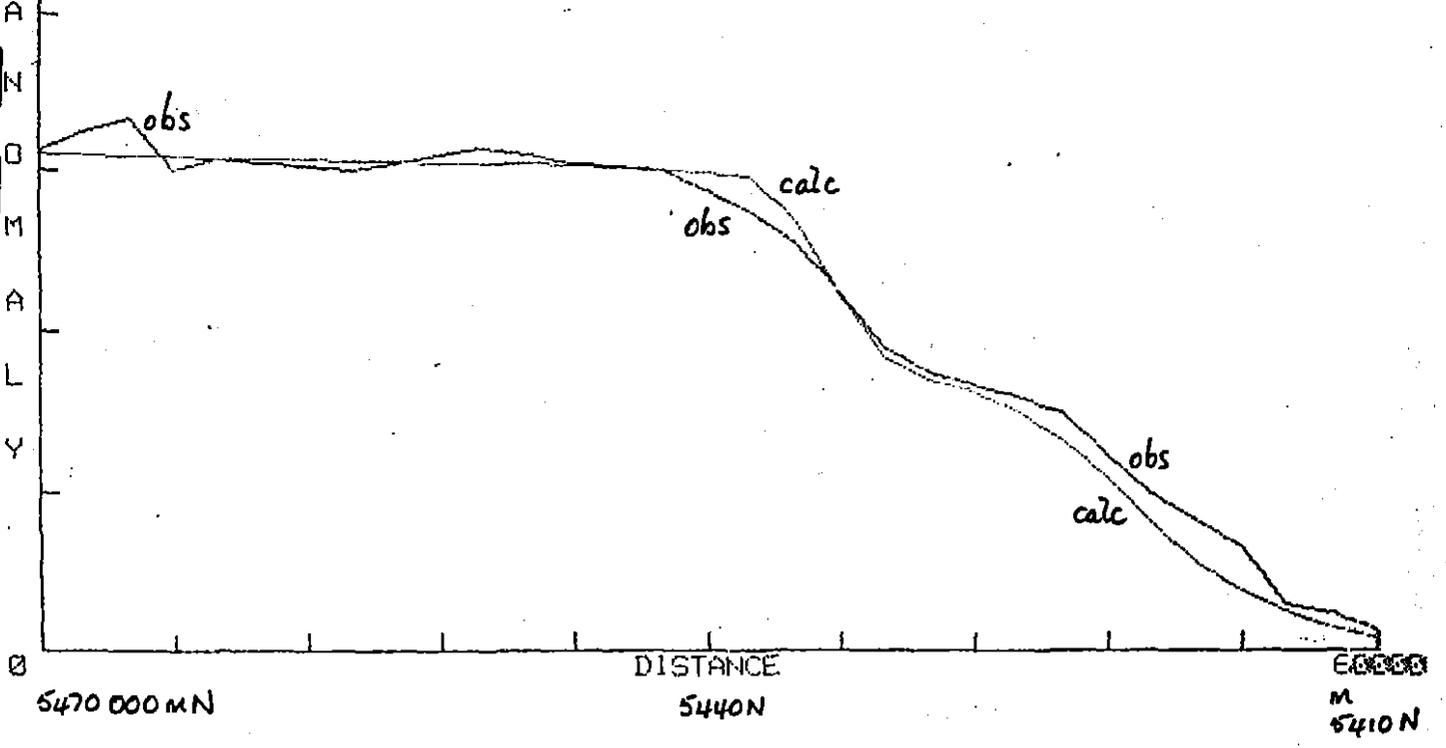


046

20
mGal

2D GRAVITY MODEL

- OBS SHIFT 10
- CALC SHIFT 9



BALFOUR-TROWUTTA LINE 330E 5470-5410N

(Balfour)

Christmas
Hills

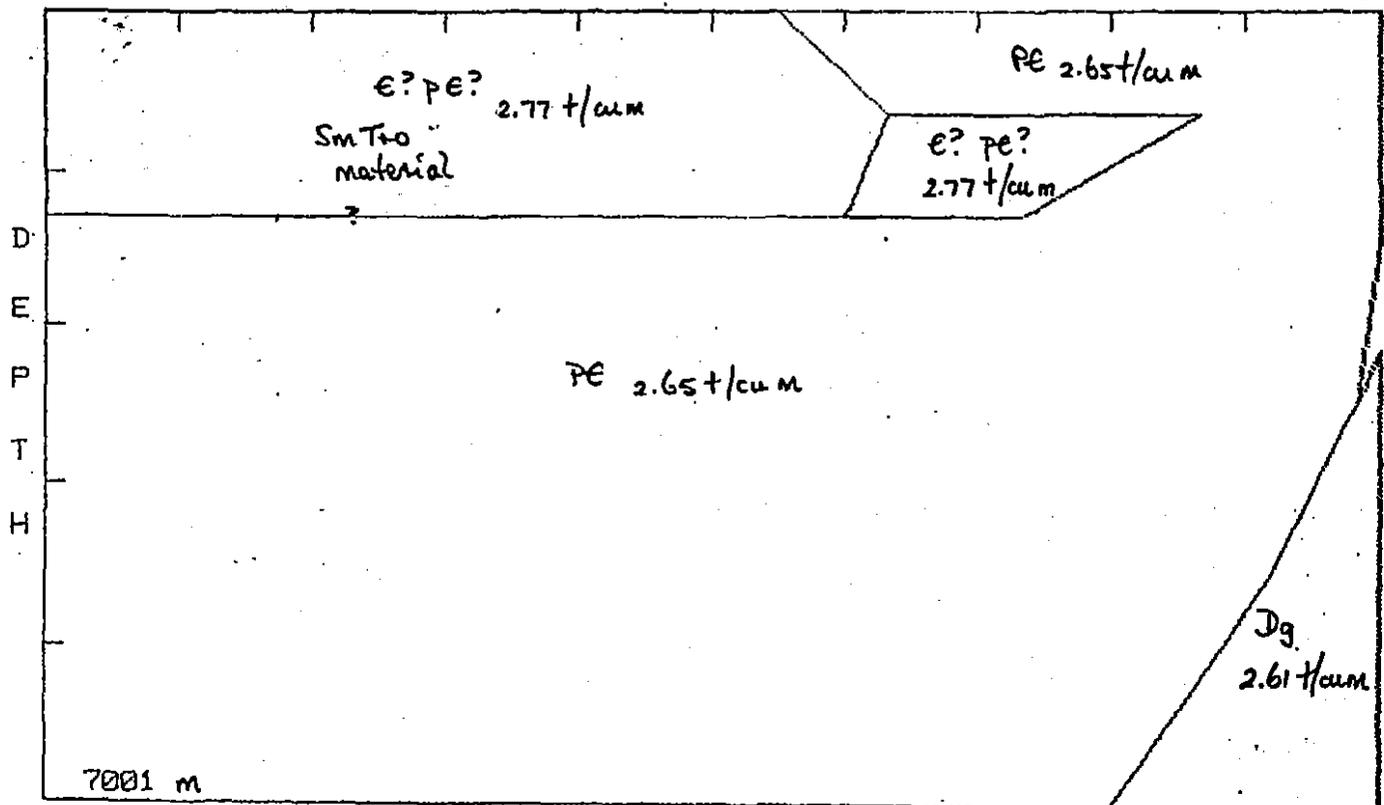
Roger R
west

Arthur
R

Lindsay
R

DISTANCE

5410 N



047

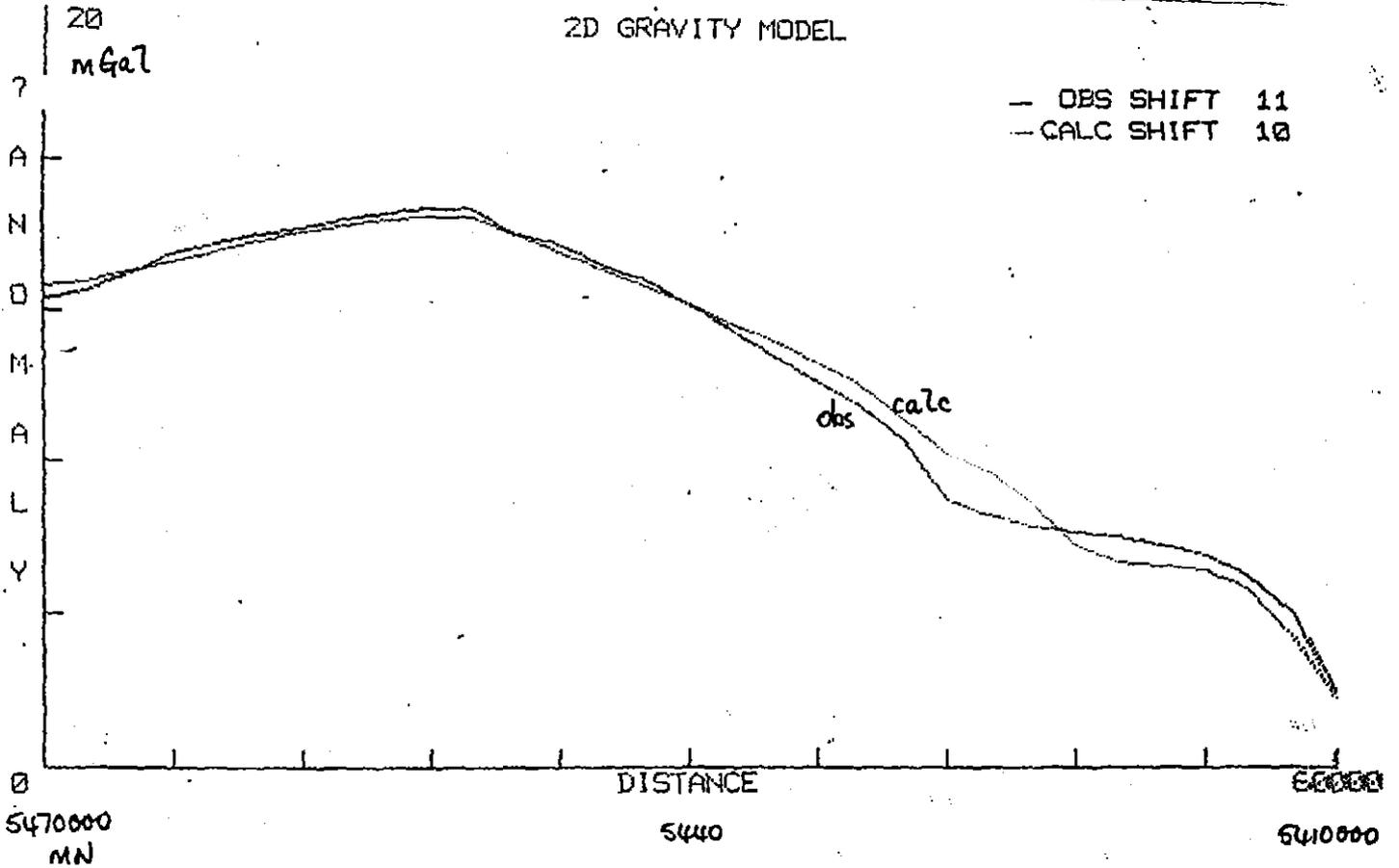
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412049

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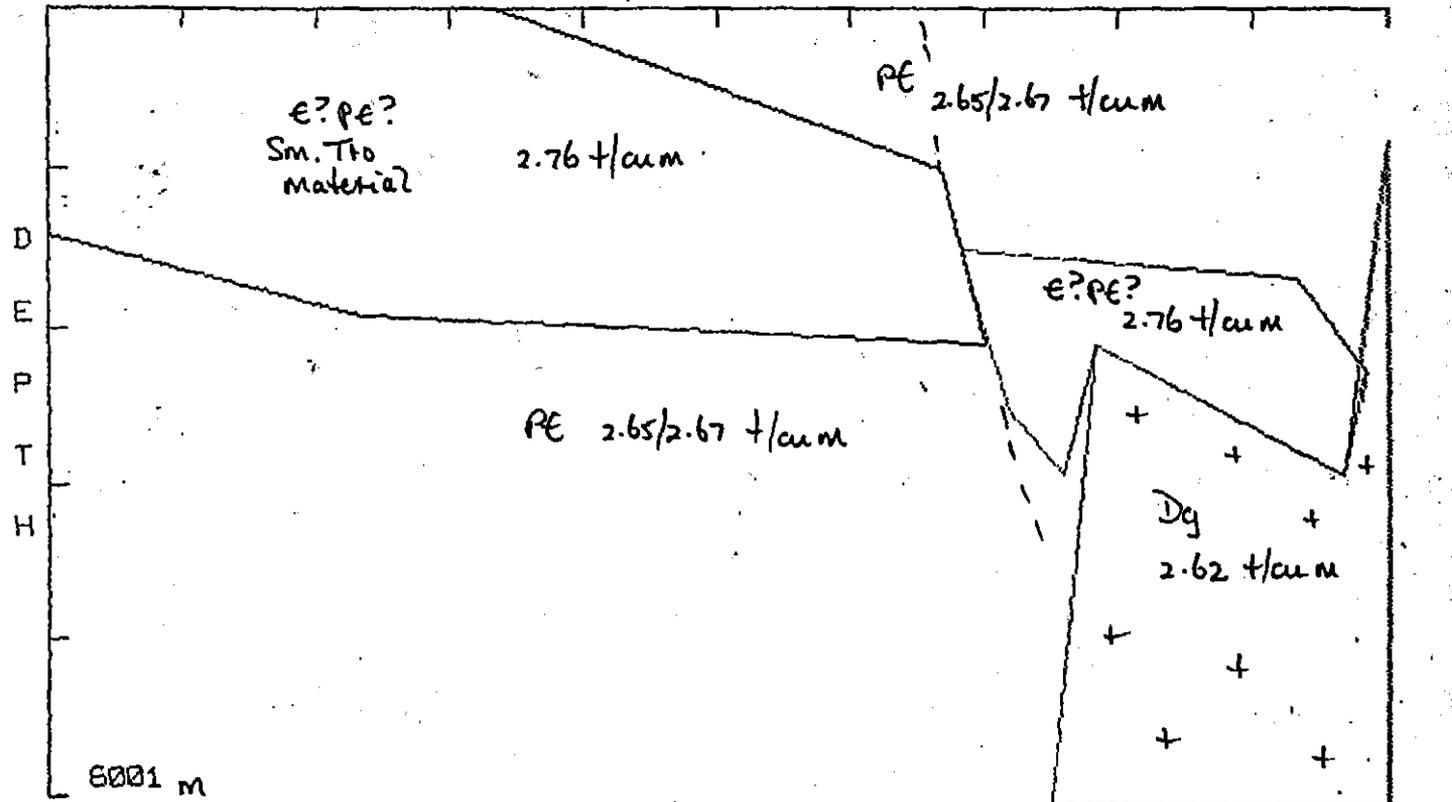
2D GRAVITY MODEL

- OBS SHIFT 11
- CALC SHIFT 10



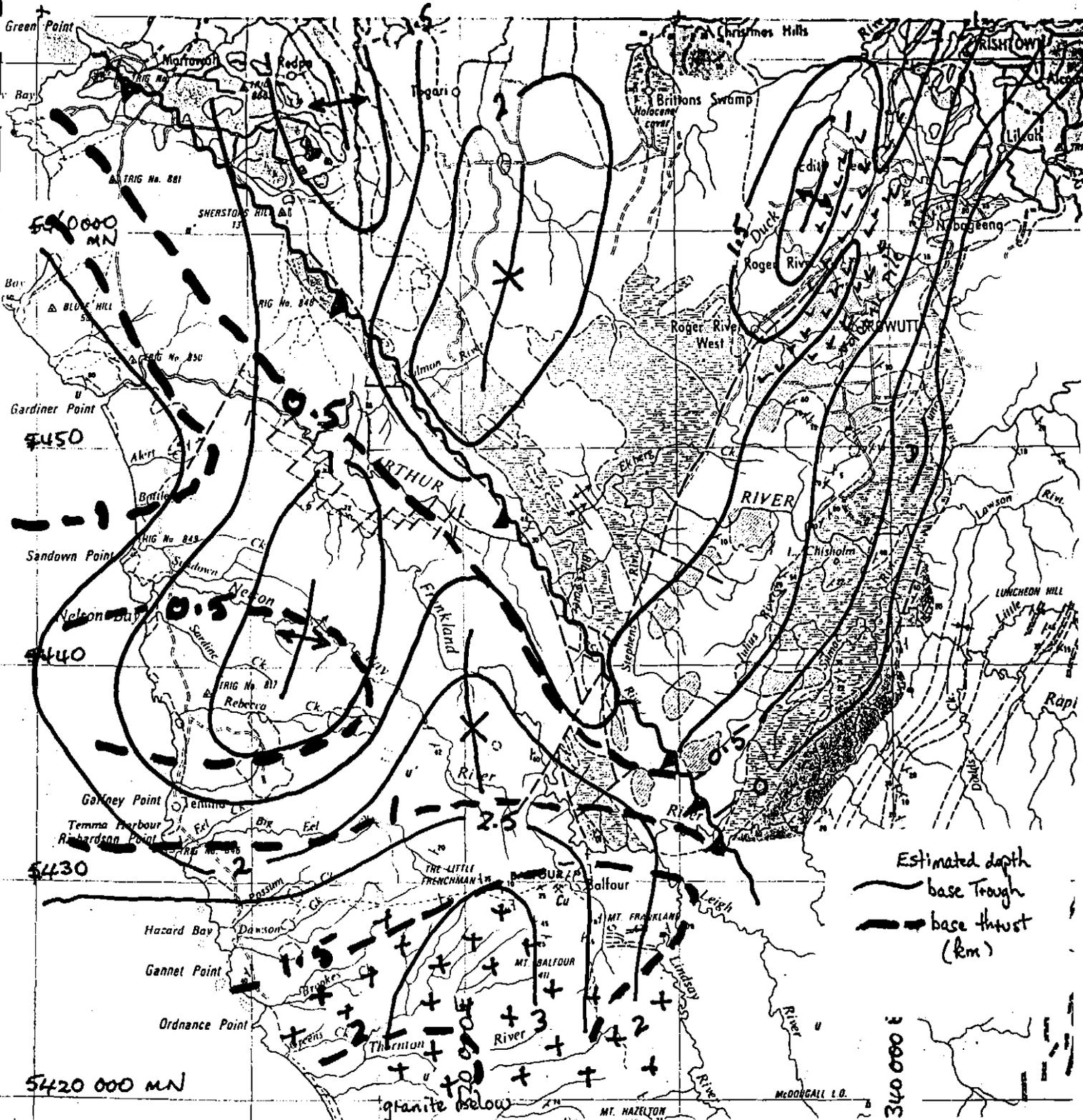
BALFOUR-TROWUTTA LINE 320E 5470-5410N
 6/3-6 3/1
 Togati Arthur R the Clump (Balfour)

DISTANCE



BALFOUR WEST GRAVITY INTERPRETATION 320 000 ME

FIGURE 18



SUMMARY OF STRUCTURAL INTERPRETATION

FIGURE 19

BALFOUR - TROWUTTA - TEMMA REGION
 (Based on limited modelling of magnetic data
 and patchy gravity data)

THE TEMMA - BALFOUR BLOCK

General inspection of both data sets has indicated that the rocks of the Smithton Trough persist SSW of Balfour and that their truncation near Balfour by faulting (Williams & Turner, 1973) is not a true account of the structures present. Review of anomalies forms suggests that the sequence is terminated, or removed, by the emplacement of the Pieman Granite.

As is the case with the Rocky Cape core there is only one way in which Precambrian rocks can massively overlie an early Cambrian trough - the structures inferred along the western side of the Smithton Trough, as previously defined, must include thrusts. This proposition has been tested in so far as current data allow. The available magnetic data have been underinterpreted but the principal argument must be carried by sparse gravity data.

Previous work, e.g., Leaman, 1988a, has identified dense portions within apparently siliceous Precambrian rocks and noted this to be odd. All previous work has, however, applied Ockham's razor to the suggestions made and simply indicated the approximate volume of such materials present. The very regional nature of previous work has also minimised the amount of critical detail which has been extracted on particular structures.

Figures 12, 17 and 18 partly remedy this situation.

Figure 12 recognises the general occurrence of siliceous Rocky Cape type rocks across the surface along the entire length of the profile. This profile could be interpreted in terms of granite alone were it not for the requirements of profiles drawn with other orientations and sampling other aspects of the section. It suggests the volume of concealed dense section (Smithton Trough rocks including dolomites and basalts) and shows that this volume is depth limited on upper and lower surfaces and is also stepped and finally terminated near Balfour. This does suggest some faulting, or ramping. The dense Lineament zone is sampled at the eastern end of the profile but the attitude of the profile is not definitive (compare Figure 11) and only the general sense of the Lineament shear slices is suggested.

Figures 17 and 18 extend from exposed Trough rocks into the complex, and supposedly faulted, Balfour area where Precambrian "basement" is exposed. Both sections show that the Trough rocks must persist beneath the Precambrian rocks in a manner consistent with Figure 12. The continuity of the sequence is disrupted by faulting and intrusion of the Pieman Granite.

While the models are crude, and no refinements are advised until the data base has been improved, they leave no doubt as to the style of structures present. The Precambrian block which extends inland from the coast, from Marrawah to Pieman Heads, is overthrust across both the Smithton Trough and part of the Rocky Cape Block itself.

Although the models are very approximate they do suggest the thrust may be folded. It is certainly disrupted. The primary structures within, or affecting, the Smithton Trough section can be traced beneath it. This aspect is suggested by Figure 15 which indicates the folded form of the Trough as well as showing the general relationship of the principal thrust.

Figure 19 is an attempt, with the current interpretation and data sets, to summarise the structures of the Temma-Balfour area. The precise position of the thrust may well be determined by magnetic data but its approximate position and orientation is indicated. The overthrust slab is not thick and rarely exceeds 1 km until south of Balfour. The Trough section is variable in thickness, due to folding, but is rarely more than 2 km thick. The complex, probable, fold near Edith Creek is also suggested.

The present work suggests the style of structuring and what might be achieved by more extensive study but this is not recommended until the gravity survey has been infilled to a station spacing of about 2 km or less. Linked magnetic and gravimetric analysis would then resolve most of the structures and detail their relationships. The relationship between mineralisation, granites and linking structures cannot be evaluated with present data.

THE WARATAH AREA

The Waratah area is peripheral to the immediate study area but it has been suggested that the Meredith Granite protrudes into it and is the source for most of the mineralisation observed there. This was also implied by Leaman & Richardson (1989a) although none of their profiles tested this assumption.

The magnetic field in this area is disturbed and consistent with a metamorphic halo although responses related to tin mineralisation and Tertiary basalts do confuse the observed patterns. Gravity data coverage is good south and east of Waratah but very patchy elsewhere.

Figure 21 presents a detailed plot of the residual gravity field. It shows that the Meredith Granite does extend irregularly into the Waratah area and that several crestal structures may be present. Two such crests may be concealed beneath the basalt-covered areas.

Modelling of these anomalies (Figures 22, 23) shows this to be the case and that it is possible that the roofs have been preserved. The relationship between granite form and Mt Bischoff is also indicated.

This is clearly an area which would repay an improved gravity coverage and detailed analysis.

STRUCTURAL INTEGRATION

An integration of the regional interpretation is suggested in Figure 20.

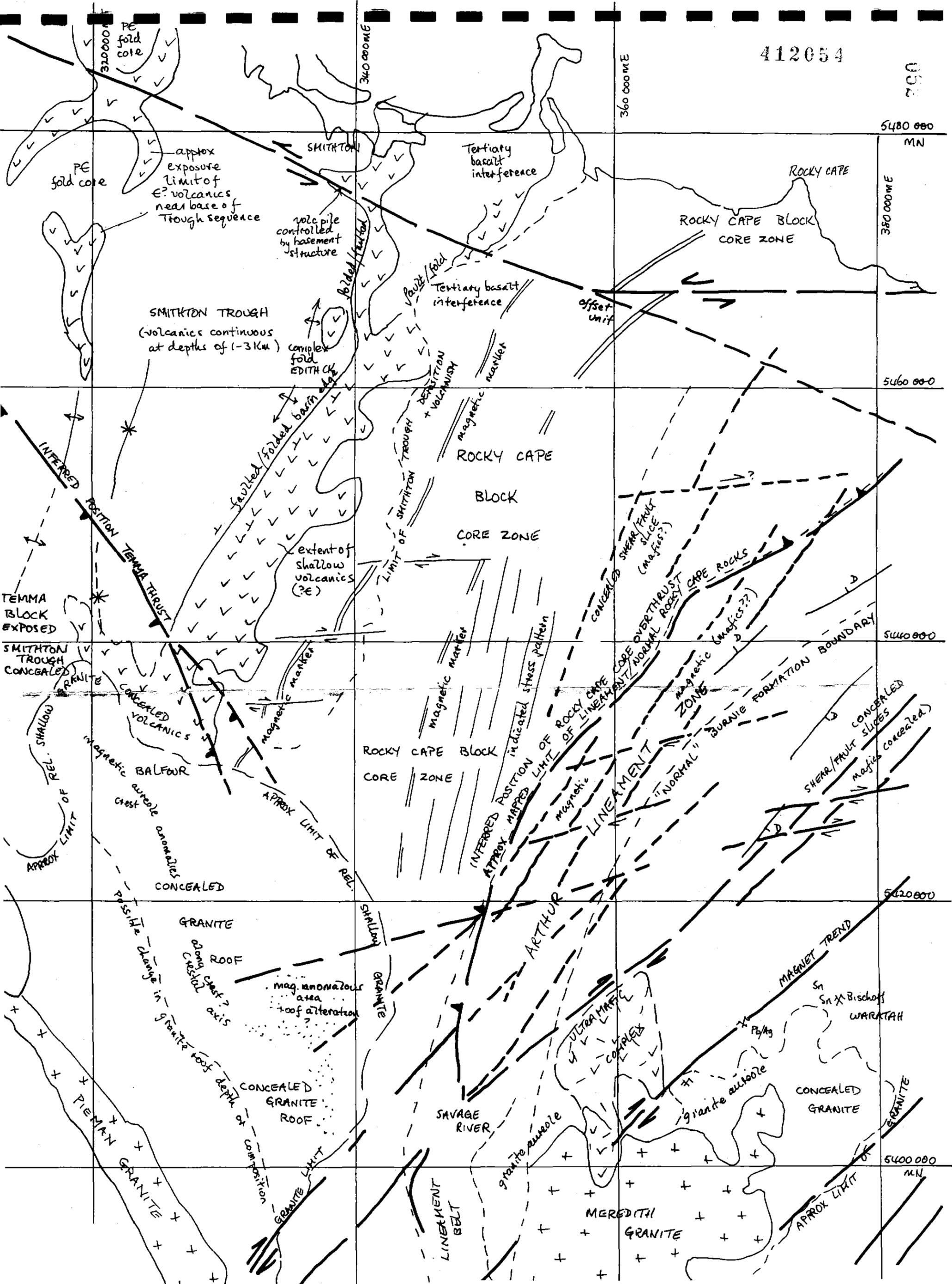
This suggests two parallel basin developments; the Burnie-Oonah development of Precambrian age and the Smithton Trough of Eo-Cambrian age on either side of a large crustal block which appears to extend through the upper half of the crust, at least, and to persist to the west as far as data exists.

The Burnie Formation-basin has been extensively sheared and many movements and igneous involvements of different ages are now represented. The shearing was acute to the original structural axis and trends more NE than the original NNE.

There is evidence for other sympathetic shear systems.

The entire basement has been disrupted and the Rocky Cape core has been displaced eastward by at least 25 km across the deformed Burnie Formation basin margin.

Possibly during the same primary event an additional slice was stripped from basement and emplaced across the Smithton Trough. There may be more than two major thrusts in this basement-involved stack. The distribution of the Pieman Granite confirms the general extent of basement mobility since the granite could only have intruded a zone under stress or motion and not a solid basement-crust slab. The presence of granites within the Burnie Formation, or its correlates, from Zeehan to Penguin and within the dislocated segments of the Rocky Cape Block SE of Balfour and NW of Montagu confirms this interpretation. They also show that the region was structurally active during the Devonian and the thrusting observed may be of this age.



ROCKY CAPE REGION REGIONAL INTEGRATION OF INTERPRETATION

FIGURE 20

De la

055

x = gravity station.

+4

375000 ME

+6

Mt Bischoff

CONCEALED CUPOLA

WARATAH

5410000 MN

GRANITE SPINE
CONCEALED

BASALT-COVERED

REGION

MODEL
PROFILE
2

CUPOLA
BENEATH

BASALT
COVER

-10

-12
EXPOSED MEREDITH
GRANITE

CONCEALED
SPINE
INFERRED

BASALT-COVERED

MODEL
PROFILE

5400000 MN

054

LINE PARAMETERS - ORIGIN, LIMIT, INCR : 0 15000

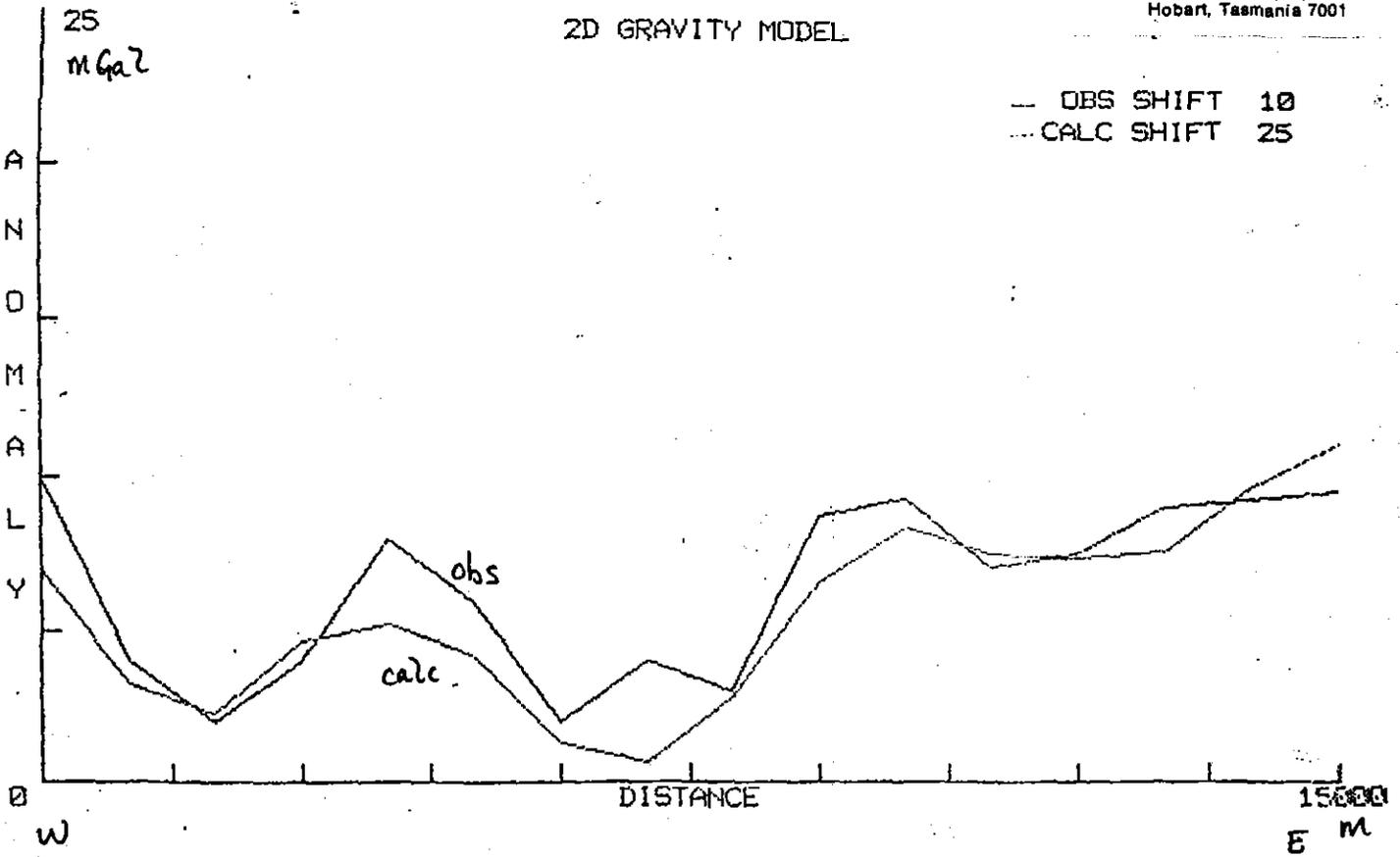
48

1000

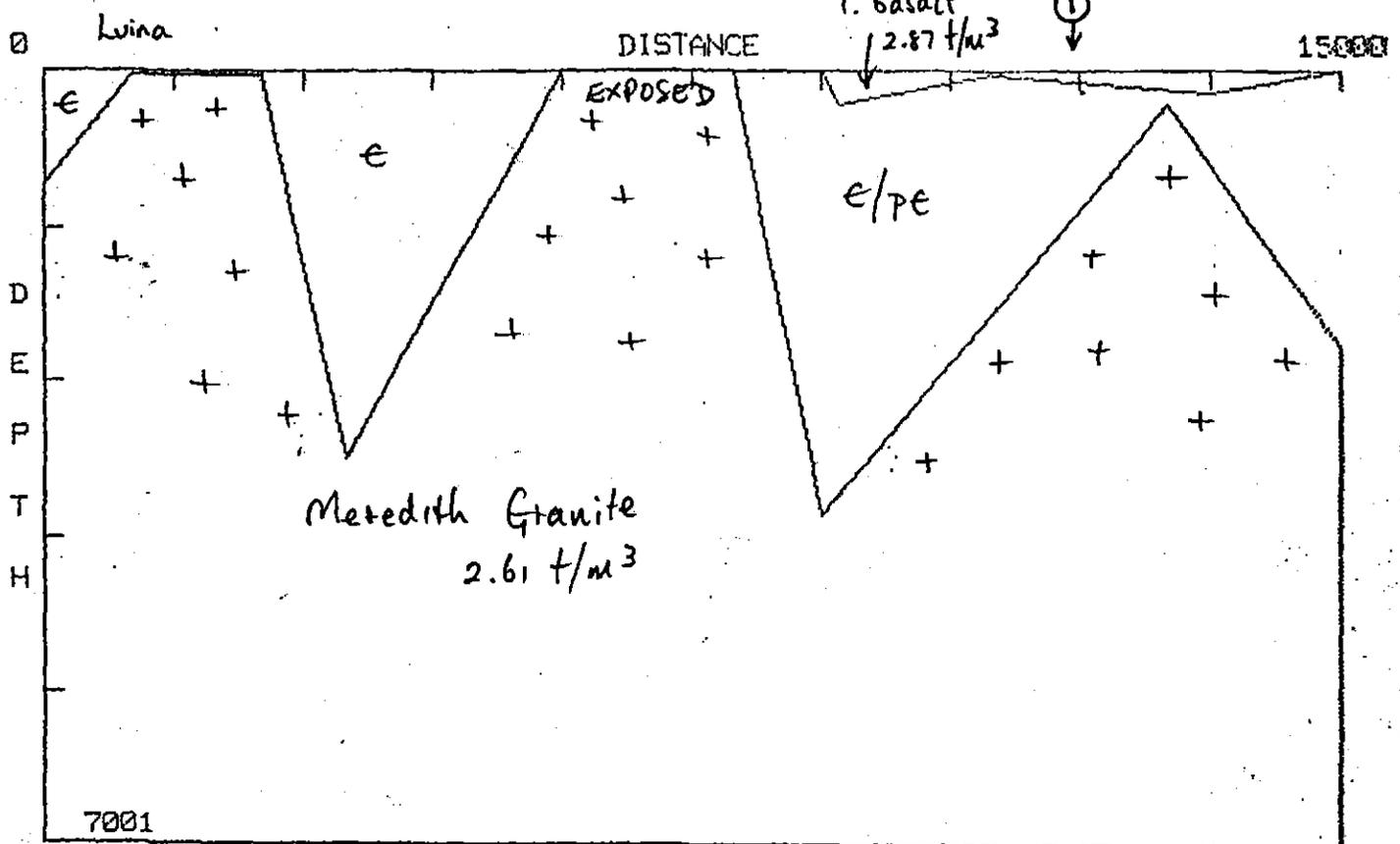
412056

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2D GRAVITY MODEL



LUINA-KNOLE PLAIN 365/4055-380/405



LINE PARAMETERS - ORIGIN, LIMIT, INCR : 0 15000 1000

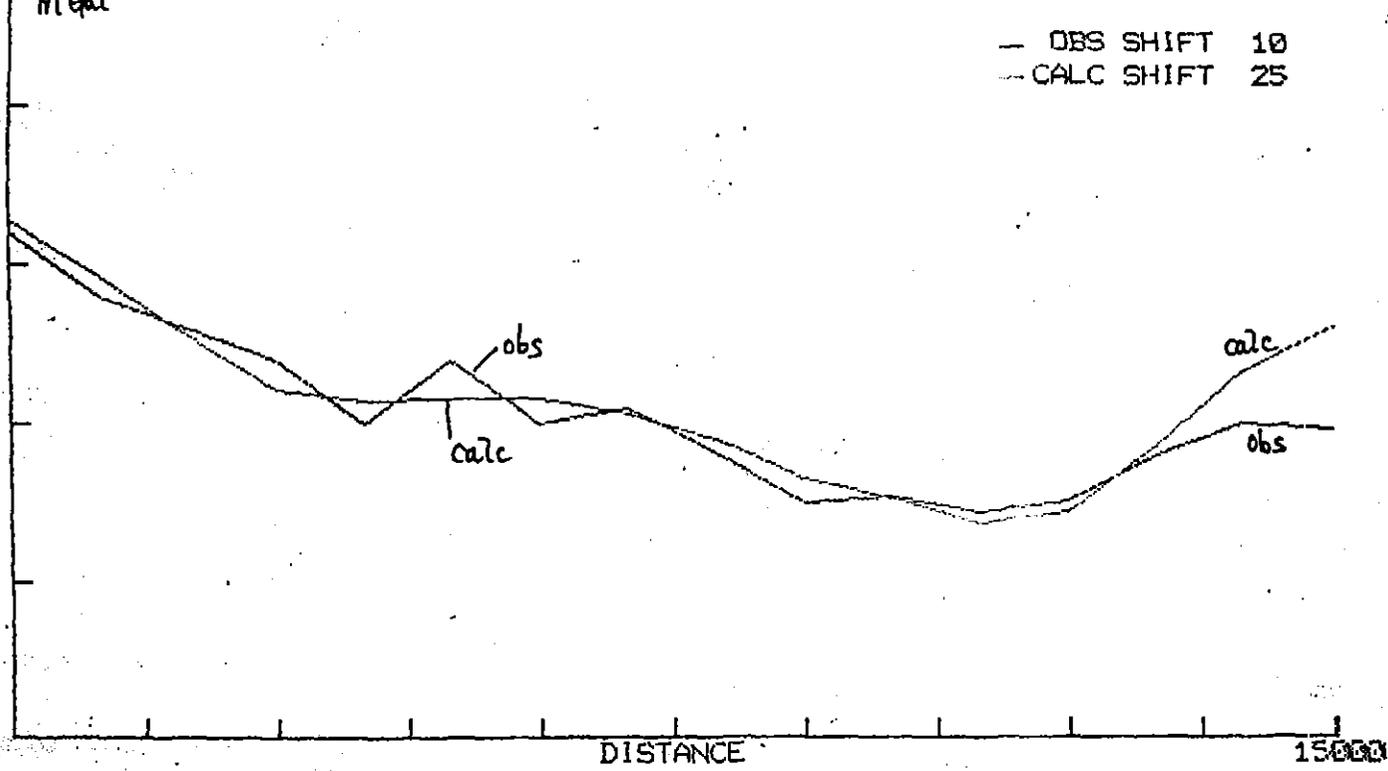
412057

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Hobart, Tasmania 7001

055
25
mGal

ZD GRAVITY MODEL

- OBS SHIFT 10
- CALC SHIFT 25



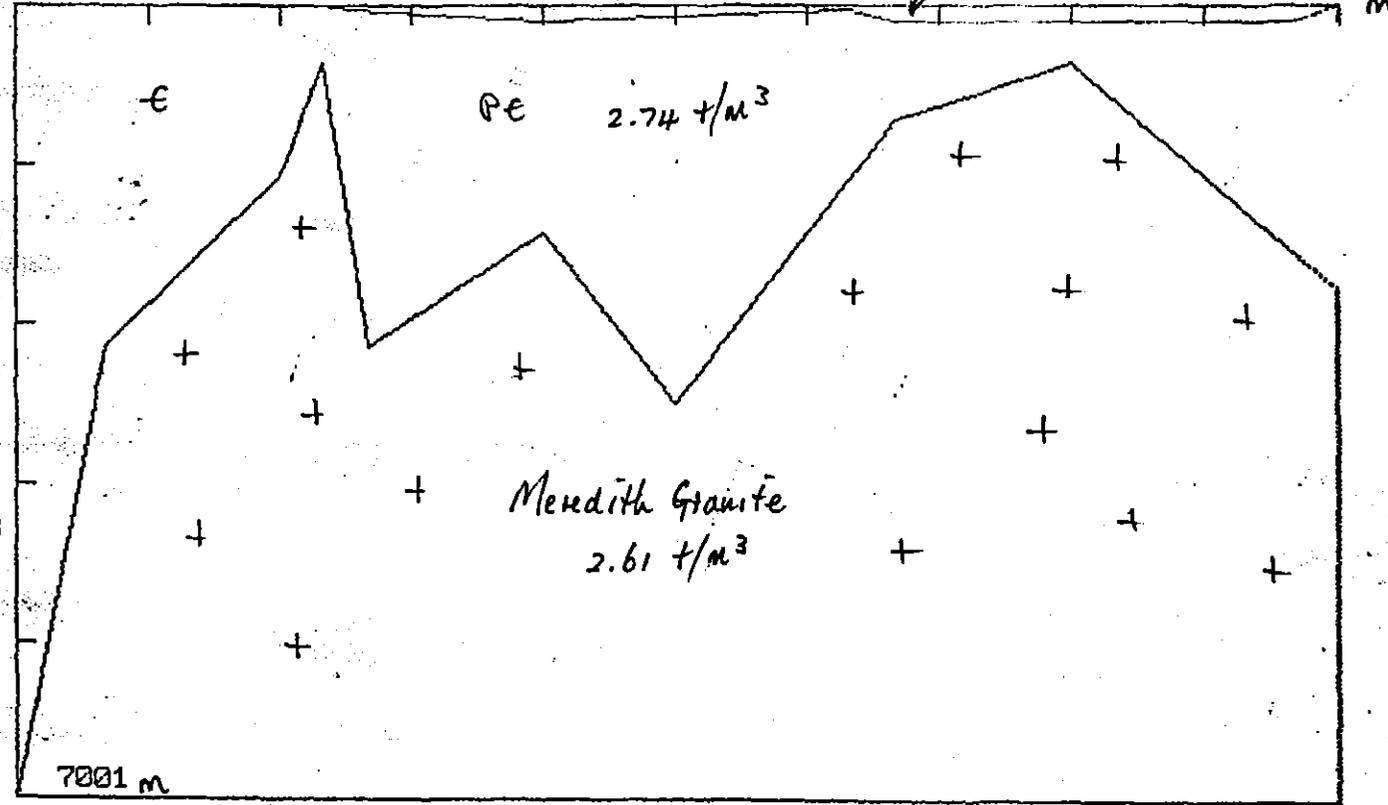
N
WARATAH - HAY CREEK 375/4145-3785/480

vmt
Bischoff Waratah

②

T. basalt
2.85 t/m³

DISTANCE 15000 m



MINERALISATION : REGIONAL IMPLICATIONS

Relatively little mineralisation is known in the area reviewed and summarised structurally in Figure 20. Known mineralised sites have been summarised by Green et al (1988).

While these occurrences must represent samples of the types of ore and mineralisation present they do not reflect comprehensive long term exploration. I have taken them to be indicators in the present discussion and have associated them with possible sources, controlling structures and host assemblages.

Silica deposits have been observed near Smithton, Wynyard and Savage River. These can all be linked to shear structures and there may be a genetic relationship. The first two sites lie on feature (4) (Figure 5) and the last can be linked to (18).

No simple explanation can be offered for the occurrence of alluvial chromite south of Brittens Swamp. Other platinoids are associated with the Heazlewood ultramafic complex.

Stratiform iron deposits occur within the metamorphosed Lineament rocks. Each deposit can be associated with major shear systems. Magnesite has a similar association.

Tin-tungsten deposits are associated with the roof of the Pieman Granite near Interview River and tin is associated with the NE margin of the Meredith Granite.

Base metals such as lead-zinc-silver are also associated with the contact zones of the Meredith Granite. The best known occurrence is at the Magnet Mine.

Gold occurrences are most common but most are alluvial. Turner (1988) describes some of the possible associations and suggests that the host rock is an altered dolomitic member of the Whyte Schist series. If it is assumed that the alluvial material has not been transported any significant distance then a strong correlation can be found between the magnetically-indicated shear structures and deposits. This correlation is unlikely to be accidental.

Copper occurrences also occur widely, both within the more altered rocks of the Lineament, and in the Balfour area. In the former case there is also an association with altered dolomite.

There are no associations of volcanogenic origin within this suite of occurrences and the structural review indicates that no lithologies equivalent to the Mt Read Volcanics are present. This is not a viable target type.

The general absence even of traces of lead-zinc mineralisation or geochemistry within the area west of the altered Burnie

Formation suggests that mineralisation of syngenetic McArthur River style is unlikely. Preliminary perusal of the magnetic data has not recovered any signatures or patterns which might suggest anomalous concentrations of sulphides within the siliceous Precambrian rocks.

Some disguised deposits may be present within the dolomitic sequences of the Smithton Trough but any signatures would be obscured by the associated mafic rocks.

There is clearly scope for Bischoff or Renison style tin deposits, associated with crestal protrusions from either Pieman or Meredith Granites, provided suitable host conditions prevail. Such deposits will be restricted to the Waratah region and to the northern contacts of the Pieman Granite where dolomitic rocks are either exposed or concealed.

Copper occurrences may provide a fascinating insight into the type of mineralisation to be sought. In the Balfour region, and to the south, copper may be associated with concealed mafic rocks and carbonates. This association is certainly true within the lineament. I suggest that, in these cases, the mafic material sourced the copper and that exchange alteration of the associated carbonate has generated a deposit with ore concentration and purification of the carbonate - to magnesite, with some release of silica. This type of process would be analogous to Mt Isa style mineralisation. It requires an active structure and fluid system. The indicators for such mineralisation would be subtle. Unless the sulphides or their gossan were actually exposed there might be no surface or chemical expression other than a local association of purified silica and dolomite. This coupling, however, might be definitive and suggest an exploration target.

The situation at Balfour is easier to conceive. Alteration of the concealed mafics (beneath the thrust) has led to removal of copper and deposition either in veins or carbonate exchange systems. It is the latter which might yield an economic deposit. All the materials are present together at moderate depth at the northern limit of the Pieman Granite.

Exploration for these restricted target styles is straightforward only in the case of tin in this environment.

Tin: The basic priority is to establish the shape of the granite and infer from it the nature of its roof and wall forms and the likely paths for fluid transfer. These then need to be assessed for host potential. Gravity methods can achieve these objectives. If pyrrhotite is associated with the mineralisation then magnetic methods may also support this analysis. Some of the anomalies south of Balfour may have this origin but much more work is needed to assess whether this is more likely than disrupted volcanics.

Gold: Gold is clearly associated with sheared carbonate rocks which may have an association with mafic rocks. Knowledge is limited but the shear factor and associated alteration may be

paramount. Magnetic methods are able to define many of these boundaries and their dips, and to trace them laterally.

Copper: Copper mineralisation styles offer new possibilities within this region. It is almost ubiquitous but not explained. I believe the suggestions made on the previous page to be original in terms of this area. Exploration needs to identify coupled silica and dolomite (purified) occurrences, perhaps with traces of copper, and then to evaluate these for concealed ore. It is essential to associate, at relatively shallow depths, complex fold and shear structures involving mafic rocks and dolomitic or comparable members of any rock sequence. A granitic source is not essential but an active fluid confluence is. Rating of possible targets requires quantitative assessment of the volume of alteration within the mafic rocks which have supplied the copper. If this volume is small then the resultant deposit will also be small. This analysis requires use of the magnetic data and detailed 3D analysis of both structures and properties.

The summary interpretation offered in Figure 20 also suggests sets of structures which may have offered paths for fluid transfer. The thrust surfaces fall within this category where in those areas where a heat and fluid source is involved. Many of the small shows around Balfour may originate, or be localised, in this way.

Figure 7 suggests critical intersections, or those sites with a high frequency of major intersections of fracture systems. Figures 7 and 20 provide approximate locations only and more detailed analysis, coupled with any ground control available, is required to accurately locate the features. The magnetic surveys possess sufficient first order resolution to achieve this goal.

The present study has not revealed much evidence for active growth faulting or feeder zones; especially those which might have been active during the late Precambrian - early Cambrian. Two possible candidates for feeder systems associated with the Smithton Trough are feature (9) and the distortion along (4) near Smithton. Any abnormalities within the mafic volcanics of the Smithton Trough, concealed beneath the dolomites of the Smithton region, can not be resolved without detailed study of both the distribution, thickness and possible alteration of properties within the unit over a wide area. This is feasible but beyond the present review. There is little suggestion for systematic or localised alteration within the exposed, or nearly exposed, volcanics east of feature (6). The patchiness of the magnetic patterns south and west of Balfour, however, may reflect such alteration since the general character is not consistent with simple burial or termination.

EL SPECIFIC DISCUSSION

Previous chapters of this report have considered the regional setting and structural issues which might impinge upon the set of exploration licences covering the Rocky Cape Block and its margins.

The following discussion considers each licence area individually in terms of

implied structures,
anomaly types, styles and sources,
alteration character,
mineralisation and associations,
recommendations for further data acquisition, analysis.

Each discussion is intended to be self contained.

EL 40/89 KEITH RIVER

The location of the area is shown in Figure 1. Figure 24 presents a partial overlay of gravity and magnetic data specific to this area.

Much of the area is magnetically quiet but two belts of intense anomalies trend NE across the EL. Each of these consists of fault or shear- bounded mafic rich blocks. Each displays dextral offsets against ENE trending features.

The residual gravity anomalies are also stable but this may be an artifact of coverage. The general anomaly character reflects the dense rocks uncovered along the lineament and which occurs east of the Rocky Cape Block thrust. The densest rocks in the area are concentrated in this zone.

Several major blocks have been defined magnetically. It is interesting to note that many of the mineralised occurrences known along the lineament have been found in this area - perhaps due to access and knowledge. Two retention licences directly overlie the eastern boundary of the lineament shear (24). Less is known of the western side. There is clear potential for tracing (24) to the SW. If the ENE offset system has any mineralising role it would be established near 363 000 mE, 5432 000 mN where such a feature intersects (24).

Comparable structures are concealed in the far NW and far SE of the EL. A geochemical or prospecting search for gold and copper in these limited areas would indicate if any primary mineralisation has been covered by the Rocky Cape thrust in the first instance and Permian materials in the second.

It should be noted that anomalies (24), (25), (26) and (27) are associated with gravity anomalies indicating more mafic accumulations locally. Most of the Arthur River mineralisation known directly correlates with the largest anomaly. The association suggests that the western closure of this feature and anomaly (23?) may be prospective.

The gravity anomalies south of Lyons River are not well defined and assessment of the continuity of the mafic assemblage requires improved coverage in order to properly evaluate the implication of the extension of (24) magnetically.

Much of the EL is not anomalous. The low amplitude magnetic anomalies dispersed south of (24) may be due to basalt remnants on high ground. The relevance of these features cannot be assessed until more is known of the surface geology. The isolated feature near the southern boundary of the EL at 363 000 mE may be of interest. It is out of character and more intense than other features. It also lies near the intersection of two primary gravity trends.

Detailed inspection of the magnetic data, followed by ground magnetics will be able to define the location of the principal boundaries. If any of the internal anomalies can be assigned to rocks other than Tertiary basalt then available profiles should be carefully re-examined for negative alteration responses.

062

EL 41/89 MT BERTHA

The location of this area is shown in Figure 1.

Figure 25 presents relevant gravity and magnetic data.

This EL covers the southern part of the Rocky Cape Block core zone. It includes part of the overthrust Rocky Cape core, the central portion of the Arthur Lineament zone and part of the roof of the Pieman Granite.

The roof limit of the granite is marked by negative residual anomalies (zone 15) and a rim of abnormally elevated magnetic anomalies. These arc from Balfour toward Savage River. The localised magnetic responses in this siliceous environment does indicate alteration and abnormal chemistry and the northern part of the anomaly near Boundary Rivulet in the far south of the EL should be inspected, as should the feature east of Leigh River (e.g., 335 000 mE, 5427 000 mN).

Gravity coverage is too coarse within zone 15 in this EL to establish the existence of any high relief cupolas on the granite but it is possible that such a feature does exist near the Leigh River. This zone might be mineralised and may be related to the magnetic anomaly defined above.

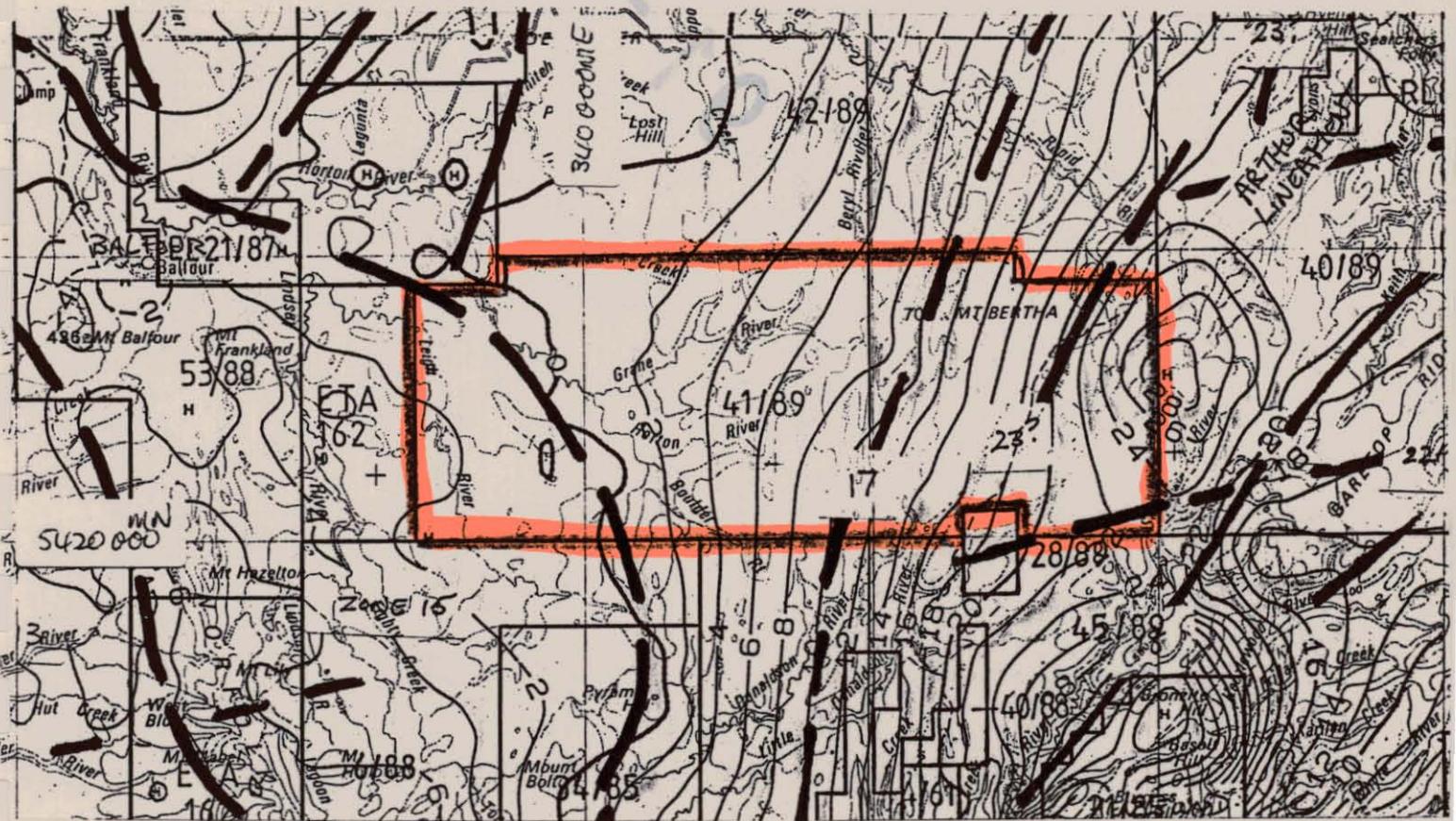
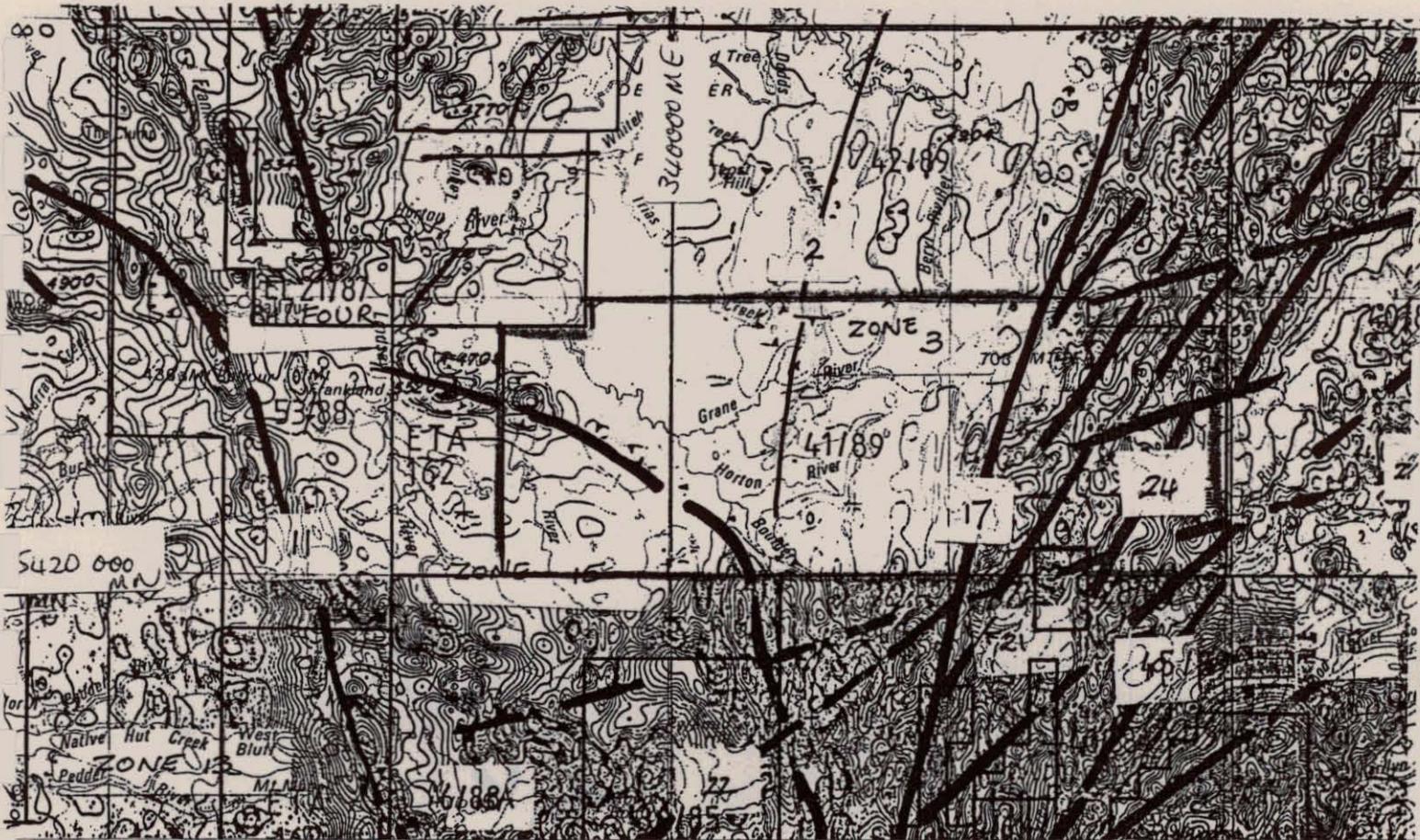
The gravity anomalies in the eastern half of the EL are dominated by the effect of the Lineament rocks and those concealed beneath the Rocky Cape Group. Some large, but ill-defined shears and faults are suggested. The rocks are very dense and probably mafic in origin near the eastern boundary of the licence area.

The magnetic data present a clearer view. The lineament zone is shown to be composed of several large blocks which do not, at this northing, appear to extend west of the metamorphic indicators for the lineament. Several ENE structures are also present. None of these features appears to extend west of (17). Structure (24) appears to mark a distinct lithological change and to be associated with mineralisation further north and it should be precisely located in this area. The intersections with other structures may have induced greatest alteration. These sites may be crucial for deposition and exchange systems involving copper and gold.

Magnetic zone 3, between feature (2) and (17), carries a unique magnetic texture suggestive of pervasive tension fracturing.

No subtle indicator anomalies have been identified within the central part of the EL.

Reliable location of many of the structural trends within the lineament zone may depend on examination of all observed profiles.



EL 42/89 RAPID RIVER

The location of this area is shown in Figure 1.

Figure 26 presents relevant gravity and magnetic data.

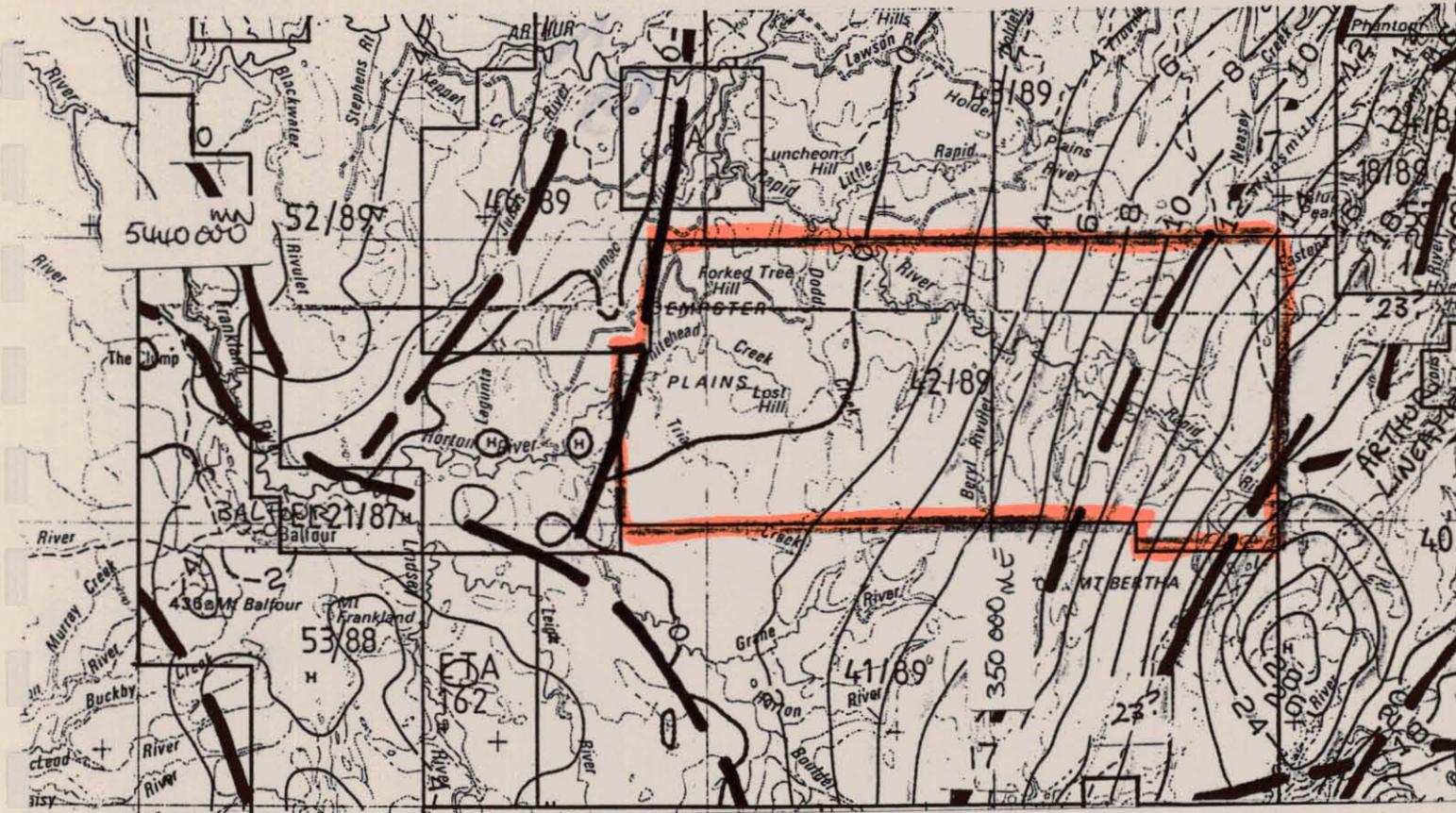
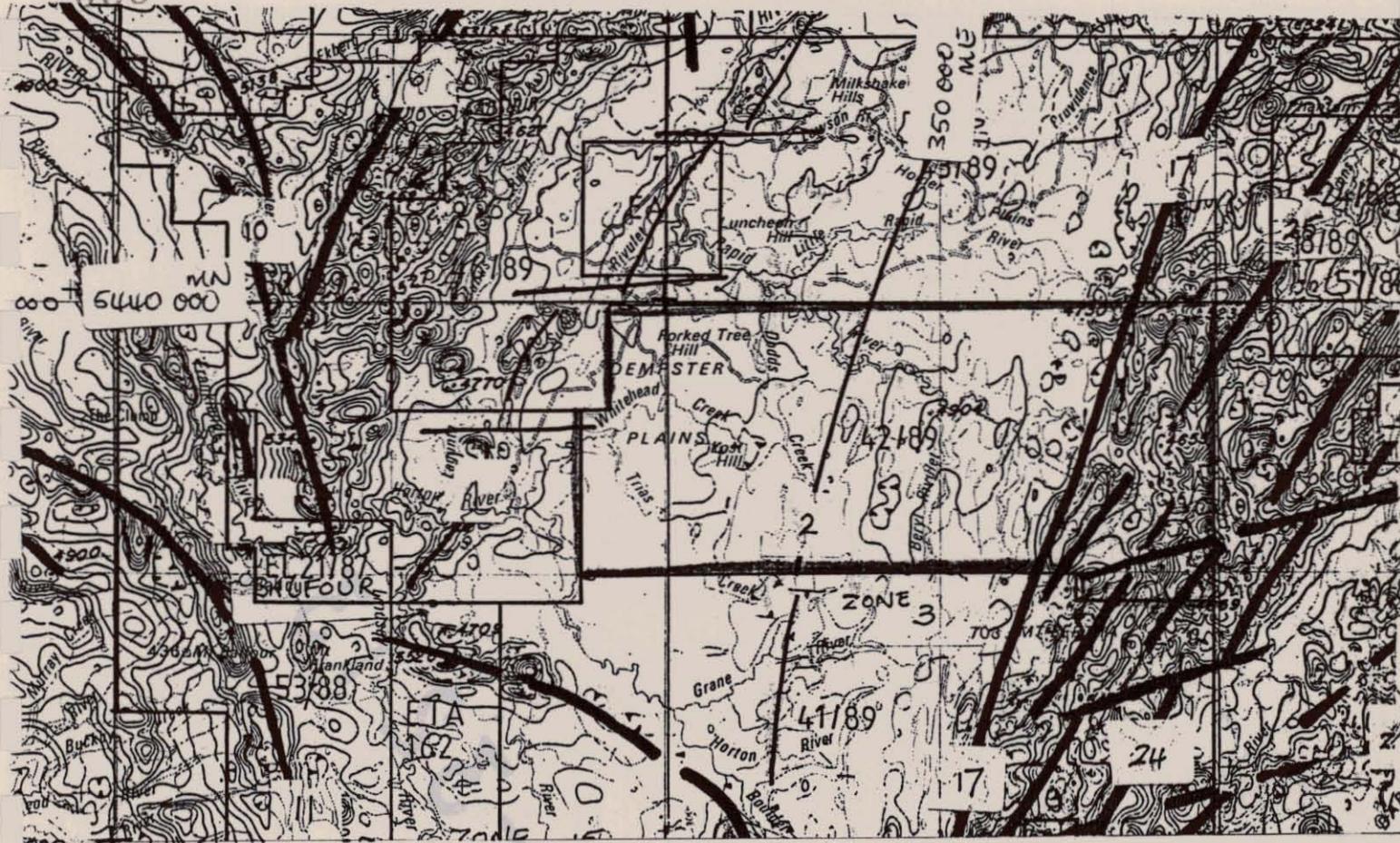
This EL covers the central part of the Rocky Cape Block core zone and much of it is magnetically quiet and gravimetrically neutral. These responses reflect the substantial thickness of siliceous Precambrian rocks present and suggest that the sequence approaches true basement scale and composition even though the eastern margin has been overthrust across the Lineament and Burnie Formation rocks.

Magnetic feature (2) marks the junction between unstressed and stressed rock suites. An oblique fracture set has been generated east of (2) (see Figures 3C, 7 and 20).

Most of the magnetic anomalies observed along the eastern side of the EL fall within the area considered to be normal Rocky Cape Group. Examination of these sources show that they are due to dipping slices of mafic or equivalent constitution at minimum depths of 1 to 1.5 km which are truncated by a west dipping interface with Rocky Cape Group rocks above the slices. The gravity data, though much more poorly defined in this area, support this conclusion.

The underlying mafic slices are terminated at depth by feature (17) and even though there is no known surface expression of this structure its projection should be examined for traces of mineralisation. This bounding feature is one of the most significant structures identified in regional analysis and it would be surprising if it never acted as a conduit. Similar comments apply to (25) although this is a lesser structure. Both (17) and (25) are wholly concealed and only identified magnetically.

The area covered by this EL appears barren on current mineral site maps and this may reflect surface conditions. Potential targets will lie at moderate depth.



EL 42/89 RAPID RIVER

MAGNETIC AND RESIDUAL GRAVITY DATA

FIGURE 26

EL 43/89 HOLDER RIVULET

The location of this EL is shown in Figure 1.

Figure 27 presents relevant gravity and magnetic data.

Rocky Cape Group rocks are exposed across most of this EL; the only exceptions being near the Arthur River in the NW and Meunna in the far east. The basal rocks of the Smithton Trough are exposed in the west and part of the Lineament metamorphic belt is exposed in the east. Exposure of the lineament lies between magnetic features (23) and (25).

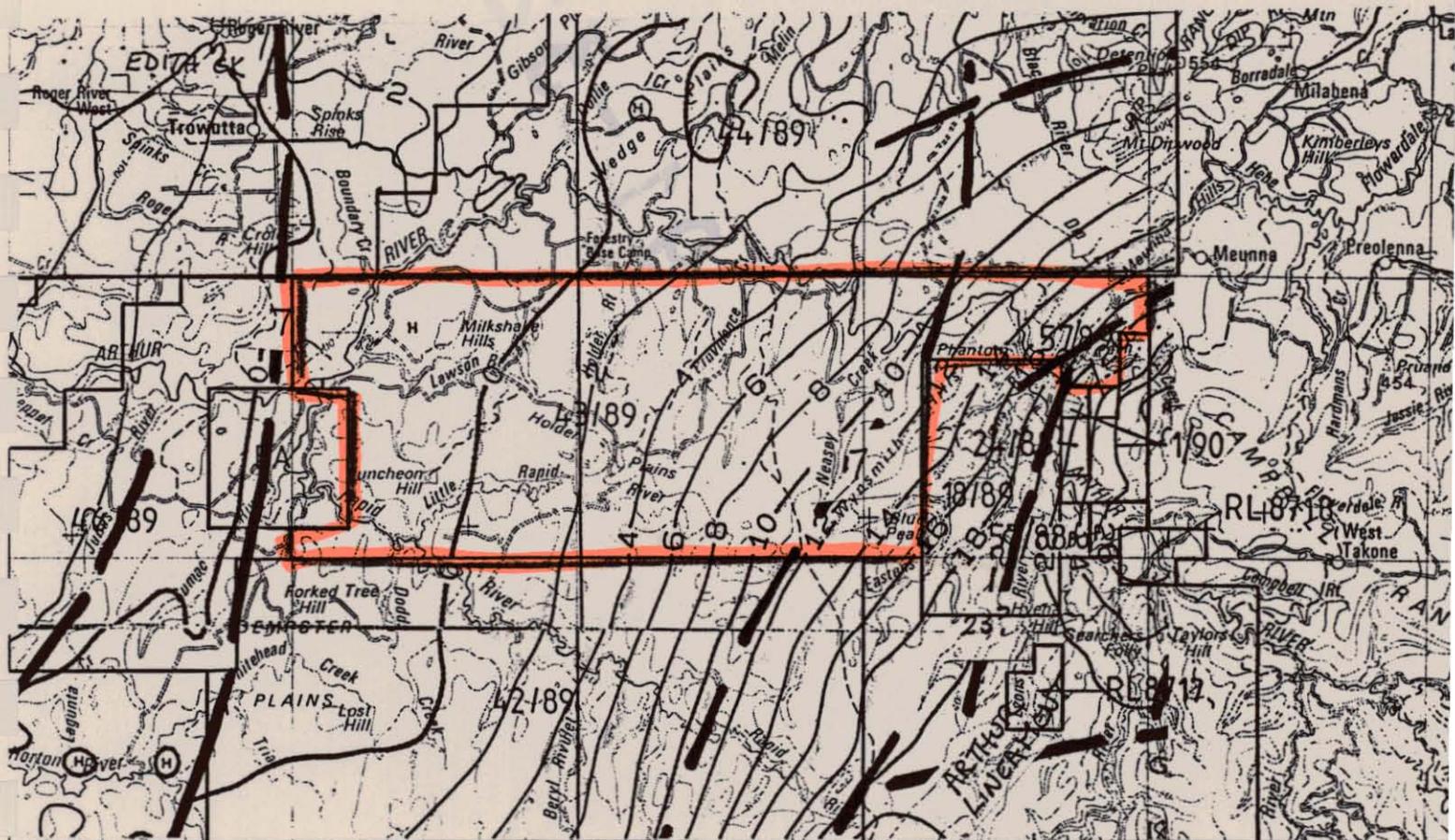
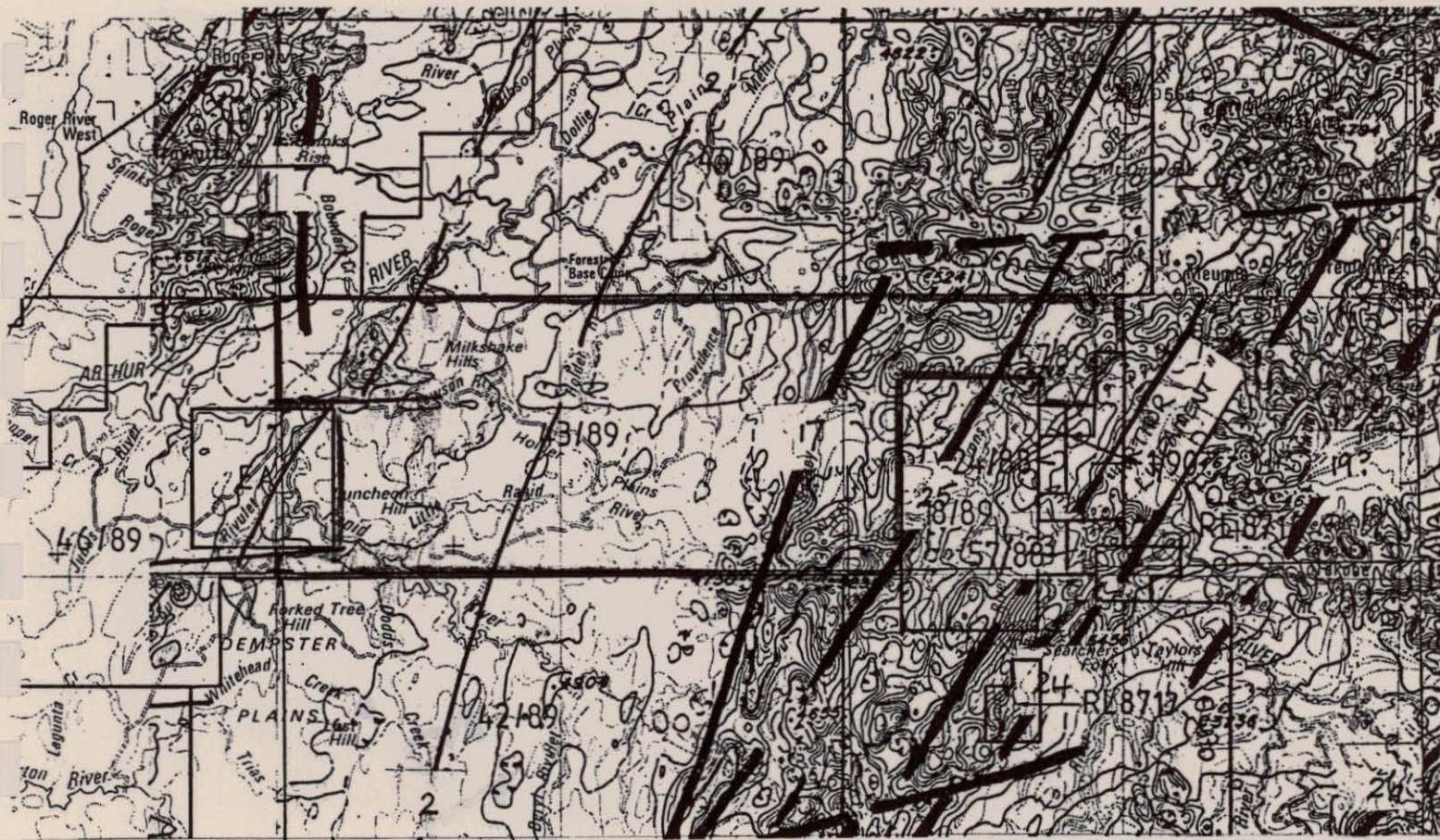
The EL includes subtle magnetic anomalies (1) and (2). These features are perhaps most accessible in this EL and their origin should be assessed. Some moderate responses occur in association with (1), including two of the dextral offsets, and this area between Boundary Creek and Milkshake Hills should be examined. Ground magnetic profiles and some property (susceptibility) determinations will probably be required to identify the source of these effects - if it is exposed. Some trace geochemistry in this area would establish if a useful mineralising or oxidised conduit is present.

A similar treatment should be applied to identify (2) which appears to produce a step anomaly effect and may represent a disguised fault within the siliceous rocks.

The projection of (17), the western limit of mafic origin slices beneath the Rocky Cape Group overthrust, to the surface should also be inspected. This may require survey of a strip perhaps 2 or 3 km wide due to current uncertainties in dips of the hidden slices and structures. If traces of mineralisation are associated with (17) then a similar ground coverage of (25) may prove productive.

Surveys directed toward assessment of features (1), (2) and (17) are probably best undertaken in this EL although the results will be applicable to 41 and 42/89.

Gravity data confirm the general implications of the magnetic surveys within the resolution of available stations. The origin of the linear intersection near the Arthur River should also be reviewed. This intersection is associated with a second order magnetic gradient which may indicate a substantial alteration effect.



EL 43/89 HOLDER RIVULET MAGNETIC AND RESIDUAL GRAVITY DATA
 FIGURE 27

EL 44/89 WEDGE PLAINS

The location of this area is shown in Figure 1.

Figure 28 presents relevant gravity and magnetic data .

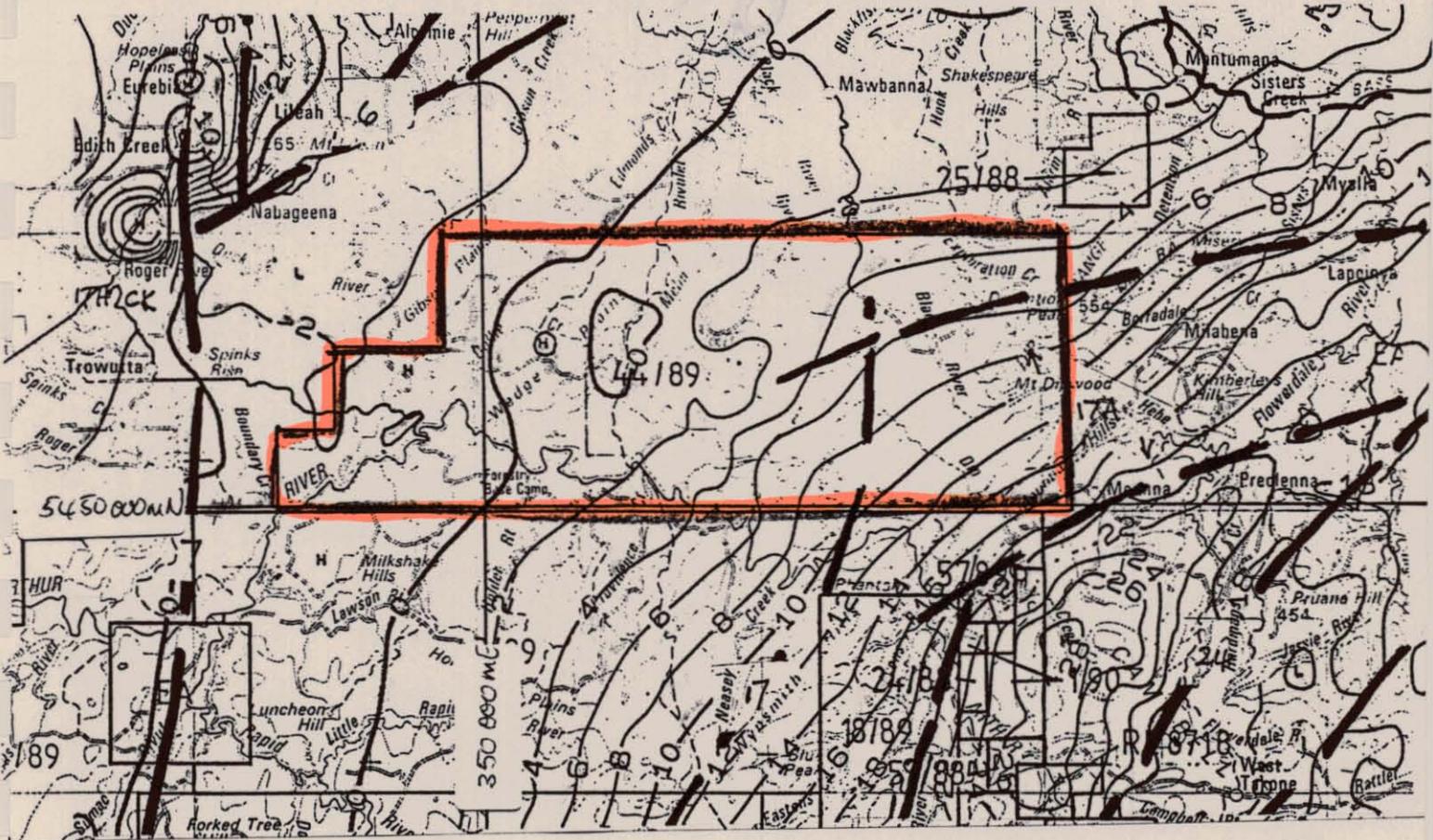
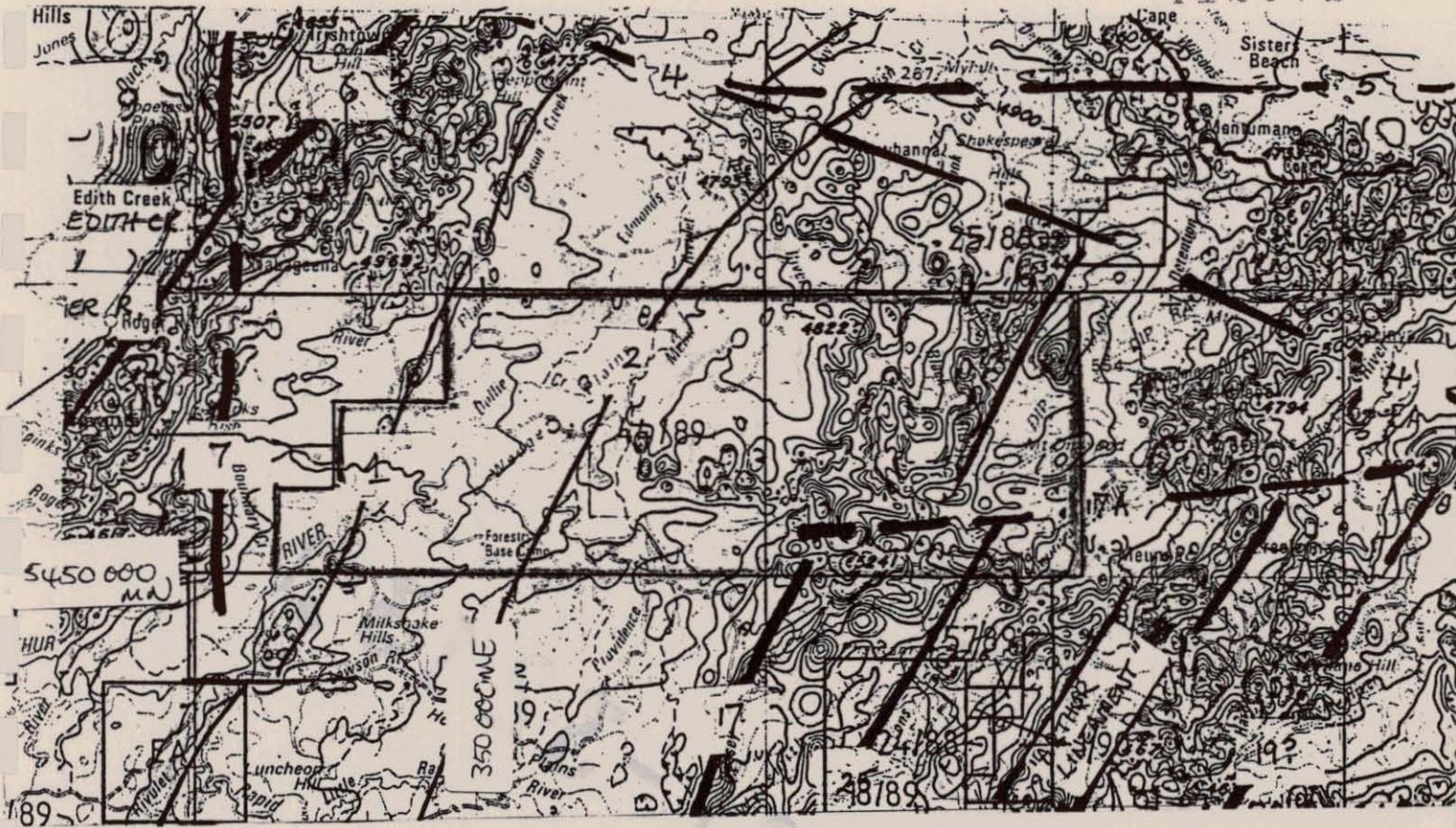
Only Rocky Cape Group rocks are exposed in this area. The gravity and magnetic fields, however, are not consistent with this surface indication.

The gravity data suggest that the denser Lineament and mafic members faulted or included within the Burnie Formation underlie the entire eastern portion of the EL. The limiting structures have been suggested. Since these underlying rocks have been mineralised, as shown by occurrences of gold along and east of the lineament, some effort should be made to locate the projections of these structures to surface. This recommendation is made on the basis that any rejuvenation and fluid passage may well have transferred metals into dolomitic hosts closer to surface. Magnetic data indicate the approximate position of the concealed fault or unit slices at depths of more than 2 km. Since there may be some offset due to dip projections some limited ground surveys may be necessary to identify the precise location of these features. It is possible that any mineral transfer may have taken place along the major thrust which has carried the Rocky Cape Block eastward. If this has occurred all mineralisation will be found east of the EL.

Magnetic features (1) and (2) cross the EL. There is some scope within this EL for identification of the origin of these features. It has been suggested that (2) is a disguised fault within the Rocky Cape Group sequence. The origin of (1) is more difficult to predict. The feature is of higher amplitude and is localised but no available mapping has identified any feature with the continuity and likely lithology required. Some susceptibility meter traverses would identify this feature - if it is exposed.

Much of the low amplitude, speckled magnetic anomaly patterns observed west of Black River are due to Tertiary basalts. The anomaly distribution would suggest that there is far more basalt in this area than has been mapped to date. It may be noted that the patches of basalt overly the gross trend intersection marked in the gravity part of the figure. This would indicate some rejuvenation has occurred.

It is not known whether the implied offset in the magnetic trends near the SE corner of the EL is significant. An ENE trend has been indicated but another, less continuous, is present to the ESE from the same hinge point near 362 000 mE, 5452 000 mN. This may be a locality worthy of geochemistry. No mineralisation is known from the area covered by this EL.



EL 44/89 WEDGE PLAINS MAGNETIC AND RESIDUAL GRAVITY DATA
 FIGURE 28

EL 45/89 SAVAGE RIVER

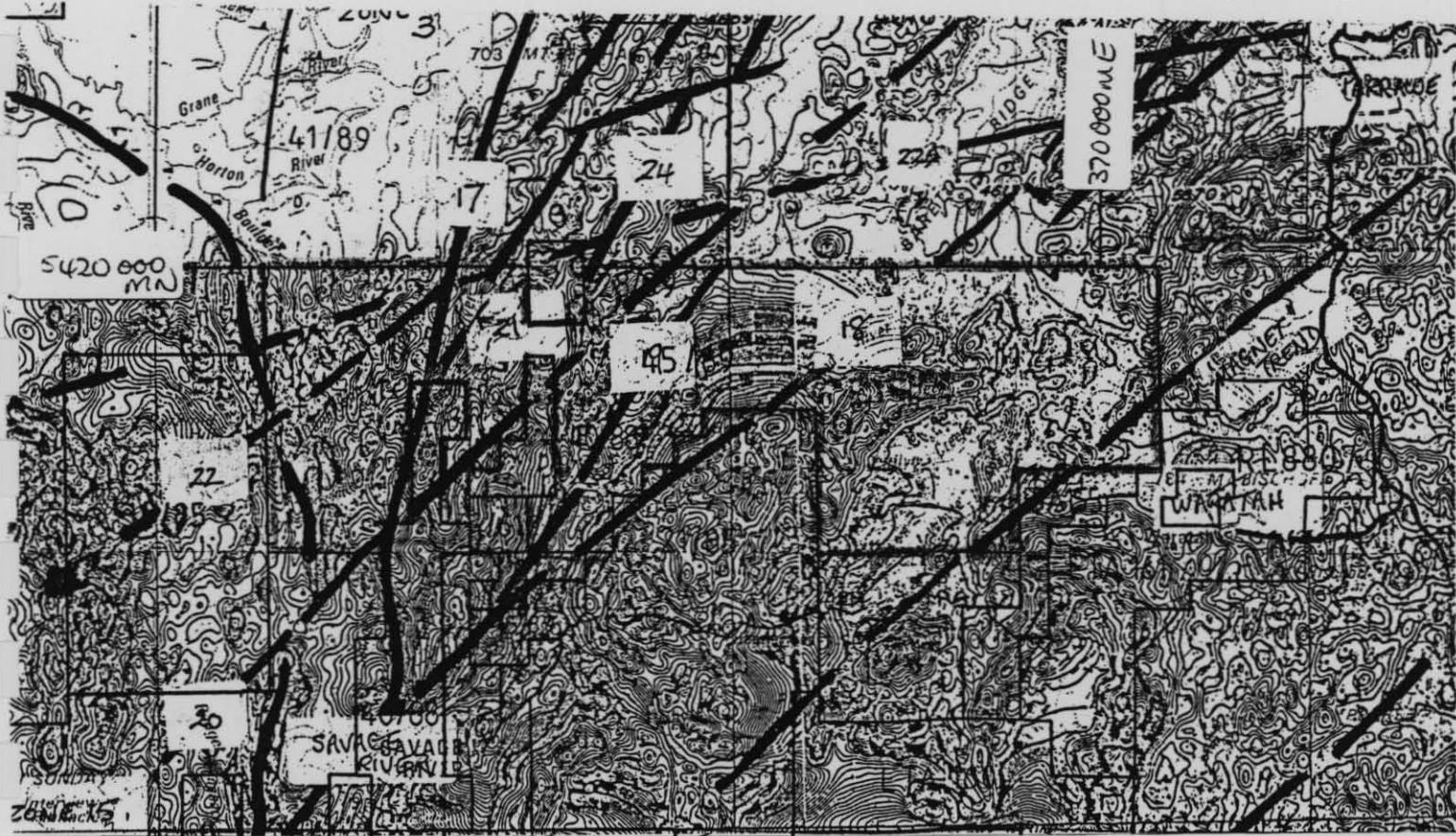
The location of this area is shown in Figure 1. Figure 29 presents relevant gravity and magnetic data.

EL 45/89 covers a much more complex environment than any of the other ELs examined in this survey. It extends from the overthrust Rocky Cape Block with the eastern limit of the Pieman Granite in the far west across the Arthur Lineament axis of high grade metamorphic rocks to the granite-intruded Precambrian and Cambrian rocks of the Luina and Waratah area. It includes the sheared NW margin of the Heazlewood Ultramafic complex.

The gravity field is simplest although this is partly due to uneven station coverage. The principal positive anomaly extends along the alignment of the east side of the lineament and this asymmetry reflects the balance between the Rocky Cape section intruded by granite to the west and the thick denser Burnie-Oonah sequence to the east. Crestal anomalies of the order of 26 mGal are associated with the metamorphosed rocks of the lineament. These are not easily separated from the effect of the mafic complex at Heazlewood and the modelling required has not been undertaken. Anomalies in the region of Luina, Whyte River and Waratah are almost neutral suggesting that the Meredith Granite extends far into this part of the EL (see also Figure 21).

The gravity survey should be upgraded in the area east of 362 000 mE in order to define the limits of the granite in depth and locate cupolas. It is interesting to observe that the general trend of existing gradients in the Whyte River region parallel the Magnet trend determined magnetically. Prospectivity of this area might be better assessed with this definition. The lead-zinc-silver occurrences are presumably related to the granite which might suggest that any deposits found will be relatively small and uneconomic. The scale of deposition may well depend on suitable hosts. Definition of granite forms is also relevant to any evaluation of tin prospectivity. Current data suggest that cupolas exist within the adjacent ETA and vacant areas to the south and west of Waratah.

Magnetic data provide additional definition of major structures. Most of these are concentrated within the area of the Lineament north of Savage River. Many of these have been excluded from the EL but the intersection of (22) with the inferred granite wall may be of interest. The magnetic survey also shows that the ultramafics extend E-W along Friday Creek, but at increasing depth. This trend may also be important and several small anomalies are displaced along it. The magnetic field east of Karilyn Creek is relatively quiet since it is free of intense thermal metamorphic aureole effects and large bodies of mafic rocks. The origin of the patchy anomalies centred around 368 500 mE, 5417 000 mN should also be determined. These are out of character. Some small isolated anomalies occur along the Magnet trend which may reflect localised alteration (e.g. 369 000 mE, 5413 000 mN).



EL 45/89 SAVAGE RIVER MAGNETIC AND RESIDUAL GRAVITY DATA
 FIGURE 29

EL 46/89 JULIUS RIVER

The location of this area is shown in Figure 1.

Figure 30 presents relevant gravity and magnetic data.

EL 46/89 covers the eastern margin of part of the Smithton Trough and its unconformable onlap onto the Rocky Cape Block.

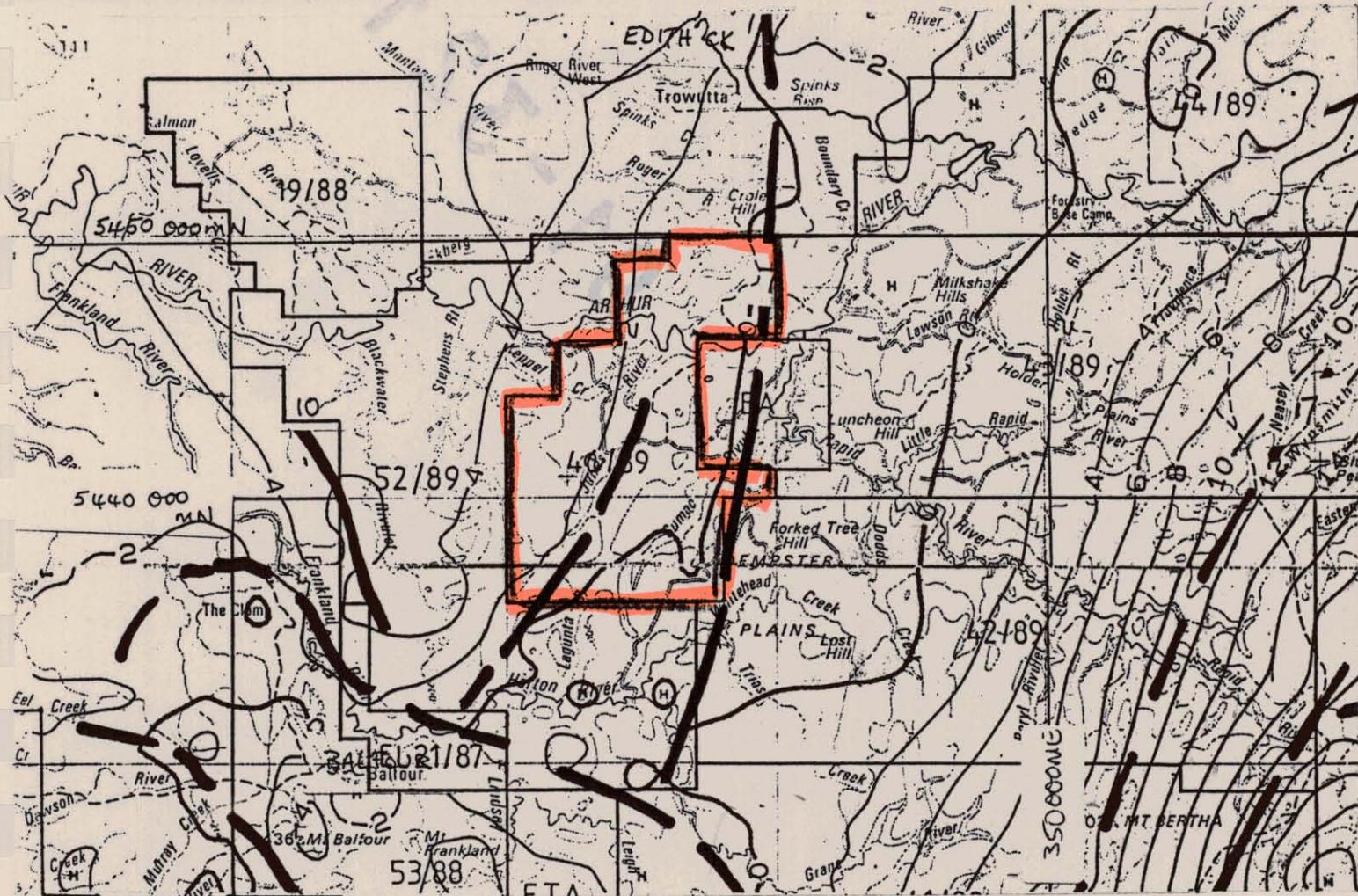
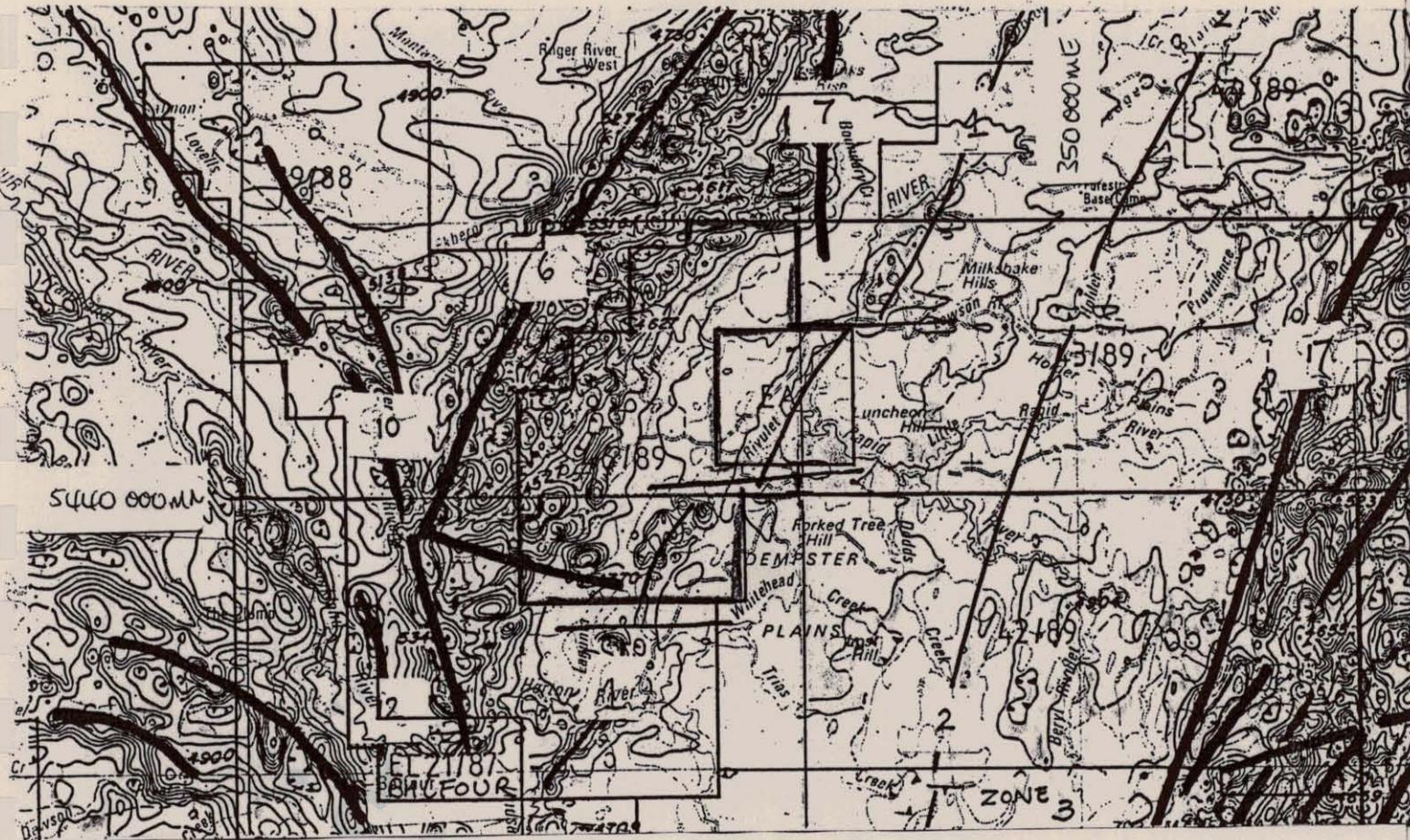
Basal dolomites and part of the mafic volcanics are exposed but the magnetic data do not suggest any truly anomalous character and the field reflects the distribution and attitude of these rocks (see Figures 13 and 17).

Magnetically anomalous character does, however, attach to the belt of anomalies within the Rocky Cape Block (feature 1). Within this EL this feature has an abnormally high amplitude which may reflect shallowness of source or some alteration. This occurrence near the Sumac Rivulet should be inspected; use of a susceptibility meter and surface magnetic profiles may be necessary to identify the source units.

The other anomalous feature of the magnetic field extends from 326 000 mE, 5439 000 mN to 333 000, 5436 000. This gradient marks an abrupt change in volcanic character and its origin should be evaluated.

Gravity data are too diffuse to offer specific guidance and the gradient suggestions may have little significance. Even so, it is apparent that the entire character of the gravity field is transformed somewhere nearby and the relationships between Pieman Granite, Rocky Cape Block and Smithton Trough generate a complex form.

Some detailed examination of the magnetic lines across the southern 3 km of the EL is recommended and that this work be done in association with recommendations for EL 52/89. The aim of this analysis should be to derive understanding of the source of the volcanic termination effect - is it geometric, including faulting, or mass alteration? - and to assess feature (1).



EL 46/89 JULIUS RIVER MAGNETIC AND RESIDUAL GRAVITY DATA
FIGURE 30

EL 52/89 BALFOUR

The location of this area is shown in Figure 1. Figure 31 presents relevant gravity and magnetic data.

This EL covers a significant part of the intersecting structures near Balfour and the remainder of the eastern volcanic sequence not covered by EL 46/89.

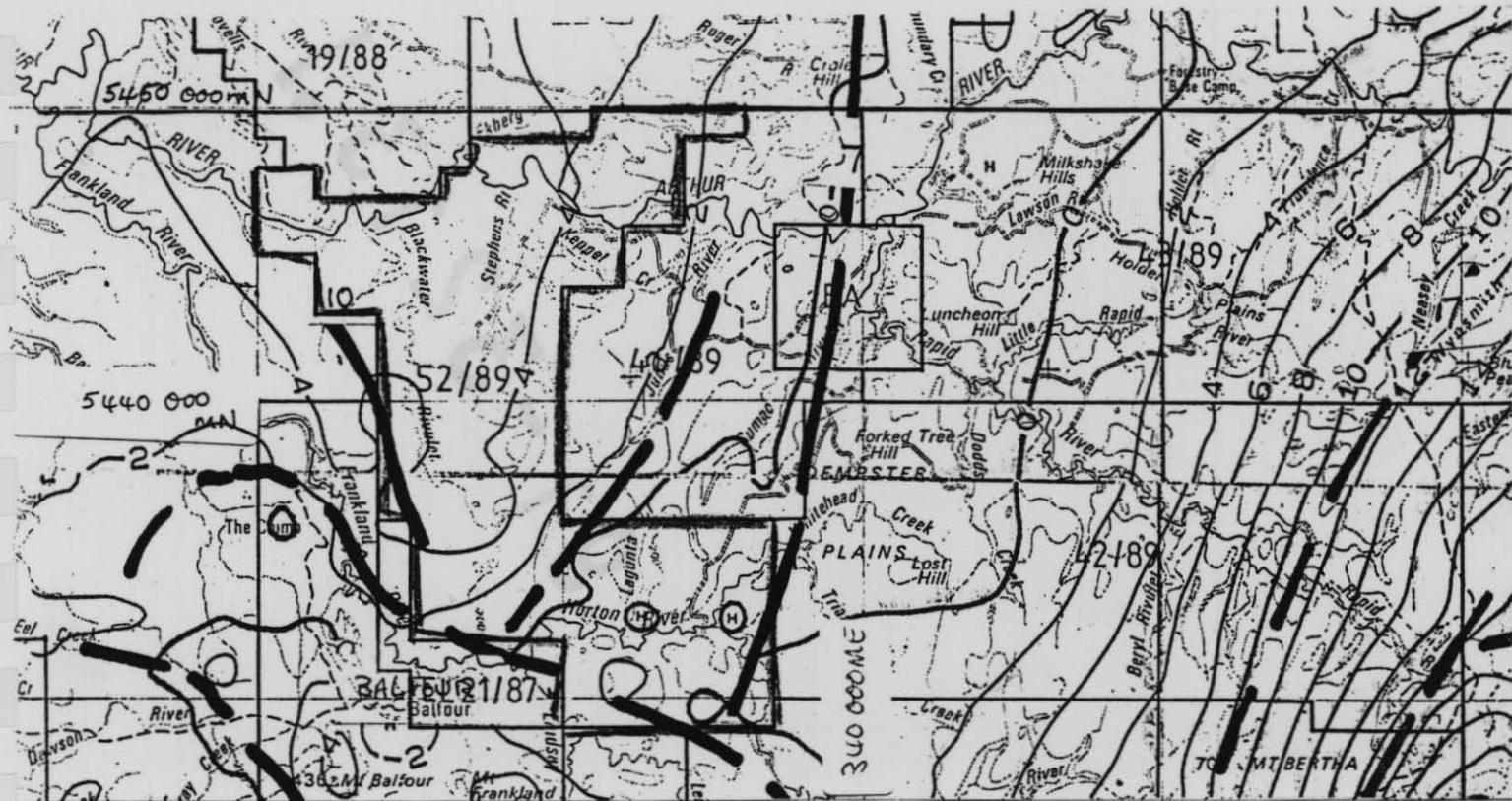
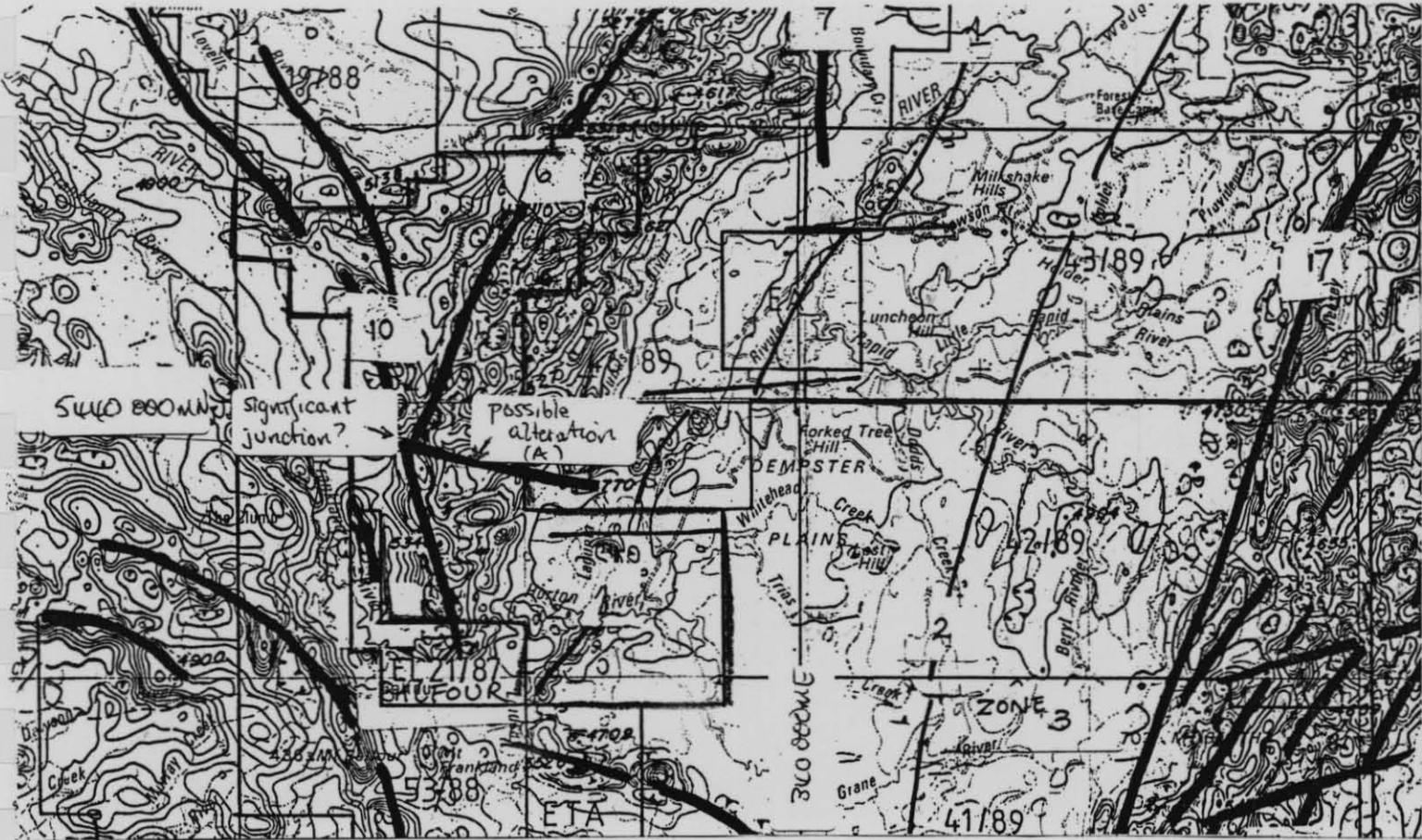
Regional analysis indicates that magnetic feature (6) defines a steep fold limb, which may be faulted as well, in which the mafic volcanics are forced to moderate depth. There is no evidence that this structure represents a major growth fault or that the sequence is significantly thickened along it. This may be possible but more gravity data and a combined gravity-magnetic assessment would be needed to confirm it. Current work does not offer encouragement. Most of the volcanics present normal magnetic behaviour and there is no evidence of massive alteration.

Anomalous magnetic character is restricted to the 60 degree arc between (10) and the gradient from 326 000 mE, 5439 000 mN to 334 000, 5436 000 which truncates the volcanic sequence. This data should be examined in detail since there are suggestions that the sequence has been altered. The loss of response at 328 000 mE, 5437 500 mN is particularly interesting and this area should be inspected. Is it due to a window in the volcanics? If not, the volcanics should be sampled.

Feature (1) is also included in this EL and its anomalous character is re-inforced. Surface tests, using magnetometer or susceptibility meter, are advised. Any systematic or non systematic changes in the source of this feature, across several ELs, should be accounted for since its changes in character may reflect source depth or alteration index. Demonstration of the latter may be important.

Regional analysis indicates burial of the volcanics west of feature (10). The disruption of the anomalies and their alignments may indicate several structures; each anomaly representing alteration or fluid passage and oxidation. The entire magnetic field is elevated slightly and the volcanics and associated Smithton dolomites persist beneath what has been termed the Temma thrust. These anomalous zones should also be inspected magnetically and chemically, especially in the southern part of the EL.

The Pieman Granite reaches beneath Balfour, on the basis of current data, and this can be expected to have emplaced or remobilised mineralisation beneath the Temma thrust structure. The granite has probably intruded the volcanics and dolomites of the Smithton Trough (now concealed) and there is potential for both tin and copper replacement-exchange deposits. It is possible that this EL does not cover the best ground which may lie under adjacent ELs or vacant ground to the west. Note that the granite extends west of The Clump. Infill gravity coverage is recommended, perhaps with agreement of holders of EL 53/88, in order to define the marginal and roof forms and depth of the granite. This is essential to appraisal of both structure and origin of magnetic features. It may also explain the known mineral occurrences and enable prediction of primary targets.



EL 1/90 MEUNNA

The location of this area is shown in Figure 1.

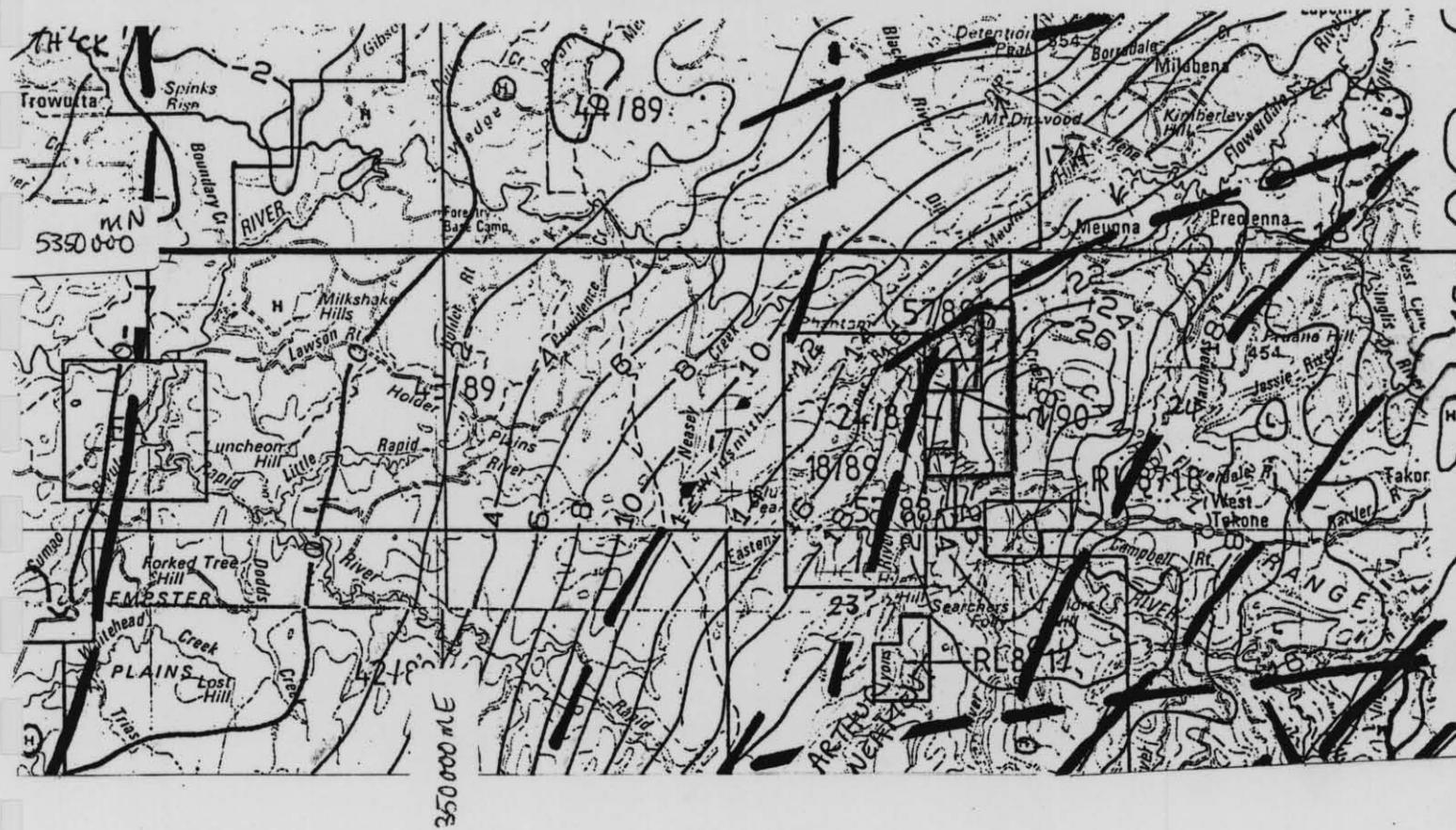
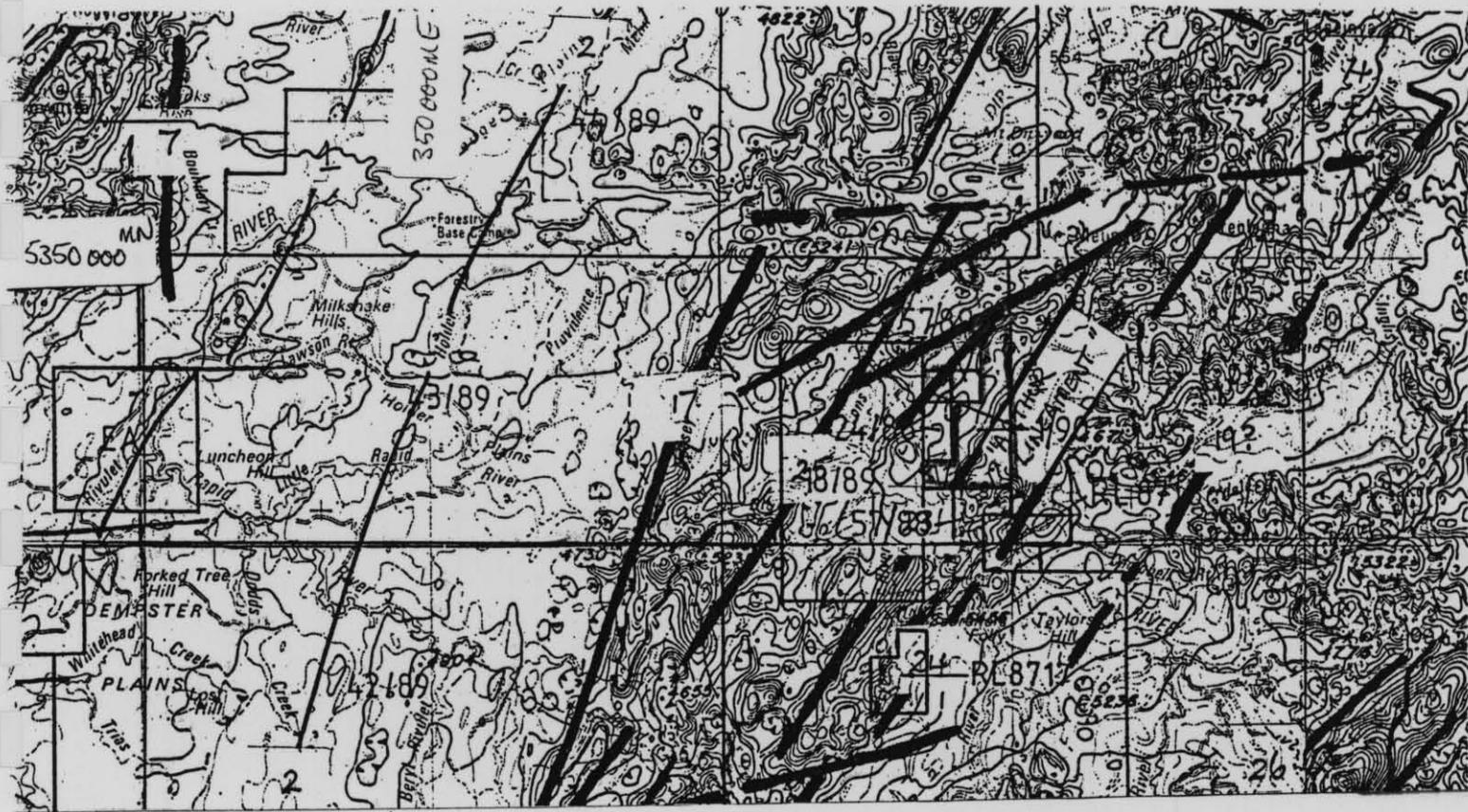
Figure 32 presents relevant gravity and magnetic data.

This small licence area lie near a large mafic accumulation within the lineament axis. It has been suggested that this is important to derivation of copper and perhaps gold mineralisation. Gravity data lack definition but do suggest that the western limit of this mafic sequence may lie in or close to the western parts of the EL. The implied change in orientation near the NW corner of the EL may also be significant.

Magnetic data suggest that the impression of the change-of-trend structures may lie about 1 km NW of the EL although a sympathetic but smaller feature may enter the far corners. The gradient, parallel to (23), may be more significant since it indicates either a change in burial or contrast which is not extensive. Indeed, the patchiness of the response of this shoulder anomaly suggests alteration or property variability. The set of magnetic units from (23) to (17), and their transference to more E-W orientations accounts for the total gravity effect.

Feature (23) is the principal magnetic response to cross the EL and its origin should be assessed. It would appear that at least part of this source is exposed. Its precise location should be determined by ground surveys and the (presumed) fault or shear boundary and contact zone tested for mineralisation. The same approach should be employed to locate and evaluate the gradient noted above and which lies about 2.5 km west of (23). The concentration of exploration activity in this area suggests that it is mineralised and identification of these major fractures may be crucial to success. Regional evaluation suggests that these dip east.

Any coupling of purified dolomite and silica should be taken as an indicator of sulphide transfer and possible alteration of the underlying mafics. If such occurrences can be found then the magnetic data in the vicinity should be assessed for indications of the volume of gross alteration. This is not feasible until after the geometric limits of the volume, or some anomalies, has been defined at surface.



GENERAL RECOMMENDATIONS

Several specific target types have been recognised within the Rocky Cape region in terms of structural controls and forms. Some others do not appear to be represented, e.g., syngenetic sedimentary or volcanogenic styles. No trace of these has been found in the past and no signatures or responses compatible with them have been identified during this review.

Fault and shear controlled mineralisation or granite controlled mineralisation is certainly present but only the latter presents direct geophysical indicators.

I have also suggested that copper mineralisation might be economic given appropriate source (mafics), host (carbonates) and structural or thermal control (granite or stress). This type of target poses several non trivial problems and requires careful definition of structural setting.

Granite-related exploration (tin and perhaps some copper) requires detailed knowledge of the form of the granite and its roof fracturing. Infill of gravity coverage north and west of Balfour, and west of Waratah is essential followed by 3D interpretation of the granite. The variable character within the magnetic field in both areas may then be appraised for structural content as well as source form and alteration leading to specific targets.

At Balfour both data sets must be fully integrated in order to predict structural forms, depths and property changes beneath the overthrust block. Any major deposit in this area would occur in dolomites above the volcanics but beneath the sealing thrust surface. A complex problem but not an insoluble one.

Surface examination of all those areas where trace copper or alluvial gold is known should be undertaken to determine whether re-formed silica and carbonates are present in association. Are any of the silica deposits found near magnesite deposits for example. Magnetic data can be used to define primary structures within the sheared belt and couplings of such shears, or their projections from depth, with such refined deposits or the raw resources such as mafics and carbonates should be examined geochemically. Leakage of some mineralisation may have occurred along the primary structures, including the thrusts, and in these cases some assessment of migration paths may be productive. Detailed examination of magnetic data, or acquisition of surface data, is recommended in those areas where the above conditions are fulfilled. This may include a stricter analysis of the dips of the sheared slices. Where copper transfer has occurred in such cases it should also be possible to evaluate the scale of implied alteration magnetically.

In all cases the sub E-W, ENE fracture set may provide the critical intersections and all known sites should be carefully located and compared with inferred positions based on the magnetic surveys. This includes alluvial sites in case the provenance is nearby. Larger scale presentations of the magnetic data should also be used for the comparison.

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