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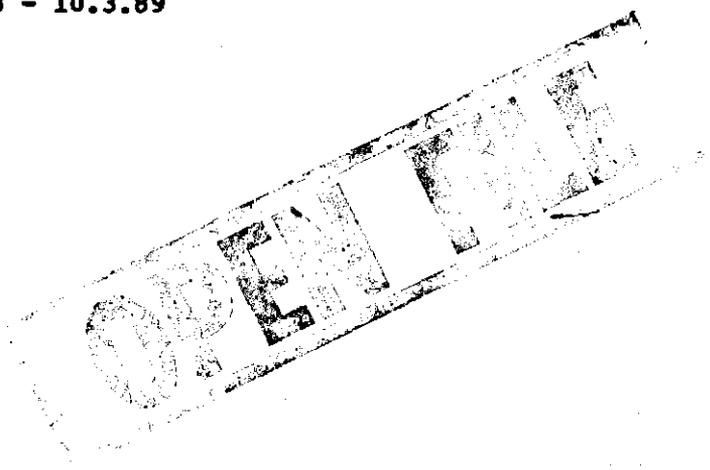
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EL27/87

PIEMAN HEAD, TASMANIA

ANNUAL REPORT

10.3.88 - 10.3.89



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SUMMARY

Precambrian relatively unmetamorphosed sandstones, quartzites and siltstones are the dominant rock types on EL27/87.

The Mid-Late Devonian Pieman Granite, a large, elongate, largely offshore pluton, has intruded the Precambrian along the western boundary of the tenement. Sub-economic base metal sulphide and tin and tungsten mineralisation is associated with the granite.

The tenement has been included in several earlier exploration licences since the late 1960's. Reconnaissance geochemistry and geophysics has been done, with some detailed follow-up. In most cases the target has been tin-copper replacement skarn deposits associated with the Pieman Granite.

Despite this work, New Holland regards the tenement as prospective for Renison Bell style tin and base metal skarn mineralisation, especially along the eastern margin of the granite. Sporadic mineralisation occurs in this area and a Year 1 geophysical interpretation suggests that known mineralisation is associated with cupolas and ribs on the steeply dipping margin of the granite.

Year 2 in-fill gravity acquisition is planned in the Interview River area prior to ground follow-up.

1. INTRODUCTION

1.1 Tenement Details

Exploration Licence 27/87 was granted to New Holland Mining NL on March 10, 1988. The Company is sole owner and manager.

The tenement comprises

- State Forest 4.3km²
- Crown land 40.5km²
- Private property 3.6km²
- Arthur - Pieman Protected Area
and Norfolk Range Australian
Heritage Act Interim Listing 95.0km²

and excludes

- Pieman River State Reserve 9.6km²
(also an Australian Heritage
Act Interim Listing)
- Mineral lease 28M/76 (Copper) 16 ha

1.2 Exploration Aims

Although previous explorers have done regional surveys and locally detailed follow-up investigations in the region, New Holland views EL27/87 as moderately prospective for Renison Bell type replacement skarn tin and copper mineralisation related to the Pieman Granite.

New Holland has made use of available regional gravity and aeromagnetic data as a primary exploration tool.

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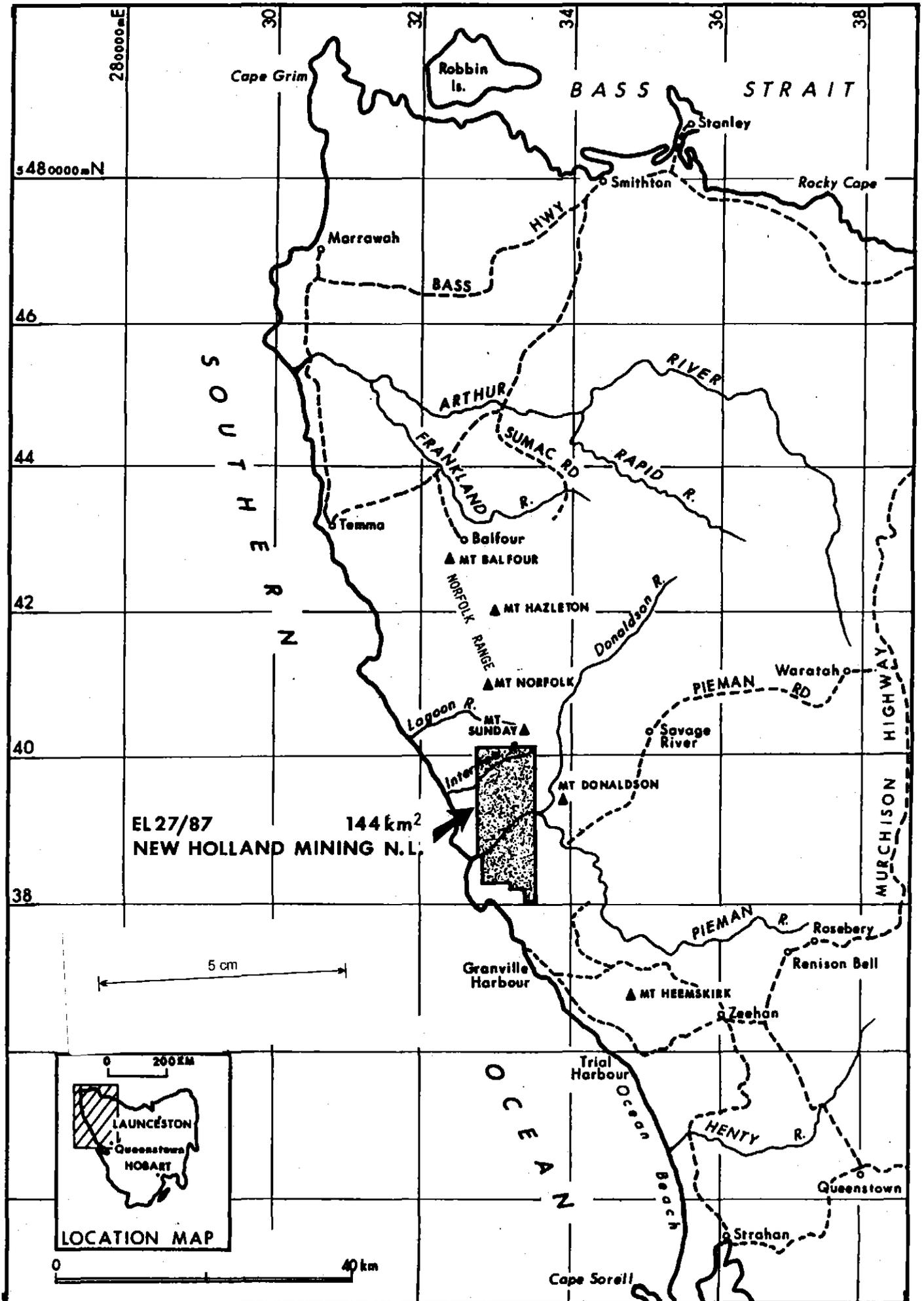


Figure 1. Location map, EL27/87.

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, 1988).

2.2 Review of previous exploration

EL27/87 includes part of the Pieman Granite and the southwestern extension of the Arthur Lineament. The granite is associated with several sub-economic tin and base metal prospects and the Lineament with minor gold and numerous massive oxide-sulphide deposits. Because of this, the district has seen considerable exploration activity at regional and prospect scale by major mining companies since the late 1960's.

Pickands Mather held EL12/65 which covered a large part of western and northwestern Tasmania. The present tenement was included in a regional stream sediment survey, in the course of which highly anomalous tin results were returned from the Pieman Head region. The company concluded that the tin was derived from reworked Tertiary sediments and did no follow-up work.

Adjoining EL's 48/70 and 49/70, granted to Renison Limited and ACI Operations, were jointly explored by the tenement holders in a syndicate with Consolidated Goldfields Australia Limited and the Mt. Lyell Mining and Railway Company. The EL's covered 1250km² extending from Granville Harbour north to the Thornton River. The group conducted regional stream sediment sampling between Sandy Cape and Granville Harbour (Bell, 1972). It followed up aeromagnetic anomalies to the west of the current EL at Rupert Point and Chimney Creek, and adjacent to the southwestern corner of EL27/87 near Conical Rocks Point (Figure 2). Gridding, ground magnetics, mapping and soil and rock geochemistry were carried out at the latter locality in an area of anomalous tin. Nearby, in Violet Creek (295142) on EL27/87, stream sediment sampling also returned anomalous copper (230-830 ppm). The best tin assay within the present tenement was at Webster Creek ((295854); 5760 ppm Sn).

The syndicate concluded that the anomalous tin and copper were shed from the Tertiary sediments of the area.

Esso Australia Limited held EL27/73 covering 2200 km² of western and northwestern Tasmania. A combined aeromagnetic and INPUT FM survey was flown in 1973. An INPUT anomaly at Webster Creek (295854) roughly coincident with anomalous stream sediment tin was investigated by ground magnetics but no follow-up rock or soil sampling appears to have been done.

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CRA Exploration's EL1/77 (5322km²) was explored as a joint venture with Geopeko after 1979. The initial exploration target was tin but emphasis included base metals after the partners commissioned a regional prospectivity review for copper, lead and zinc (Legge, 1980). Legge summarised previous work, noting that the general area of 1/77 had been extensively explored for granite-related tin-skarn deposits. He suggested also that the numerous, mainly sub-economic base metal sulphide and tin occurrences might pre-date the granites and could reflect original basin conditions in the Precambrian.

CRAE and Geopeko also commissioned Carey (1981) to do a regional photogeological interpretation of the tenement.

An initial CRAE panned concentrate stream sediment survey in 1977 detected several tin anomalies in and near EL27/87. These were followed up by further sampling in 1982/3 (Weir, 1982, 1983). Anomalous metal values were returned from the Interview Granite (i.e. Pieman Granite) anomaly ((295903); 2550 ppm Sn; see Figure 2), at Destination Creek ((345915) to (353933); 300-1800 ppm Pb) and south of the Pieman River where the ACI consolidated syndicate had explored in 1971-72. Ground follow-up on the Interview Granite anomaly proved disappointing, and the Destination Creek anomalies could not be repeated (Weber, 1983a,b).

South of the Pieman River, thirty kilometres of gridding were combined with ground magnetics and bedrock geochemistry (337 samples) in a search for Renison Bell tin skarn replacement deposits. Although elevated zinc assays and spot highs of tungsten, copper and lead were reported, CRAE and Geopeko found no areally significant anomalous zones which warranted further work. Like previous explorers, they concluded that the high tin assays were derived from Tertiary sediments.

The partners relinquished the portion of EL1/77 covering the present tenement in 1985 (Weir, 1985a).

CRAE and Geopeko Limited also joint ventured exploration on EL36/80 (115km²) which overlapped the northeastern corner of EL27/87. The aim (Weber, 1983c) was to explore the southern extension of the Balfour-Norfolk Range tin-copper occurrences, and the eastern side of the Interview River copper workings and minor lead-zinc prospects (Figure 2). The Interview-Pinnacles anomaly (350990) in the northeast of the present tenement was investigated by stream sediment and rock chip sampling. Anomalous panned concentrate results (Au, 2 ppm, Pb 125 ppm, Mo 100 ppm and Ba 220 ppm) and elevated Zn, Fe and Mn were obtained but the partners considered the area of insufficient merit to warrant further attention (Dickinson, 1985; Weir, 1985b).

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EL64/83 (previously 13/81, 1/73) was held by Abignano Constructions Pty. Ltd. adjacent to CRAE's 36/80 on the Interview River. The company explored for tin, copper and tungsten at and adjacent to several old prospects, including the Copper Reward mine (Figure 2) within EL27/87. Two diamond drill holes were completed on tungsten-tin vein deposits west of EL27/87. Sub-economic mineralisation was intersected. At the Copper Reward Mine (300978) currently held under mining lease by Abignano, economic grades of copper mineralisation occur, but with a strike length of 40m the orebody is not viable (Gouge, 1983, Brink, 1985).

2.3 Tenement Geology

Most of EL27/87 has been mapped by the Department of Mines as part of the Pieman Heads 1:63360 geological map sheet (Gee *et al*, 1969). Various exploration companies have made subsequent additions and revisions.

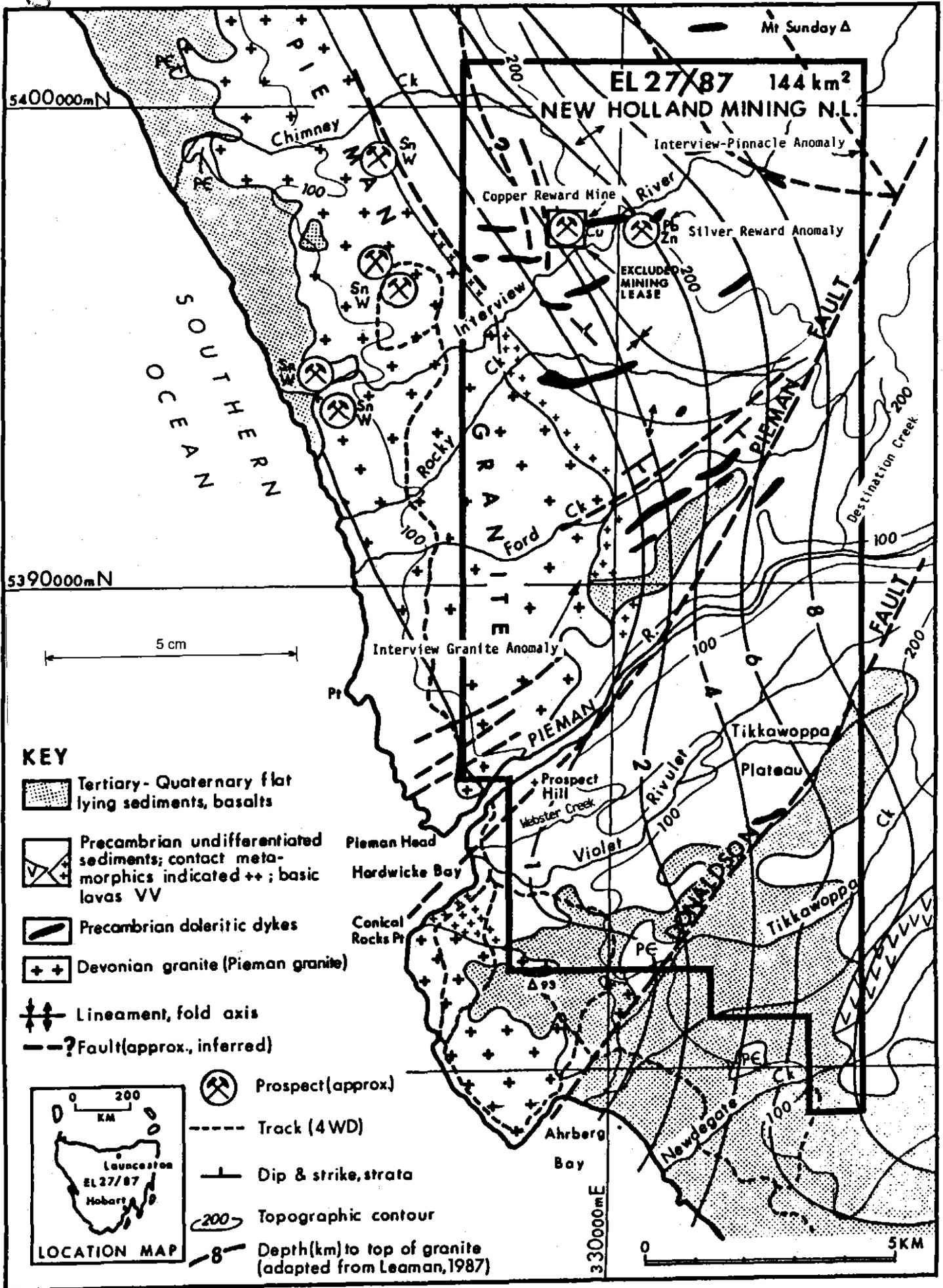
Rock types on the tenement include Precambrian Rocky Cape Group sediments (locally intruded by Precambrian mafic dykes), Mid-Late Devonian Granite (the Pieman Granite), Tertiary basalts and sediments, and Quaternary sediments.

Precambrian The Precambrian rocks are relatively unmetamorphosed quartzites, siltstones and mudstones with minor volcanics. The sequence is undifferentiated, but Gee *et al* (1969) has subdivided it into the Lagoon River Quartzite, Interview Siltstone and the Rupert Beds. Structurally the area is very complex, but the rocks generally young to the southeast, with a regional N-S or NNE-SSW strike subparallel to the Arthur Lineament (Figure 2). Some Precambrian beds show strong axial plane cleavage, and others contain disseminated magnetite which produces magnetic anomalies.

The rocks are locally intruded by Late Precambrian (c 725 Ma) mafic dyke swarms. The dykes are narrow, elongate, concordant and discordant bodies, broken by faulting, and extensively altered to amphibolites. Similar dykes are common in the Rocky Cape Group along the northwestern boundary to the Arthur Lineament.

No major carbonate sequences have been reported from the tenement, but extensive dolomite and magnesite occurrences are known from the Savage River east of EL27/87. Strike extensions of these rocks may occur beneath Tertiary and Quaternary cover in the southeast of the tenement near Newdegate Creek (Figure 2).

Devonian The Mid-Late Devonian Pieman Granite intrudes and has contact metamorphosed the Precambrian rocks. Little detailed work has been done on the pluton, which is a large, elongate, largely offshore body with partly fault-controlled margins. It may be connected at depth to the Heemskirk Granite further south.



Geology from: Gee et al (1969), various Dept. Mines Tas. Open File reports.

Figure 2. Generalised geology, EL27/87.

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Leaman (1987) has done a provisional regional interpretation of the granite. His depths to the top of the granite are contoured in Figure 2. More recent work (Leaman pers. comm.) suggests that the pluton's steeply dipping margin is more irregular than indicated. There is a possibility of sub-surface extensions of the granite to the east and northeast where it may have sourced the copper-tin mineralisation at Balfour and along the Norfolk Range. Most previous workers attribute the copper, lead, zinc, tin and tungsten prospects along the Interview River to the Pieman Granite.

Tertiary Basalts and Sediments These materials, undifferentiated on Figure 2, are widespread in the southern part of EL27/87. They probably represent remnants of the Henty Surface, a deeply dissected fluvial landform of Tertiary age which occurs extensively in western Tasmania (Banks et al., 1977; Baillie and Corbett, 1985).

Small areas of Quaternary deposits occur along Chimney Creek and the Interview River.

2.4 Mineralisation

Sub-economic deposits of tungsten, tin and copper are known from the Pieman-Interview River area, and anomalous elevated gold, zinc, lead and molybdenum have been returned from stream sediment samples throughout the district.

Within EL27/87, the most significant mineralisation occurs on the Interview River at and near the old Copper Reward Mine (300978). At this locality, six sub-vertical quartz-pyrite-haematite veins varying from 0.1-2 m wide strike about 270-330°M (Brink, 1985). Two of the veins, within Abignano Construction's mineral lease 28M/76 (16ha) carry chalcopyrite (up to 1.12% Cu) and minor silver (0.6-6 ppm) with trace gold (0.03 ppm). All the remaining veins lie within EL27/87. Strike lengths range from 100-1000 metres, but none carries more than trace copper values (best, 103 ppm Cu, 0.2 ppm Ag).

The veins are contained within quartzites and banded siltstones of the Interview Siltstone which have been intruded by Precambrian mafic dykes. The rocks have been regionally metamorphosed, apparently by the Pieman Granite which has presumably sourced the mineralisation.

A small lead-zinc prospect occurs south of the Interview River about two kilometres east of the Copper Reward. Very little is known of the area, but it probably corresponds with CRAE's Silver Reward anomaly (Weber, 1983c) where rock samples have returned anomalous lead. The siltstones in the area contain carbonate.

West of EL27/87, between Chimney Creek and the Interview River, Abignano Constructions has explored a series of apparently en-echelon sub-vertical quartz veins within the Pieman Granite. The veins contain local high grade tungsten mineralisation over a possible strike length of 2500 metres (Brink, 1985). Wolframite with minor scheelite occurs as discrete lenses up to 10m long associated with tourmaline, cassiterite, muscovite, pyrite and arsenopyrite in a quartz gangue. The veins strike 020°M with local cross-fracturing striking 320°M. Samples taken from some of the old workings show assays of 8-10% WO₃ from veins 0.15-0.4m wide.

Brink (1985) concludes that 1.6 mt ore grading 1.4% WO₃ are present. Abignano Constructions holds leases over all the tungsten prospects, but like the Copper Reward Mine, there has apparently been no modern production.

The Company has also proved up several small sub-economic alluvial tin deposits near the tungsten veins. A combined volume of 8000m³ grading 1.5kg/m³ cassiterite is indicated (Brink, 1985).

2.5 Regional Geophysical Interpretation

As part of its Year 1 programme, New Holland Mining NL commissioned Dr. D.E. Leaman to review existing gravity and magnetic data over EL27/87. His report (Leaman, 1988) is included here as Appendix 1. Leaman concentrated on the form and metamorphic effects of the Pieman Granite. The main conclusions are :

- o the granite is a complex intrusion with an irregular, steeply dipping eastern margin associated with ribs and spines.
- o localised thermal metamorphism of the Precambrian rocks has taken place, but no major magnetic (i.e. pyrrhotitic) anomalies are apparent. Potential for large-scale replacement bodies is limited.
- o some local cupolas are associated with known Sn-W mineralisation.
- o in-fill gravity coverage is recommended near the Interview River mineralisation, and near the Pieman River, prior to prospect evaluation. Three-dimensional evaluation methods would be appropriate.
- o field work should concentrate on rock sampling for geochemical anomalies and magnetic properties over cupolas near known mineralisation, prior to possible drilling.

3. DISCUSSION

Despite regional surveys and locally detailed follow-up by previous explorers, EL27/87 remains moderately prospective for Renison Bell replacement skarn tin and copper mineralisation related to the Pieman Granite.

There is some indication of potential carbonate host rocks within the Precambrian sequence.

The most prospective area on the tenement is the region north of the Pieman River, and in particular near the Interview River, where base metal mineralisation is known.

The potential for economic mineralisation is likely to be strongly influenced by the form of the eastern edge of the Pieman Granite. Leaman's (1988) geophysical interpretation of the pluton suggests a generally steep margin with indications of shelving between the Pieman and Interview Rivers. As part of its exploration programme, New Holland may acquire infill gravity data and commission a more detailed interpretation prior to ground follow-up.

4. PROPOSED FUTURE EXPLORATION

New Holland's Year 1 geophysical work and literature review have highlighted the underexplored potential of parts of EL26/87 for replacement skarn tin-copper mineralisation associated with the Pieman Granite.

It is proposed in Year 2 to follow up the work with

- (a) the acquisition of in-fill gravity data near the Interview River, and 3-D interpretation to delineate areas for ground follow-up.
- (b) Geochemical surveys and magnetic property sampling at prospect level prior to possible target drilling in Year 2 or 3.

In each case, helicopter support will be used as much as possible.

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APPENDIX 1
Regional Geophysical Review (D.E. Leaman)

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EL 27/87 PIEMAN HEAD
REGIONAL GEOPHYSICAL REVIEW
for
NEW HOLLAND MINING N.L.
by
Dr. D.E. Leaman

December 1988

PIEHEAD

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SUMMARY

Exploration licence "Pieman Head" includes a large part of the Pieman Granite of western Tasmania. This granite is one of the least understood of all plutons in western Tasmania; there being no appreciation of the chemical variation within the intrusion and only a sketch outline of the overall form of the pluton. It was clearly a mineralising granite although known mineralisation is minor and this may reflect its form and disposition of potential host rocks.

EL 27/87 covers a large part of the pluton and the seemingly unmineralised Pieman River and Pieman Head region even though previous exploration has identified significant traces of tin and tungsten.

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 Pieman Granite is shown to be a complex intrusion structurally with irregular ribs and marginal spines. Contacts are generally very steep and there is limited shelving and no large section of unexposed roof cap. The overall form of the intrusion may be a dislocated and irregular tabular slab which dips east overall.

The present work suggests that parts of the intruded Precambrian sequence have been altered by thermal metamorphism around the contact. Some moderately magnetic sources can be identified which are not consistent with mafic rocks. No highly magnetic sources have been inferred and any pyrrhotite concentrations will be minor. This would indicate that opportunities for large scale replacement deposits were limited. Several local cupolas have been identified; some can be associated with anomalous Sn-W geochemistry, and there is need for further evaluation.

The feasibility of using the relatively low cost gravity and magnetic methods within the area has been established by this review. Such data are able to resolve irregularities on the margin of the granite and relate them to abnormal responses within the intruded rocks. The present work provides a skeletal outline of intrusion form and gross structuring in the country rocks and has reached the point at which 3D methods can be applied efficiently.

The extant magnetic coverage needs no further infill but the gravity coverage could be complemented. The known mineralisation - as along the Interview River - is associated with relatively small distortions in the intrusion and gravity field and consequently no gaps in survey in excess of the size required to define these should be tolerated. Some infill surveys are recommended in the vicinity of the Pieman River.

INTRODUCTION

EL 27/87 "Pieman Head" is located on the west coast of Tasmania at the mouth of the Pieman River.

The licence includes the entire southern part of the Pieman Granite which has yielded small amounts of tin. Previous exploration has been general, primarily geochemical, but locally extensive. Details have been provided in the annual report for which this is an appendix but includes work by a consolidated syndicate, Esso Minerals and CRA/Geopeko. The best available geological basemap is that of Gee et al (1969).

The mineral prospect compilation of Jennings et al (1967)(revised) offers no great encouragement but shows four deposits in the region (two Sn/W, one Cu, one Pb/Zn) - all near the northing of the Interview River. Collins and Williams (1986) add little to this appraisal. Previous exploration would indicate that significant amounts of tin may be present in the area but no deposits have yet been identified. Some may occur within the granite itself. Full appraisal of the prospectivity of this area clearly depends on some understanding of the form of the granite and this, up to this review, has not been available. Only when the roof and marginal forms of the granite have been identified and described can the intruded rocks be effectively assessed to moderate depths for host potential.

This review was thus 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 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 with the exception of an INPUT survey by Esso. None are relevant to first order structural 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). 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 and south of the Pieman River (see Figure 4). 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 Figure 4. 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; 1988 a, b, c). No equivalent structural assessments have been attempted.

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 Pieman 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 5). 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 and a probable branch structure. As such it intruded up to 9 km of Late Precambrian Oonah Formation and Rocky Cape suites. 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 Figure 4. This 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 the same prospects as Jennings et al (1967) indicating that either exploration over 20 years was ineffective or that the area is barren or not easily appraised. Indeed, access remains a problem. The latter explanation requires careful consideration.

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 interesting (Figure 4). There are several features.

A strong gradient outlines most of the mapped exposure of the Pieman Granite. This is particularly evident near the northern contact of the granite south of Hardwicke Bay and along the southeastern contact of the granite north of the Pieman River (G7-Figure 4). At about 5395 000 mN the gradient begins to diverge from the mapped outline of the granite. A similar pattern exists on the western side of the granite and a relatively positive anomaly is associated with the coastal Precambrian exposures north of Hardwicke Bay (G4).

The gradients due to the mass of granite extend several kilometres east of the mapped body but are far from uniform. Principal irregularities have been labelled in Figure 4. Anomalies G1, G2 and G8 may represent relatively minor deviations in the form of the intrusion but G5 and G6 must reflect a larger contact spine or cupola. None of the anomalies listed can be associated in any way with surface geology and it is interesting that the largest (G5-6) essentially extends the mapped shape of the granite at least 3 km to the southeast.

Anomaly G3 locates the peak negative values within the intrusion. These appear localised and in other granites often reflect economically significant changes in petrology or texture.

If it is assumed that the perturbations described in the gravity field are related to contact irregularities in the form of the granite margin then the correlation with magnetic anomalies supports the concept. Quantitative tests of these presumptions are described in subsequent sections.

There are no large magnetic anomalies in the context of the total survey of western Tasmania but the features reproduced in Figure 3 are significant.

Anomalies fall into three main categories; large and regional, strike extended unit-related and relatively small and localised.

The largest regional effect is associated with the principal exposure of the Pieman Granite. This asymmetric effect places the axis of the anomaly near the eastern contact of the granite

(M13) but a substantial positive gradient is located near the western coastal contact. There is no suggestion of any comparable eastern gradient. This would indicate that the form of the intrusion itself is asymmetric and that there may be much more granite to the immediate east than west.

Strike extended anomalies can be associated with the onset of the Arthur Lineament near the Pieman River. These produce the NE grain evident in the SE quadrant of Figure 3.

Most anomalies, however, are small and isolated. Several occur at, or close to, the granite contact as mapped (e.g., anomaly M1, M6, M7 and M12). Several other apparently comparable features occur up to 5 km east of the contact (e.g., M2, M3, M4).

Comparison of the magnetic and gravity fields shows that all such features can be related to granite form changes on the basis that the gravity field deviations reflect ribbing or cupola development on the margins. Thus magnetic anomalies M2 and M3 occur on either side of G1 and M9 correlates with G6 such that M8 and M10 fall on either side of probable spine G6.

The reality and implication of these presumptions has been tested below. There is no doubt that the responses noted in the potential fields are related and that the granite is the dominant influence on their generation.

If the contention of Collins and Williams (1986) that worthwhile mineralisation (especially tin) will be associated with pyrrhotite in replacement deposits is accepted then anomalies around the mapped margin of the granite must be reviewed. While simple inspection of the field using the available geological basemap can suggest several anomalous pieces of Precambrian rocks the lack of rock property observations limits more extensive conclusions.

MINERALISATION RESPONSES

An attempt was made by Leaman (1986) 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 along the Interview River are associated with clear anomalies but it is unclear to what extent these are simply bulk alteration effects or how general the response pattern might be given the presumption that many other such anomalies exist in the area immediately east of the granite contact and have a similar origin. It is not immediately obvious what mineralogy or property contrast is responsible for the features noted in the magnetic field. Time and data have not permitted evaluation.

Previous exploration, though limited in coverage, has certainly located zones of anomalous tin geochemistry. Such sites lie either within the granite in the vicinity of anomaly G3 or marginal to the granite at M6 or possible concealed extensions of the granite as in the headwaters of Websters Creek (at M14, or around G6-M9). These correlations would suggest that the gravity and magnetic responses are related to mineralisation or mineralising processes.

No mineralisation appears to be related to the western contact of the granite or the zone offsetting the two sections of the granite along the Pieman River.

TREND PATTERNS

Gross patterns defined by previous work have been outlined above (Figure 2).

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 but the projections of extensive E-W features are dominant and the Interview River mineralisation is associated with such a corridor. Trends sub parallel to the Arthur Lineament may also be observed (termed strike extended anomalies above).

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.

Four E-W profiles were selected for interpretation and each has been examined with regard to each data set. The profiles were selected in order to provide tests of the concepts and implications outlined or suggested by inspection. Not every anomaly defined in Figures 3 and 4 have been tested but enough have been examined to establish the nature of sources and source distribution within the region.

Consistent curve fit parameters have been sought during all modelling. In gravity terms this has equated with a neutral shift balance but the magnetic data require an offset of at least 20 nT.

Note that the residual anomalies presented in Figure 4 do not include the effect of the ocean to the west and this source has thus been excluded from the modelling process.

Line 5397 500 mN. Figures 9 and 13.

This profile was designed to test the nature and origin of the anomalies near the known Interview River mineralisation, especially M2, M3 and G1. Contact anomaly M1 is also included.

Gravity analysis shows that the apparently minor negative inflection represented by G1 reflects a major cupola on the granite margin. The mineralisation is associated with the crest. The overall gradient to the east is abnormal and cannot be completely generated by the granite alone. A bulk increase in rock density of Precambrian rocks is implied as the Lineament zone is approached.

The magnetic analysis wholly supports the gravity view but fine details it. All anomalies can be related to the contacts implied in Figure 9. Although the model suggests a rather arbitrary depth limit this is really a reflection of resolution. The disposition and attitude of sources is consistent with contact skin effects no more than 1 km wide. Extreme effects are noted only above the granite pinnacle in the Interview River.

The easternmost magnetic anomaly has not been modelled but can be correlated with the density contrast within the Precambrian rocks.

The implied magnetic contrasts relate to bulk thermal alteration of the generally siliceous units and are relatively subtle. No significant amounts of magnetite or pyrrhotite are implied.

Line 5395 000 mN. Figures 8 and 12.

Similar conclusions may be drawn for anomalies at this northing. This profile was selected in order to evaluate the regional contribution of the granite and anomaly M4. It also tests G3.

The gravity interpretation (Figure 8) suggests that anomaly M4 is associated with a granite pinnacle but that it may be more than one kilometre deep. The magnetic data permit a shallower interpretation but, in the absence of rock property control information, this may be misleading. The three dimensional character of all the anomalies may also lead to false estimation. The association, however, is indisputable.

Magnetic modelling also confirms an extension of M1 as a contact effect.

The northing of this profile forces consideration of the regional anomalies due to the western granite contact. This issue was ignored at 5397 500 mN and its omission accounts for the different curve fit parameters. The need for some allowance of such an extended and large source is clearly seen in the profile where the long regional tail of the anomaly is little disrupted by thermal alteration effects.

Anomaly G3 is not satisfied by the gross model. This suggests that a local light phase of the granite is present. If, as other models imply (lines 5390 000 and 5387 500), the western margin of the granite dips eastward then the volume of such material could be substantial.

Line 5390 000 mN. Figures 7 and 11.

This profile was intended to test the character of the regional anomalies related to the western margin of the granite, contact anomalies such as M6 and features related to anomalies G6 and M9.

Since the profile transects the pluton near its southern extremity two dimensional assumptions are not fully satisfied. Some allowances have been made for this in Figure 7 by permitting some density variation within the granite model. The gravity field fit is not good and this reflects the three dimensional character of the intrusion. It is clear, however, that the negative response (G5) is related to a cupola extension from the eastern margin of the granite. In keeping with other profiles it is necessary to introduce a density contrast within the Precambrian succession. The profile would also suggest that the material between the main body of the granite and the cupola is denser than normal. This could be consistent with some bulk thermal alteration.

The magnetic interpretation is dominated by the regional effects of the western granite contact and suggests that this contact dips eastward. There is insufficient gravity data to test this concept. Other magnetic anomalies are consistent with contact effects. The profile also considers anomaly M11. This stratigraphic feature is of comparable magnitude to M6 but the features are separable by their overall character as seen in Figure 3.

Line 5387 500 mN. Figures 6 and 10.

Although the profile is affected by three dimensional responses from the southern end of the granite north of Hardwicke Bay it was selected in order to evaluate further the responses associated with G6 and M9 and the surrounding features such as M8 and M10 (and M14 indirectly).

The style of the gravity model suggested from previous profiles is crudely adequate and anomaly G6 is certainly related to an offset cupola. The fit is poor due to three dimensional effects. The magnetic model is more satisfactory. An easterly dip for the western contact is again implied. Other anomalies reflect the general disposition of the granite margin as implied gravimetrically.

The present interpretation offers a consistent view of the Pieman Granite and the alteration within the rocks about it. It is a simple view based on two dimensional methods and there are many instances where such an approach is not valid or valid in detail. This does not affect the overall conclusions to be drawn but the work reported here would allow a primary three dimensional model of the granite and its cupolas to be generated and refined. Most of the localised magnetic responses are also three dimensional and the modelling has not overinterpreted these features as a result. The implied contrasts are offered only as an order of magnitude.

Three dimensional methods have been beyond the scope of this review but it is evident that precise definition of targets within the magnetic anomalies may depend on them. A more critical issue may relate to consideration of the disposition and volume of carbonates in the intruded sequences near such anomalies.

CONCLUSIONS

Review of regional data in the region of the Pieman Granite and Pieman Head has indicated

1. The Pieman Granite may be composed of at least two phases. The present work is not sufficiently definitive to suggest the structural patterns and relationships of the contacts but the gravity method could do so. Tin mineralisation appears to be associated with the lighter phase near the mouth of the Interview River.
2. The pluton has a crudely tabular form and the western margin may dip steeply east. Many contacts appear to be fracture-controlled.
3. The intrusion form reflects gross fracture and strike trends within the intruded Precambrian rocks. In the region of the Pieman River marginal extension, much of which is not exposed, ignores the fracture margin represented by the trend of the river which may be related to gross strike trends.
4. The north eastern face of the granite is complex in form with a series of ribs and cupolas projecting to within a few hundred metres of the surface up to 5 km east of the mapped boundary. Each of these projections is associated with magnetic anomalies whose form and location are not simply related to surface lithologies but which is more directly associated with (presumed) thermal alteration about spines of granite. The altered zone extends no more than 500 to 1000 m from the granite contact.
5. The marginal irregularities identified have some economic significance. There is evidence of mineralisation near two contact anomalies (M6 and M14) and two known sites are associated with a cupola (G1, M2, M3 - Interview River).
6. Mineralisation within the granite is related to a less dense phase.
7. Thermal metamorphism of the Precambrian Formations has the effect of increasing magnetic contrast. Once the conversion has been made the effect is consistent for up to 1 km from the margin of the granite.
8. Given the implications of a mineralising granite of irregular and largely concealed form the area has been underexplored. Geochemical and mapping studies should be restricted to small areas containing positive magnetic anomalies near inferred cupolas. More refined modelling may be required to describe such sites for targetting.

RECOMMENDATIONS

1. Although the geophysical-structural review is not especially encouraging within the Pieman Granite itself the identification of major intrusion phases and controlling structures does warrant some geochemical testing in the region of minimum gravity residuals.
2. The area east of the granite contact is considered prospective for Sn-W, Pb-Zn 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.
Since the detailed shape of the granite margin is relevant to exploration of any target the following are suggested.
 - a) Sample lithologies in the general locations of magnetic anomalies for determination of anomalous geochemistry and magnetic properties. Knowledge of contrasts will enable improved source depth and shape estimates above the cupola rim of the granite.
 - b) Refine the gravity interpretation using 3D methods and an initial model based on the present work. It may be necessary to infill parts of the survey area but this could be done after sampling demonstrates the validity of the targetting approach in areas where both data sets are adequate.
 - c) Detailed host rock and chemical studies should be restricted to zones above cupola roofs inferred from refined model studies.

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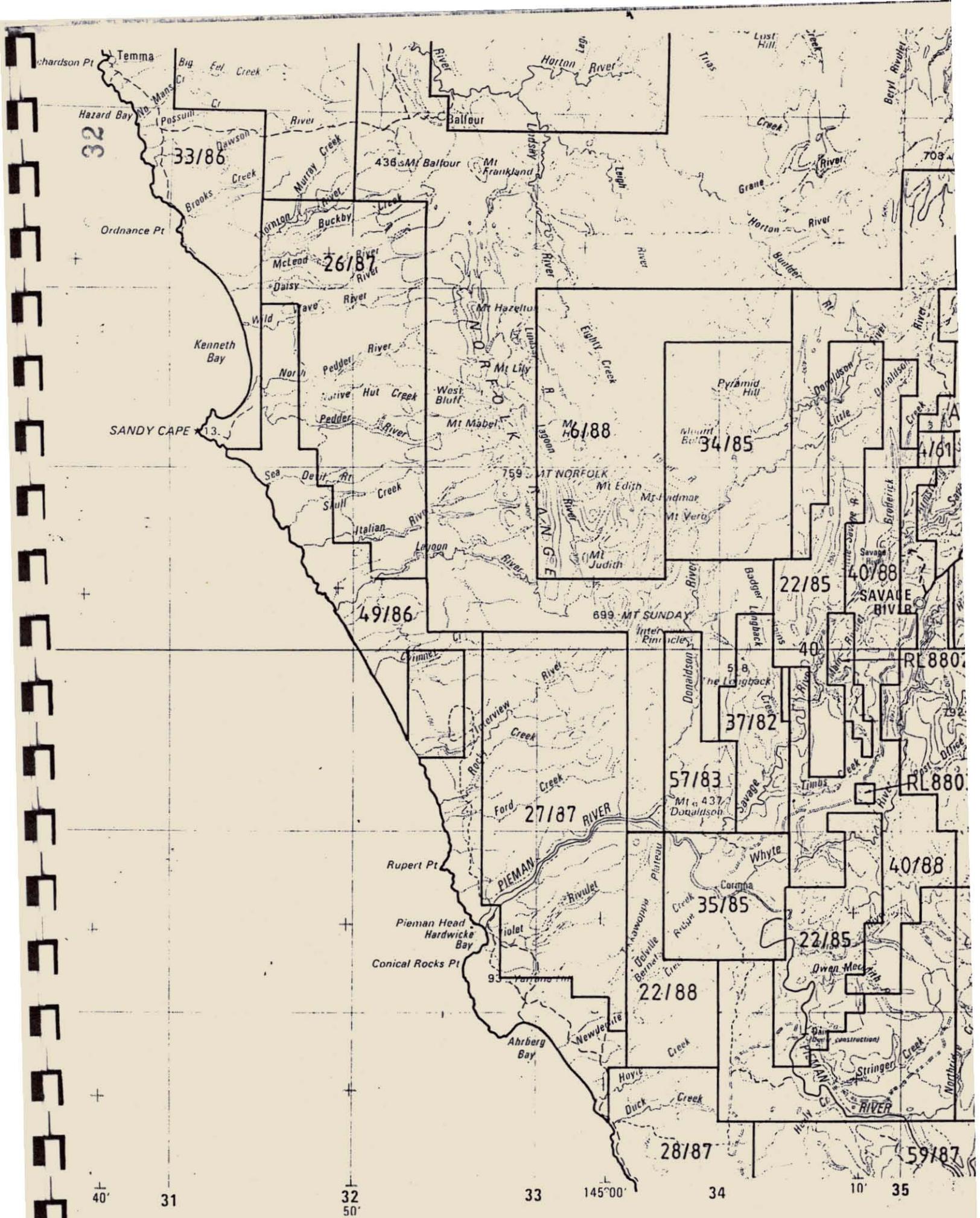
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Leaman Geophysics
by

D. Leaman

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M.Aus.I.M.M., M.M.I.C.A

21-12-88



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LOCATION DIAGRAM

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FIGURE 1

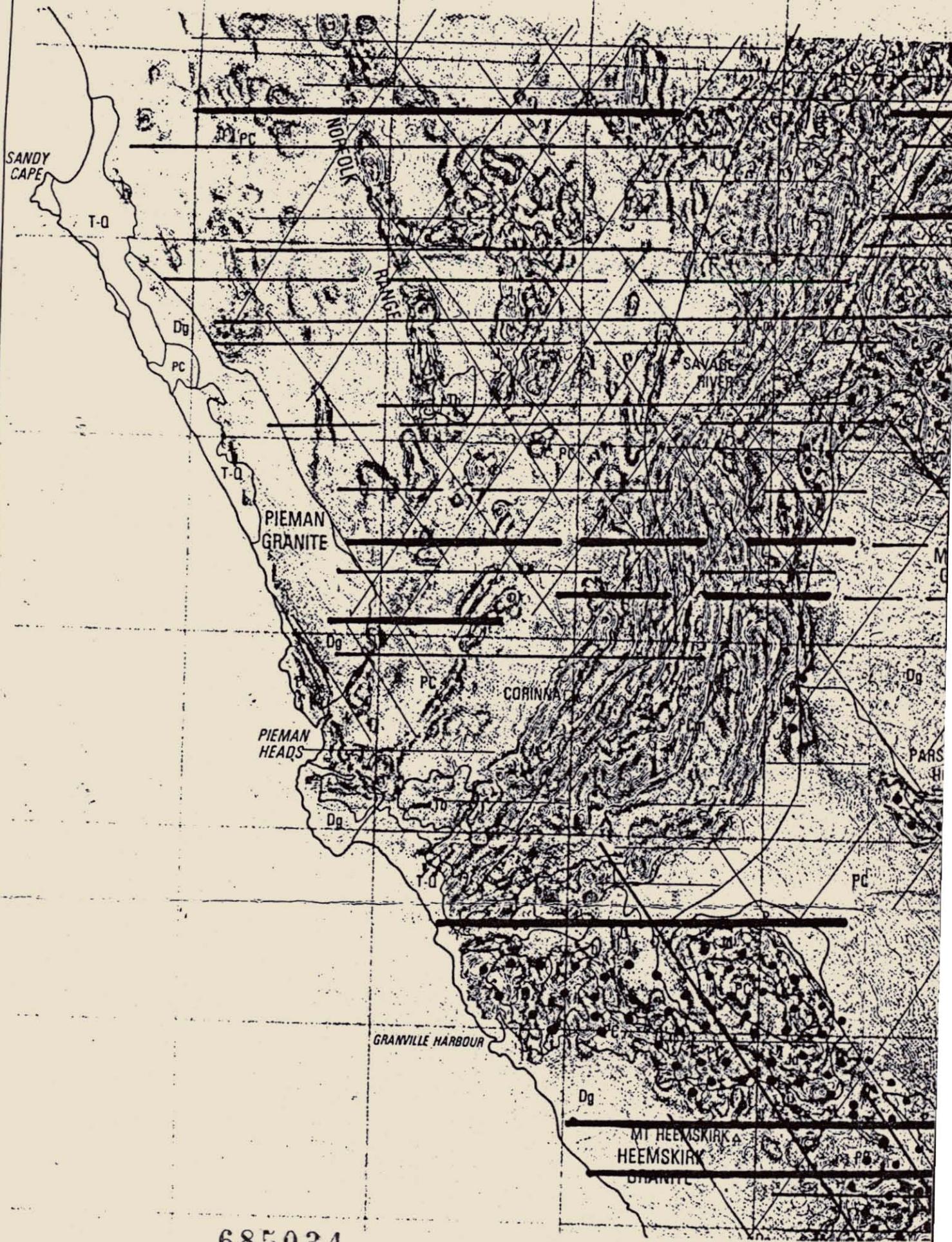
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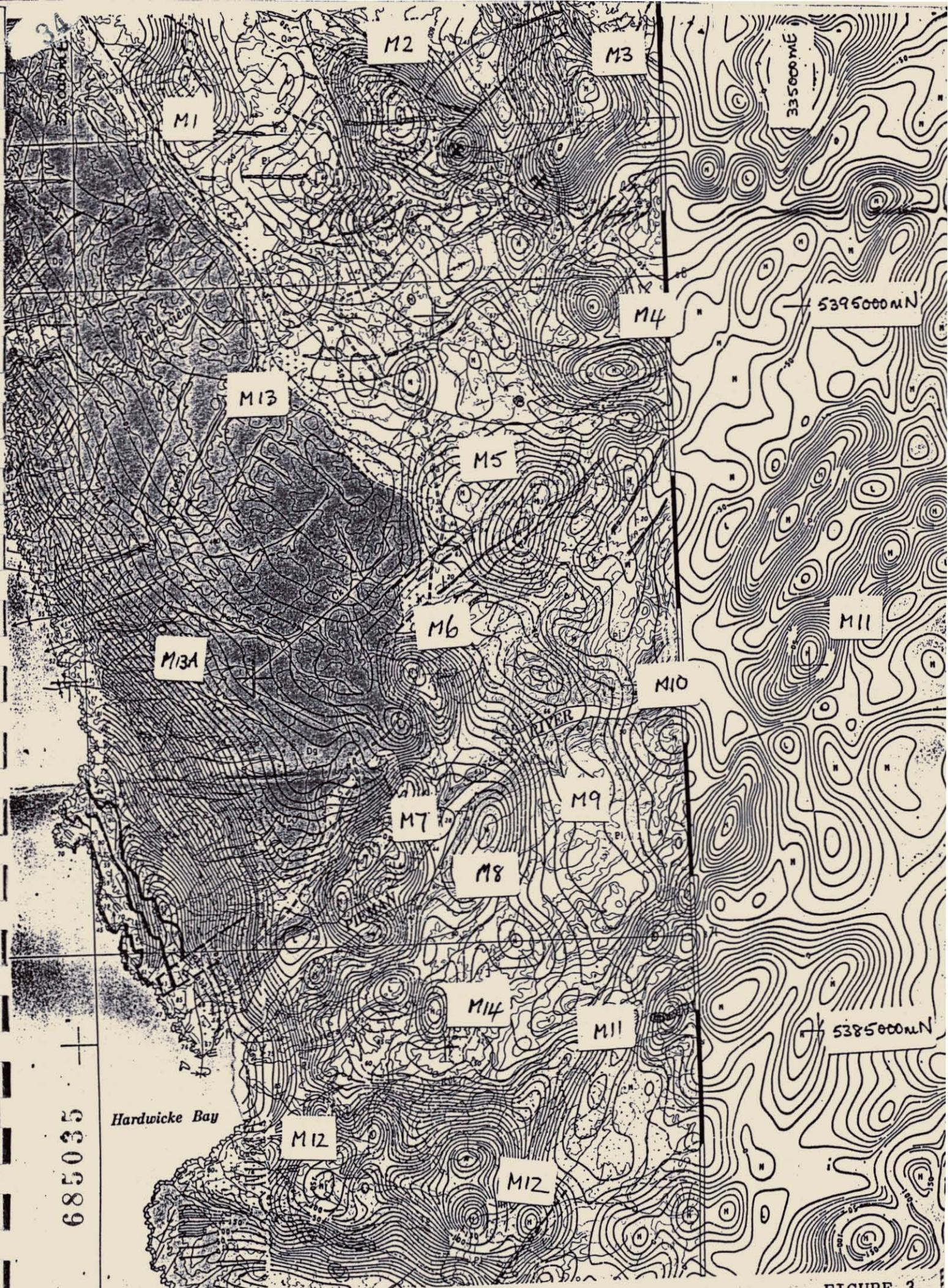


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REGIONAL MAGNETIC FIELD AND TRENDS

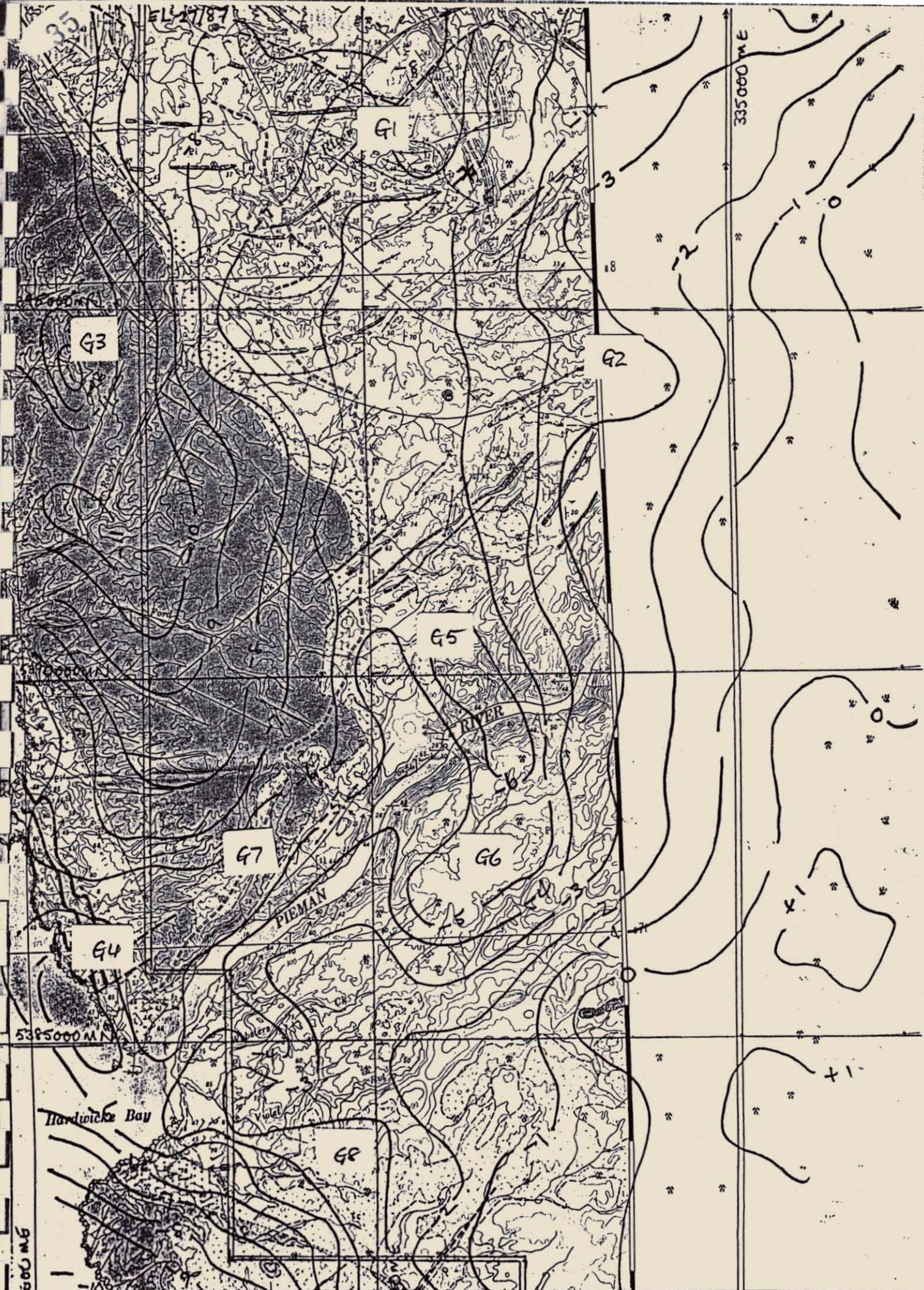
(Mines Dept 1981 survey- Corbett et al, 1982; Leaman, 1986)

FIGURE 2



GEOLOGY AND MAGNETIC FIELD
 (Refer Corbett et al, 1982; Leaman, 1986; Gee et al, 1969)

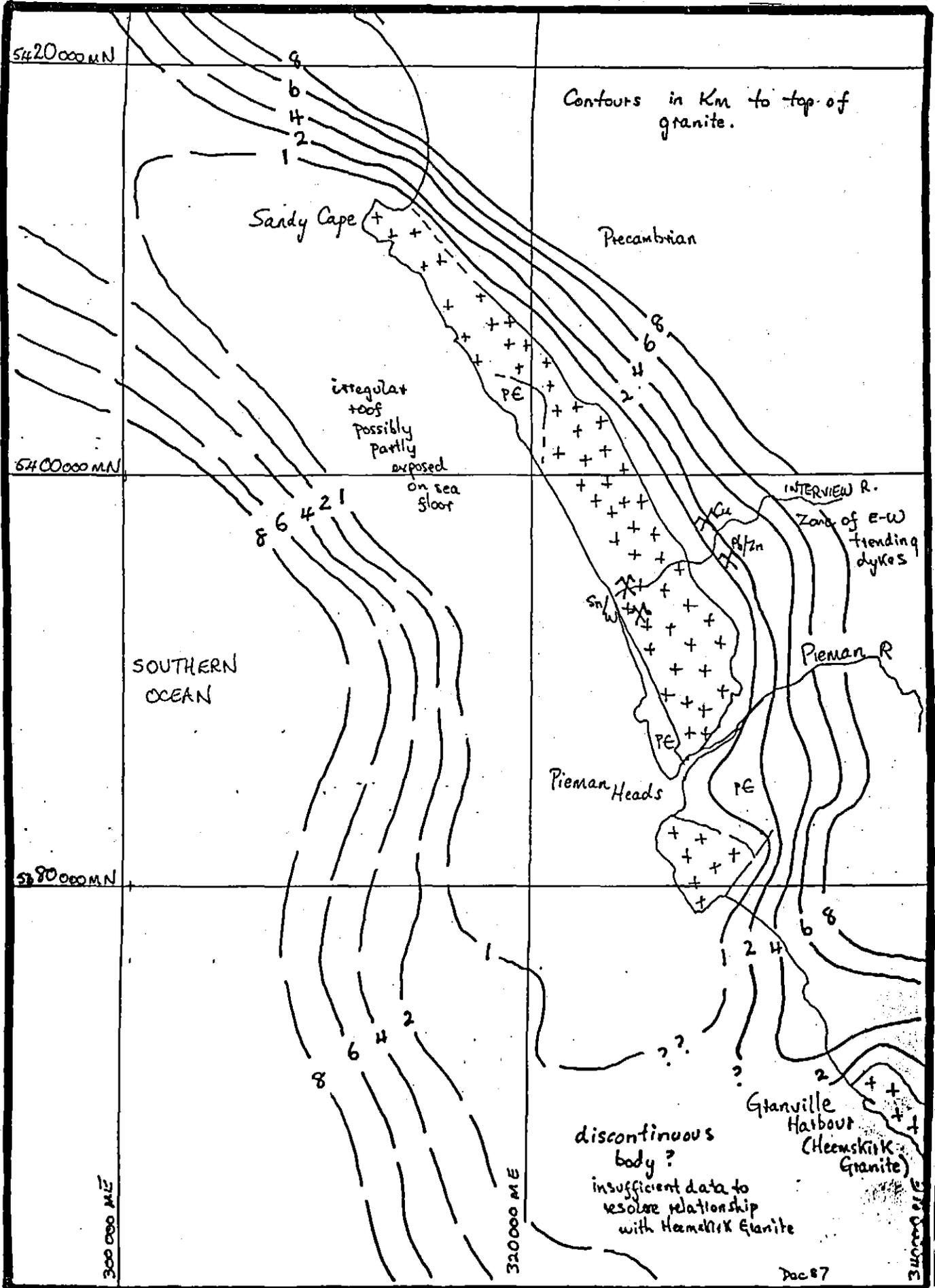
FIGURE 3



GEOLOGY AND RESIDUAL BOUGUER ANOMALIES
 (Refer Gee et al, 1969)

FIGURE 4

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IOUS INTERPRETATION OF FORM OF THE PIEMAN GRANITE FIGURE 5
(er Leaman, 1988a)

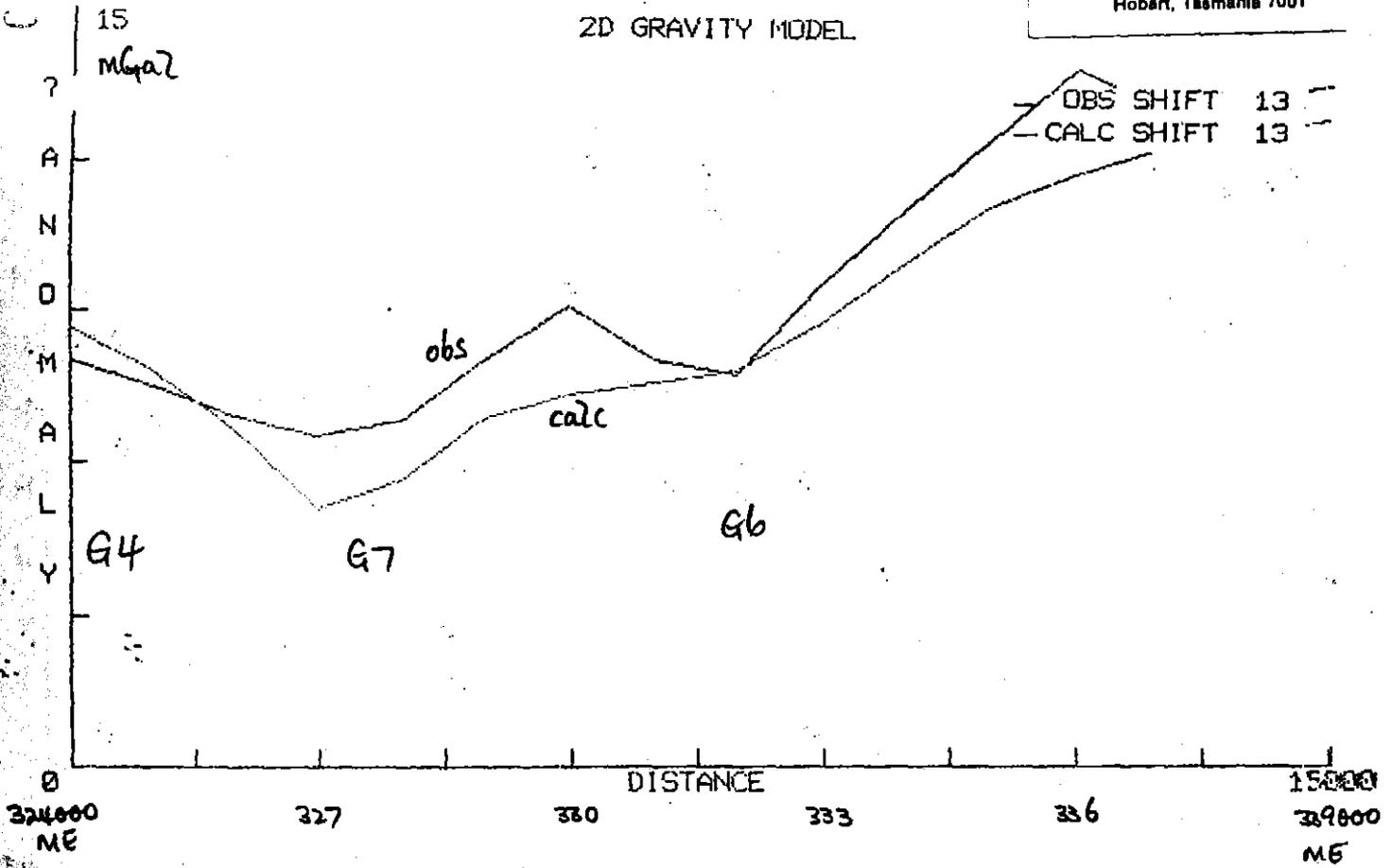
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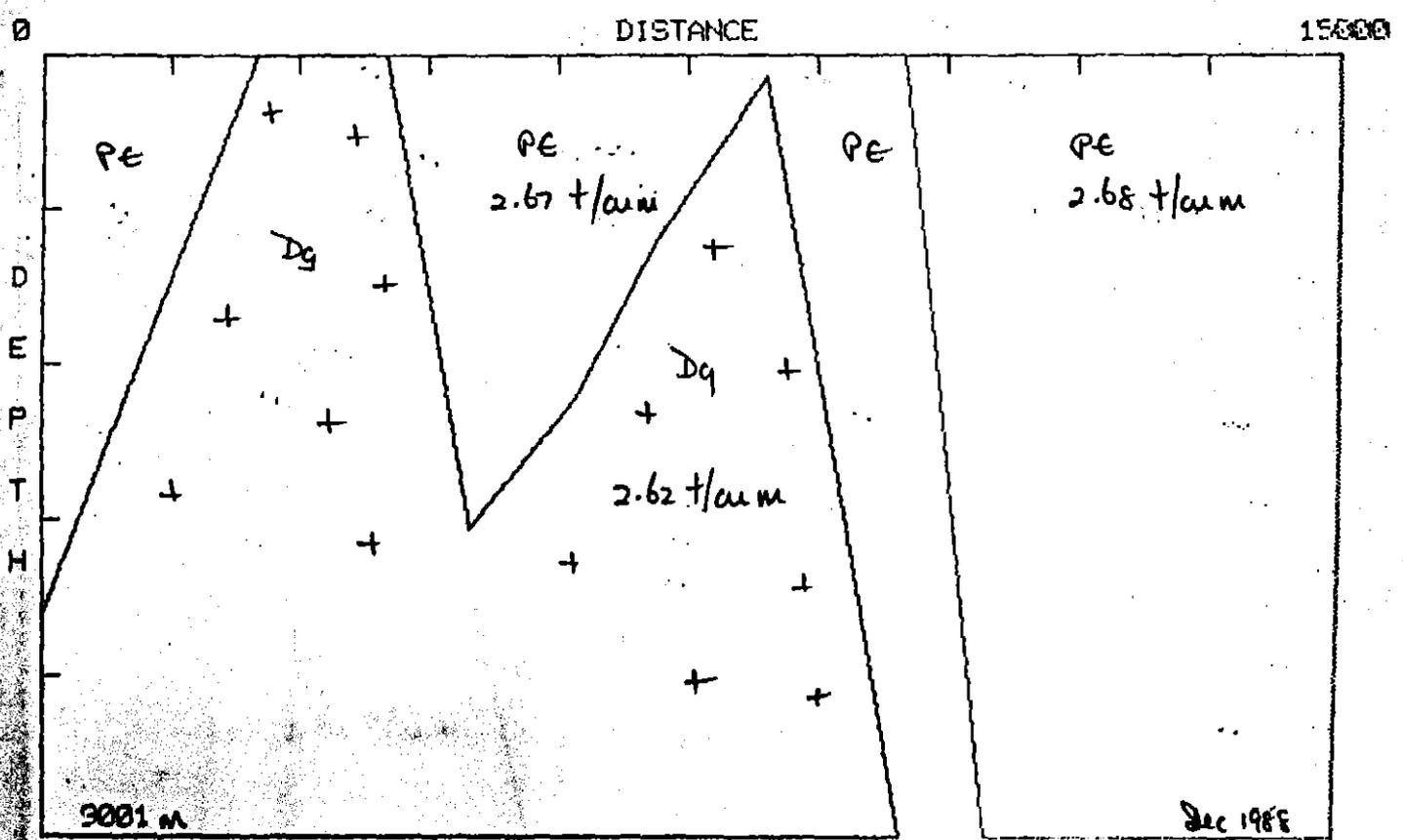
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2D GRAVITY MODEL



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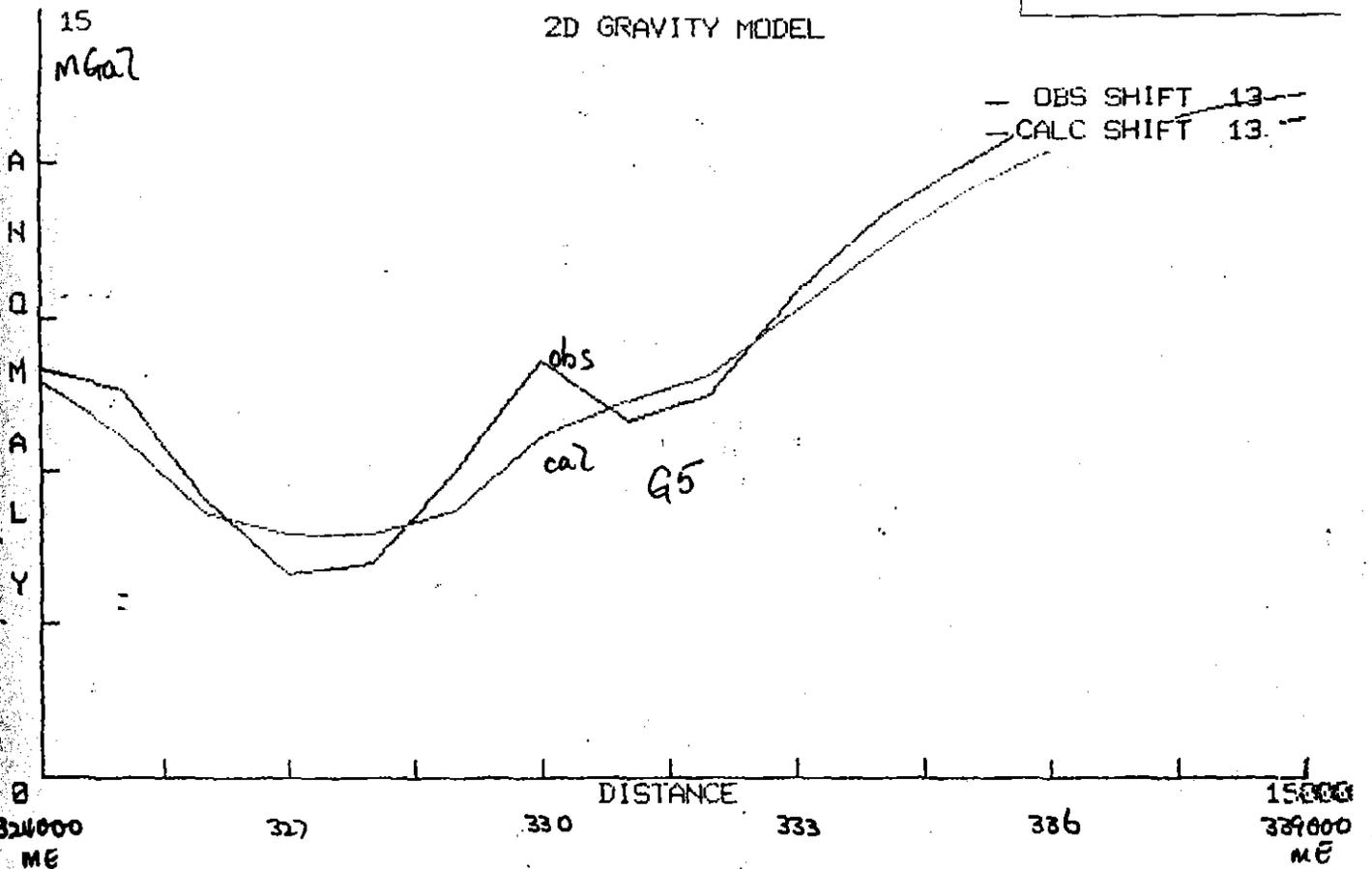


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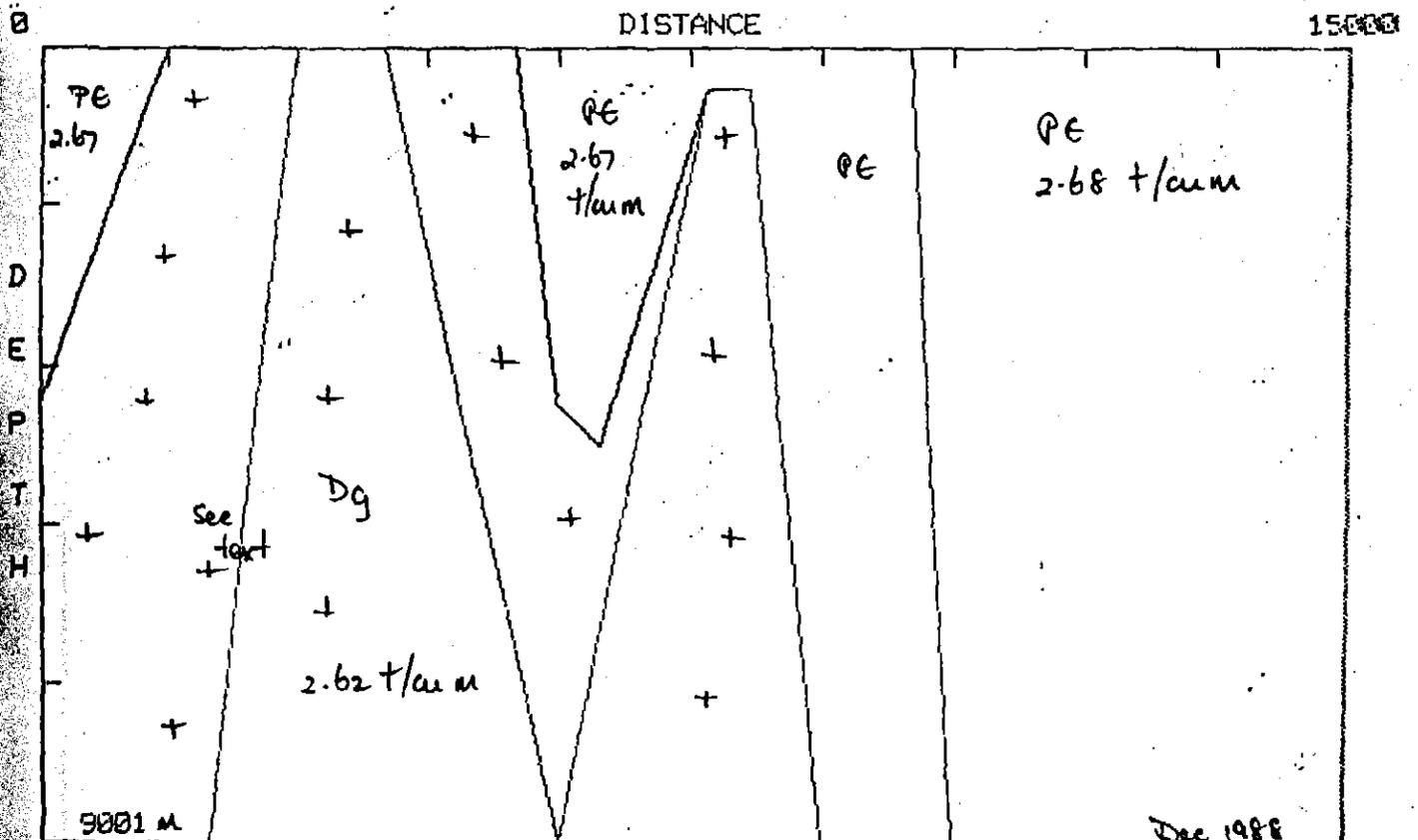
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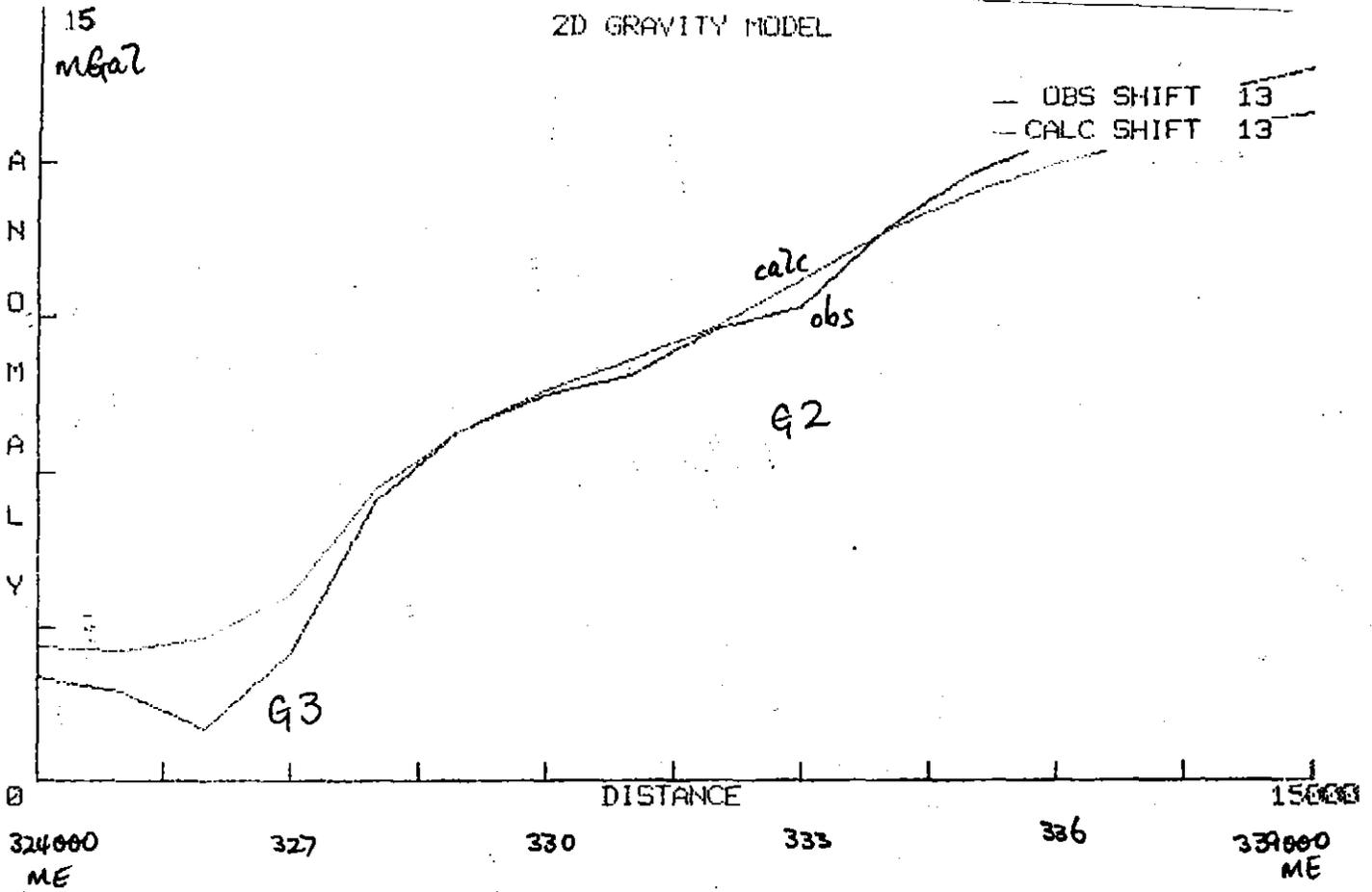
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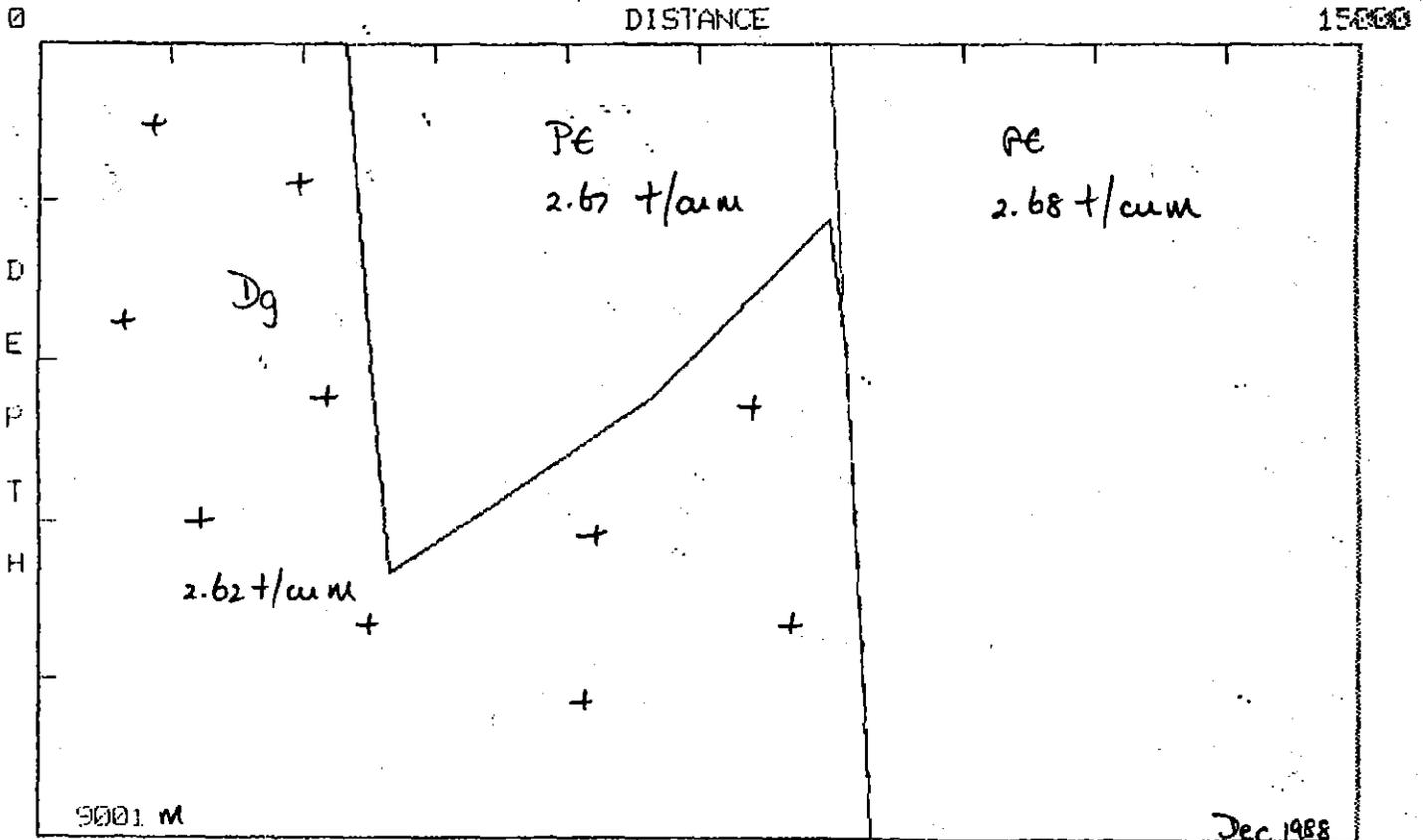
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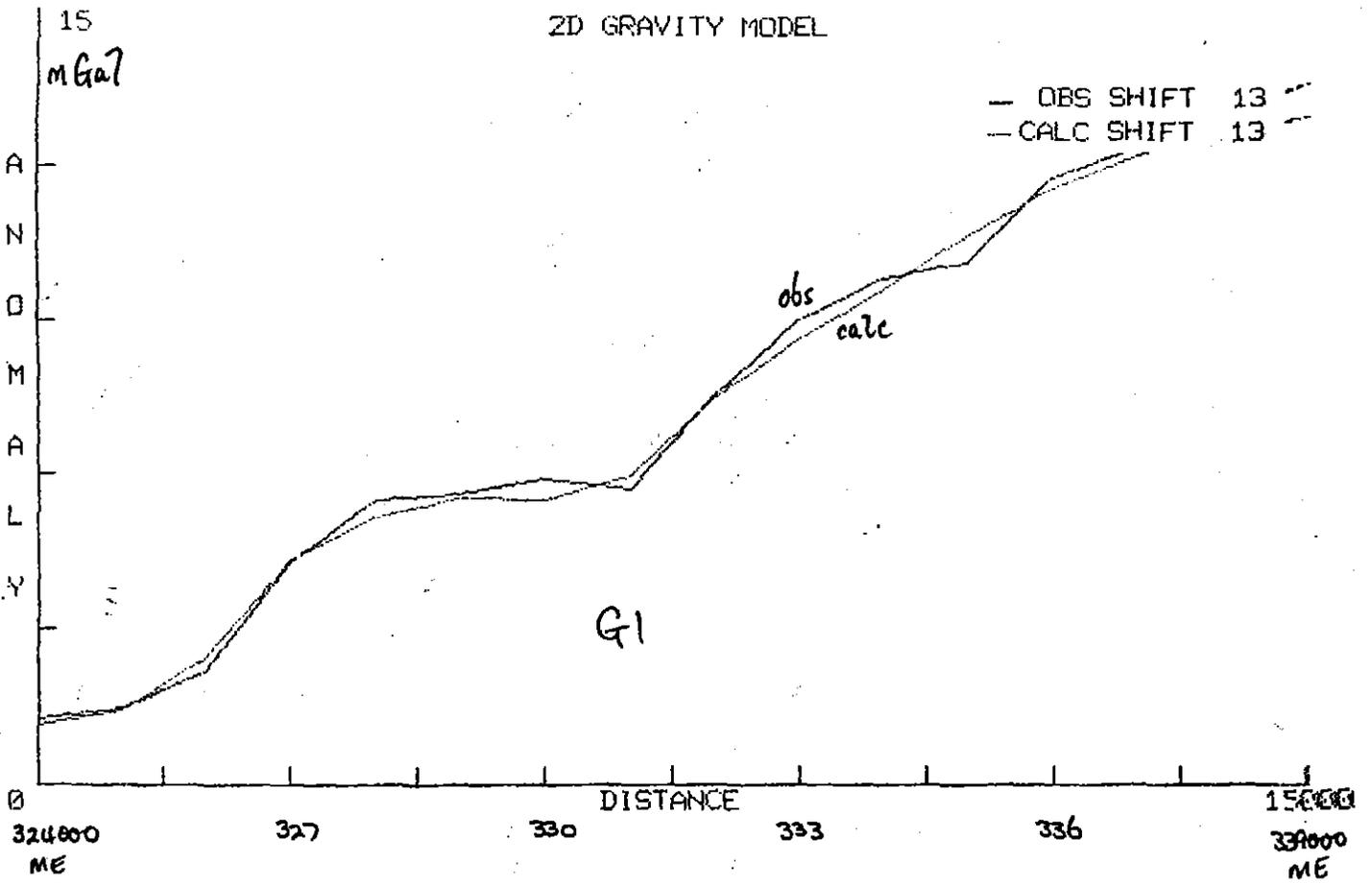
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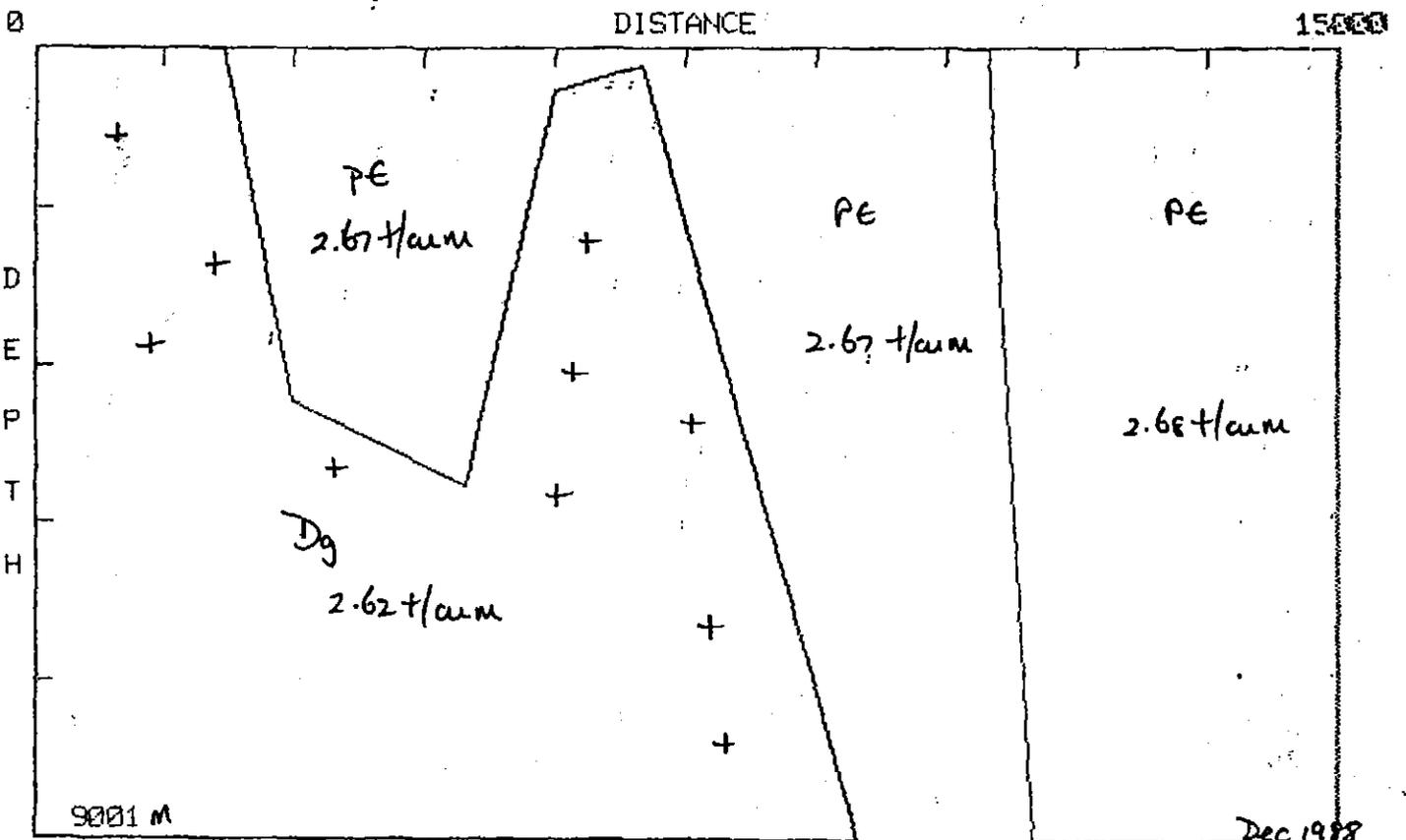
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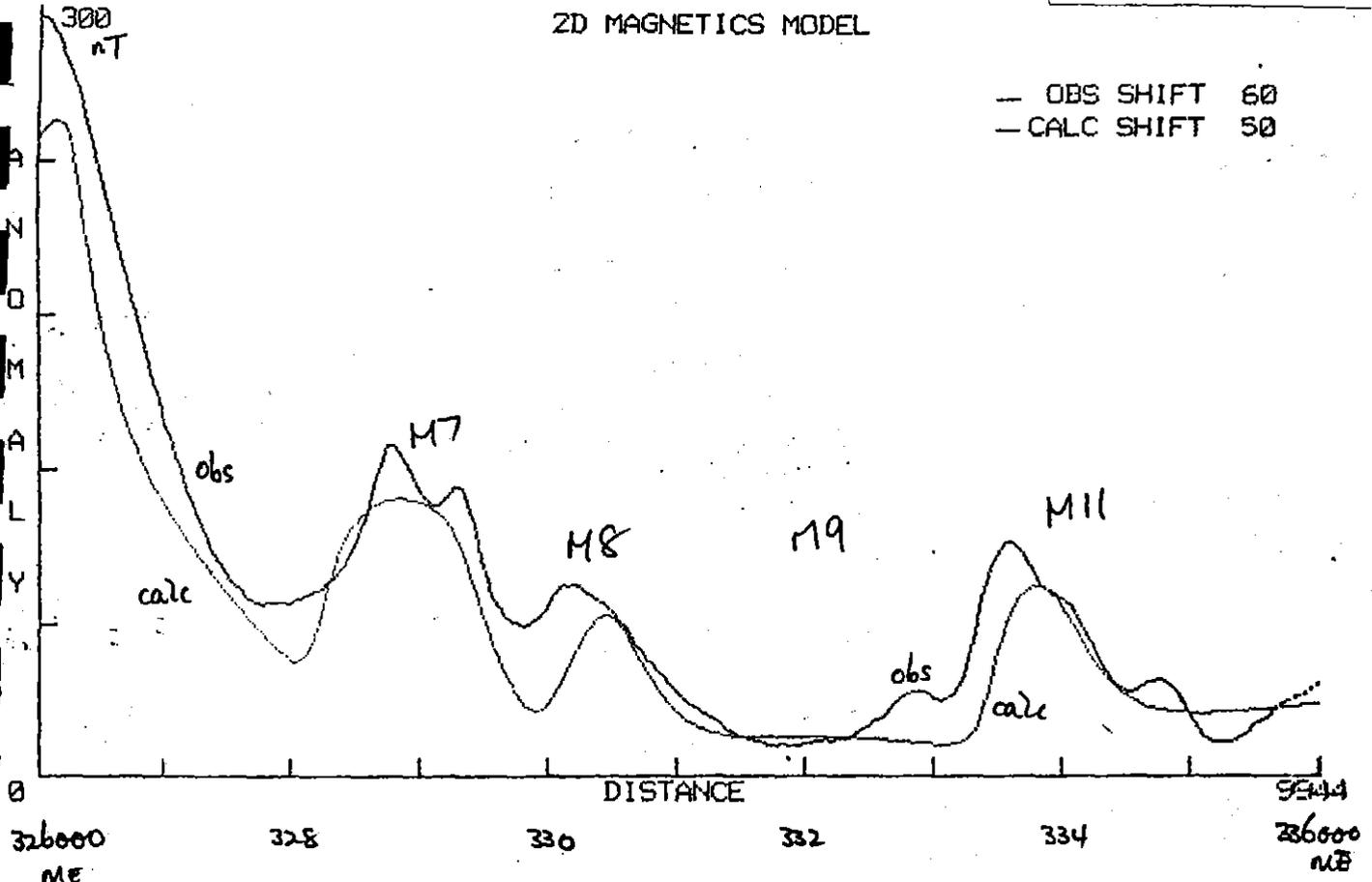
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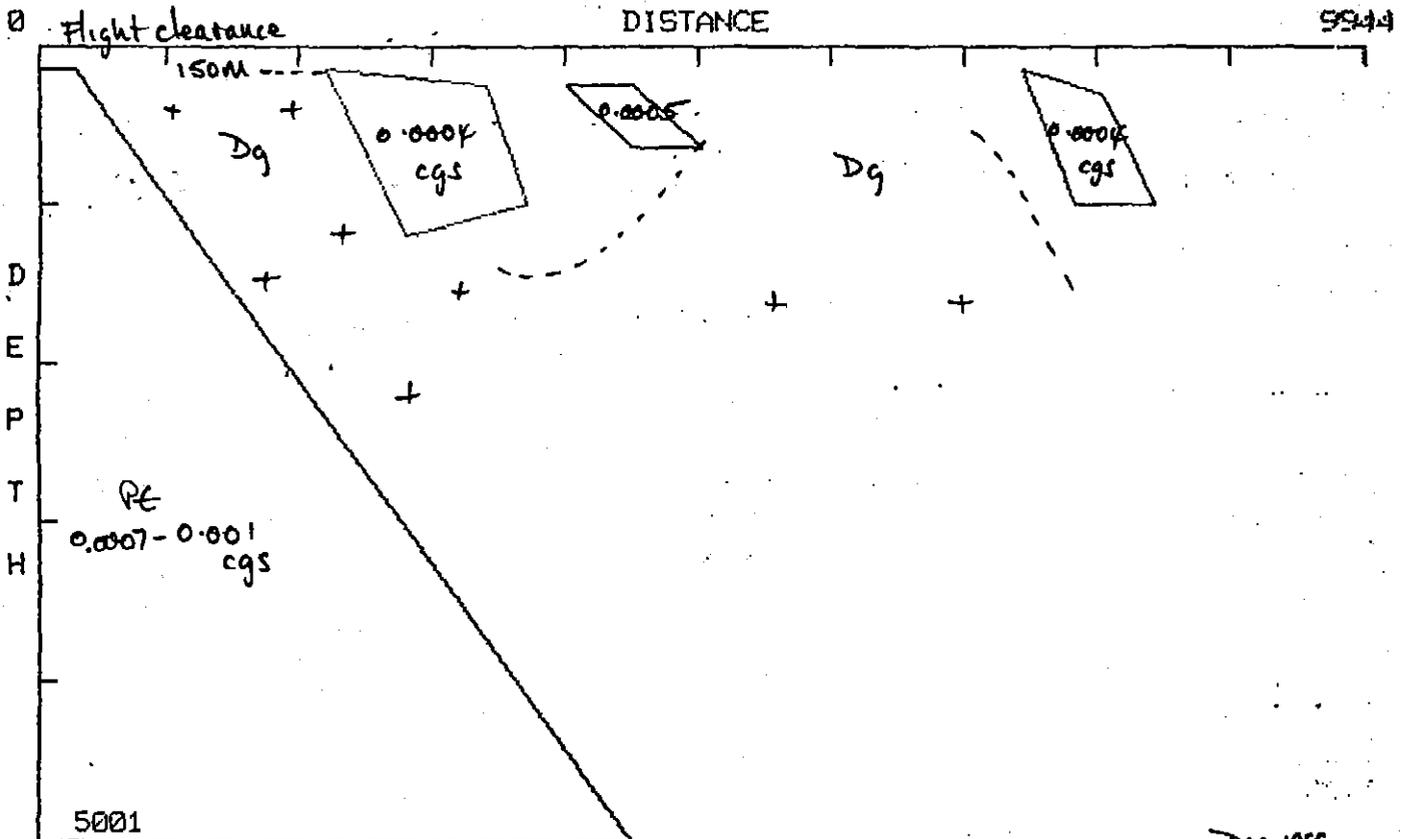
LEAMAN GEOPHYSICS
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2D MAGNETICS MODEL

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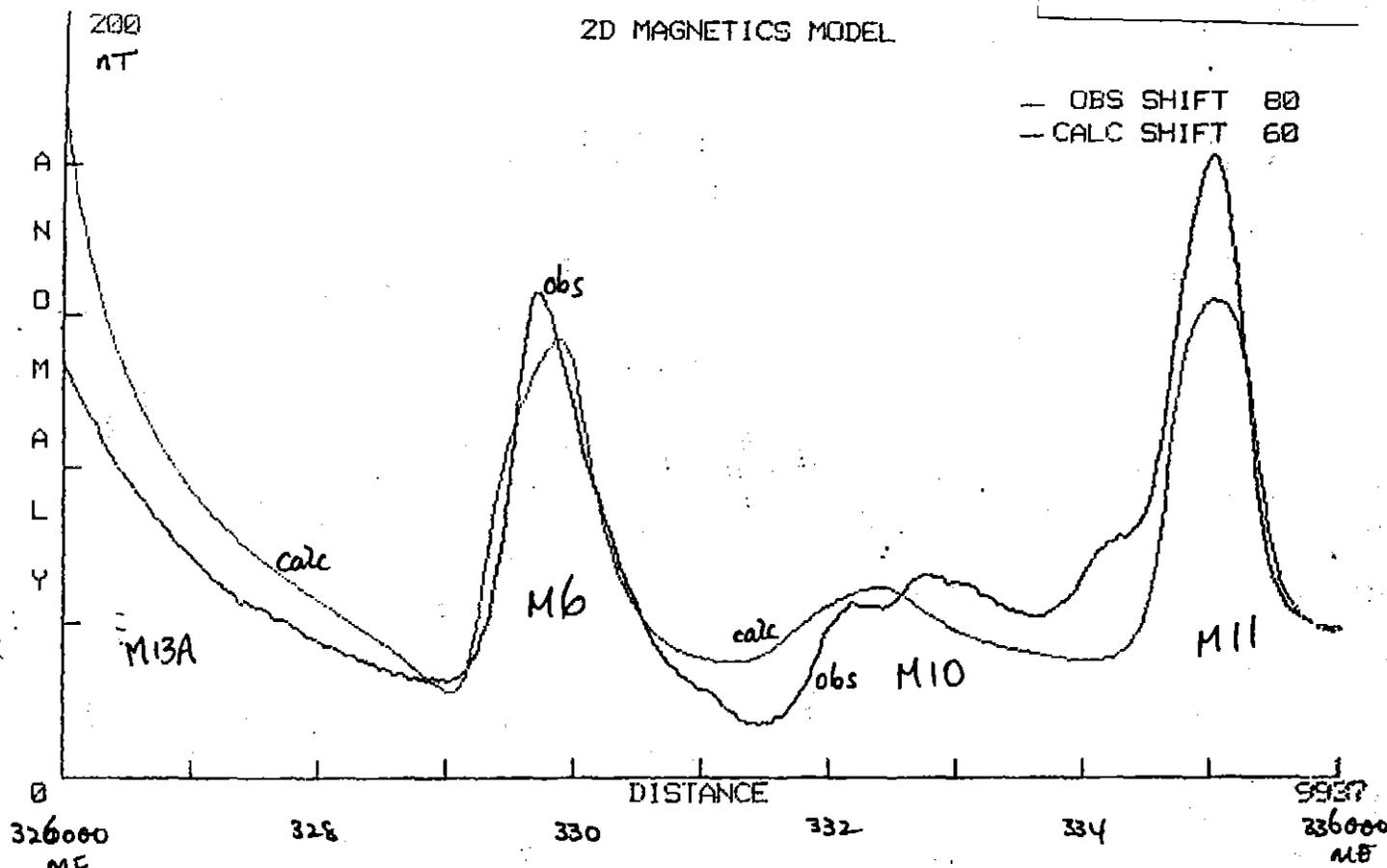
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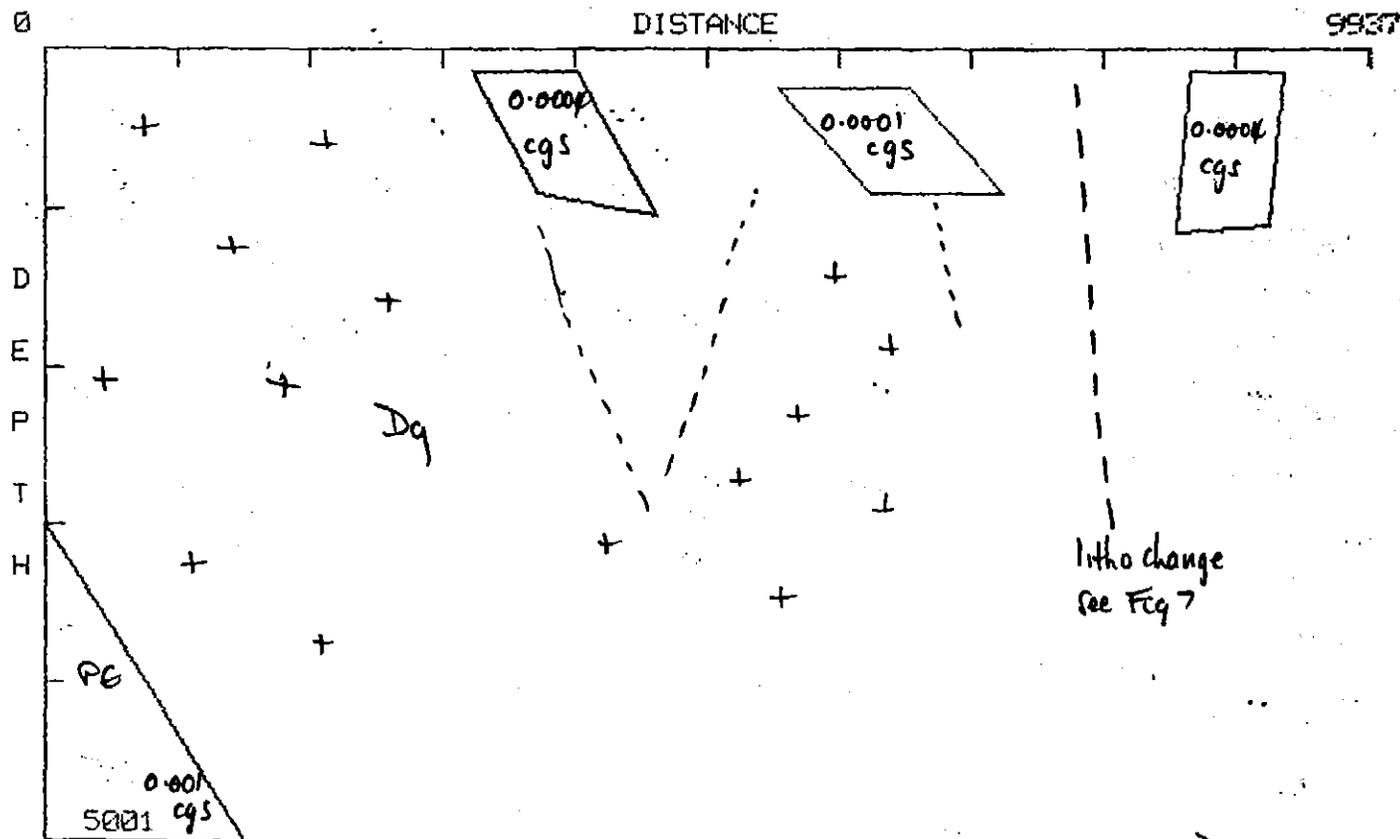
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2D MAGNETICS MODEL



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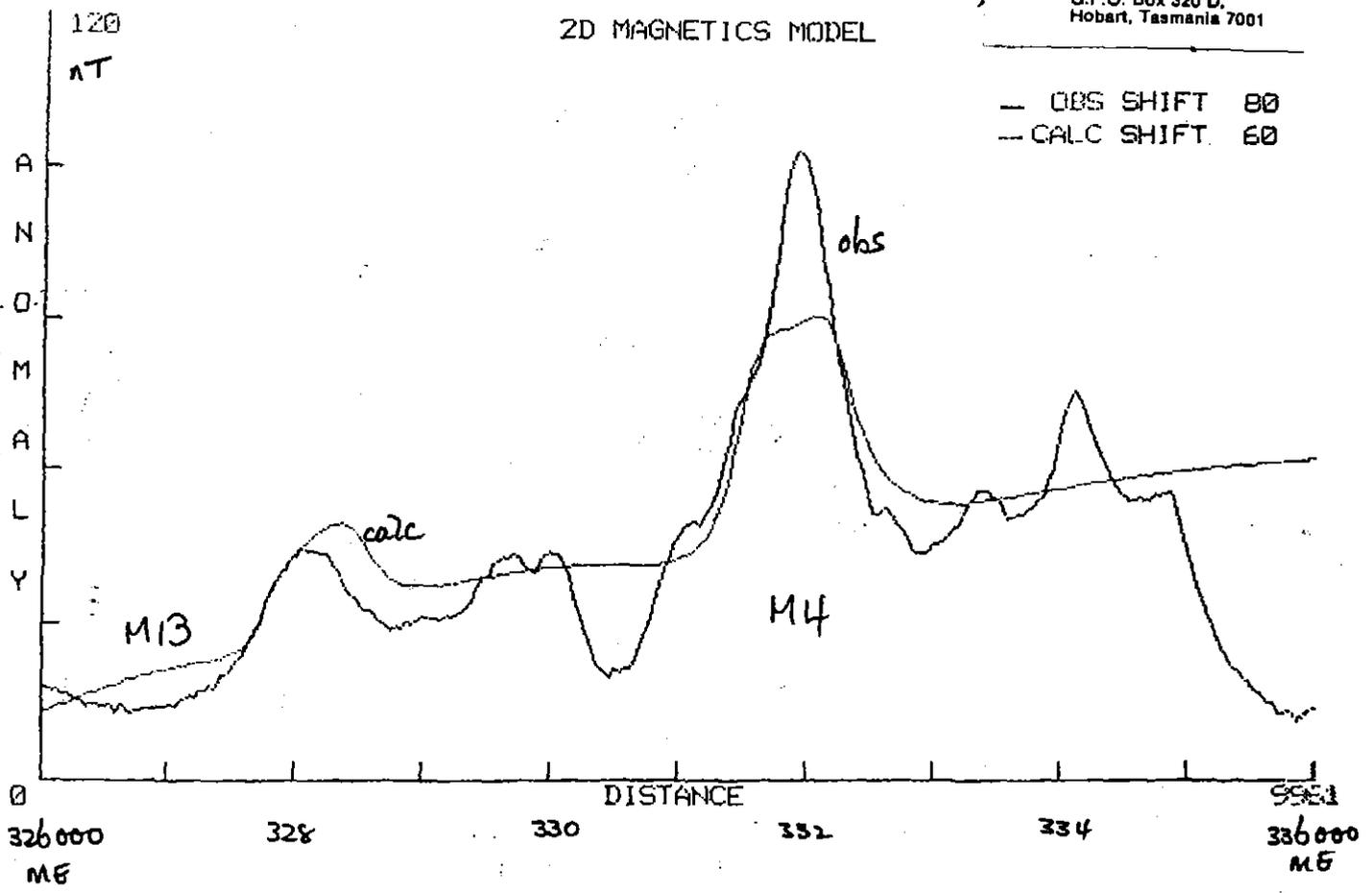
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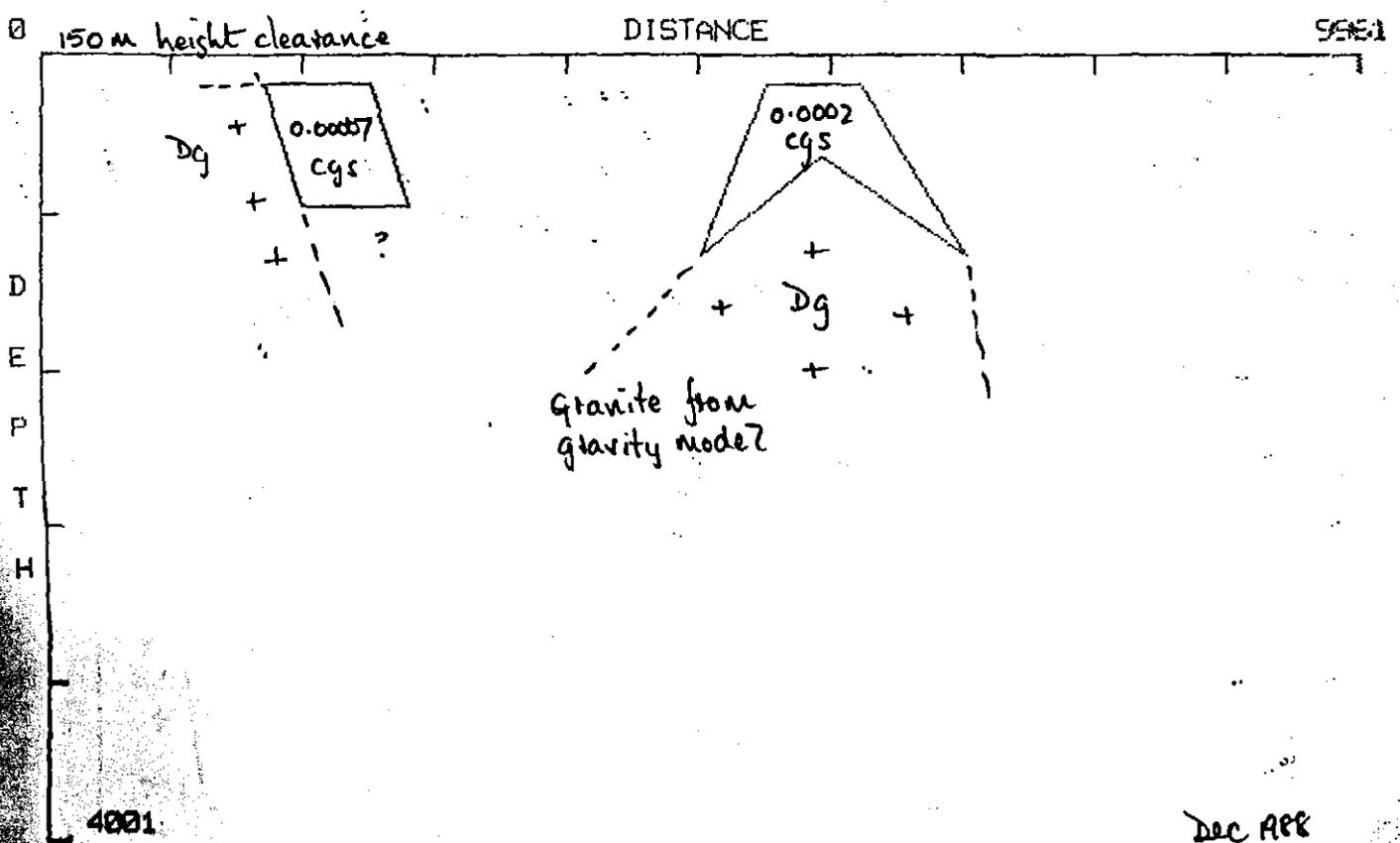
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2D MAGNETICS MODEL



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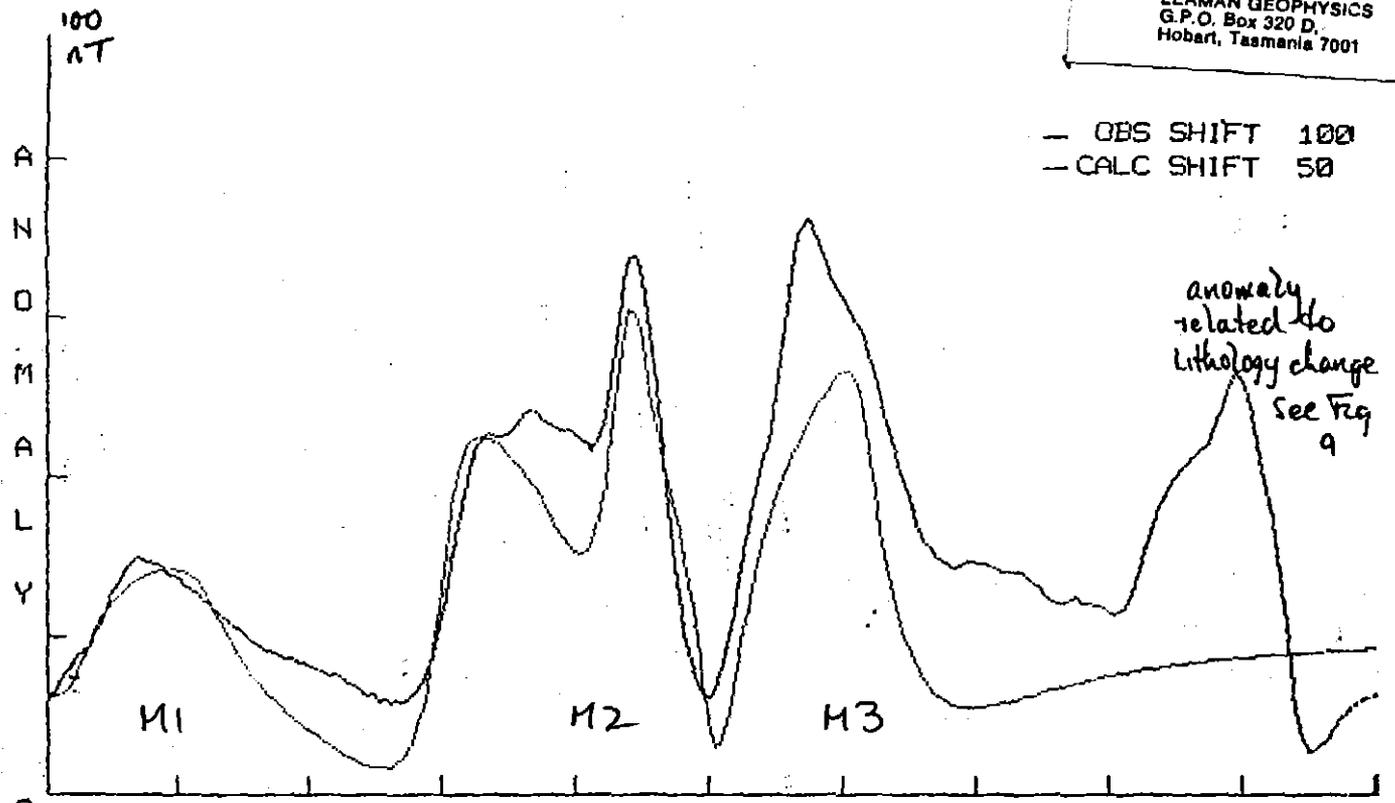
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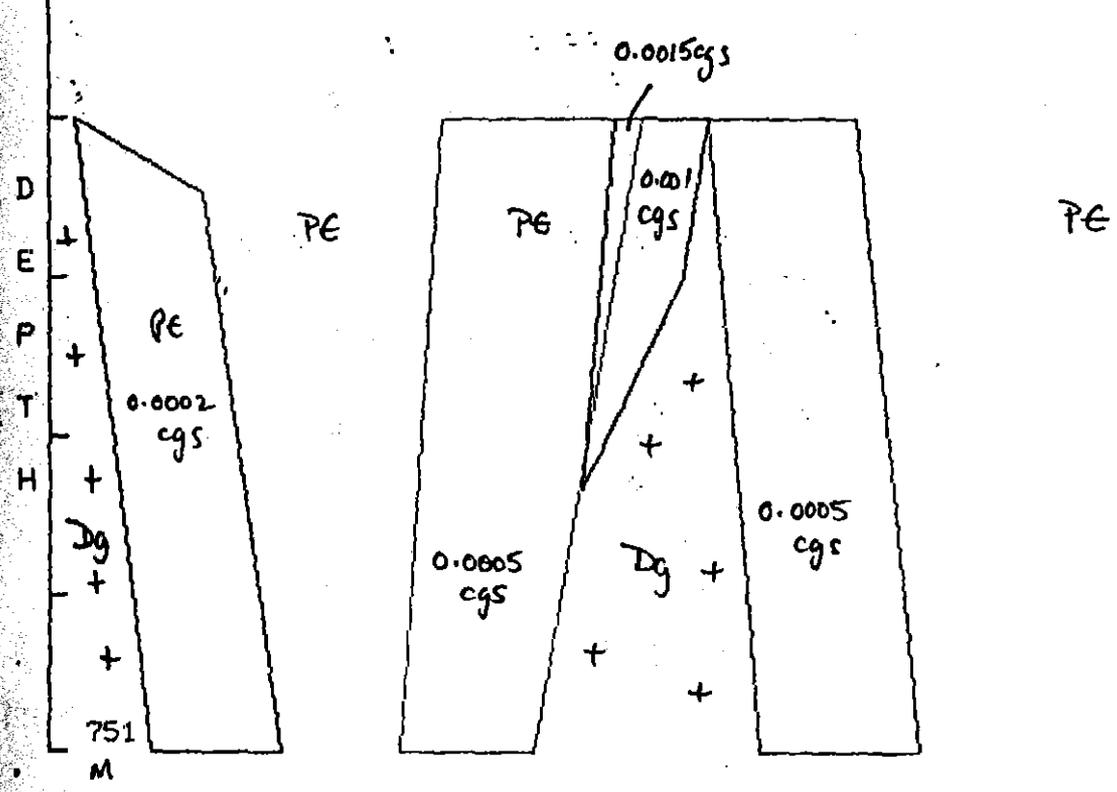
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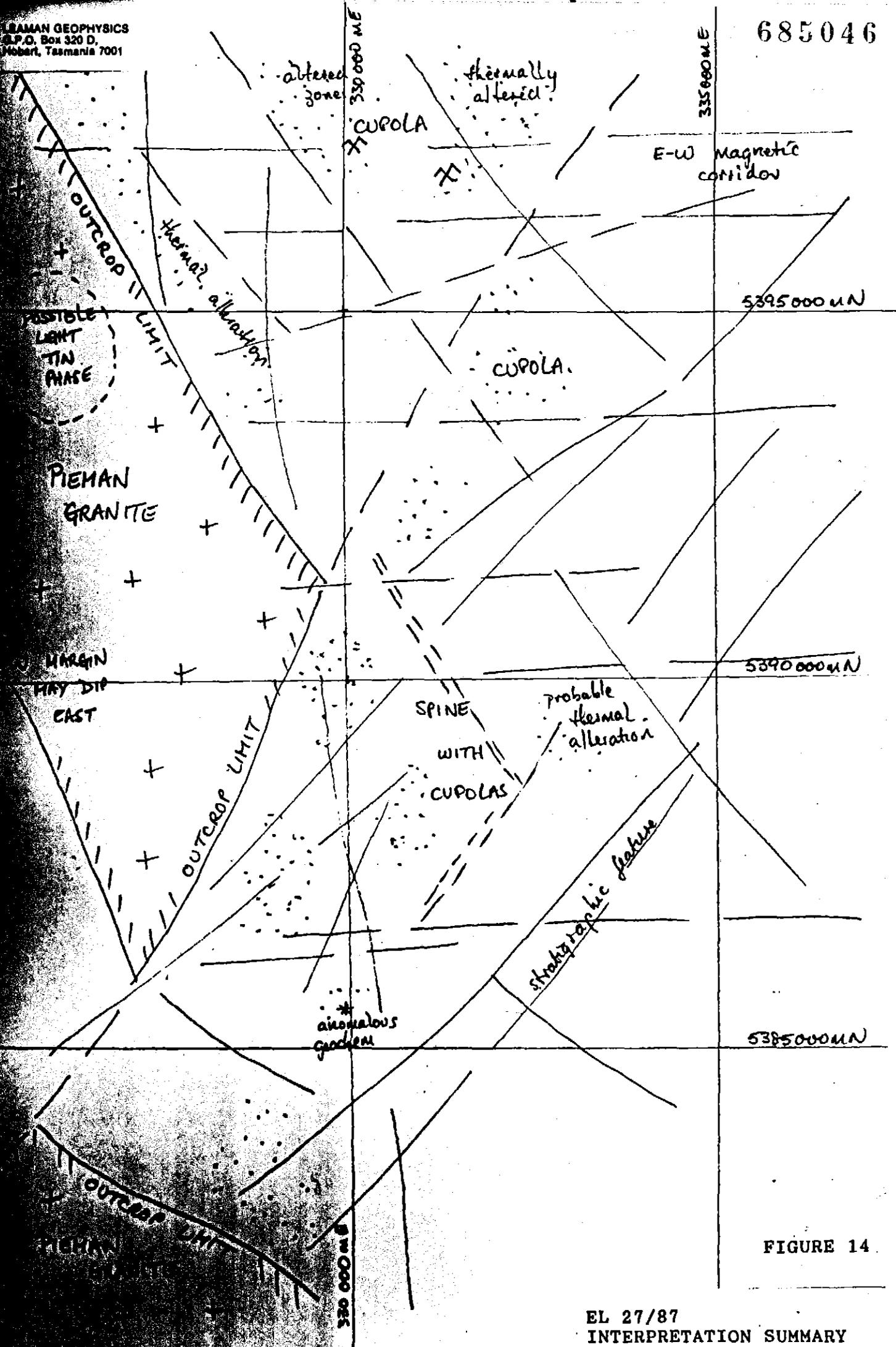


FIGURE 14