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NEW HOLLAND MINING NL

EL28/87

GRANVILLE HARBOUR, TASMANIA

ANNUAL REPORT

YEAR 1

(12.12.87 - 12.12.88)

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SUMMARY

1. Most of EL28/87 is underlain by the Devonian Heemskirk Granite, a small, partly offshore, pluton associated with significant tin and silver-lead-zinc mineralisation. It intrudes Late Proterozoic and lower Palaeozoic rocks.

2. Mineralisation within the granite is mainly tin and polymetallic sulphides in late-stage, hydrothermally altered greisen veins localised along pre-existing joints and lineaments. Recorded hard-rock production is about 500t of metallic tin, mostly before 1890. Minor alluvial production is recorded.

3. The Heemskirk Granite has an extensive metamorphic aureole. Associated mineralisation is predominantly replacement-type skarn or fissure-infilling tin-sulphides and silver-lead-zinc. West to east zoning of the mineralisation towards Zeehan is related to the thermal effects of the granite. Recorded production from the Zeehan field is 200,000t Pb, 2700t Zn, 837t Ag.

4. Several smaller replacement-type tin and sulphide deposits are known adjacent to the northern boundary of the Heemskirk Granite. The largest of these, St. Dizier, has reserves of 5mt tin ore.

5. The district has seen extensive regional and prospect evaluation since the early 1970's. Most exploration was concentrated within the Heemskirk Granite.

6. By comparison, the northern third of EL28/87 is relatively underexplored, even though replacement skarn tin and sulphide mineralisation occurs in the metamorphic aureole of the granite.

7. Geopeko Limited drilled an intense elongate magnetic anomaly north of Granville Harbour and established widespread sub-economic tin-sulphide skarn mineralisation.

8. Recent independent regional geophysical interpretation by New Holland Mining, using new gravity data to supplement the existing magnetics, predicted the location and depth of the Geopeko prospect. The anomaly is largely unexplored, and the area has excellent potential to host large tonnage Renison Bell style replacement tin-base metal deposits.

9. An exploration programme is proposed to test these concepts, based on acquisition of more gravity and magnetic data to aid target definition.

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1. INTRODUCTION

1.1 Tenement Details

Exploration Licence 28/87 (Figure 1) was granted to New Holland Mining NL on December 12, 1987. The Company is sole owner and manager.

The tenement comprises (guide only):

• State Forest	$27.2km^2$
• Timber Reserve	$6.5km^2$
• Private Property	$13.1km^2$
• Crown Land	$87.7km^2$

and excludes about $1.07km^2$ of tin mining leases

• 4M/78	8ha, St. Dizier area
• part of 15M/78	4ha, St. Dizier area
• 32M/78	25ha, Amy Creek area
• 33M/78	25ha, Amy Creek area
• part of 53M/81	6ha, St. Dizier area
• 44M/82	33ha, St. Dizier area
• 51M/84	5ha, Big Rocky Creek area
• 32M/88 (gravel?)	1ha, Big Rocky Creek area

1.2 Exploration Aims

New Holland recognises that the potential for undiscovered economic mineralisation within the Heemskirk Granite is low considering the detailed work of previous explorers, principally Renison Ltd. (Roberts, 1980,. 1984, 1985).

However, the northern third of EL28/87 straddles the metamorphic aureole of the granite, and includes favourable host rocks in the Oonah Formation with established tin-base metal replacement mineralisation of the Renison Bell style. This area is underexplored, particularly in light of the recent work by Leaman (1988a) and New Holland (Leaman, 1988c) and has excellent potential for large tonnage Renison style deposits.

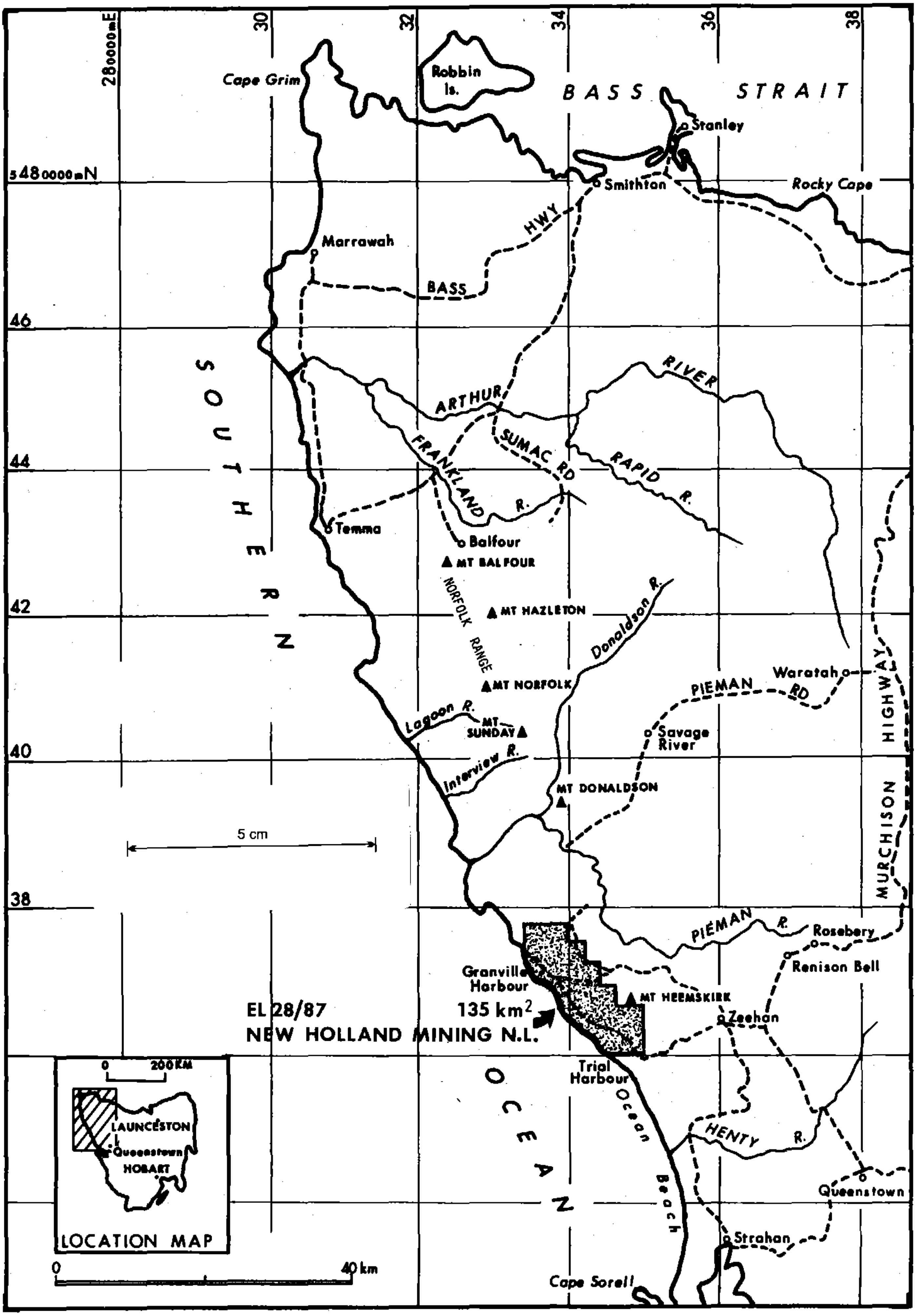

Figure 1. Location map, EL28/87.

2. WORK COMPLETED IN YEAR 1

2.1 Summary

The main Year 1 activity towards the exploration aims has been

(a) a review of all previous exploration and the compilation of a prospectivity report on the tenement (Cromer, 1988)

(b) preparation of a regional geophysical interpretation of the licence area based on existing gravity and magnetic data (Leaman, 1988c) with particular reference to the northern margin of the Heemskirk Granite.

2.2 Review of previous exploration

The Zeehan area including much of EL28/87 has seen two main phases of exploration: an earlier, prospecting and mining period following the discovery of tin, silver, zinc and lead near Zeehan in the 1880's, and a modern exploration phase by several major companies since the 1960's. Numerous reports pertain to both periods.

Exploration since the 1960's includes regional reconnaissance mapping, geochemistry and geophysics with detailed follow-up work in old prospects within and along the margins of the tin-bearing Heemskirk Granite. Aspects of this modern work relevent to EL28/87 are summarised below.

Anzeco (Lockhart, 1975) investigated a prominent aeromagnetic anomaly (from a previous survey by Rio Tinto Aust. Exploration) north of Granville Harbour near Gourlay's Creek. Anseco's concept was tin-bearing magnetite skarn arising from contact metasomatism of calcareous hosts near the northern contact with the Heemskirk Granite.

The anomaly coincides with outcropping magnetite-pyrite-limonite deposits associated with quartz-tourmaline veins. Ground magnetics and rock geochemistry (W, Cu, Pb, Zn, Ni, Co, Sn, V) were disappointing.

Most of the southern part of EL28/87 was included in EL11/76 held by Renison Ltd. The licence was progressively relinquished and finally dropped in 1985. Renison carried out regional mapping and photogeology, and detailed work in several old tin prospects (Roberts, 1980, 1984, 1985). Gridding and mapping along the southern boundary of the Heemskirk Granite for Renison Bell style tin mineralisation proved discouraging, as was the subsequent search (1976-81) for low grade, large tonnage, greisen-tin deposits near Federation Plateau. During 1980-83 Renison investigated the polymetallic tin-silver-zinc deposits in old workings east of the southeastern corner of EL28/87, but concluded grades were too low. The exploration over ten years established significant but low grade, low tonnage, tin mineralisation within and along the contact zone of the Heemskirk Granite.

CRA Exploration held large parts of western and northwestern Tasmania under Licence 1/77, the southern part of which included the northern third of EL28/87. The Company in joint venture with Geopeko commissioned a regional appraisal of the lead-zinc potential of the region (Legge, 1980). Legge's work is a useful summary of previous exploration, regional geology, structure, geophysics and mineral settings. He noted that the central west coast of Tasmania is a top ranking tin producer (e.g. Renison Bell, 28mt at 1% Sn) with significant lead, zinc and silver (e.g. Zeehan 200,000t Pb, 837t Ag, 2700t Zn), mostly hosted in Precambrian rocks. Previous companies had carried out three major regional drainage surveys, with detailed follow-up at several localities including Granville Harbour and St. Dizier. Three regional airborne EM surveys had resulted in prospect evaluation based on tin-related magnetite-pyrrhotite and iron-related magnetite-pyrite anomalies. Many anomalies, however, remain untested.

Legge suggested the base metal sulphides and possibly some of the tin mineralisation in the Heemskirk area pre-dated granite intrusion. He postulated that the zoned cassiterite-lead-zinc-silver mineralisation in Precambrian and Palaeozoic sediments extending east from the Heemskirk Granite to Zeehan may be related more to original sedimentary basin conditions than the metamorphic effects of the granite. He briefly tabulated rock geochemistry assays of 117 samples from the massive magnetite-pyrite-quartzite beds north of Granville Harbour (within EL28/87) where the best results were then (ppm) Pb 85, Zn 130, Cu 870, Ag 3, Sn 1000.

CRA Exploration and Geopeko jointly reassessed these magnetic and geochemical anomalies north of Granville Harbour previously explored by Anzeco in 1975. The partners carried out mapping, soil sampling, IP and diamond drilling near Gourlays Creek (Kendall, 1984) north of an exposed north-trending spine of the Heemskirk Granite. Like Anzeco, the concept was Renison Bell type tin mineralisation in calc-silicate Precambrian metasediments. The geochemical anomaly (Sn, Cu, Zn) extended over a strike of two kilometres, in two subparallel zones, coincident with a prominent aeromagnetic anomaly. Extensive Tertiary sedimentary and basalt cover made adequate sampling difficult.

Three diamond drill holes totalling 741m were drilled on the peak magnetic anomaly. Hole 1 (198m) intersected a pyroxene-garnet magnetite-sulphide skarn including 1m at 0.3% Sn. Other intersections included 5m of skarn with disseminated chalcopyrite (34-39m), and 3m of massive pyrite-siderite-magnetite (151-154m). Hole 2 (167m) returned no tin, but 1m of massive magnetite-pyrite was intersected (51-52m) as well as 4m of massive pyrite-magnetite-barite-quartz (69-73m). Hole 3 (376m) penetrated 63m of quartzite and shale carrying minor pyrite and pyrrhotite (70-133m) and 15m of massive pyrite-pyrrhotite-chalcopyrite-magnetite (291-306m) in an overall strongly metamorphosed sequence of pyroxene-garnet skarns and mineralised hornfels.

Recently, independent detailed geophysical interpretation of the aeromagnetic data and new gravity data by New Holland Mining NL (Leaman 1988c) has considerably enhanced the tin-base metal prospectivity of the northern margin of the Heemskirk Granite, and of the Gourlays Creek - Granville Harbour in particular.

2.3 Tenement Geology

Most of EL28/87 covers the western portion of the Devonian Heemskirk Granite. The northern third of the tenement is underlain by Late Proterozoic metamorphosed sedimentary rocks locally obscured by post-Carboniferous flat-lying sediments, dolerite and basalt (Figure 2).

Late Proterozoic

The oldest rocks are folded, metamorphosed quartzites, phyllites and slates of the Late Proterozoic-Early Cambrian(?) Oonah Formation which elsewhere in the area conformably underlies lower and middle Cambrian sediments of the Crimson Creek Formation. Probable Oonah correlates crop out north of Granville Harbour (e.g. Gourlay's Creek) where they are extensively thermally metamorphosed by the Heemskirk Granite.

Devonian Heemskirk Granite

The Heemskirk Granite is a mineralised, oval-shaped pluton, much of which is probably offshore (Leaman 1988a,b). The pluton and adjacent areas have been extensively explored and have been the subject of numerous recent Mines Department and University studies (e.g. Blissett, 1962a,b; Both and Williams, 1968; Klominsky, 1972; Wells, 1978). The pluton is middle-Late Devonian (345-375 Ma).

Two major granitic rock types occur - an older, "red" granite and a "white" granite associated with tin mineralisation, indicating the body is a multi-phase intrusion.

Several workers (e.g. Klominsky, 1972, Leaman, 1988b) have suggested the Pieman, Meredith and Heemskirk Granites are connected at depth.

The Heemskirk Granite is strongly jointed. Major directions are NE-SW and E-W. Mineralisation is strongly related to structure, and particularly to joint and lineament intersections.

Mineralisation within the Heemskirk Granite

Various styles are recognised (Wells, 1978, Roberts, 1980), all associated with late-stage hydrothermal alteration of greisen veins localised along pre-existing joints and lineaments. Typically, the greisen veins contain a central zone of quartz-topaz-tourmaline with selvages of mica bordered by an argillaceous zone. All zones may carry tin, and although rich pockets of tin-greisen were known, these have long since been worked out. The remaining ore bodies are generally low-tonnage, averaging about 1% Sn (Wells, 1978). Several deposits carry polysulphide ores as well as cassiterite - usually pyrite, sphalerite, galena and chalcopyrite with minor bismuthinite, hematite, magnetite, wolframite and fluorite.

Most of the early mines and prospects were located in the "white" granite near Federation Plateau along the southern boundary of the pluton (the South Heemskirk field).

Reported production of metallic tin is about 500t (Federation Mine 200t), most of it before 1890.

Mineralisation adjacent to the Heemskirk Granite

The Heemskirk Granite has produced widespread and locally significant tin, silver, lead and zinc mineralisation within its metamorphic aureole. Host rocks include the Late Proterozoic Oonah Formation and Siluro-Devonian sediments. Both occur east of EL28/87 where they host the rich silver-lead-zinc ores of the Zeehan district. The ores appear to be zoned laterally eastwards from the granite (Both and Williams, 1968. Collins and Williams, 1986).

Several small tin-base metal deposits are known along the northern margin of the Heemskirk Granite, e.g. St. Dizier, Tasman and Granville Harbour. At St. Dizier (5mt tin ore) the ore body is a stratabound, replacement high temperature pyroxene-garnet metasomatic assemblage with disseminated tin in the Oonah Formation. The mineralisation is associated with an adjacent buried north-trending spine of the Heemskirk Granite. Similiar mineralisation occurs in the Granville Harbour area, which New Holland's recent work (Leaman, 1988c) has shown to be also underlain by at least one granitic spine.

2.4 Regional Geophysical Interpretation

As part of its Year 1 exploration programme, New Holland Mining commissioned Dr. D.E. Leaman to review existing regional geophysical data over EL28/87 (Leaman, 1988c). His report is presented here in Appendix 1.

In additional to postulating three rather than two granitic types in the Heemskirk Granite, and verifying a major E-W shear? corridor through the pluton, Leaman paid particular attention to the shelfing, northern boundary of the pluton. Figure 9 in the Appendix is a NW-SE gravity line from the coast at Duck Creek to Trial Harbour (Figure 4). The interpretation suggests one or more spines of granite shelving north under the Granville Harbour area at depths less than 1.5km. A maximum thickness of 100m of Tertiary sediments and basalts is also indicated.

Figure 11 is an east-west magnetic line sampling the large anomaly previously explored by Anzeco and Geopeko north of Granville Harbour near Gourlay's Creek. The interpretation (combined with gravity) discounts an igneous source and Leaman suggests a large body rich in magnetite and pyrrhotite at about 150m depth (250m below aircraft). This implies contact metamorphism and sulphide replacement by a relatively shallow granite mass, which is supported by the gravity data

The geophysical interpretation substantially agrees with the prospect evaluation (including drilling) carried out by Geopeko and CRA Exploration (Kendall, 1986) over the same aeromagnetic anomaly.

Leaman's work has highlighted the anomalies in this area, untested or underexplored by earlier exploration companies.

3. DISCUSSION

Year 1 work has highlighted the northern part of EL28/87 as being the most prospective for replacement style skarn tin and base metal mineralisation associated with buried extensions of the Heemskirk Granite.

Two areas require detailed attention - the Gourlay's Creek area north of Granville Harbour and the anticlinal Oonah Formation on a trend north from St. Dizier and Tasman further east. These are the stippled regions in Leaman's Figure 15 (Appendix 1).

The CRAE-Geopeko joint venture established widespread sub-economic mineralisation in Gourlay's Creek. Although the partners drilled an intense magnetic anomaly and detected tin-sulphide replacement mineralisation, they did not have the benefit of regional gravity coverage which sheds new information on the shape and extent of the mineralising granitic spine from the Heemskirk Granite.

In addition, the joint-venture relinqhished the area partly as a result of corporate policy rather than geology, and most of the Gourlay's Creek and other anomalies are underexplored.

The granitic spines are the source and major control on mineralisation. In-fill gravity and magnetic data will allow detailed interpretation of the anomalies for follow-up prospect evaluation.

4. PROPOSED FUTURE EXPLORATION

To adequately test the tin-polymetallic sulphide prospectivity of the northern third of EL28/87, Year 2 exploration will consist of

(i) a gravity survey of perhaps 100 or so stations using available access, and helicopter-supported where necessary.

(ii) a detailed aeromagnetic survey of about 200-250 line kilometres (line spacing 150m, sample interval 10-12m).

both covering about 35km^2 north and east of Granville Harbour.

The data acquisition and detailed interpretation should be accompanied by completion of a prospect/geological map of the area and limited mapping and rock sampling (for geophysical properties). This approach will lead to target definitions for exploratory drilling in Year 3.

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APPENDIX 1

Regional Geophysical Review

by

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EL 28/87 GRANVILLE HARBOUR

REGIONAL GEOPHYSICAL REVIEW

for
NEW HOLLAND MINING N.L.

by
Dr. D.E. Leaman

October 1988

GRANHARB

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FIGURES

SUMMARY

Exploration licence "Granville Harbour" includes a large part of the Heemskirk Granite of western Tasmania. This granite is perhaps the best understood of all plutons in western Tasmania; there being some appreciation of the chemical variation within the intrusion and the overall form of the pluton. It is of unquestionable economic significance having sourced the mineralisation of the Trial Harbour and Zeehan fields. Mineralisation in these areas is related to shelving and marginal irregularity at modest depths and alteration of the roof rocks.

EL 28/87 covers the heart of the pluton and the seemingly unmineralised Granville Harbour region even though minor shows and prospects are evident.
This review has assessed the available magnetic and gravity data with a view to determination of the form of the pluton in this region, its effect on the country rocks and identification of any primary controls on intrusion or possible mineralisation. As such it provides a substantial improvement on existing information.

The Heemskirk Granite is shown to consist of three major lithologic members and there is evidence of east-west structuring and control of the distribution of these units. The pluton has significant E-W extension and there are suggestions of fracture control on the intrusion. The northern margin is compound in form; including at least one rib and complex shelf structure on a steeply dipping surface. The little mineralisation known from this area is certainly related to these deviations which extend up to 3 km from the exposed contact. The cover of Tertiary sediment and basalt in the Granville Harbour region has clearly affected previous appraisal and prospecting of the area and this cover may be up to 100 m thick locally.

The present work suggests that members of the Oonah Formation have been altered by thermal metamorphism around the contact. Some highly magnetic sources can be identified which are not consistent with mafic rocks. Pyrrhotite concentrations have been inferred.

The feasibility of using the relatively low cost gravity and magnetic methods within the area has been established by this review. Such data is able to resolve irregularities on the margin of the granite and relate them to abnormal responses within the intruded rocks. Tertiary effects can be separated but such resolution requires more detailed magnetic data. Some infill of the gravity data base is advised and the region of the inferred northern granite shelf near Granville Harbour should be reflown using high resolution magnetometry.

INTRODUCTION

EL 28/87 "Granville Harbour" is located on the west coast of Tasmania some 25 km west of Zeehan. Tasman's landfall, Mt Heemskirk, lies within the EL (Figure 1).

The licence includes the entire western part of the Heemskirk Granite which has yielded modest amounts of tin. The northern margin of the granite is included but few mineralised sites are known adjacent to this margin (e.g., Tasman River, St Dizier and Eureka) and these do not bear any consistent or obvious relationship to each other or the granite. Within EL 28/87 previous exploration has been restricted north of the granite by limited access and Tertiary cover (Blissett and Gulline, 1962). It is also fair comment to state that the region has not been fully explored; most effort has been limited or very localised although some geochemical coverage has been more regional within the granite area. The best geological map has been reproduced as a base for figures 2, 3, 4 and 5.

The mineral prospect compilation of Jennings et al (1967) (revised) shows minor groups of tin prospects and some isolated copper prospects. Most of these are indicated on the geological base map. Others are shown in Figure 1. Copper mineralisation has been noted near Mt Heemskirk and St Dizier but the occurrences north and northeast of Granville Harbour are of particular interest. These suggest that the Precambrian and Tertiary-covered area north of the granite may well be prospective. The granite itself, clearly is. More recent compilations show (as in Figure 1) stratabound tin or massive pyrite/magnetite occurrences north of Granville Harbour.

This review was commissioned with three basic objectives.

1. to provide a regional view of the granite and any anomalous character within or around it.
2. to assess the form of the granite beneath the Precambrian and Tertiary rocks near Granville Harbour and any relationships between inferred structure and known mineralisation.
3. to suggest areas which warrant more detailed examination and the methods which might be used.

Available regional gravity and magnetic data have been used for this review.

DATA

Only geophysical data with regional coverage and value has been used for this review. In effect this means aeromagnetic and gravity data.
Some other data exists; IP-R, EM and surface magnetics (see Leaman, 1980 for a tabulation). Such surveys are of variable quality and very limited coverage. None are relevant to first order appraisals and often can not be understood without such appraisal.

The aeromagnetic data used was acquired by the Mines Department in 1981 (Corbett et al, 1982; Leaman, 1986 a). It represents the most recent, fully recoverable and digital data set of uniform specification. The line spacing was about 500 m, with sampling at some 40 m, and nominal terrain clearance of 150 m. The contractor's contour presentation is given in Figures 2 and 3.

The gravity data was extracted from the Mines Department Tasgrav and Mt Read gravity data bases. The coverage is nearly complete at a spacing of 1 km; there being some modest gaps north of the granite. Much of this data was acquired recently as part of the Mt Read Volcanics Project and has not been previously interpreted. The raw data has not been presented. A residual compilation based on the regional formulation of Leaman (1988 c) has been given in Figures 4 and 5 instead. This primary separation is crucial to any specific evaluation of local structure.

PREVIOUS WORK

The only regional assessments in the public or open file domain based on available data or, in the gravity case, earlier compilations of the data bases have been prepared by Leaman (1986 a, b; 1987; 1988 a, b, c). No equivalent structural assessments have been attempted but the Heemskirk Granite has been subject of petrological and prospectivity review (e.g., Klominsky, 1972).

Leaman (1986 a) suggested a broad thermal alteration halo about the Heemskirk Granite extending from north of Granville Harbour to Zeehan and Trial Harbour (see Figure 8). Several major E-W magnetic corridors were also inferred with superimposed NW-SE lineaments. Individual prospects were cursorily reviewed and all appeared to fall within regions of disturbed mangetic field.

Leaman (1986 b) was only able to consider the eastern part of the granite due to data limitations. The study did confirm the presence of granite shelves extending toward Zeehan which correlated with the magnetic/thermal alteration effect. The response across and within the granite appeared anomalous and was not explained. Very few observations were available and some were considered suspect. The data available indicated that part of the granite offered a positive contrast.

Leaman (1987) updated the qualitative trend analysis provided by Leaman (1986 a, b) as part of a review of major mineralised sites and their gravity and magnetic responses. The distribution of mineralised sites is indicated in Figures 6 and 7 with respect to granite form and trend systems inferred.

None of these early interpretations offer much detail on the western and northern faces of the Heemskirk Granite.

Leaman (1988 a) generated an interpretation of granite forms as part of a regional study of Precambrian and Lower Palaeozoic structures in north west Tasmania. This work was commissioned by the Mt Read Volcanics Project in order to provide a crustal setting. The Heemskirk Granite was included in the study. The analysis was limited by the regional nature of the work to fragments of three profiles but a generalised shape was suggested (see Figure 7). A bulk density of about 2.62 t/cu m was implied for this granite which has a root more than 8 km deep within the crust.

Leaman (1988 b) suggested a regional setting for the granite. It was placed near the late Precambrian margin of the proto-Dundas Trough. As such it intruded up to 9 km of Late Precambrian Oonah Formation and possibly the basal Cambrian Formations (including members or correlates of the Success Creek and Crimson Creek Formations). All these youngest Precambrian rocks include dolomitic members.

The net result of Leaman (1988 a, b) was production of a crustal formulation which could be used to prepare residual Bouguer anomaly maps (Leaman, 1988 c). The concept known as Mantle88 was refined and checked. It has been used to generate the presentation shown in Figures 4 and 5. This is a crucial development potentially of greater value than the regional setting interpretations which made it possible since it allows more reliable and comprehensive use of the gravity data base and frees the interpreter of the need to consider crustal sources and the surveyor of the need to acquire extended profiles. More reliable local interpretations are facilitated using simpler procedures and methods.

This review is built upon, and dependent upon, the implications and formulations of the foundations provided by Leaman (1986 a, 1988 a, 1988 c). The present review fine details the above work and assesses exploration factors in a way which would not be possible without that foundation.

Collins and Williams (1986) have recorded tin prospects west and north west of St Dizier. Neither were known to Blissett and Gulline (1962). All three are quoted as stratabound replacement deposits. Magnetite and pyrrhotite are also present. This is consistent with a concealed pluton margin and the inferred character of the intruded rock sequence (note Leaman, 1988 b). This style of deposit can be contrasted with the greisen/disseminated type within the southern half of the granite - believed to lie within a small, domal body of alkali feldspar granite. Klominsky (1972) and Wells (1978) considered that the bulk of the granite is composed of biotite granite (red) and intruded by a sheet of more alkaline biotite-muscovite granite (white). Tin in the white granite is greisen disseminated (e.g., Federation) but is occasionally polymetallic (e.g., Sweeneys). Collins and Williams (1986) note that the large deposits and potential targets are related to stratabound cassiterite - pyrrhotite replacement ores in Precambrian - Cambrian sedimentary sequences whereas other deposit styles tend to be low volume or low grade.

This summary of previous work or knowledge status has emphasized those elements which are regionally relevant or which might affect prospectivity assessment and exploration direction. More specific information has not been sought or recovered for this review.

INTERPRETATION

QUALITATIVE COMMENTS

The following notes outline features of the gravity and magnetic fields and any obvious relationships. They also serve to draw attention to those elements perceived to be relevant to further exploration and worthy of immediate quantitative estimation (below).

The residual gravity field is striking (Figures 4 and 5). There are three particular aspects.

1. The predominance of nearly E-W trends and N-S gradients. The largest occurs north of the northern margin of the granite in the region of Rocky Creek and extends to the Pieman River well east of the N-S eastern margin of the granite. (It was this effect which first established the existence of granite beneath Zeehan)
   A subtler feature occurs near 5362 000 mN. It is a relatively negative E-W axis unrelated to survey looping.

2. The east and west margins of the granite appear more negative than the core of the pluton. In the region of Mt Heemskirk some of this effect might have been ascribed to inadequate terrain correction were it not repeated at the coast where such explanations are invalid. The related gradient is onshore and clearly not due to Tertiary or Recent sediments offshore. The negative responses indicate a lighter marginal phase which in north east Tasmania is usually associated with tin-bearing granites (e.g., Lottah; Leaman et al, 1975).

3. The heart of the pluton is relatively flat gravimetrically; there being little more than 1 mGal relief for much of the exposure, regardless of topography. This indicates a high degree of compositional homogeneity for the pluton.

It is interesting to compare the location of known mineralised sites and these elements. The copper (and gold?) occurrences noted by Jennings et al (1967) lie on or near the largest gradient (1).
In the northern half of the granite most tin (subsidiary copper?) occurrences are not far removed from the Mt Heemskirk negative but, significantly, the many tin occurrences in the south lie within a positive segment of the heart zone. In the context of the entire pluton and its pattern of responses this latter area is clearly anomalous (white granite).
The relatively positive core and negative marginal responses have thus been confirmed by updated and recent survey. These were aspects which led Leaman (1986 b) to troubled and uncertain conclusions. The variations are clearly important and their explanation is crucial to any appreciation of the prospectivity

of this granite.

The magnetic field offers a different perspective on the Heemskirk Granite and its metamorphic effects.

The granite is generally quiet magnetically and a large part is virtually non magnetic. The broad sweeping gradient evident in Figure 3 is due to contact effect some kilometres to the west and minor variations may be due to flight clearance differences or small oxidation effects. The eastern part of the granite is much more disturbed. Some of the responses are sizeable negative effects which form one half of the contact response. The contact response would be generally minor but the thermal alteration of the Oonah Formation has modified the effective contrast. The couplet anomaly near "Tasman River" is of this type. The greatest effects appear to be north of Mt Heemskirk.

Responses south and west of Mt Heemskirk which lie wholly within the granite cannot be related to any marginal reaction but may be associated with internal contacts between granite phases.

Little trend information is evident at the scale of Figures 2 and 3 - except near 5362 000 mN where the field is clearly distorted in an E-W sense. Gravity data also reflect this zone. The general gradient across the granite steepens south of this corridor and indicates a bulk compositional change with subtle magnetic contrasts when compared with the northern part of the pluton.

If the contention of Collins and Williams (1986) that worthwile mineralisation (especially tin) will be associated with pyrrhotite in replacement deposits is accepted then anomalies north of the mapped margin of the granite must be reviewed. Some are clearly associated with Tertiary basalt, but may include disguised basement effects, while several correlate with exposed Oonah Formation. One such example lies immediately east of St Dizier. While simple inspection of the field using the available geological basemap can suggest several anomalous pieces of Oonah Formation the mapped blanket of Tertiary rocks renders many correlations doubtful.

It is noteworthy that the only known outcrop of Cambrian mafic rocks in the area (a gabbro) generates little direct response. This may reflect line position, mapping or alteration. The Tertiary basalts always produce a response.

MINERALISATION RESPONSES

An attempt was made by Leaman (1986 a) using the same magnetic data to identify any patterns between mineralisation and responses. Patterns do exist but it is not known how relevant or specific these are due to the 500 m line spacing and the small scale of the known mineralised sites.
Sites such as Tasman River and St Dizier are associated with major anomalies but it is unclear to what extent these are simply bulk alteration effects. Time and data have not permitted evaluation. Prospects within the southern part of the granite are related to areas of generally disturbed field or changes in gross composition but no other pattern is evident. No known mineralisation is associated with the obvious and major central E-W disruption of the granite although this same zone clearly controlled much of the mineralisation of the Zeehan Field.

TREND PATTERNS

Gross patterns defined by previous work have been outlined above (Figure 6).
The extant gravity data suggest some NW-SE elements but in general only first order or E-W features are evident.
The magnetic data offer a more refined view - especially within the granite. The NW-SE system suggested by gravity data can be recognised north and west of St Dizier where most features appear random and is predominant within the granite although cross cut by the central E-W system.

Within the granite it is possible to identify orientations which can be related to photo-lineaments, fractures or major faults (see base maps).

QUANTITATIVE EVALUATION

Both data sets have been assessed. Time constraints on this review have limited analysis and effort has therefore been concentrated on those elements defined qualitatively.

Two gravity profiles have been selected for inclusion based on summation of characters resolved (Figures 9 and 10).

Line 1 (Figure 9) extends NW-SE from the coast near Duck Creek across the pluton to the Montagu Mine near Trial Harbour. It samples the zone of generally extended negative field north of Granville Harbour as well as the central E-W feature within the pluton and the more positive southern part of the pluton.
The basalt-covered area can be correlated with the negative zone north of Granville Harbour. However, if the profile is examined it will be observed that no more than -1 mGal can be ascribed to the mapped distribution of Tertiary rocks. The bulk gradient is

not modified. The step deviation is equivalent to about 40 m of Tertiary sedimentary material. Since the deviation is negative any combined basalt/sediment sequence must be gravimetrically dominated by the sediment even though basalt may outcrop. A section comprising 100 m of sediment and 30 m of basalt would yield -2 mGal, or -1.4 mGal with 100 m of basalt. This suggests the nature of any Tertiary balance. The topographic relief implies a maximum section thickness of 100 m presuming no deep concealed channel fills. There is no evidence for such leads since coastal exposures of pre-Tertiary rocks are continuous.
The response is therefore granite-related, not Tertiary-related. The disturbed gravity field response extends northward from the irregular exposure at Granville Harbour although coverage is inadequate to define it completely.
The model suggests one alternative for the form of the northern margin of the granite. Extended treatment would be required, coupled with some additional coverage, to determine details with assurance. All solutions recovered at this stage require some form of shelving at a depth no greater than 1000 to 1500 m with some abrupt steps.

Profiles drawn across the subtle spine of negative anomaly trending NW from St Dizier/Tasman River mines confirm the general suggestion of line 1. This spine represents a smaller and more steeply dipping rib on the granite face.

Line 2 (Figure 10) illustrates this feature. All essential characters observed on line 1 can be recognised on line 2 north of the granite margin. The general absence of Tertiary materials at this easting allows their exclusion from further treatment. The gradient change at 5372 000 mN reflects the spine on the margin.

The two profiles presented yield some assessment of the mass balance within the granite. Line 1 shows that the southern "white" granite is denser by at least 0.02 t/cu m and although the selected figure does not include any tested options the central E-W offset is clearly seen to be in the style of a fault with respect to the composition of the granite and that the white granite is repeated north of it. The sheet-like contact suggested by Klominsky (1972) can yield the response but a major repetition with moderate angle contacts is more likely. The E-W axis thus represents a major structure in existence prior to and controlling intrusion.

The negative marginal anomalies reflect low density phases (-0.02 t/cu m). Analysis reveals at least three phases to the Heemskirk Granite and that each occurs as a significant volume; not limited sheets or sills (density: 2.60, 2.62, 2.64). The overall density contrast between granite suite and Oonah Formation is consistent with more regional assessment and available property data.

Several line orientations have been tested although few satisfy the simple assumptions of this level of modelling. The resolution of consistent model fits and geological presumptions requires a model balance of 15 mGal (refer upper right of Figures 9 and 10). This difference shows that the sections, which intersect at about 45 degrees, are compatible and that the inferred density variations are inescapable and correct.

Magnetic analysis faces different issues. Reliable and detailed modelling can only be justified on the observed data; i.e., on E-W lines, due to coarse line spacing (500 m). A few lines were selected in order to examine the nature of sources within the intruded Oonah Formation north of the granite.

Consider line 1450 (Figures 11, 12 and 13). This line, at about 5371 500 mN, samples the southern part of the large anomaly north of Granville Harbour (corresponding to the negative gravity effect) which also appears to correlate with much Tertiary basalt.
Figure 11 provides a spectral depth estimate solution generated by a specially conditioned operator approach. It suggests relatively deep sources in the region of the basalt (100 to 150 m below surface, 250+ m below aircraft) which are much more localised than the mapped distribution of surface basalt would imply. If the source are related directly to Tertiary rocks then a deep lead is implied. This is not sustainable gravimetrically but the station spacing may be too coarse to be certain.
In Figure 12 the anomaly, ascribable to basalt, has been modelled. This generates three problems; the basalt - if the source - must be much thicker, of very high contrast - up to an order of magnitude greater than normal, and associates with an anomalous model fit balance. The fit balance should be in the range 60 to 90 nT, or of that order, not 200 nT, based on all profiles (including those of Leaman, 1986 a). If the source is taken to be a single flow or flow pile then a ridiculous contrast must be assumed. On this basis it may be concluded that while the surface Tertiary rocks may contribute to the effect they do not generate it. Note also that the overall gravity effect due to Tertiary cover is slightly negative demonstrating a sedimentary predominance.
Figure 13 provides an alternate solution which accepts the general validity of the spectral treatment. This enables a much better model balance but the minimum contrast required is still very high and is certainly not due to any regular igneous rock. A source rich in magnetite or pyrrhotite is implied and this source lies within the Oonah Formation and is no part of the Arthur Lineament sequence to the north of the Pieman River. Stratabound concentrations of this type have recently been recorded peripheral to the Tertiary cover. Sources of this type reflect contact metamorphism and sulphide introduction by a shallow granite mass. (Gravity data imply a shelf beneath). On this basis magnetic data would suggest granite at shallower depth than the gravity data althought the relatively steep gravity gradient noted on line 1 (Figure 9) at about 5370 000 mN (near Big Rocky Creek) was not fully matched in the model and this does indicate that some shallow spines may be present.

Spectral analysis of the type presented in Figure 11 is limited by the sampling of the present survey and some options are not available. In the example given it is not possible to expand the band width without losing the target due to end of line data loss. An increase in sampling of about 3 or 4 to one is desirable; i.e., a sample interval of about 10 m.

Figure 13 also presents some indication of the style, magnitude and contrast required of sources within the Oonah Formation. These could be ascribed to local igneous members or altered mudstones but a fold relationship may be inferred for a single unit. This plunges southward from Duck Creek toward the granite west of Tasman River. The implied contrast is consistent with an altered mafic rock, igneous rock of intermediate composition or a schist with a few percent magnetite. Few igneous rocks have been mapped in the region and the latter lithology is thought to be most likely.

Figure 14 (line 1423) examines the character of such anomalies close to the granite margin. The form of the profile is distorted by the overall effect of the contact and three dimensionsal methods are required for complete resolution. Even so the general style of the fold sources has been confirmed in broad terms. The peak effect is greater due to the greater width of source at this northing but nearness to granite does not appear to have modified the contrast. It should be noted that it may well be possible to find a solution in which the geometry/ contrast balance is equivalent. The smaller anomaly to the west of the fold couplet represents the southern extension of the principal feature in line 1450 and the negative effect is part of the same relationship.

CONCLUSIONS

Review of regional data in the region of the Heemskirk Granite and Granville Harbour has indicated

1. The Heemskirk Granite is composed of at least three major lithological units. The present work is not sufficiently definitive to suggest the structural patterns and relationships of the contacts but the gravity method could do so. The lighter (2.60) and heavier (2.64 t/cu m) phases appear to intrude the intermediate red phase.

2. The pluton has significant E-W extension and the northern margin has the form of a fracture-controlled feature at this orientation.

3. Phase intrusion has either been controlled, or offset, by major E-W features and stress fields with a major discontinuity in the heart of the pluton.

4. The northern margin is compound in form. Overall the northern contact of the granite dips north with a considerable east-west extension. Spines, ribs or shelves are superimposed. A large shelf, possibly composed of several spines and steps, extends north of Granville Harbour. The specific trend of any components to this shelf is unclear but the effect is northward. A rib extending north of St Dizier trends north west. Each effect extends at least 3 km from the limit of exposure. Gravity data may be used to resolve these features or interpret fine detail.

5. The marginal irregularities identified have some economic significance. The few mineralised sites around the northern margin of the granite are not far removed from their axes.

6. Most mineralisation within the granite is related to the more magnetic and denser "white" granite. This is not a universal observation but close review of the granite composition near all sites would be required to establish a pattern. Gravity data are able to resolve the internal character of the granite. The existing gravity and magnetic data sets cannot resolve specific signatures for the small prospects known.

7. Thermal metamorphism of the Oonah Formation has the effect of increasing magnetic contrast. Once the conversion has been made the effect is consistent for up to 1.5 km from the margin of the granite.

8. The underexplored area north and east of Granville Harbour is both mineralised and prospective. Anomalous magnetic sources have been shown to occur beneath Tertiary cover and these appear to be associated with stratabound replacement mineralisation.

RECOMMENDATIONS

1. Although the geophysical-structural review is not especially encouraging within the Heemksirk Granite itself given past exploration and mineralisation styles, the identification of major intrusion phases and controlling structures does warrant some geochemical testing.
   a) are any metals (including Cu, Au) enriched in any one phase or along the E-W offset zone?
   b) are the contacts enriched between the phases? Gravity gradients define these zones.

2. The area north of the northern margin of the Heemskirk Granite is considered prospective for Sn-W, Pb-Zn and possible Au mineralisation. Traces of all are known but tin is the most likely target associated with this granite in the contact zone with Oonah Formation dolomitic hosts.
   It has not been possible during this review to examine in detail the sub-basalt sources north of Granville Harbour and the existing data is not ideally suited in any event.
   Since the detailed shape of the granite margin and the precise location of sub-Tertiary sources is relevant to exploration of any target, not to mention separation of any effects introduced by Tertiary cover, the following are suggested.
   a) Refly the area north of the granite using a high resolution magnetometer, sample spacing of about 12 m and line spacing of no more than 150 m. This will allow proper appraisal of basalt effects and specification of deeper targets.
   b) Infill the gravity survey of the same area to a nominal spacing of 400 or 500 m. This will allow definition of contact forms and irregularities.
   The present review has established the feasibility of this approach using data of limited resolution.

3. It has been beyond the scope of this review to search all previous literature. The next phase of exploration should be linked to a reliable prospect location plot and any geochemical data available. This may also require some detailed mapping of exposed Oonah rocks near Big Rocky Creek. Samples should also be collected for property determination; susceptibility, remanence, and density.

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Report submitted on behalf of
Leaman Geophysics
by

D. Leaman

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

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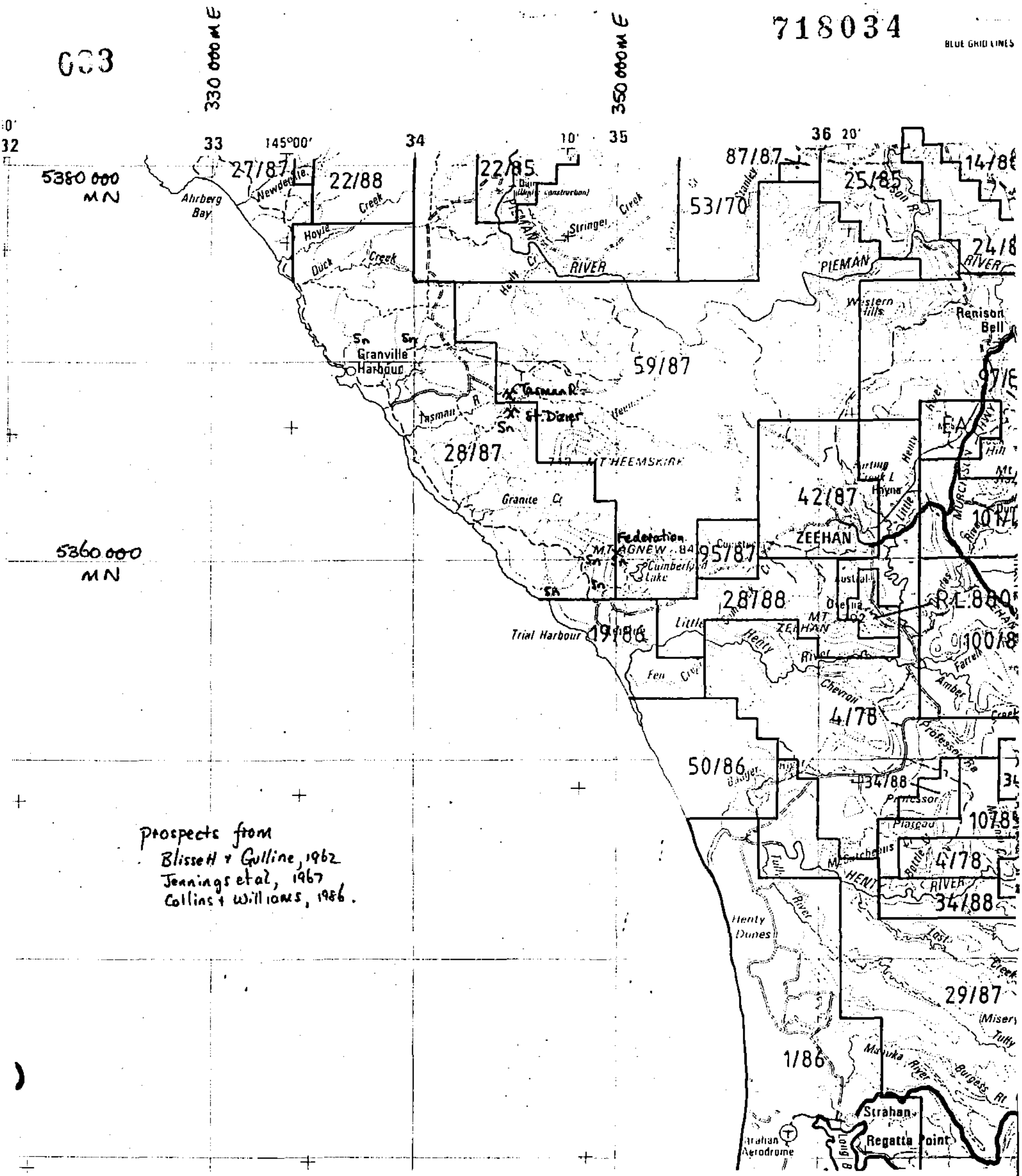
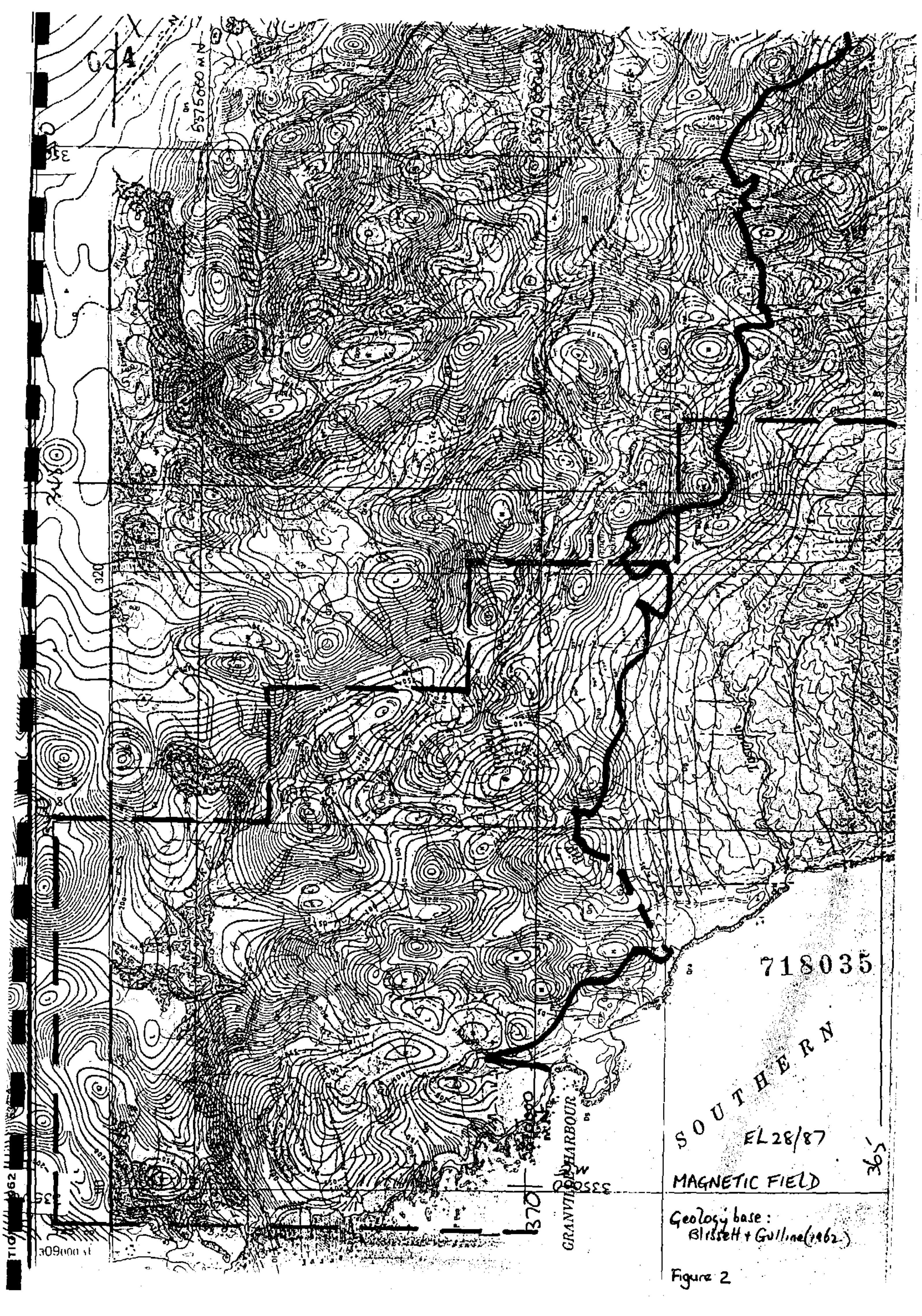


EL 28/87

LOCATION DIAGRAM

FIGURE 1



718035
SOUTHERN
GRANVILLE HARBOUR
EL28/87
MAGNETIC FIELD
Geology base:
Blissett + Gulline (1962)

Figure 2

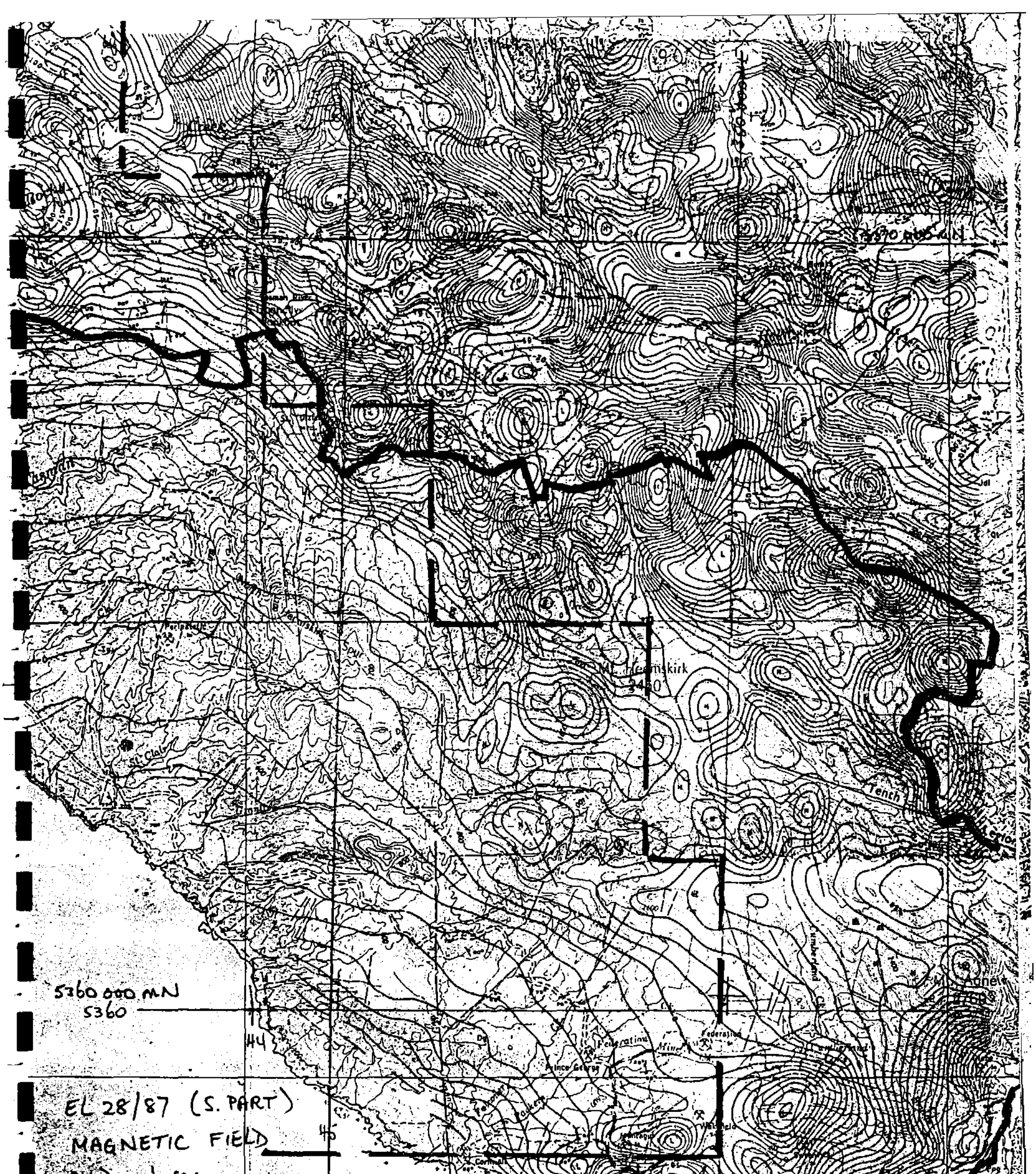
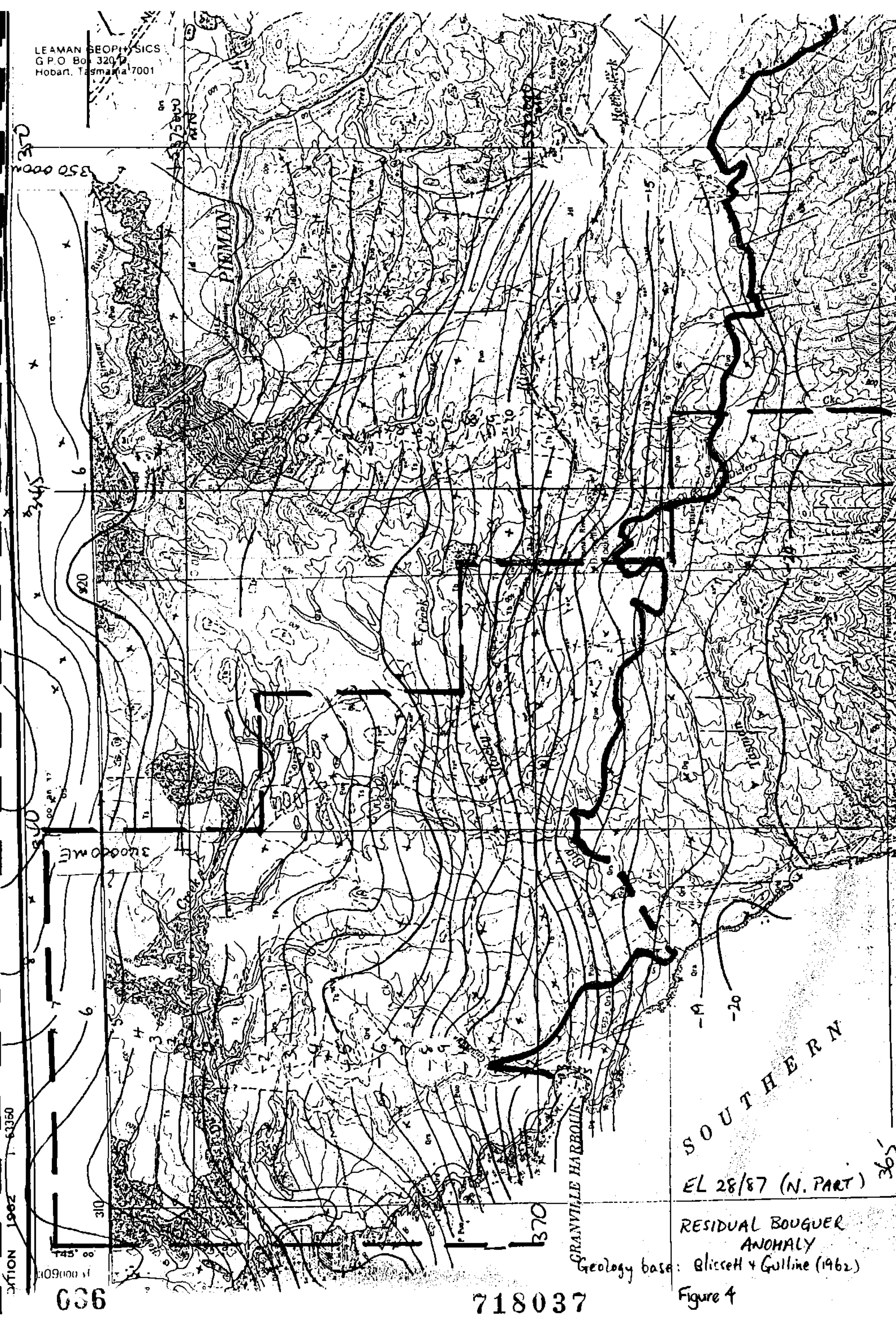


FIGURE 3

718036



EL 28/87 (N. PART)

RESIDUAL BOUGUER ANOMALY

Geology base: Blissett + Gulline (1962)

Figure 4

636 718037

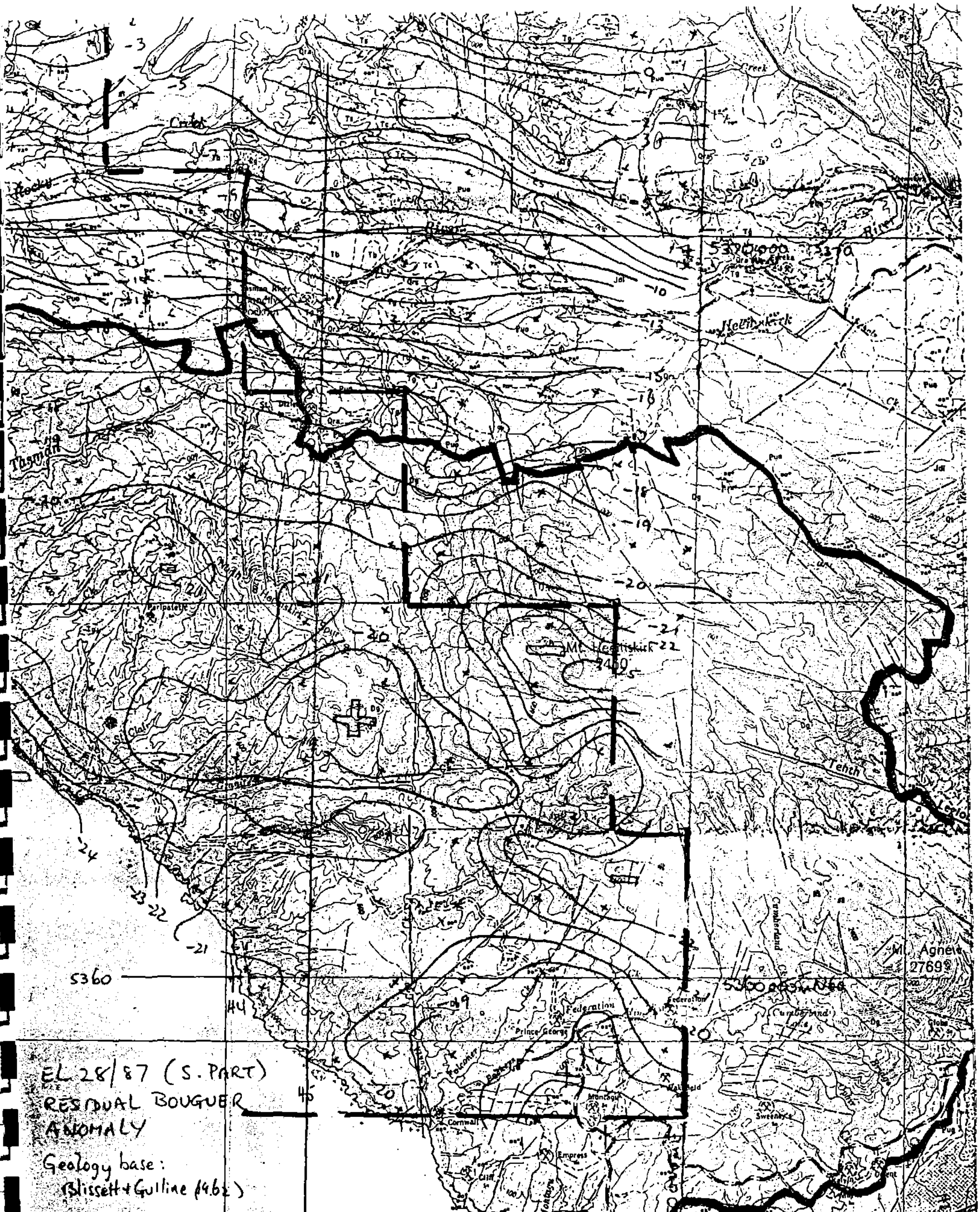


FIGURE 5

007

718038

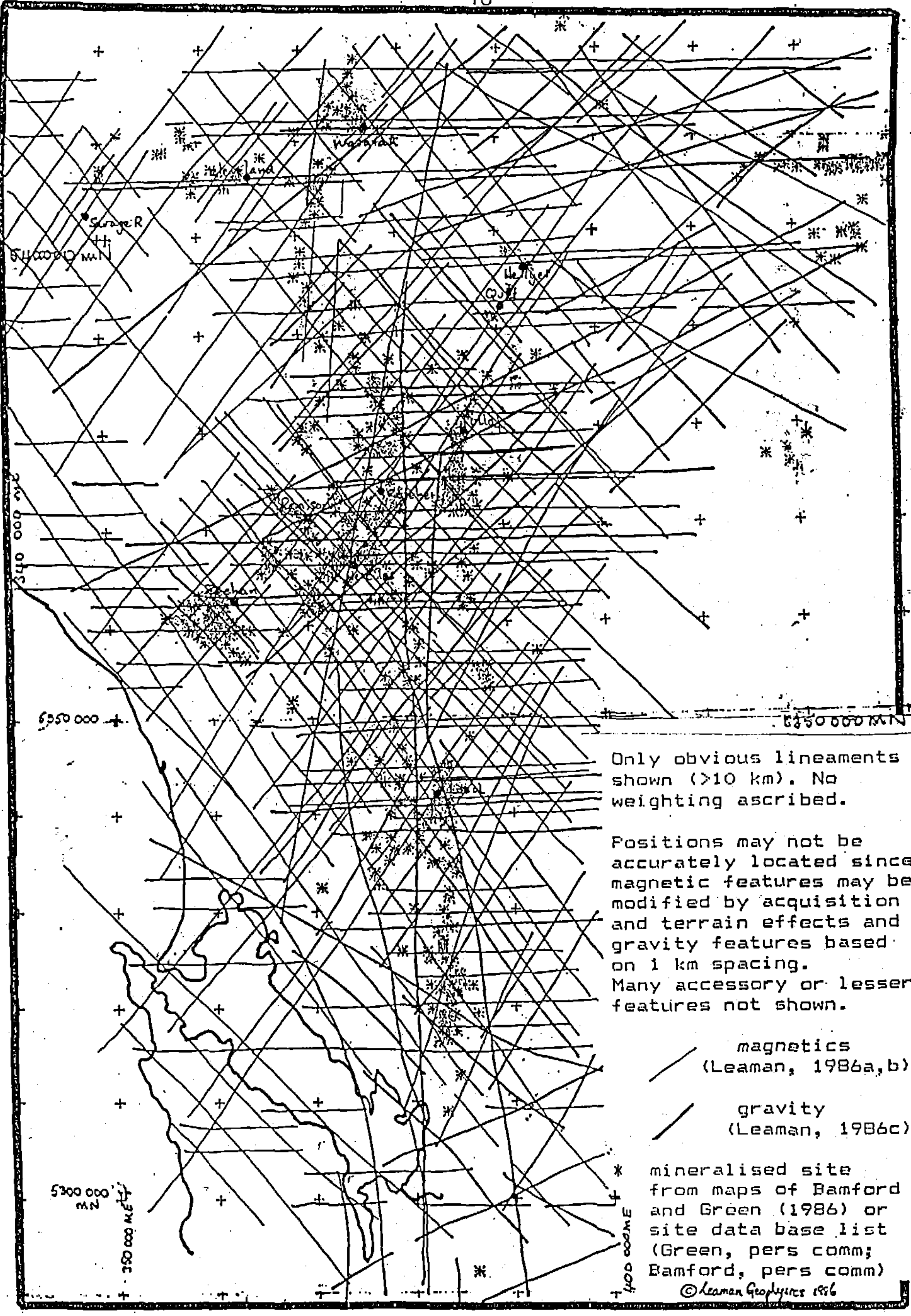
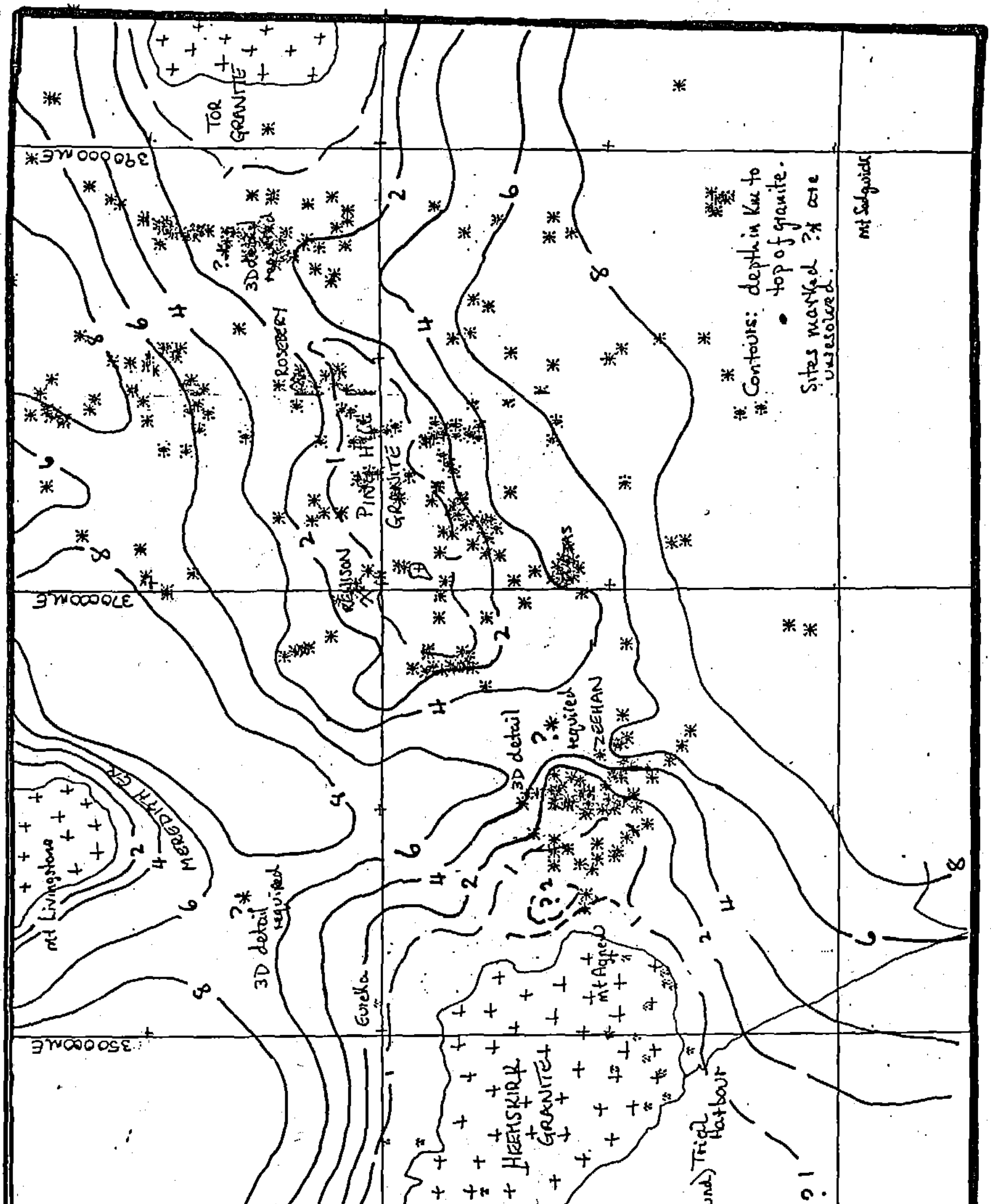


FIGURE 6: LINEAMENT 1 - ALL MINERALISED SITES
from Leaman (1987)

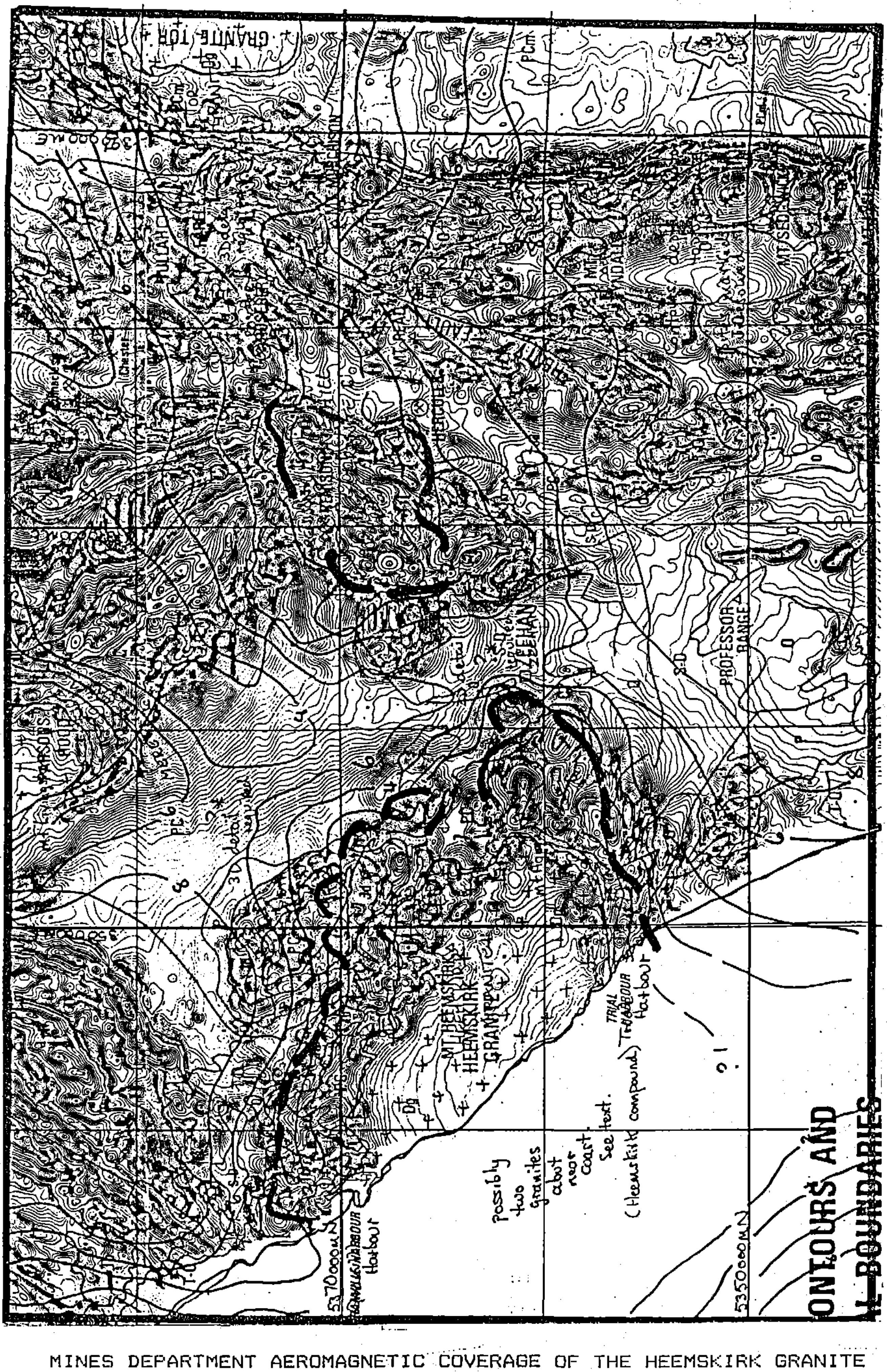
LEAMAN GEOPHYSICS
G.P.O. Box 320 D,
Hobart, Tasmania 7001



PROVISIONAL INTERPRETATION : FORM OF THE HEEMSKIRK GRANITE
(Mineralised sites indicated, from Leaman (1986a), Bamford and Green (1986))

FIGURE 7

040



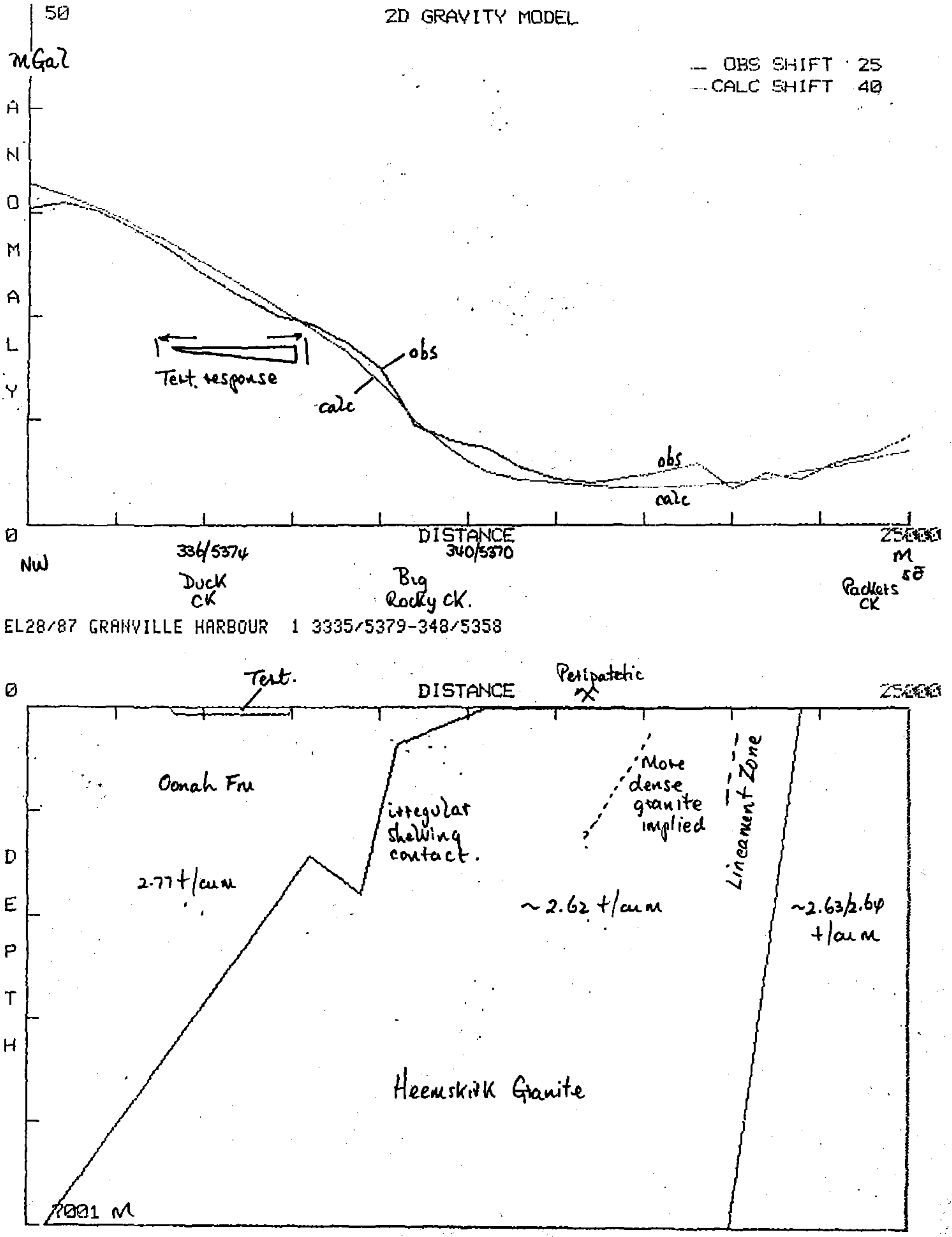
MINES DEPARTMENT AEROMAGNETIC COVERAGE OF THE HEEMSKIRK GRANITE
Contours from provisional interpretation of the form of the intrusion are also shown. FIGURE 8

718041

G41

LINE PARAMETERS - ORIGIN,LIMIT,INCR : 0 . 25000 1000

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



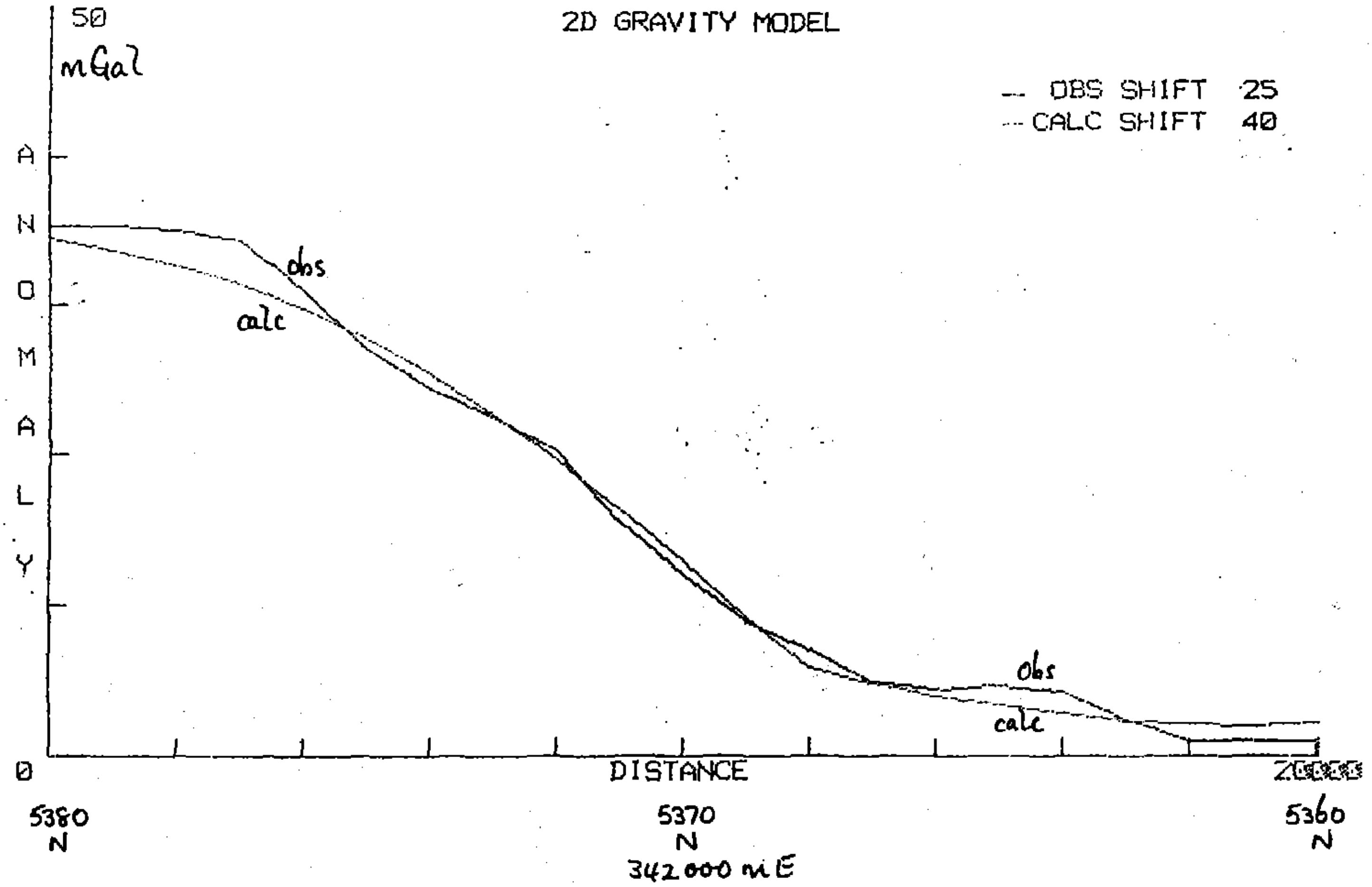
GRAVITY INTERPRETATION LINE 1

FIGURE 9

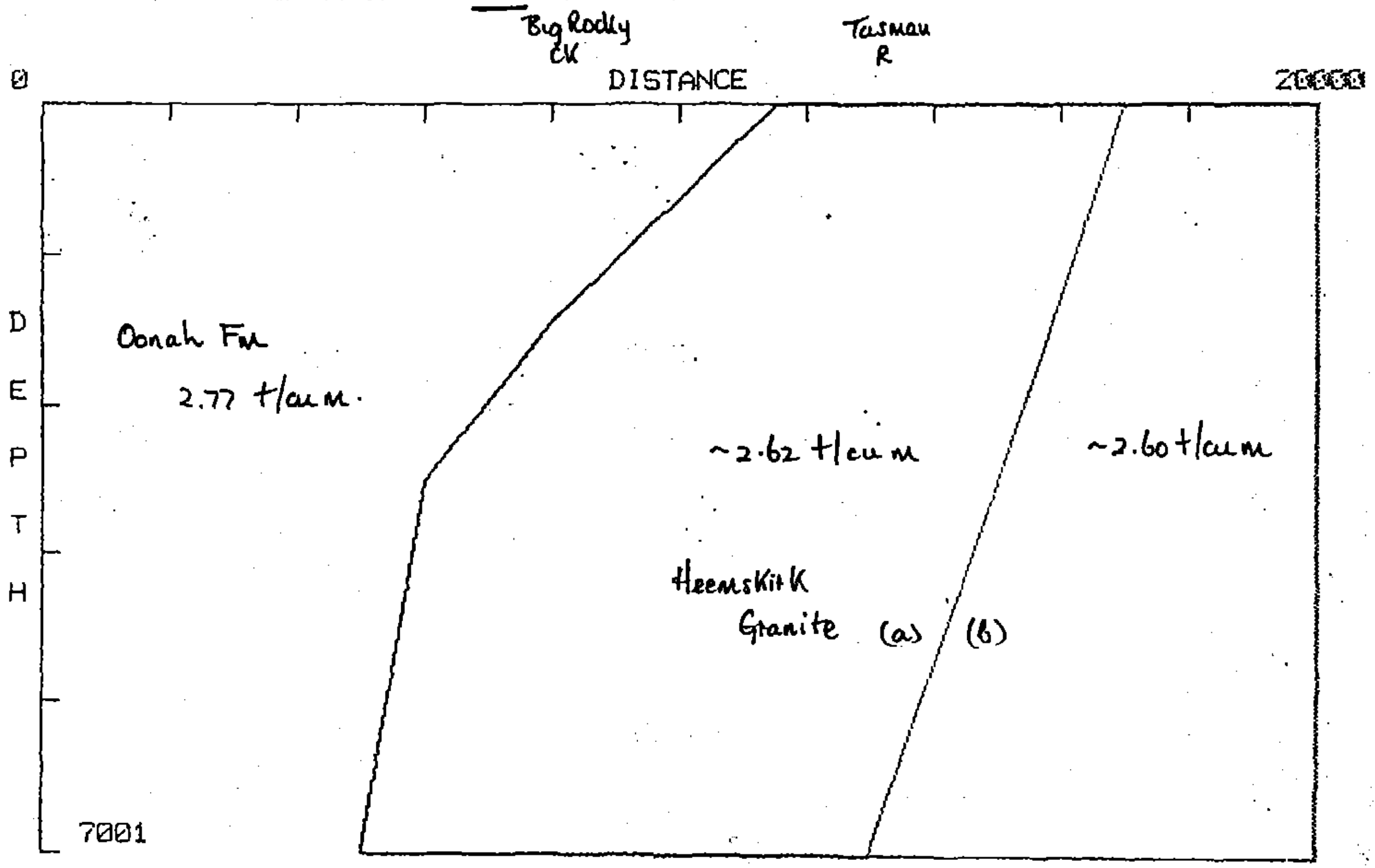
718042

LINE PARAMETERS - ORIGIN,LIMIT,INCR : 0 20000 1000

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



EL 287/87 GRANVILLE HARBOUR 2 342E 5380-5360



GRAVITY INTERPRETATION LINE 2

FIGURE 10

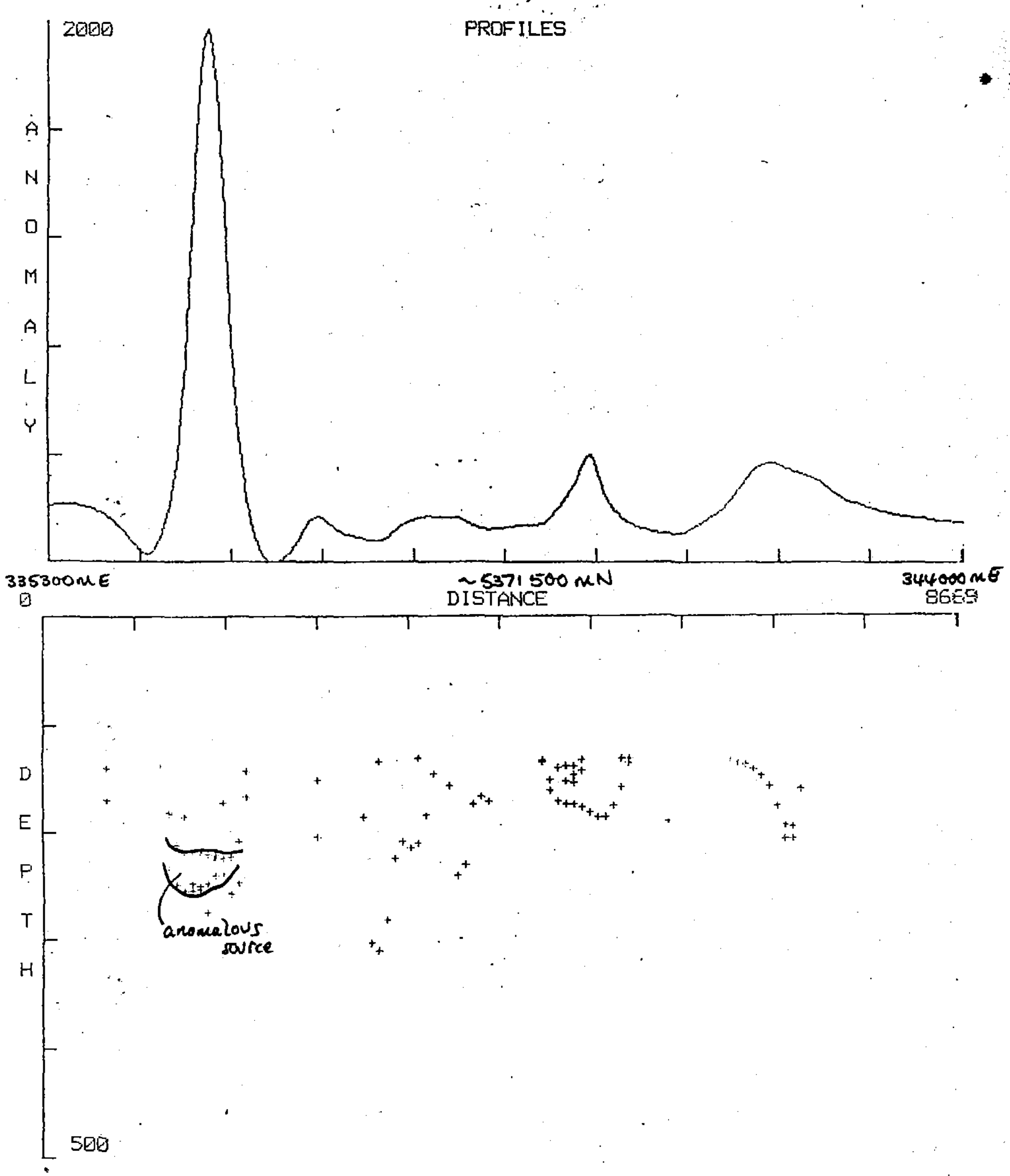
G43 GRANVILLE PROJECT LINE 1450
B:M1450

718044

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

SAMPLE SPACING (M) : 37.04701
SAMPLES : 32

I B:M1450 GRANVILLE PROJECT LINE 1450
ZERO SHIFT : 119.2



SPECTRAL ANALYSIS MAGNETIC LINE 1450

FIGURE 11

644 718045

MAG2D
LEAMAN GEOPHYSICS

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

EL 28/87 GRANVILLE HARBOUR 1450 53715N 3353-344

FIELD DATA

INTENSITY	INCLINATION	DECLINATION	OBS LEVEL	LINE DIRECTION
62500.0	-72.0	13.0	0.0	90.0

LINE PARAMETERS - ORIGIN,LIMIT,INCR : 0 8669 37.04701

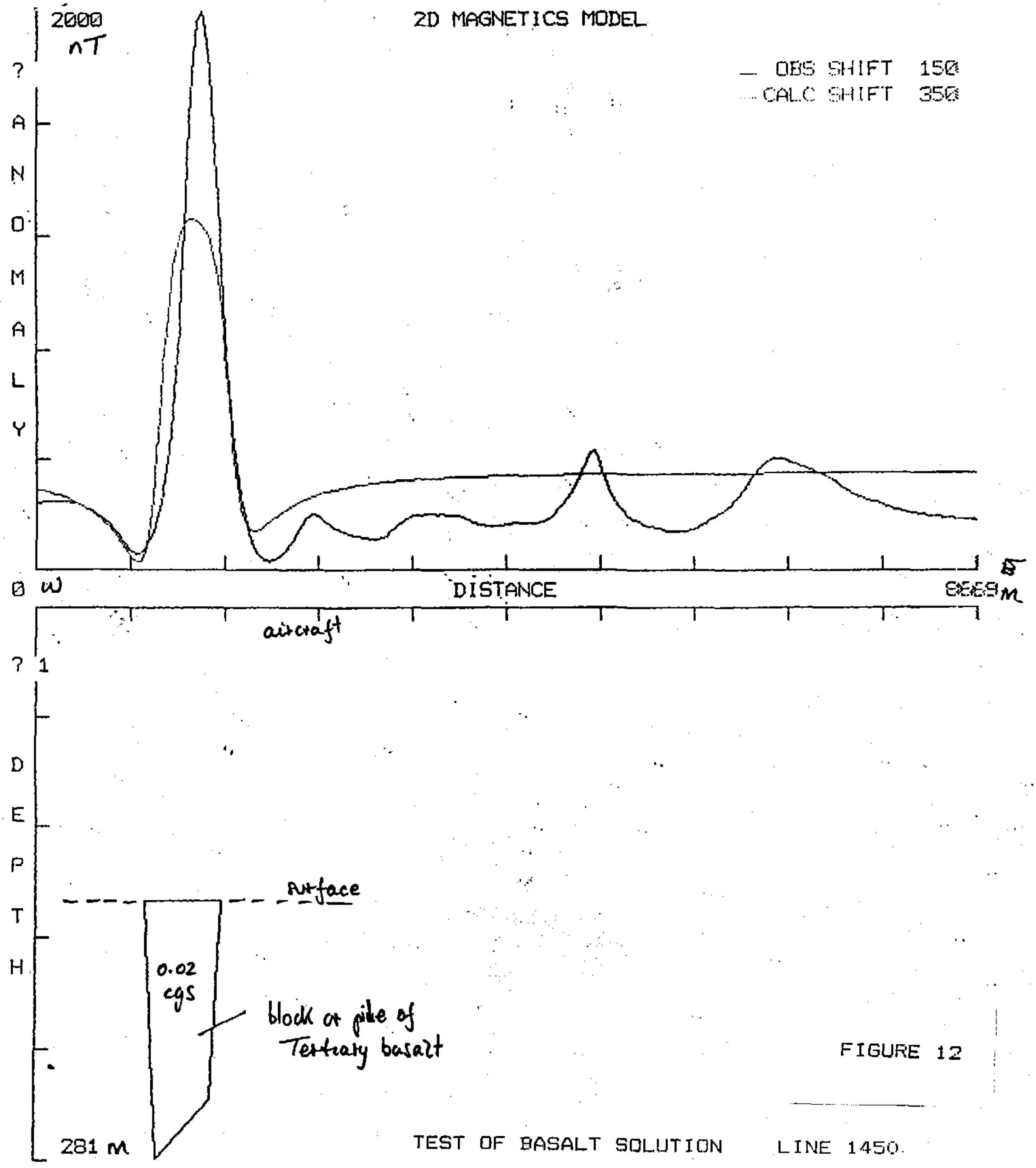


FIGURE 12

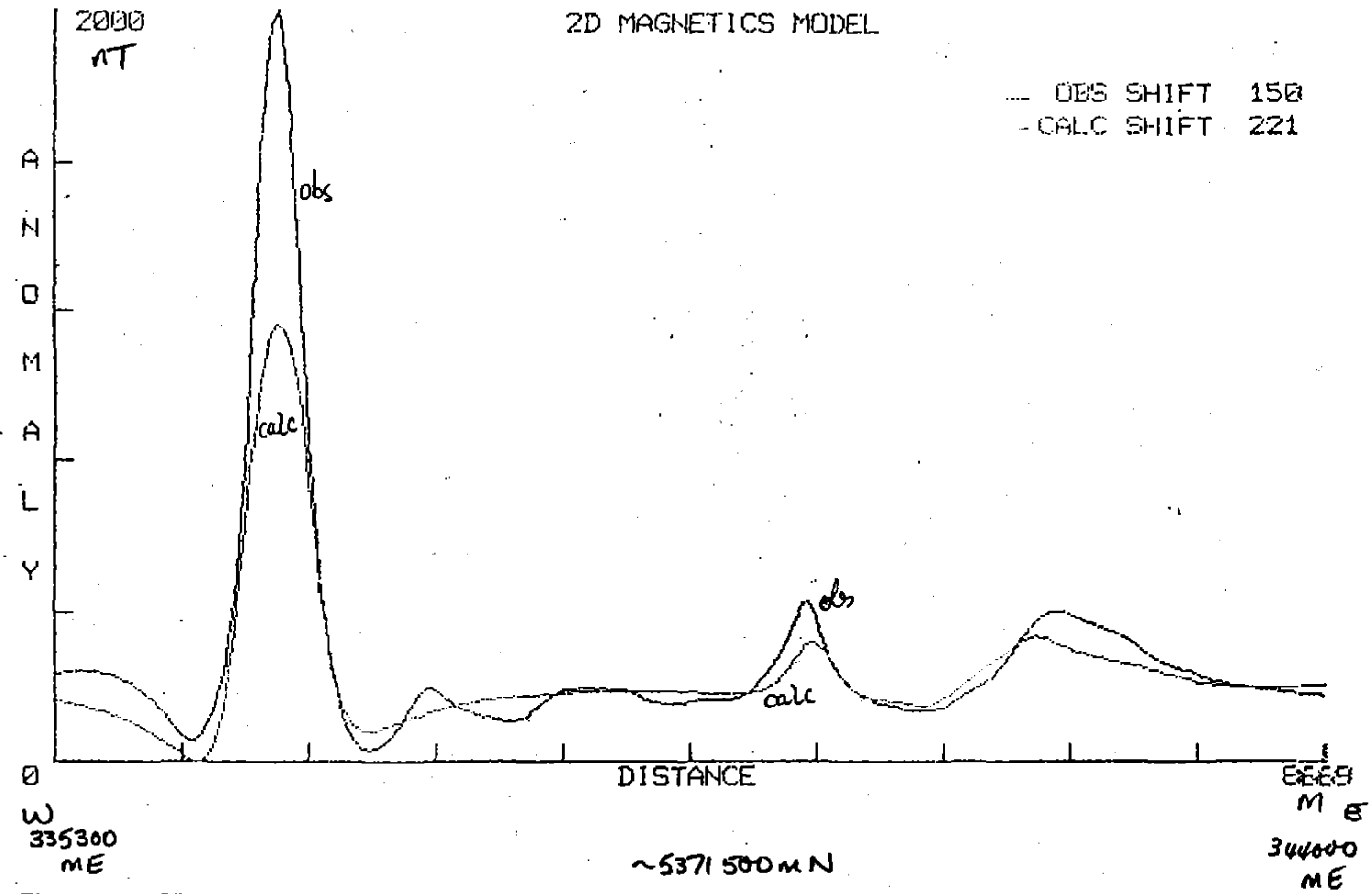
TEST OF BASALT SOLUTION LINE 1450

645

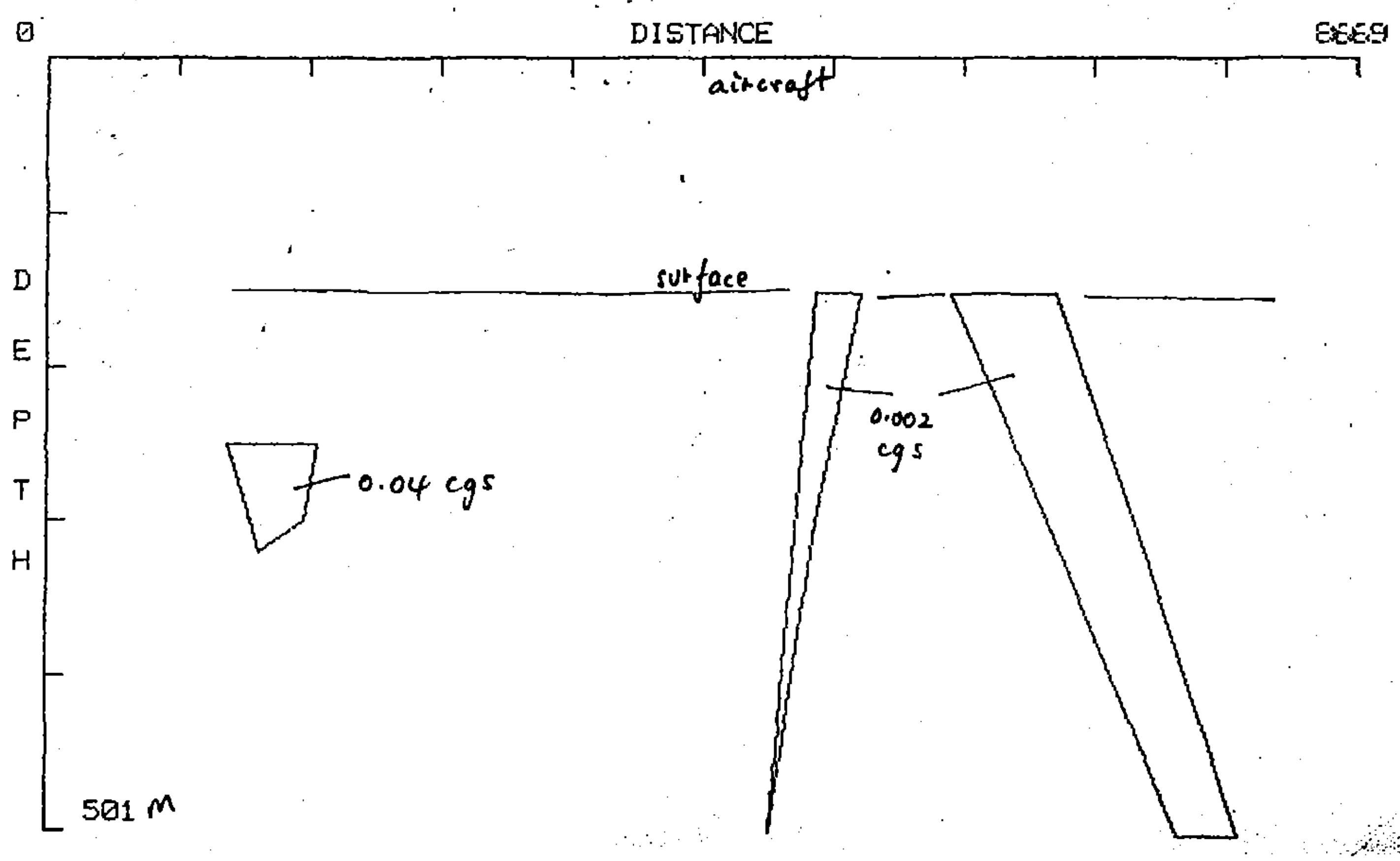
718046

LINE PARAMETERS - ORIGIN,LIMIT,INCR : 0 8669 37.04701

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



EL 28/87 GRANVILLE HARBOUR 1450 53715N 3353-344
3+300M 4-400M



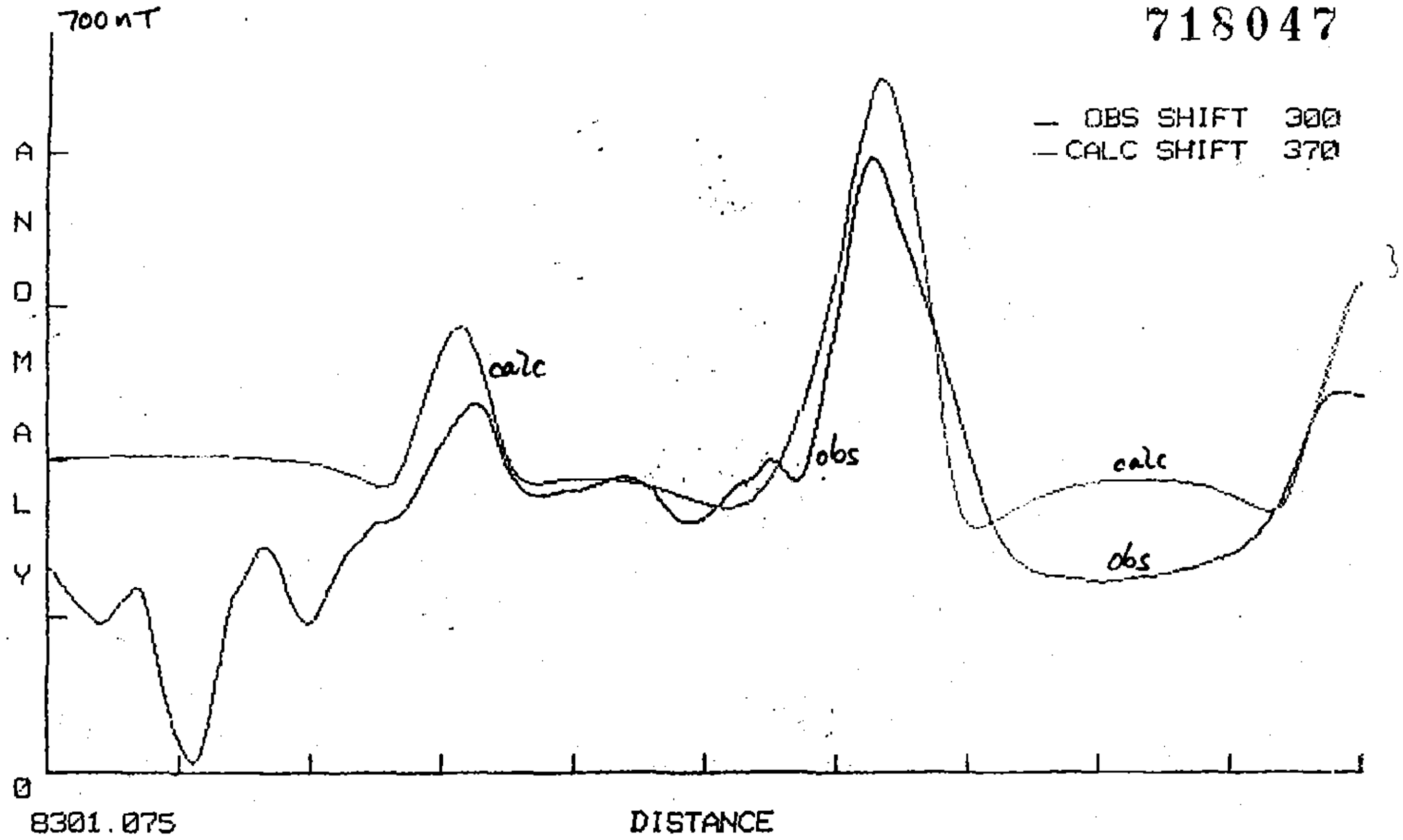
OONAH FORMATION SOURCE SOLUTION LINE 1450 FIGURE 13

64b

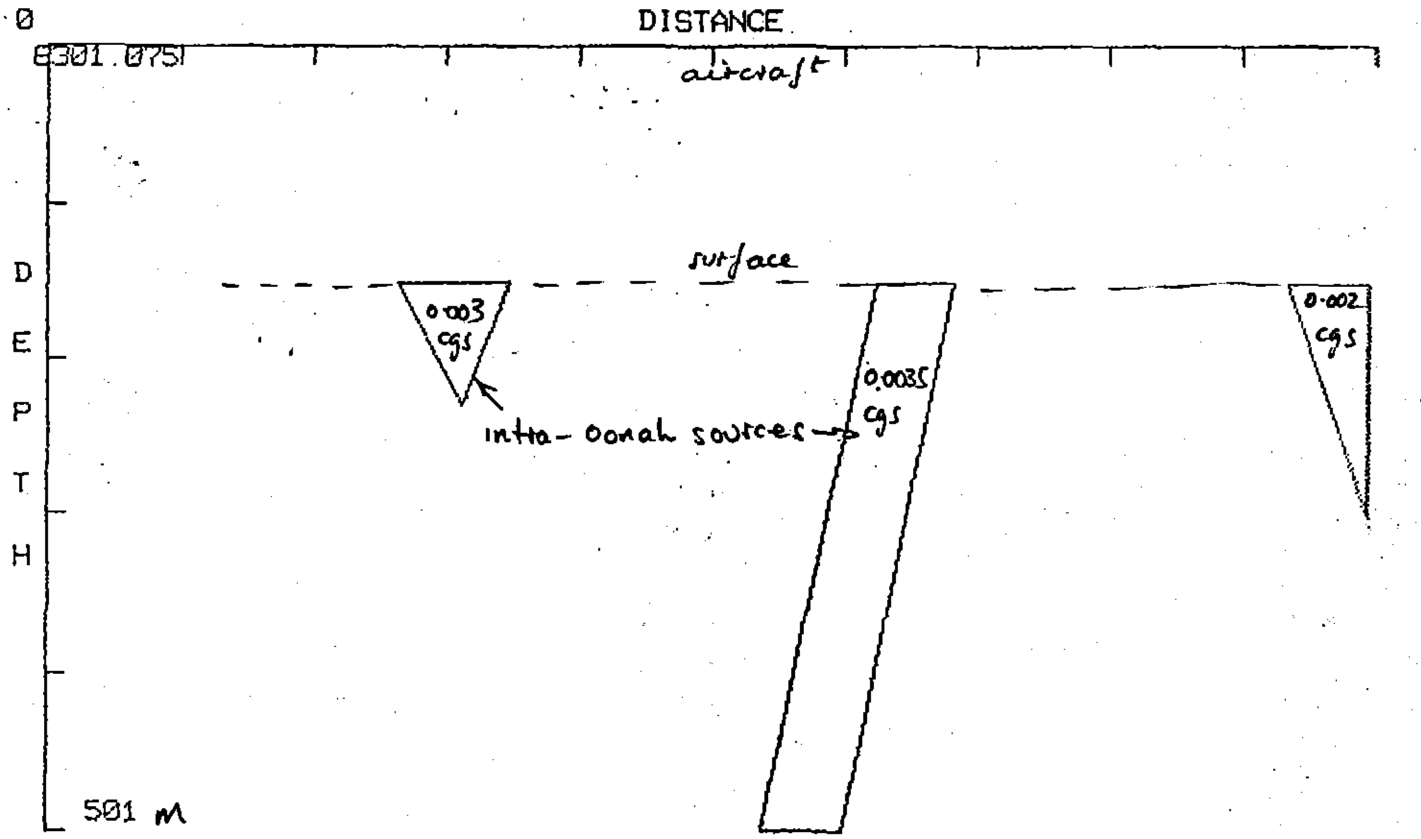
LEAMAN GEOPHYSICS
G.P.O. Box 320 D,
Hobart, Tasmania 7001

LINE PARAMETERS - ORIGIN,LIMIT,INCR : 0 8343 41.92462

718047

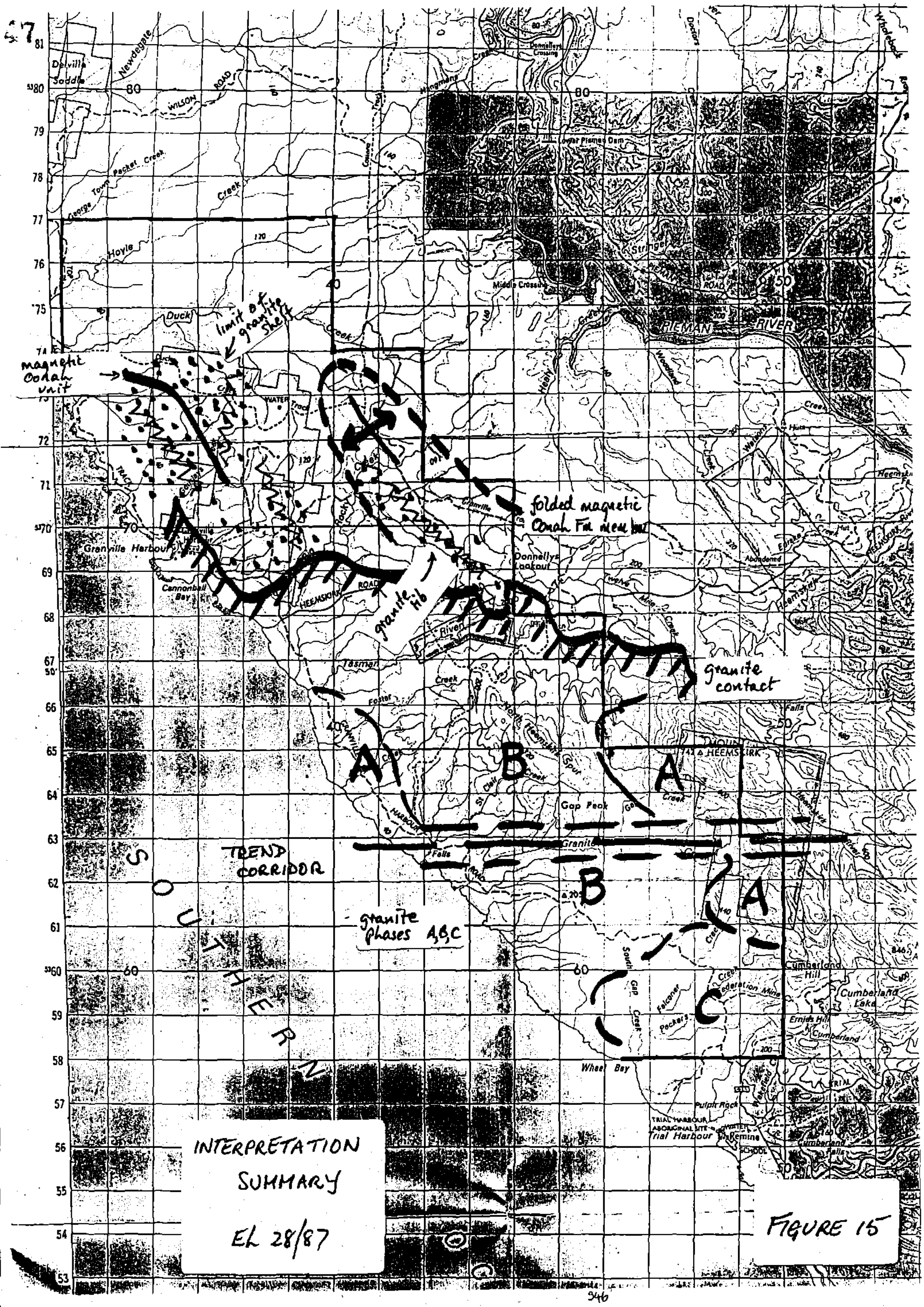


EL28/87 GRANVILLE LINE 1423 5370400N 3365-344E
K5=-004



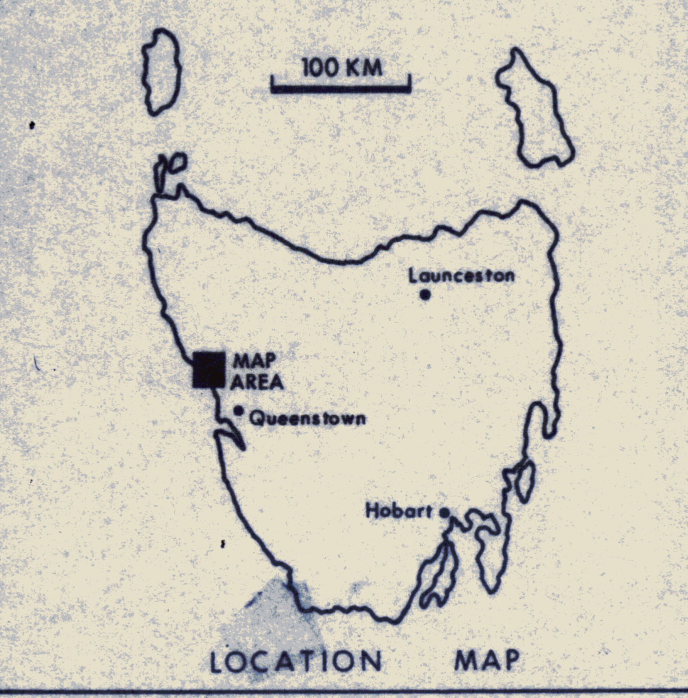
MAGNETIC INTERPRETATION LINE 1423

FIGURE 14


magnetic Oonah unit
limit of granite shelf
folded magnetic Oonah Fm member
granite Hb
granite contact
A
B
A
B
A
C
TREND CORRIDOR
granite phases A,B,C
SOUTHERN
INTERPRETATION SUMMARY
EL 28/87
FIGURE 15
Granville Harbour
Cannonball Bay
HEEMSKIRK ROAD
PIEMAN RIVER
Donnellys Lookout
Gap Peak
Cumberland Hill
Wheel Bay
Trial Harbour

346

718048



1000m 500 0 1 2 3 4 KM

KEY

Q	Quaternary sediments, probably more extensive than shown
Tb	Tertiary basalt, boundary approx., tertiary sediment cover indicated by T
S-D	Siluro-Devonian sediment, undifferentiated
O	Ordovician sediment, undifferentiated
Po	Precambrian – Whyte Schist
Pw	Precambrian – Oonah Quartzite and slate
+ +	Devonian, Heemskirk Granite

- Geological boundary - approximate
- Angular unconformity; approx., inferred
- Fault - approximate
- Aeromagnetic anomaly, values in nT
- Geopeko grid over Gourlay's Creek anomaly
- Geopeko DDH (position approx.) with bearing
- Magnetic horizon, Gourlay's Creek grid

5 cm

718049

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NEW HOLLAND MINING N.L.
Part of EL 28/87
GRANVILLE HARBOUR, TASMANIA

Geological Compilation

REF.	2887-1
COMP.	WCC
DRAWN	T. K. D
DATE	NOV'88
SCALE	1:25,000

Based on Dept. of Mines published maps various company open file reports held by the Dept. Aeromag. contours adapted from Leaman, 1988 (Appendix I, this report)

FIG. 2

88-2878

7684