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Mt Read Volcanics Project

Geophysical Report 3

Gravity interpretation West and northwest Tasmania

by D. E. Leaman

Tasmania

MINERAL RESOURCES TASMANIA

027002

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MOUNT READ VOLCANICS PROJECT:

GRAVITY INTERPRETATION
WEST AND NORTH WEST TASMANIA

by
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for
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August 1986

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SUMMARY

Several thousand new gravity observations have been added to the TASGRAV data base as part of the Mount Read Volcanics Project. These observations have been concentrated along the West Coast Range but extend from Elliott Bay to Waratah, and east to Cethana with a nominal station spacing of 1 km. Beyond this area coverage is limited to older, more regional surveys. Although all surveys have now been terrain corrected precision limitations persist due to use of barometric levelling prcedures.

The data base provides a platform for evaluations of regional structure and is able to resolve most sources in the 2 to 30 km depth range where coverage permits. The present definition of the gravity field does not permit general interpretation of shallow or small (third order) structures and this review was directed at whole crust and large intracrustal structures.

Qualititative interpretive comments are provided for the entire survey area. Quantitative assessment has been restricted to seventeen profiles and review of possible source contributions and gross structure. This approach is consistent with the nature of extant geological information suitable for interpretive control and the definition of the gravity field itself. It was designed to provide a basic first order structural interpretation. There remains considerable scope for refinement of the interpretation provided at first and second order scales within the heart of the west coast province but more complex and time consuming 3D procedures are required. Several important zones which might benefit from such an approach include the Rosebery region, evaluation of the materials beneath the Great Lyell Fault along its length (from Elliott Bay to Lake Julia) and roof forms for the batholith centred on Guildford.

The gravity field within W and NW Tasmania is characterised by a rising coastward gradient although this is sometimes modified by shallow sources and broken or duplicated. This gradient is only partly due to mantle shape effects and is primarily sourced by a thick Lower Cambrian sequence. Two troughs more than 12 km deep are implied; one E-W in NW Tasmania and the other N-S in W Tasmania. The western trough (Dundas Trough), at least, contains large volumes of mafic volcanics. Data is not available to adequately define the W or N side of these troughs (rifts) which are at least 25 km wide.

Only the Tyennan Precambrian core is essentially intact as a thick piece of old continental crust and there is evidence that sections of it have been broken and/or moved westward by up to 15 km. The Rocky Cape, Forth and Cape Sorell Blocks while not completely assessable with present coverage appear to be parts of large and now disrupted thrust sheets with motion from the west. The Cambrian troughs extend beneath all blocks at depths of 1 to 5 km.

Smaller exposures of Precambrian rocks near Dundas and north of Rosebery are broken portions of similar slices which may be partially underthrust near Rosebery. The isolated occurrences of remobilised ultramafics, which are gravimetrically insignificant apart from those at Heazlewood, delineate the approximate position of the primary Cambrian detachment modified by Devonian movements. The same concept also applies to the Badger Head Block in N Tasmania.

Several large faults occur within the trough materials. The Henty and Lyell Faults appear to be folded Cambrian thrusts near the eastern margin of the Dundas Trough. Each raised western and deeper materials along the trough edge. Most other large faults appear to be essentially Devonian based on the relationships implied between the thick units within the Cambrian and younger rocks. One of the largest of these features lies along the north shore of Macquarie Harbour and this is thought to be the side of a very large Devonian thrust sheet with motion from the E or NE. This is consistent with the structure pattern between Strahan and North Dundas.

The inferred relationships between trough and basement suggest that the features described represent aborted continental rifts.

Devonian granites are concentrated near the junction of the Cambrian rifts. All are very large intrusions extending to depths of 9 to 11 km and the Housetop, High Tor and Heemskirk plutons, at least, abut one another or are essentially one mass. The Pieman and High Tor intrusions are either marginal to the rifts or occur within dislocated basement. The Heazlewood ultramafic complex in the same region represents a sample of the generally concealed contents of the rift axis. Cambrian granites are small and insignificant bodies located high on the rift shoulders but whose intrusion or development may have been controlled by major crustal fractures and which then fed mineralising fluids into the local environment. These bodies may have sourced the Mount Read Volcanics which have an economic significance out of proportion to the amount of material involved when compared to the entire Cambrian sequence. They were accumulated as relatively late stage continental piles of no great thickness.

Tertiary structures reflect rejuvenation of significant mobile zones between large blocks which have been subject to movement in Cambrian and Devonian times. Thus the "S" shaped basin extending from Strahan follows the NW-SE trend of the Macquarie Harbour faulting then a N-S zone along Birch Inlet which accepted most of the vertical component of the Devonian movement. The final NW-SE arm occupies the same axis as a lesser Devonian thrust block edge. The pattern is thus a simple en echelon extensional system. Deepest sedimentation (800 m) occurs at the junction of these trends. The present coverage is unable to fully define the Tertiary structures but a mix of symmetrical and asymmetrical "basins" are inferred with a thickness of 400 to 500 m. These are consistent with a drainage pattern engraved within a depressed zone with isolated lakes at critical points.

Trends cannot be well defined with the present coverage and treatment but many features are subjectively identified which have no obvious surface control. These may be E-W, NW-SE or NE-SW and form a pattern not unlike that inferred from unprocessed magnetic data. Most mineralisation is related to granites, either roofs or margins, and in particular to the concealed spine of Devonian granite between Granite Tor and Mt Heemskirk. Other mineralised sites occur around exposed, or suspected, sites of Cambrian granite with mineralisation concentrated along parts of the Mt Read Volcanics. There are concentrations related to the trends noted and these must be better defined.

The structural sequence inferred from interpretation of the form of gross geolgical units from the gravity data is

- formation of a continental rift about a polygon elbow
- mafic activity reducing with time within the rifts
- late stage acid-intermediate activity high on rift shoulders
- rift failure due perhaps to wrenching (mid, then late Cambrian)
- compression with movement of rift and basement from the west
- formation of a proto West Coast Range
- stabler and quite thick sedimentation to the west of the rise
- initially unstable but overall relatively thin sedimentation to the east above the rift shoulder (from early Ordovician)
- Devonian termination of sedimentation
- compression from the E or NE and disruption of the Tyennan basement with some movement westward
- intrusion of fracture granites near the rift junction-probably the hottest point.

The Mount Read Volcanics are shown to lie east of the Cambrian rift margin upon thick continental basement. Volumetrically these materials are not especially significant.

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INTRODUCTION

Gravity coverage in western Tasmania has been substantially increased as part of the Mount Read Volcanics Project. New data has been specifically concentrated along the exposed length of the Mount Read Volcanics from Guildford in the north to Elliott Bay in the south using a nominal station spacing of one kilometre. When coupled with existing surveys this provides a consistent gravity coverage over most exposures of Cambrian units. The coverage in North west Tasmania is less satisfactory with an average spacing of only 2 to 2.5 km. Peripheral areas are more regionally covered with a station spacing of 3 to 7 km. See Figure 1 for details of coverage.

Most of the data interpreted in this report have been acquired since 1980 and no previous partial or regional interpretations have been reported since survey activity was increased in late 1980. The most recent interpretation available is that of Leaman et al (1980) which was based predominantly on BMR (Zadoroznyj, 1973) and other regional data acquired prior to 1975. The only other interpretation of substance is that by Sheehan (1969) for the Sheffield area.

The gravity coverage has been upgraded from a nominal 5 to 7 km regional spacing to around 1 or 2 km in order to provide a reasonable definition of the regional field around those mineralised areas likely to be surveyed in some detail, either as part of this project or in future, and to generate an independent, large scale structural review of the volcanic arc and its surrounds.

These objectives are of equal importance although explorers seeking a structural context for mineralisation may not see the need for the first and those undertaking detailed surveys may not see the need for the second. Both, however, are essential to understanding and interpretation of gravity data at any scale.

Few detailed prospect surveys have been undertaken in recent years and most early surveys were too restricted, inadequately corrected and unable to define crucial regional influences. These were fatal weaknesses and led the method into disrepute. A pity, since work by Leaman and Richardson (1981) and Hudspeth (1985) suggests that the gravity method is an excellent second order exploration tool applicable at the stage when electrical methods are often overused.

Gravity methods are essentially structural and the reasonable coverage now available permits assessment of the major units or structural blocks and their relationships to depths in excess of 10 km. This aspect of the gravity field has been stressed in this report in order to further structural understanding and extract any

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potential relationships between structure or structural control and mineralisation within and beyond the Mount Read Volcanic arc.

This report is not an exhaustive treatment, but an indicative analysis designed to form the basis of future work by suggesting how the data may be handled and which interpretive procedures are likely to prove most cost effective in various geological regimes. Comment is therefore provided on data acquisition and processing limitations or problems. Time has not permitted an evenly comprehensive interpretation of the entire coverage and segments have been selected for more detailed work. This material provides a foundation for extended interpretation and allows some appraisal of the limitations and relationships implied in more restricted line analysis. Efforts have been made to extract bulk estimates of rock properties from the anomalies and this data can be contrasted with the measurements summarised by Hudspeth (1986).

This report forms only one unit in the Mt Read Volcanics Project regional appraisal. Others include interpretation of magnetic data (Leaman, 1986a, b; Bishop, 1986), collation of rock properties (Hudspeth, 1986) and ore deposit signature studies (Bishop et al, 1986).

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SURVEY DETAILS AND RESULTS

The subset of the TASGRAV data base interpeted in this report was derived from several sources. All observations have been referenced to the BMR isogal network tie stations and corrected for drift and terrain (to a radius of 19 km using the method of Hammer (1939). No separate tidal correction was made. Surveys of non government origin have, where necessary, been tied to the state network, reviewed for elevation precision and uniformly terrain corrected by Leaman Geophysics. Few surveys, other than those by the Geological Survey, have ever been terrain corrected which, in light of the range of corrections noted, must have induced considerable error. All observations have been reduced using a density of 2.67 t/cu m. Survey sources are summarised in Figure 1.

Position and observational errors are generally small, usually less than 0.05 mGal in total. Significant errors are introduced by elevation estimate errors and limited definition of station location for terrain correction. Apart from some very localised, detailed surveys (e.g., Leaman and Richardson, 1981; Hudspeth, 1985) all elevations have been determined barometrically and controlled by trig or basemap spot heights. The quality of such estimates is variable depending on field techniques used, available control, general terrain and reduction procedures (refer Leaman, 1984). It is likely that the general precision is no better than 1 to 2 m resulting in an uncertainty of at least 0.3 to 0.6 mGal in the Bouguer anomalies. In the case of older surveys, often using less rigorous methods, elevation estimates may be no better than 2 to 5 m. Many terrain corrections have been calculated on the basis of reported position and elevation. Specific site details are often unavailable for many important sites in the surveys by Sheehan (1969), Zadoroznyj (1973), Shell Co (1981-3) and may not be wholly defined in all Geological Survey data. Zones close to the station may not be accurately compensated as a result. The error may exceed 0.5 mGal at individual stations. In general, however, the error in terrain corrections is likely to be less than 0.1 or 0.2 mGal. Typical terrain corrections are less than 1 mGal west of the range unless stations were located in valleys or ravines and 0.5 mGal NW of Que River. Values within the Ranges may exceed 25 mGal and are typically more than 3 or 4 mGal.

The probable minimum RMS error is estimated at 0.5 mGal which means that the data should not be contoured with intervals less than 1 mGal nor interpreted beyond an equivalent envelope. A realistic overall estimate of precision is thought to be about 0.7 mGal. Consequently the gravity field has been contoured with a minimum interval of 2 mGal (Figures 5 to 9). Heavier lines mark 10 mGal intervals.

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The survey is fit for structural interpretation, unlikely to carry any definition appropriate to prospect evaluation but suitable for provision of regional settings for detailed surveys provided such surveys are tied to the base network. Refer to Appendix 2 for details of tie stations.

Contoured compilations of the Bouguer anomalies are presented in Figures 5 to 9 and 35 to 37. Figures 35 to 37 carry a grid base only and may be used to review contours free of clutter contributed by the geological base in Figures 7 to 9. Data sources are indicated in Figure 1. The continuity, detail or absence of contours reflects data distribution and contour reliability within areas marginal to surveys undertaken expressly as part of the Mount Read Volcanics Project.

INTERPRETATION

A: GENERAL

i) Introduction

The interpretation is presented in two parts. A qualitative commentary relates anomalies to lithology and gross structure for the entire area under review and this is supported by a limited quantitative analysis. A selection of profiles has been modelled simply and some critical structures have been evaluated in detail.

The time allocated for this interpretation has not permitted a complete assessment of structural issues. The work described is intended to provide a guide for exploration purposes, an indication of the information deducible, and the methods required to extract it. It has been prepared as a companion for the magnetic interpretations (Leaman, 1986a, b). Emphasis has been placed on evaluation of structural relationships.

Apart from the work of Sheehan (1969) no part of the area examined has been previously subject to any comprehensive gravity interpretation. This largely reflects absence of data. Sheehan's assessment was limited by coverage unevenness and omission of terrain corrections. The average correction for his 6950 series stations is in excess of 2 mGal and values range from 0.1 to 16 mGal.

An assessment of the gravity field across Tasmania, with emphasis on crustal forms (Figure 3), was provided by Leaman et al (1980) using the entire gravity base as available in 1975 (unchanged and uncorrected in western Tasmania in 1980), and specific features were commented. These are shown in Figure 2. Anomaly 2 was related to the Arthur Lineament, 3 to the Heazlewood complex, 14 to the Macquarie Harbour Tertiary Basin, 15A to Heemskirk Granite, 15B-16 an unexplained E-W trend. None of these features was evaluated. Although the interpretation was directed at crust-Moho forms the contribution of granites within the upper crust was grossly assessed. Figure 4 presents the granite model inferred. While the interpretation was coarse and may well have interlinked an array of sources it suggested that the Heemskirk, Meredith, High Tor and Housetop Granites effectively form a single batholithic complex. This would imply that mineral deposits in the Zeehan, Rosebery, Renison, Hercules, Que, Bischoff and Hampshire regions are located in the roof rocks and that the exposed granites represent cupolas or pinnacles. This structural relationship may overprint or control some mineralisation patterns.

ii) Geology

This report does not purport to provide original geological observations in respect of surface distributions of materials. It does describe alternate interpretations of the gravity field based on the available mapping and infers the volumes and possible relationships of those materials at depth. To this extent it has been controlled by the mapping and compilations of Corbett (1984), Brown (1983) and the 1:250 000 maps of Williams and Turner (1973), Corbett and Brown (1975) and Williams and Corbett (1977).

Details of geological units may be found in Brown (1986) or Corbett and Lees (1986) but the materials and relationships may be summarized as follows. Metamorphosed Precambrian rocks of the Tyennan region are exposed east of the Cambrian Mt Read Volcanics axis while correlates of the Oonah Formation (part of the Rocky Cape Block) are exposed to the west. There are two distinct ?Eocambrian - Cambrian sequences. South and east of the Henty Fault Zone a volcano-sedimentary sequence including greywacke, siltstone, tuffs and some basalts is overlain by an acid - intermediate volcanic pile (Central Volcanic Sequence). This is overlain by the Sticht Range Beds (quartz wacke, siltstone) and the Tyndall Group acidic volcanics and volcaniclastic conglomerates. North and west of the Henty Fault the sequence consists of Success Creek Group (mudstone, quartzite, dolomite), Crimson Creek Formation (mafic lithic wacke, mudstone), the Central Volcanic Sequence and the Dundas Group including the Rosebery Beds (greywacke, siltsone, mudstone, conglomerate, felsic tuffs and intermediate-basic volcanics). There is an array of Cambrian intrusives including ultramafics (at least partly remobilised), gabbros, felsic porphyry and granite. Pre Dundas Group rocks are not well exposed and the sections examined are rarely continuous. Predominantly basaltic sequences beneath the Dundas Group appear to be exposed at Strahan and south of Macquarie Harbour.

The Owen Conglomerate of late Cambrian-Early Ordovician age unconformably or disconformably overlies the Cambrian or Precambrian sequences. The Ordovician Gordon Limestone Subgroup overlies the conglomerate (where present) with varying degrees of conformity. The Siluro-Devonian Eldon Group consisting of mudstones, quartzites overlies the Ordovician rocks conformably(?).

Most units have been folded several times in their history, the latest orogeny being in the late Middle Devonian. Massive intrusion of granites accompanied this event. Permo-Triassic rocks of the Parmeener Super Group were deposited on the irregular topography of the early Permian and were later intruded by Jurassic dolerites. Only remnants of these post Carboniferous rocks persist, mainly NW of Waratah. The northern part of the area is blanketed by Tertiary basalts while substantial thicknesses of Tertiary sediments occur in fault-controlled depressions south from Macquarie Harbour.

iii) Materials and properties

The rock materials of the region surveyed were outlined briefly in the previous section. Table 1 summarises what is known of the densities of these materials. Sampling programmes which form part of the Mt Read Volcanics Project were continuing at the time of preparation of this report and the results will be presented by Hudspeth (1986). The table does not detail pre Silurian units since these are not particularly relevant to western Tasmania. It is clear, however, that there are considerable gaps in information for Lower Palaeozoic units. This deficiency partly reflects sampling problems. Most Cambrian determinations have been derived from the Tullah - Rosebery - Mt Read region. As shown in interpretation many of these sites lie in materials altered by granites at shallow depth. Most sedimentary rock determinations from this region are 0.02 to 0.05 t/cu m higher than comparable lithologies elsewhere while more altered specimens may be up to 0.1 t/cu m higher. An example of this variation is provided by andesites and andesitic pyroclastic rocks which have a typical density of about 2.75 t/cu m at Que River and Mt Read but 2.79 to 2.96 t/cu m (av 2.84) at Farrell or Sterling Valley. Variations of this type, which may be related to mineralisation - especially small increases in pyrite content or alteration/dolomitisation, affect decisions concerning appropriate "normal" values.

The table presents my assessment of the available determinations, both laboratory and anomaly inferred. Anomaly inferred values are based on the regional interrelationships of anomalies from major bodies. These values may be compared with the laboratory determinations which display wide ranges. The "mean" values stated are not arithmetic means for all values but means of the limits of the set cluster and designed to eliminate obvious weathering effects. Some ranges considered to be affected by alteration have been marked #. Weathered or altered values are included in the gross ranges but may have been excluded, subjectively, from lithology review or included as a separate entity.

Variations are a function of lithology, sampling, location in the region, alteration or mineralisation. Local grouping of formations may affect the synthesised integrated mean. There is an overall bias within the determinations toward the central area between Tullah and Queenstown.

The values ultimately used in modelling must be treated as approximate bulk estimates. The densities assigned in models are relative to fundamental assumptions based on perceived densities for Cambrian section, Devonian granites and Tyennan basement. These have been cross correlated for consistency in terms of contrast differences.

The units used for density, while dimensionally SI, are cgs value equivalent (i.e., 2.67 t/cu m = 2.67 g/cc = 2670 kg/cu m). The gravity unit used throughout, the mGal, is the defacto SI standard for gravitation and less confusing thant the unit of acceleration (micrometre/sec/sec).

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TABLE 1: DENSITIES OF ROCKS IN WEST AND NORTHWEST TASMANIA

Unit: age/group	All units in tonnes/ cubic metre Measured bulk density range	Mean	Effective density inferred
POST DEVONIAN			
Quat. sediments (dry)	1.5 - 1.8		
Tert. sediments	1.82 - 2.15	2.0	2.0 - 2.1
basalts	2.9 - 3.2		
Jurassic dolerite	2.8 - 3.15	2.9	2.9
Triassic rocks	2.3 - 2.51	complex. see other	
Permian rocks	2.37 - 2.66	references	
DEVONIAN			
granodiorite	2.69 - 2.72	2.7	2.7
granite/adamellite	2.59 - 2.65	2.63	2.62-2.64
ORDOVICIAN TO DEVONIAN			
Crotty sandstone	2.5		
Gordon Limestone	2.7 - 2.92	2.72-2.74	2.74-2.76
Caroline Ck Ss	2.25 - 2.68		
Owen Conglomerate	2.6 - 2.8		
CAMBRIAN			
Ultramafics	2.43 - 3.2		
gabbros	2.78 - 3.11		
porphyry	2.72		
andesite	2.66 - 2.87	2.70-2.76	2.74
Mt Read Volcanics	2.6 - 2.77	2.71-2.74	2.73
(mineralised)	2.80 - 3.08		
basalts	2.69 - 2.89	2.80-2.89	2.85
misc lavas(inc felsite)	2.71 - 2.77		
Dundas Group			
wackes	2.64 - 2.87	2.72-2.77	2.74
conglomerates	2.82 - 2.85#	2.83	2.80
siltstone/shale	2.61 - 2.83	2.72-2.78	2.75
sandstone	2.81 - 2.83#		
Rosebery area	2.65 - 2.84		
Farrell Slates	2.68 - 2.79	2.75-2.76	
fault zone schists	2.7 - 2.9	2.81-2.87	
misc tuffs	2.64 - 2.84	2.71-2.76	2.74
agglomerate/breccia	2.69 - 2.87	2.73-2.78	2.75
tuffs (mineralised)	2.71 - 3.22	3.00-3.15	
hornfels	2.80 - 3.00	2.87-2.90	
(altered)	2.78 - 3.20	2.90-3.00	
skarn	3.20 - 3.40		
PRECAMBRIAN			
misc quartzites	2.59 - 2.7	2.67-2.69	2.68
Schists/phyllites etc	2.59 - 2.75		
Dolomite	2.84 - 2.91		

B: REGIONAL COMMENTARY

Bracketed anomaly numbers refer to labels shown in Figures 5, 6.

South of Mt. Darwin:

The gravity field south of Mt. Darwin is dominated by the effects of Tertiary structures and the apparently anomalous Cape Sorell Block. These effects were evident in the coarse regional compilation by Zadoroznj (1975) and Leaman et al (1980). The apparent peculiarity of the Cape Sorell Block was noted by Leaman et al (op cit) and commented on subsequently by Mudge (1982). Bouguer values APPEAR excessively positive when compared to coastal sections north of Strahan and south of Elliott Bay. The block is bounded by strong gradients. The Tertiary basin and its associated strong negative anomaly suggests that the structures defining this block were active during late Cretaceous and early Tertiary times. Mudge (1982) sought to explain this block as a late Mesozoic accretion possibly made feasible by wrenching and creation of King Island. Quantitative studies (below) show that this is not the case and that the anomalies are an artifact of retention of Cambrian basin characteristics and presence of the entire Lower Palaeozoic sequence; factors which reccur nowhere else without disruption or intrusion of Devonian plutons leading to reduction of anomaly amplitudes and continuity.

The dominance of the major step gradient (1A-1E) is evident (Figure 6). The probable trend of the mantle - continental margin effect is marked by (13-13) with a gradient of less than 8 mGal/10 km. It parallels the coast. Anomaly (1) induces a step of about 20 to 25 mGal (2A-2D). The block of raised anomaly is bisected by the Macquarie Harbour Tertiary basin (4D). Peak values (2A-2C) are about 5 to 6 mGal higher than the basic step anomaly and can be correlated with steep limbs of Cambrian mafic volcanics. Anomaly 2D may also be of this type but it lies near the core of an anticline which may be exposing material which sources the entire step anomaly. Note that there is no pair for (1) within the onshore coverage so that no comparable step down is known to exist.

The gentle, more dispersed gradient at (3) north of Elliott Bay can be related to thickening of the Lewis River Volcanics (marginally denser than basement). There is no obvious response related to Cambrian granites on the coast. Anomalies 4A-4D can all be related to Tertiary sediments. It will be observed that the extent of these anomalies is much less than the mapped coverage except in the case of 4A. The effect of Tertiary cover is recognisable on some profiles - Figures 12 to 17, quantitative discussion). The structure southeast of Moores Valley (4A) produces a distinct basin. Its linkage with 4B is tenuous. Tertiary and Ordovician-Silurian cover thickens northward toward 4C and the deep zone is quite narrow. The anomaly pattern between 4C and 4D, when compared with presumed Tertiary outcrop suggests that the thickest sedimentation lies near the northern side of the Tertiary - covered area. The lateral structure near 4C greatly modifies the step gradient (1C-1D). The change in character between 1A and 1B reflects more mafic contents in the exposed units (also Leaman, 1986b) while that between 1C and 1D and 1D to 1E reflects greater source depths.

The line of small, relatively positive anomalies (5) defines the limits of Tertiary cover and exposure of thin Cambrian sections on Precambrian basement north of Thirkell Hill. Anomalies 6, 6A and 7 can be associated with lithological variations in basement. The texture about 6, however, indicates additional, unmapped dislocations in the region of Frederick Hill. Anomalies 8 and 9A may also be associated with basement or thin Palaeozoic sources. (8) lies south of the exposed basement within the Elliott Ranges and may indicate a thick wedge of Ordovician rocks. (9A), however, extends across strike from Mt McCall and suggests disruption and lithological change at quite shallow depths. The more positive anomaly between 8 and 9A matches the shape of the fault block at Western Plains and implies relative uplift of pre-Ordovician materials. Anomaly 9B is consistent with a thick sedimentary or fold wedge of Ordovician-Silurian rocks west of the Engineer Range and north of the faulting at McCall.

Mt. Darwin to Tullah:

Within the area covered at a station density of about 1 km five significant gross features can be recognised. Geological correlation of many of these features is not immediately evident using available surface mapping. It is clear that the gravity field reflects primary structures within the upper crust. Processing of regional aeromagnetic data exposed comparable features - see Leaman (1986a). Many gradients transect surface trends. Extensions of several of these features were described above.

1. The largest, consistent gradient (1D-1E) trends N-S along the axis of the West Coast Range from Mt. Darwin to about Lake Julia. The gradient is nearly linear across a 20 km width south of 5345 000 mN with relatively minor aberrations which may indicate survey deficiencies. This gradient along the face of the range appears to correlate with the Great Lyell Fault. (But see quantitative discussion below which evaluates the significance of this gradient and its source). The termination of the effect near Lake Julia and its intersection or offset with the Henty Fault is unusual. The comparable gradient trends E-W from this point. There is no surface explanation for this trend although similar characters are reflected by magnetic data.

2. West of Queenstown there is a substantial positive anomaly (2D) which, seen in regional perspective (e.g. Figure 8), rolls over to the coast before being lost in the coastal gradient. It is likely that this feature is an extension of the Cape Sorell Block effect rounded off by three dimensional effects and down faulted north of Macquarie Harbour. The negative trend apparent through Zeehan, Renison, Rosebery and Farrell completes this illusion.

3. The largest single anomaly (15A-B) is presumably related to a granite pluton. The intrusion at Granite Tor is exposed near 15A and minor granite exposures are known in the River Forth 20 km to the east.

4. A significant negative trend (14-15A) has been defined between Granite Tor (15A-B) and Zeehan, and may extend to the exposed Heemskirk Granite (14). The association between Devonian granites and anomaly is inescapable. This relationship was inferred from the

much cruder data base available previously (Leaman et al, 1980 and Figure 4). The association is confirmed at Renison and Pine Hill and by deep drilling east of Rosebery near the Murchison Highway. (The presence of granite at relatively shallow depths over a wide area must have introduced some isotopic and geochemical confusion with respect to mineralisation genesis and emplacement in this belt which also includes Hercules. A volcanogenetic origin for some ores may be difficult to appraise or, at least, some indicators may prove ambiguous).

The shape of the pluton appears to have been controlled by E-W structures on its southern face and NE-SW structures on its NW face.

5. The trend described in 4 above transects an apparent platform of minor anomalies (10A-B-C). These are all associated with the West Coast Range. The labelled positions are located along the crest of the range at the apparent axis of the Mount Read Volcanics. Immediately west of this position the effects of the gradient (1D-E) are dominant although this is not immediately apparent in the contour pattern. THe pattern may reflect terrain factors, pockets of contrasting materials or small errors. It is distinctive and suggests that basement values and fundamental character extends a considerable distance west of exposure. Some basement character is evident in anomalies 11 and 12 but most variation can be related to Lower Palaeozoic cover. The general levels of the Bouguer anomaly and the extent of the platform indicates that basement is present as a relatively shallow dipping (and faulted) shelf beneath the Mount Read Volcanics and the West Coast Range.

Anomalies 11 and 12 define fault blocks containing Ordovician and Silurian rocks east of the range. The E-W anomaly (11) implies either a pod of Gordon Limestone or a shallow basement horst and thin cover. Raised basement, while not directly supported by extant mapping, is consistent with faulting in the region (see Figure 8). Since such a structure would be post Cambrian but pre Devonian some rejuvenation without obvious onlap evidence is feasible. Anomaly 12 is of the same type. In each case E-W trends are dominant and these persist across the range. Anomaly 2E is not well defined but is associated with Cambrian exposures at the SE end of Professor Range. Anomalies 2D and 4D were described above. Neither are well defined for any distance either side of Strahan due to access difficulty and survey coverage priority further east. The complex anomaly pattern near Zeehan reflects a detailed survey with spacing of about 500 m.

North of Tullah:

The character of the gravity field in the northern section of the surveyed area is quite different. It is dominated by large negative anomalies. Three of these, 15, 19 and 23 can be directly related to exposed plutons (Tor, Meredith and Moina). The depressed character of the field between 19, 23 and 26 also implies much concealed granite or shallow basement. The former solution is most likely given that the Housetop Granite is exposed north of 26.

Sizeable positive anomalies arc around the suite of granites. Anomalies 17A and 17B are not precisely located but appear to lie on the western side of the Arthur Lineament and may not be associated with it. 18B is related to the Heazlewood complex. Anomalies 22 and 25 probably represent normal background where granite is absent. The positive nose (18A) corresponds to exposed Oonah Formation but the effect may reflect the residual response retained after allowance for the effects of the Heemskirk and Meredith Granites.

A gradient of the style noted further south (1A-E) may be observed between 21 and 24A. It corresponds to a similar exposed geology. A small fragment of the "Range" character is indicated south of this zone at 10C. Anomaly 20 may be correlated with the thin belt of exposed Oonah type Precambrian rocks exposed north of Rosebery. Anomalies 24A and 24B are local positive effects and may indicate alteration or mineralisation or a local increase in the proportion of andesitic or mafic volcanics.

This brief qualitative discussion suggests some critical relationships between certain rock units and the gravity field. These relationships and structures have been quantitatively assessed in so far as was possible within the time frame of the project. These results are described and analysed in the following section.

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C: QUANTITATIVE ASSESSMENT OF STRUCTURE

i) GENERAL ISSUES:

Analysis has been restricted largely to a profile analysis of structures and some specific issues to assess the resolution of the data available in mineralised areas. The treatment, essentially two dimensional, was designed to suggest possible regional relationships and provide the basis of an initial three dimensional model although 3D extended and more resolving interpretations were beyond the immediate scope of this study. The data available restricts analysis to regional issues but review of the profiles interpreted does allow deep seated components of the gravity field to be separated.

No attempt was made to filter the gravity field since filter parameters could not be reliably estimated without much appraisal and experience with the local sources and their likely overlap. The presence of a major fold belt with sources likely to range from the surface to depths in excess of 10 km near the continental margin inevitably mean that large scale and structurally critical components of the field may be imperfectly separated or even lost during filtering. The range of overlapping anomaly wavelengths can be seen from inspection of Figures 10 to 22 to be considerable and to disguise the ever-present continental margin effect which may work in the same sense as many large upper crustal sources. Local deviations in the filter may also lead to uncertain results.

In order to provide an indicative structural mass distribution and assess the interaction of large sources the observed Bouguer anomalies have been used throughout. This approach yields a measure of consistency and avoids introduction of filter errors but some other limitations have been imposed by the data available. A band about 25 km wide contains observations at 1 km spacing; beyond this coverage is irregular with stations at 4 to 7 km. Consequently it is not possible to fully specify any profile beyond the detailed band and segments of the "observed profile" shown in the figures are often gross interpolations. No great weight should thus be placed on relatively minor details within such interpolations. Any major deficiencies have been overcome by modelling profiles 45 to 60 km long using models in excess of 140 km long in order to adequately appraise sources up to 30 km deep (including the continental margin effect). This additional content, though not presented in the figures, was especially critical at the coastal end of each profile. The Moho profile used in each case was based on the statewide interpretation given by Leaman et al (1980) and modified as necessary. The original Moho interpretation (Figure 3) might well be revised by the enormous expansion of the data base since 1975-1980.

Several other issues have been assessed. The high relief terrain imposes other problems. Where profiles involve relief in excess of 300 to 500 m the observed profile has been converted, in alternate examples, to allow for modelling comparison tests of the terrain and sources within it.

Densities inferred in figures are relative and assigned on the basis of controlled values. These are limited and all estimates are

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regional bulk integrations. There may be locally significant deviations which have not always been evaluated. Where these have been incorporated any variation is noted in the Figure. On the basis of available density correlations two basic assumptions have been made; Precambrian rocks have a base bulk value of 2.66 - 2.70 t/cu m and much of the Cambrian sequence is 2.74 - 2.76 t/cu m. The density of the lower crust may lie in the range 2.75 - 2.90 t/cu m but is not relevant to this study since upper crustal densities apply, at least gradationally, to depths of 12 to 15 km and no substantial vertical excursion of this material is likely until much closer to the continental margin.

The west Tasmanian crust is highly siliceous. Any variation in control densities would adjust estimates throughout sections but the contrasts are better defined. Present rather limited knowledge on contrasts indicates -0.07 t/cu m for Cambrian to Precambrian columns which implies an effective upper crustal depth range of 10 to 15 km. Siliceous upper crustal materials may possess gradational properties and contrasts with depth and the base of model lines midcrust can imply a clear cut off that is neither intended nor probable. It nevertheless serves to indicate the depth to which real contrasts persist from the surface. A mantle base level of 27 km has been used for reference.

Many profiles were selected to allow comparisons with the magnetic interpretation (Leaman, 1986a, b). Without detailed assessment or continuation of magnetic data the magnetic interpretation tends to be depth limited at about 3 to 5 km. Comparable gravity data (residual) would lead to similar constraints but use of the observed Bouguer anomaly provides a more comprehensive crustal view.

A test of the validity of the interpretations is provided by the shift differentials shown in the upper right of each Figure. If consistent contrast and geological assumptions are employed and all sources above the Moho are reasonably assessed and properly related then the differential should not vary by more than 1 or 2 mGal (allowing for data precision, goodness of fit and regional components of mantle derivation). The observed shift represents the value added to the actual data to obtain values within the plot frame while the calculation shift is the value added to the model results to match this. Since the latter has, or should have, a base or median of zero then the arbitrary base of the observed data can be evaluated. For E-W lines in W Tasmania the differential is +5 for models which do not allow in terrain sources and -5 for those which do. These differentials vary smoothly and slowly with northing demonstrating some long wavelength mantle effects.

The discussion is in two parts. The first outlines considerations for solution of individual profiles while the second provides an assessment of the implications of the models according to structural member or aspect and summarises the structural interpretation.

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ii) REVIEW OF PROFILES:

An array of profiles has been provided. The set of profiles presents the range of options considered by the accepted interpretation path and variants are not generally provided on a comparative basis for individual sections. Other grossly different paths which could not be sustained are commented in the text. Variations tend to be minor but some major alternatives considered crucial to the discussion are presented in Figure pairs. In all other instances variants can be evaluated from alternate profiles (e.g. content and scale of Cambrian section - Figures 12 and 13, or the effect of near surface terrain sources - Figures 23 and 24).

All east-west profiles in western Tasmania possess a similar form; a step with a slight regional trend. The gradient comprising the step may be variable, or even in two parts, but the style is consistent. Low values are associated with the Precambrian basement east of 390 000 mE and high values with the coast.

There is little evidence of significant base crust contributions in the gravity field within the basement areas but such effects are SOMETIMES recognised at the coast. Much depends on the nature of the materials on the shelf, immediately offshsore. The step gradient is observed several kilometres west of the limit of basement exposure where surface geology indicates that most lower Palaeozoic units are much thicker. Since only the Cambrian suites are significantly denser than the Precambrian basement the response generally reflects a major increase in thickness of Cambrian rocks. In those cases where the anomaly step is in two parts or "rolls over" toward the coast other major sources must be involved - often Devonian granites.

Although some ambiguity must attach to densities or contrasts presumed the general form of the profiles demonstrates that the Precambrian rocks are generally much less dense than Cambrian rocks but comparable to or slightly denser than other Palaeozoic rocks except the Gordon Limestone. Low amplitude anomalies within the Precambrian areas reflect differentials between siliceous, pelitic or highly metamorphosed variations in lithology. The scale of these variations is never comparable to the response observed north or west of the apparent margin of Cambrian deposition. Three rock suites dominate the gravity field - Precambrian basement, the Cambrian volcano-sedimentary pile and Devonian granites.

The scale of all Figures is approximately natural. True natural scale is provided by Figures 45 km long and 27 km deep.

Elliott Bay to Moores Valley:

LINES 5240 000 mN	from 355 to 400 000 mE.	Figure 10.
5254 000 mN		Figure 11.
5265 000 mN		Figure 12.

Profile control is poor west of 370 or 375 000 mE and the observed profile is based on partially corrected marine data. Errors are not believed to be large, but have not been evaluated, and stations are widely separated. The general trend of the profile and magnitude of the Bouguer anomaly are not in doubt.

The models offered for profiles south of Moores Valley and which sample the Cambrian section between Elliott Bay and the southern arm of the Tertiary basin at Moores Valley are similar and may appear geologically unrealistic whne compared with some other interpretations in this report. This reflects two important factors; minimal control near and beyond the coast limits the detail which can be justified in the model and so only gross concepts are tested, and the structures north and south of Moores Valley are different in detail if not in style. NW-SE structuring in the region of Moores Valley has been shown magnetically to be related to significant differences in trend, lithology and properties (Leaman, 1986b). These differences are clearly displayed by the magnetic characteristics of the Mainwaring Group. Allowances for compositional variations, due to changes in volcanic and sedimentary proportions, are reflected in presumed densities along the belt of Mainwaring Group (also Figuree 11, 12).

Each profile presents a simple step anomaly with a superimposed gradient. Both step and gradient represent an integration of effects and are not the result of simple structures or Moho configuration in isolation. The Moho effect is significant at these northings due to approach of the shelf to the coast and the termination of profiles close to the continental margin but it is swamped by the contributions from upper crustal geology.

There are some common elements to each solution and these, coupled with the slight but important differences between profiles, allow inference of a consistent and probably unique style of solution. This comment should not be taken to mean that the interpretation is invariant, rather that, in gross terms, the concept is fixed.

There are three principal elements to the model concept.

1. The Tyennan Precambrian block is density zoned but the contrasts are relatively small. Background is of the order of 2.66-2.68 t/cu m (representing quartzites predominantly) and is locally increased to 2.70-2.73 t/cu m (with abundant pelites). The pelitic zone broadens and becomes dominant southward. The shape of the contrast differences is not critically determined and the densities simply represent minima (within maximum indicated volumes) and may be more locally derived. The Precambrian basement block with a bulk density of about 2.70 within the crust provides the base for the anomaly step. Deviations due to Tertiary sediments or folded Ordovician cover are recognisable on lines 5240 and 5265 (Figures 10, 12).
2. The folded Lewis River Volcanics extend east of the step anomaly and do not source it. The extension of basement anomaly levels into this zone shows that this part of the Cambrian section is not more than 2 or 3 km thick, Figure 12 suggests a greater thickness but the relevant part of the model for line 5265 is uncertain due to Tertiary cover effects. Cambrian granites and/or Ordovician rocks are shown to be quantitatively unimportant and induce very subtle variations only. In Figures 10 and 11 the Cambrian granite bodies have been modelled as

carrot-shaped reflecting the quite small volumes involved. The position of the step gradient, the contrast between the Lewis River Volcanics and Precambrian basement and the effect of the Moho shallowing westward shows that the basement must extend at depths of less than 3 km at least as far west as the zone of faulting which introduces the Mainwaring Group.

3. The step gradient reflects the presence of sizeable volumes of mafic volcanics and the rapid reduction in the effect of the basement. Unfortunately model definition is reduced (esp. Figs 10, 11) due to poor control on the observed field. The sundry, more reliable aspects of each section, however, can be tested for consistency between profiles. These suggest that the Mainwaring Group materials dip westward en-masse but probably form an isoclinally (and possibly locally overturned) folded block of considerable thickness at moderate depth. This is alluded to in the models but the maintenance of the step shows that more than a limb of dense materials is present. The anomaly reflects reduction in basement content and an essentially horizontal slab of Lower Cambrian mafic materials (however contorted). The slab represents the gravimetric view of such a folded section. The role of mantle effects is mollified in these profiles by the increasing water depth which, by flattening the gradient, shows the Moho component to be quite small. The thickness of section dominated by mafic volcanics, or their proportion, cannot be determined reliably using simple methods or the available data.

From the inferred relationships these models imply that the Lewis River Volcanics form the youngest part of the sequence and were accumulated at a rift margin. The Mainwaring and Dundas Group rocks provide a sampling of the rift trough contents - materials becoming more basic with depth. The mafic rift sequence appears to have been overthrust from the west per the fault complex west of Wart Hill. The rift sequence, at least 25 km wide, was at least 12 km thick. The more sedimentary rich members of this sequence are exposed south of 5266 000 mN in contrast to more igneous members further north. This difference, representing uplift of different parts of the sequence, produces the distinctive magnetic responses around the northing of Moores Valley. The whole sequence was subsequently folded yielding the simpler syncline-anticline pattern north of Elliott Bay and illustrated by the basal Ordovician rocks.

Figures 10 to 12, and some other sections, suggest the possibility of basement - usually at a slightly higher than normal value - beneath the trough. These components are not resolved and often convenient artifacts at the base of the model and may be absent. Such elements have sometimes been included to offer options, as in Figure 13, and their absence would vary only slightly the depth of section and the concept described.

LINE 5274 000 mN: from 355 to 400 000 mE. Figure 13.

Data are patchy west of 370 000 mE and east of 394 000 mE and these extensions of the profile are based on coarse interpolations. The scale of the Figure is natural.

The core of the interpretation is consistent with the magnetic view (Leaman, 1986b). Any E-W Bouguer profile drawn south of Macquarie Harbour exhibits a strong step at about 375 000 mE. A regional gradient is suggested east and west of this feature but it is not well defined by available data.

The synclinal core filled with Eldon Group materials and overlain by a graben or half graben filled with Tertiary sediments cannot generate the anomaly observed and may contribute less than 20% of the effect as shown by the notch between 379 and 383 000 mE. The Siluro-Devonian rocks contribute only a small part of the regional effect; the anomaly is generated by the juxtaposition of large volumes of contrasting materials. There is no evidence for this contrast within the Precambrian basement and the observation of a thick Cambrian sequence west of 373 000 mE is consistent with the data.

The interpretation suggests a thick lower sequence, probably not equivalent to Lewis River Volcanics, which thins rapidly eastward. This is overlain by basic rocks equivalent to the Mainwaring Group which also thin eastward. The materials labelled S-D clearly include some Ordovician rocks and may include some late Cambrian rocks but their thickness is insignificant.

Use of magnetic inferences on the form of the Mainwaring Group and overall estimation of the contrast interface leads to recovery of acceptable densities to depths up to 15 km east of 373 000 mE.

Crucial potential conflicts in interpretation arise west of 373 000 mE where a large thickness of tightly folded and possibly partly overturned Cambrian rocks is exposed. The models offer a MINIMUM bulk estimate of the volume of Cambrian rocks by using a slightly denser Precambrian variant. Other sections support the presumed range of 2.66 to 2.72 t/cu m for Precambrian rocks overall. The block relationship can be re-arranged in various ways and faults and thrusts may dislocate the generalised, folded interface in the style of Figures 10 to 12.

Tertiary sediments are reflected by the two steep gradient steps and the profile depression at 381 000 mE. The deposits may be up to 350 m thick.

LINE 5295 000 mN: from 355 to 400 000 mE. Figure 14. Natural scale.

Data control is limited west of 365 000 mE and east of 390 000 mE. The main body of the interpretation is consistent with the magnetic view (Leaman, 1986b). The gravity data add a crustal outlook and suggest the scale of Cambrian deposition west of Birch Inlet.

The large step anomaly reflects the edge of the Precambrian basement and the thick pile of dense Cambrian rocks. The consistency of the step and the obvious regional component superimposed upon it shows that the Cambrian pile extends beyond the coast; the existence of exposed Precambrian rocks south of Cape Sorell notwithstanding. This implies that either the Precambrian rocks are overthrust, possess densities comparable with the Cambrian rocks to depths of at least 10 km or that some combination of Moho and section effects produces the top of the step. There is no supporting evidence for the second option anywhere in the surveyed area. The Precambrian-Cambrian contrast is always at least -0.04 to -0.08 on bulk scales. Magnetic evidence also indicates that highly magnetic (and dense) sources such as the Mainwaring Group underly these basement rocks. The elevation of anomaly near 364 000 mE suggests the presence of a very dense member in the sequence. The third option is possible but unlikely given the obvious regional component in this region, the regularity of the step and the correlation of the implied regional gradient and that anticipated from gross Moho estimates. The thrust option is the preferred solution.

The anomaly associated with the small exposures of Cambrian granite indicates a small but depth limited source. The intrusion does not have a great depth range unless it also narrows with depth. As modelled the form is compatible with dislocation of its base by thrusting. Although further deep thrusting is the preferred solution the model cannot be used to suggest the sense of dislocation (compare also Figures 18, 19). This requires unravelling of the structure and, as suggested in the next section, more than one period and sense of thrusting is implied.

The structural pattern east of 386 000 mE is a straightforward folding of relatively thin post Cambrian materials.

The model implies a continuous basement across the section. This need not be the case and cannot be reliably resolved due to the great depths involved. At the depths implied it is likely that workable contrasts are lost or muted. It is possible that siliceous crust is absent beneath the Cambrian trough. It is certainly thin and the gravity field defines only the eastern side of a major Cambrian rift.

Line 5310 000 mN: from 350 to 400 000 mE. Figure 15

This profile offers a more disjointed but confirmatory view of the structure suggested at line 5295 000 mN. The main break in anomaly pattern occurs near 374 000 mE beneath Macquarie Harbour. West of this zone the anomaly is strongly positive, east of it the gravity field is flat and negative. This confirms that a thick pile of dense materials - upper crustal and not base crustal sources - generates the enormous anomalies observed. Although geological mapping is limited by water and Tertiary cover there is no doubt that a major break in Cambrian and basement geology occurs mid harbour. No Precambrian rocks are observed north of the harbour. The potential conflict between observed, faulted blocks of basement at Cape Sorell and the inference of a very thick section is stressed by this model. The basement blocks must be basal overthrust remnants. No other explanation is feasible. The thickness of such slabs cannot be determined unambiguously due to the effect of dense volcanics (Mainwaring Gp) within the Cambrian sequence. These are indicated as a virtual marker horizon but neither the thickness nor position in the sequence can be reliably estimated with present data. Any Mainwaring Group equivalents present east of 374 000 mE cannot be resolved due to the uncontrolled Tertiary cover which, in association with other profiles, is probably very thin.

The model suggests rapid thinning of the succession eastward as indicated by mapping and other sections. The relationships between implied overall succession relationships near the major fault zone indicate that some lateral movements may be involved to juxtapose inconsistent elements.

The model also attempts to illustrate the effect of basement variations by including pelitic variants. The distinction between a Cambrian pile with dense volcanic members and a pelitic sequence of comparable depth range is evident. Tertiary materials do little more than reduce the base level of the primary gradient although a thickness of 400 m is implied.

Fault labels and correlations indicated on Figure 15 and subsequent Figures are also provided in plan (Figure 30).

Lines 5320 250 mN	from 350 to 400 000 mE	Figure 16
5326 500 mN		Figure 17

The perspective of these two models is similar. The differential sampling of the southern end of the dropped Siluro-Devonian Strahan block and the northern side of Macquarie Harbour, however, aids appreciation of what the marginal faults may be or may disguise.

The central Harbour fault which has ultimately controlled Tertiary deposition and terminated the Cape Sorell basement blocks is easily recognised. See also discussion line 5310 000 mN.

The structuring east of the West Coast Range is similarly defined. Contrasting basement blocks are folded and the structuring includes a thin sequence of Late Cambrian to Devonian rocks.

The zone between the effective basement margin and the faulting within the harbour is complex, largely covered by Tertiary and Cambrian rocks and distinctive. It leads to a breaking of the gravity gradient and the effect is most pronounced on line 5326 500 mN which includes a significant sample of the down faulted Strahan block. Note, however, that much of the gradient modifications and reversal are related to Precambrian basement - either within fold cores or in overall shallowness eastward. The anomaly observed is essentially induced by anticlinal folding of a thick Cambrian sequence which also includes a dense member comparable with that observed south of the harbour. Faults between 370 and 380 000 mE appear to dip east. Only this relationship between a thick Cambrian sequence and disjointed basement blocks readily yields the anomaly pattern - especially where the sequence is beginning to thin rapidly eastward. Line 5320 250 mN is especially critical in this respect since it implies a substantial basement rise or much reduced section. In addition the Cambrian granite at Mt. Darwin is depth limited and restricted to those members of the sucession not far from basement (not necessarily the oldest overall).

In the region of Mt. Darwin, however, there are indications of west dipping structures which have brought up lower, and thicker, members of the succession. These features juxtapose Ordovician rocks with a mix of Cambrian materials. The models suggest interfering fold and fault systems.

The distinctive step and rollover in the main anomaly gradient is thus related to both the Tertiary cover and the uplifted basement core in the anticline along the northern side of the harbour. It is less distinct in the southern profile due to greater basement depth.

Strahan to Tullah:

Line 5343 000 mN: from 355 to 400 000 mE. Figures 18,19

Two versions of this profile have been included. Each repeats the principal eastern and generally shallow elements of the structure which generate the bulk of the observed anomaly. However, certain characteristics of the Cape Sorell block and concealed faulting along Macquarie Harbour suggest that all the materials north of Macquarie Harbour may be displaced westward by at least 10 km. This hypothesis requires that the harbour faulting represent the transgressive side of a thrust sheet (Figure 30 and next chapter). Part of the disturbance may be evident in the region of Elliott Range.

The Bouguer anomaly reduces coastward for the reasons noted above; shallowing basement at the coast, granite or increasing thickness of Tertiary sediments. The models differ only in respect of materials at depths in excess of 5 to 10 km. Irrespective of the structural genesis implicit in the models the primary axis of Lower Palaeozoic deposition and volcanism is defined and is consistent with sections south of Macquarie Harbour. In either model thinning or absence of original crust is implied and the zone from 360 to 370 000 mE represents the side of the original rift. The mid section options illustrated indicate coherence of structural relationship. Similar interpretations are feasible at 5274 and 5295 000 mN while sections 5310 and 5326 000 mN are complicated by cover and partial display of the Strahan block. The dropped Strahan block is fully represented in these models, only the extent and dislocation of the Cambrian part of the section is uncertain. The thickness of Ordovician to Devonian rocks is not well defined and a maximum is indicated at the densities used. No independent assessment is possible due to the folded and faulted nature of this part of the structure which is not well exposed. The local anomaly peak which falls over this region reflects the deep concealed Cambrian sequence and not the much lighter post Cambrian materials. Only the Gordon Limestone Super Group has a density approaching that typical of Cambrian rocks but this forms only a small part of the younger succession.

The Great Lyell Fault offsets and lifts the western part of the east side of the trough. The feature appears to dip westward at depth and is probably folded into the structure overall. Cambrian rocks to east and west are distinct; materials to the west are more altered, and probably older, on the basis of density and magnetic properties. The structural pattern may be recognised in the models for the region south of Moores Valley and may well be present elsewhere.

The King River faulting along the east side of the range is consistent with all southern models.

Line 5350 250 mN: from 350 to 400 000 mE. Figure 20

This model is directly comparable with that for line 5343 000 mE. Blocks at ,and east of, the King River are very similar but the zone between the Great Lyell Fault and the King River is broader. A westerly dip on the Lyell Fault is more easily established. The structure near the Henty River is not simply evaluated. Several features intersect near this zone, including the Henty Fault. The model could show any near vertical dips and these options are indicated. Assembling other sections suggests that both senses may be correct in that two of the larger features possess opposing attitudes (see Figures 16 to 22). This model also samples the northern part of the Strahan block, the southern part of the Zeehan block and the Firewood Siding Fault. These features, and the implied axis of Cambrian deposition, are consistent with other sections.

Much of the anomaly reduction near the coast is thought to reflect the root of the Heemskirk granite. There is little indication of any gross regional gradient, even the anomaly form east of 385 000 mE is dependent on the interaction of covering materials upon a denser variant of the Precambrian basement and no regional content is necessarily implied. A similar caveat must be attached to the attitude of the King River structure. A west dipping interface is implied within the basement but this should be considered a gross approximation and not a certain guide to more recent displacements.

Line 5363 000 mN: from 340 to 400 000 mE. Figure 21

The model is consistent with magnetic interpretation and shows the Heemskirk granite and the syncline at Zeehan. The anomaly is not well defined west of 352 000 mE and the form ascribed to the base of the granite may be invalid. The uplifted basement at Dundas must be thrusted, as suggested magnetically, in order to satisfy the density requirements near 371 000 mE. But where from? This is considered to be Oonah type Precambrian and yet Tyennan basement is not far removed. This leaves three possibilities; either the material has been incorrectly identified, the rift margin lies near an old suture abutting the basement types or the material has been underthrust from above and from the west before Devonian folding and faulting dismembered it. See also discussion for line 5372 and next chapter. Although the extension of the Lyell Fault is shown as a vertical structure the density pattern which accounts for this solution could readily be attached to a west dipping feature. Other options are feasible depending on the thickness of Ordovician presumed. The Precambrian basement near the base of the Tyndall Group is strongly zoned and locally altered (391 000 mE).

Line 5372 000 mN: from 340 to 400 000 mE. Figures 22, 23

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This model samples structures at Renison and Rosebery. Solutions of the type outlined in previous sections are not possible. The section is dominated by granite, from Granite Tor in the east to (presumably) the Heemskirk pluton in the west. The northing of this section slices this very large slab of granite east of the connection with the Heemskirk mass. Leaman et al (1980) considered these bodies to form one mass using sparse regional data. Lithologies surrounding this pluton are abnormally dense (2.80 - 2.89 t/cu m), especially around Renison and Mount Black. Thermal metamorphism and alteration probably accounts for the changes.

The granite has displaced or absorbed much of the section and the character of the gravity (and magnetic) field is distinctive. Gross E-W trends are evident and the limited volume of remaining (altered) sedimentary rocks show reduced responses. Modelling suggests that various units near Rosebery either dip shallowly east or steeply west. It is likely that these features represent fragments of the thrusts inserting basement at Dundas and Ramsay River and which are themselves cross cut by rejuvenations of the Henty Fault system. Resolution of these features is feasible with 3D analysis.

The most significant part of this model lies west of Renison. The anomaly increases toward the coast but at a rate not accountable by Moho effects. Only Precambrian basement is exposed. The Figures present alternative solutions for the observations; an unusually dense, essentially carbonate total section or a thicker overthrust slab consistent with structures inferred near Cape Sorell. The first option is most unlikely on two grounds which serve to illustrate the risks involved in this type of interpretation and accounts for the number of profiles examined. Such a solution is not justified by the volumetric availability of the lithologies implied nor by the responses of basement elsewhere. Secondly, if the axis of thick Cambrian deposition were extrapolated into this region it would lie at, or west of, 360 000 mE - or near the centre of the gradient observed. By analogy with other models, and allowing for the relatively gentle gradient noted, this would mean that the section could be present but totally concealed by at least 3 to 5 km of basement - Figure 23. The offset bringing in the basement block occurs within the rocks along the northern side of the Renison pluton. The presence of Cambrian rocks at Heazlewood, north of the Meredith Granite, along trend from the inferred southern axis of deposition does indicate that the basement exposed east of the Arthur Lineament north of Zeehan is overthrust in a manner comparable with the Cape Sorell block.

Tullah to Guildford:

LINE Bronzite hill to High Tor 356500E/5413500N to 399000/5371000
Figure 24

Anomalies are not well defined in the region of the Heazlewood Complex or the Meredith Granite and no close fit has been sought between calculated and observed profiles. This inevitably weakens the solution offered since a number of variants could be conceived.

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The style of these variations is suggested by solutions given in Figures 22, 23, 25 and 26. The overall concept of the model is consistent throughout and there is no evidence of gross invalidity.

The scale of the anomalies shows that the Meredith Granite has viable contrasts to a depth of 9 to 10 km and the pile of mafic materials adjacent to it is no less than 6 or 7 km thick using conservative volumes and contrasts. The misfit to the west at the Arthur Lineament (end of section) and across the Rocky Cape basement indicates that this is not true continental basement (see above and Figures 25 to 29). Note that although the Figure conveys only that portion of the model covered by reasonable data the extended model required to produce the extract shown in the Figure incorporated several variants for the Lineament and the Rocky Cape Group. It was concluded that the Cambrian trough must extend west of the Lineament at depths in excess of 3 km. Extension of the survey will be required to confirm this conclusion and perhaps locate the western side of the trough.

Mantle effects are not significant along this profile. The basement densities employed ensure that only minimum estimates are provided for the Cambrian sequence. The model also shows that the volume of Precambrian material within the faulted block along the Ramsay River is quite small and probably east dipping which is consistent with the magnetic interpretation (Leaman, 1986a). This block of Precambrian material is probably connected beneath basalt with the rocks at Waratah. It is underlain by Crimson Creek Formation, associated materials and basalts. The section east of 375 000 mE is comparable with other sections further south in that the Cambrian sequence thins rapidly eastward and loses dense, presumably mafic members. Only in the region of possible extensions of the Henty Fault are densities locally raised. This may indicate upthrusting or, more likely, alteration.

The High Tor Pluton dominates the east end of the profile. Gradients imply a very steep sided intrusion.

LINE Waratah to Barn Bluff 366500E/5423500N to 416500/5373500
Figure 25

LINE Henrietta to Cradle Mt 385500E/5439000N to 412700/5384500
Figure 26

These profiles form a pair which extend the interpretation from W Tasmania to NW Tasmania and offer an indication of the granite content of the section. Each profile has the same form although the negative effects of granite within the section is more evident on the northern line. Granites are certainly implied close to the southern line as suggested by the character near Waratah and it is likely that the foot of the Meredith Granite does impinge on the section at depth. (Option in Figure 25).

Mantle effects are not significant along these lines and the overall gradient reflects an increasing thickness of Cambrian section westward. The gradient is almost certainly modified by granites in and around the profile but these simply vary estimates of the thickness of section and do not affect the gross implications of the model. Mafic units are likely to be present toward the western end of each section, at least, and any further incorporation of granite effects would only broaden the need to include such materials somewhere in the trough. It might be argued that no basement is present beneath the western half of the section. This is possible but cannot be unambiguously evaluated by methods used to date since a sizeable increase in granite section is required to counterbalance the changes implied in the Cambrian section. It seems more reasonable at this stage to propose a simply faulted and thinning basement as would be found at a rift margin than any abrupt change. Magnetic data and trend character could be used to infer that there is a compositional change concealed within the basement in the region of the Henty Fault. This hypothesis would require the Henty Fault to be a rejuvenated basement suture linking the Tyennan and Rocky Cape Precambrian types. It may be remarked that this would permit simple insertion of the Ramsay River and Dundas inliers of Rocky Cape type (Figures 21 and 38) unless actually dismembered parts of the Rocky Cape Block.

The model confronts the Precambrian exposures at and north of Waratah to suggest that the structural style is comparable with that at Cape Sorell and north of Zeehan. In each profile the fit near the Arthur Lineament depends on the presence of a wedge of "Heazlewood type" material within the section - probably at some depth. The models also indicate that the Cambrian sequence thins rapidly SE onto Tyennan basement and that the amount of pre Ordovician section is generally less than 1 km in the syncline along the Mackintosh River.

In each case there is evidence to support the mapping zonation within the Tyennan basement but the contrasts and volumes involved are relatively small. The zonation is reflected by locally bulbous positive anomalies. Each section ends in the High Tor Pluton which is again shown to possess steep margins. A fracture granite, within basement, is implied which contrasts with the more steppy and possibly slightly more dense bodies within the trough.

The model implies that granite is virtually exposed on both lines south of Moina. While it is certain that it is not particularly deep, being of the order of a few hundred metres, these models do not properly allow for the effects of the terrain or the sources contained within it. Several profiles do make such allowance and these have been contrasted with simpler profiles not adjusted for the terrain sources in order to ensure that no significant errors have been introduced by the additional processing assumptions in this two dimensional approach. These lines would benefit from such analysis by indicating a variable and slightly deeper roof for this intrusion. The entire interpretation is consistent and the gross results are clearly unaffected by shallow sources.

Review of the Figures will show that the style of the models for each line are not inconsistent and comparable with solutions deduced near Rosebery, Queenstown and even Elliott Bay. The Bronzite Hill profile (previous section, Figure 24) is exceptional in that thick accumulations of basic rocks are exposed. Similar materials are presumed to be widespread in this region. The continuity of the Bronzite Hill section is, however, also complicated by the location of the Meredith Granite and the isolated, thrusted portion of the basement north east of the Huskisson Syncline in the Ramsay River.

The density anomaly associated with the Henty Fault System and the Farrell Slates (also Figures 23, 24) can also be recognised in Figure 25. The slates alone do not appear to be the primary source of this effect since density measurements from this region are not as elevated as the models require. The varied inferences concerning the Henty Fault and the base Cambrian interface across several sections indicates that this structure carries both thrust and strike slip motions in order to juxtapose various deeper parts of the section.

The Cradle Mountain profile (Figure 26) contains all the elements of the Barn Bluff profile except that the westward extensions of the Housetop and Moina Granites begin to dominate the gravity field. The presence of these bodies modifies the overall anomaly by introducing a depression in the field while retaining the overall gradient effects.

Both profiles demonstrate that the contribution of up to 250 m of Tertiary basalt and unknown but variable thickness of sediment do not introduce any significant variation within the gravity field. This suggests that Tertiary sources are short wavelength and essentially filtered by a 1 km spacing.

North west Tasmania:

Lines 5440 000 mN:	from 380 to 440 000 mE.	Figures 29
419 000 mE:	from 5450 to 5390 000 mN.	Figure 27, 28

These models review the scale of the Housetop Granite which is far more massive than surface exposure would indicate. The east - west line (Figure 29) suggests the scale of the body. Local anomaly variations reflect Tertiary materials in most instances.

The north - south section (Figure 27, 28) samples the end of the Housetop Granite (5440 mN) and the northern extension of the Granite Tor pluton (5402 mN). The section is otherwise explained by at least 8 km of Cambrian rocks given the basement density employed.

Two versions of line 419 000 mE have been provided. These illustrate how two, geologically acceptable, solutions can be generated and separated. Each allows the same surface facts and use observed profiles which differ only at the south end (due to data base update between calculation of the versions). Such differences do not affect this discussion. The solution in Figure 27 indicates small cross sections of the two plutons and retention of the bulk of the Cambrian trough. The Precambrian material to the N and NW (Penguin - Burnie) is modelled as true basement at acceptable but, in terms of experience elsewhere, slightly elevated density. This solution yields a calculated shift with respect to the observed

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shift of -26 mGal. This flags a suspicious result, or at least one which is incompatible with other interpretations, since other solutions for profiles not embodying in-terrain geology contributions have a near neutral shift relationship. There is a general pattern for unadjusted terrain models along W Tasmania of +8 mGal reducing to 0 mGal. -5 mGal for a more easterly line is consistent with this pattern given the doubts introduced by overall precision (2 mGal) and the trend sweep of the profiles. The alternative solution (Figure 28) is not unlike Figure 26 (Cradle) but presents a not unexpected expansion in section of the Housetop and Granite Tor Plutons. It also reduces the gravimetric significance of the supposed Precambrian basement to the north.

It might be argued that the option shown in Figure 27 is the correct one but the key elements noted above illustrate, by consistency along strike, that this cannot be so. Solution at one profile cannot verify a concept. Only when consistent geologic and gravimetric factors are obtained can the model be accepted. Many issues relating to the precise definition of the granites in this region can only be resolved by whole geology, contrast-weighted three dimensional methods. Figure 29 resolves the compatible structure normal to Figure 28. Some depth limitations are indicated but the body of the section must be composed of Cambrian trough fill. The sampling of the Rocky Cape Block (west end) and Forth Block (east end) suggests detachment consistent with the Zeehan area and Badger Head (Leaman, 1973). A solution to line 5440 mN was found which is consistent with Figure 27 but it requires an unbelievable and dense basement distribution and faulty shift factors.

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iii) STRUCTURAL IMPLICATIONS

The preceding section of this interpretation examined a set of 17 profiles and discussed possible variations and limitations. However, as noted on page 30 there are certain inexorable criteria which limit the possible structural solutions and provide a single model style for this region. While these criteria are most sensitively associated with 3D modelling worthwhile constraints can be placed on more basic techniques. In these respects the interpretation offered is believed unique in style although subject to variation in detail until improved surface mapping and survey coverage are available, and 3D procedures applied.

There are a number of structural issues raised by the basic modelling undertaken and the very suggestive nature of the implied solutions indicates a bias on my part toward a preferred solution. This is not so and was not intended. Some alternatives have been included to demonstrate the range of options available. Each profile presentation is the culmination of many evaluations and rearrangements in each section and generally offers the best, geologically coherent fit consistent with all control relevant to the scale of analysis. Several hundred different variants or combinations of models were tested. Two profiles were also examined to assess gross mantle options and source contributions. These results have not been presented here since the objectives were somewhat esoteric and designed to test mantle forms or crustal plate and subduction concept models. The latter are often proposed in the literature although few authors will provide scale descriptions of how they propose these models to operate or look. There are several critical elements to a subduction model and none of these appears to have been preserved from the Palaeozoic of Tasmania. Certain lower crust - upper mantle features should have retained the impression of the subducted plate if there had been one. There is no evidence of such structuring and the deduced model would seem to be a far simpler and more accurate representation of the structure given petrological considerations (Brown, 1986).

The following comments are intended as an integration of the structural concept implicit in this interpretation. It is clearly only a first step and subject to revision.

1. THE PRECAMBRIAN BLOCKS

These materials are nowhere consistently denser than about 2.72 t/cu m although lithological variants may be considerably denser. On a crustal scale it is likely that the effective contrast for these

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materials extends at least 15 km deep and that the crust is highly siliceous to that depth. This results in a bulk density of 2.69 or less and pelitic variants may increase this to 2.70-2.71 t/cu m where the volume is significant.

Three classes of Precambrian rocks have been identified during this study.

CLASS 1:

The first class of basement rocks lies within the Tyennan Block (see Figures 30,31). The gravity response in this region, with minor deviations (below) is consistent with predominantly silicic materials throughout the upper half of the crust.

It has been argued throughout that the gradient observed in all profiles represents essentially the combined effects of mantle relief and a thick Cambrian succession containing a large proportion of mafic or mafic - derived materials. The contribution of the Cambrian materials is never less than an order of magnitude greater than the mantle effect irrespective of location. The gradient when seen whole is part of a step anomaly; the western or northern side of which has not been covered by the present survey although data offshore or further NW may contain it. Further survey or data correction (offshore data) is needed to assess this point. It may be suggested that the gradient might be due to basement density contrasts. This is a feasible explanation on many profiles were such a contrast demonstrable. Unfortunately the entire pattern of the interpretation precludes it since there are several clear instances (e.g. Figures 10 to 15, 17) where the gradient can be associated with Cambrian materials at surface. Additionally, bulk density zonations within the basement suites are relatively low contrast or small volume and if covered by any other material would generate a more subdued effect than observed. No Tasmanian Precambrian unit of any substance is known which might possess the desired properties. It is unreasonable to propose one that is nowhwere indicated. The rocks of the Arthur Lineament, while altered and distinctive magnetically, do not offer a density change able to induce the desired effects. The limited regional coverage of the Lineament supports this conclusion. The interpretation is built on extrapolation of established geology, reasonable crustal inferences and relationships, consistency along strike after allowance for obvious disturbances and feasible materials and contrasts.

Thus the values observed for the field across the Tyennan Block are consistent with thick crust in massive juxtaposition with thick Cambrian rocks. This block is the only proven example of essentially in situ continental material.

CLASS 2:

Given the relationships evident between Precambrian and Cambrian successions the occurrence of Precambrian blocks juxtaposed with thick Cambrian sequences without any sizeable negative response implies that such blocks are depth restricted and not in situ. This conclusion can be registered for all Precambrian exposures around

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the coast between Point Hibbs and the Tamar River - including the Rocky Cape, Forth and Badger Head Blocks. The Badger Head Block was considered overthrust from the east by Leaman (1973) but any sense from the north would be consistent with deductions for other blocks (below). The Forth Block has not been subject to detailed study but its situation is consistent with other blocks (Figure 29).

The two Precambrian blocks at Cape Sorell are thought, but not without argument, to be of Tyennan and unknown types (possibly Rocky Cape). Ultramafic rocks are located at, or near, the eastern face of the more easterly block containing probable Oonah/Rocky Cape material. While this is important, as described below, both blocks are detached and have no penetration of the upper crust. A maximum thickness of 3 km has been ascribed but they are generally much thinner.

Other Precambrian blocks, Rocky Cape Block including the Arthur Lineament, Penguin and Badger Head Blocks, are all similarly detached but the available data and western limits to this interpretation preclude evalution of the amount of movement. The dislocation is likely to be several tens of kilometres. Although the Rocky Cape Group has only been presented in detail in Figure 23 similar forms were used to extend the models in Figures 25 to 28 westward. A thickness of about 6 km is possible but the absolute basement is up to 10 km deeper.

Ultramafic rocks are located in arcs around the curved fronts to the east or south of all the Precambrian blocks north and west of the axis of Cambrian deposition. While many of these rocks have been remobilised and displaced all are gravimetrically insignificant. While magnetically dominant these units occupy small volumes and are probably totally detached from one another in the complex structuring between western and eastern sequences.

CLASS 3:

The third class of Precambrian block is represented by the faulted Oonah type fragments exposed at Dundas and in the Ramsay River north of Rosebery. The Ramsay River block is larger and may continue beneath basalt cover to Waratah. These materials are certainly detached, of limited volume and may have two origins. The first origin was alluded to by Leaman (1986a) by suggesting that these were parts of a single thrust block, probably from the east, subsequently dismembered and linked by the Rosebery Fault system. Corbett and Lees (1986) have argued that the Rosebery Fault is indeed a thrust but that the materials beneath it have been underthrust from the west. This is wholly consistent with the composition of the material and the magnetic and gravity interpretations of the form of the bodies. The first option seems unlikely given the composition of the blocks and the nearness of the Tyennan basement. This view would be modified if the Henty - Lyell Fault systems mark the approximate location of an original suture between basement types (subsequently torn apart by rifting) or were applied near the point at which relatively unmetamorphosed Rocky

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Cape materials overlapped an older Tyennan core. This occurs east of Adamsfield, which is perhaps the other side of the older nucleus. In an overlap or contact option limited thrusting from the east could well insert these blocks and they may not be directly associated with the Rosebery Fault. Detailed 3D analysis of the Rosebery region would resolve this issue. (See also concept sketch, Figure 41). Figures 21 and 38 suggest how easily insertion could have occurred from the east if a basement interface was present. The overturning of the Waratah block (Ramsay River extension) does indicate that it may be separate from the main Rocky Cape Block and its detachment.

2. THE GRANITES:

Two suites of granitic materials are represented in the region examined.
The CAMBRIAN granitic rocks are exposed near Elliott Bay, Birch Inlet, Mt Darwin, Mt Murchison and Moina. In all cases, using conservative and probably high densities, these have been shown to be volumetrically small and located around the periphery of the Tyennan core. They intrude thin sequences on basement and are consistent with local magma chambers sourcing volcanic piles. There also appears to have been a mineralising halo.

The DEVONIAN granites occupy large volumes and are almost certainly related if not interconnected. It seems likely that the multi phase Heemskirk and Granite Tor plutons, Granite Tor - Moina - Housetop plutons, and Housteop and Meredith plutons are either abutted, united at depth or parts of a single huge intrusion. The cross sectional area of all plutons is several times greater than mapped exposures. The Granite Tor pluton is probably the largest and is unroofed only in quite small exposures. It underlies much of the Rosebery-Renison-Tullah region and clearly controls much mineralisation. The styles of intrusion vary between steep sided, probably fracture controlled bodies within thick basement to more shallowly dipping features within the Cambrian trough sequence. The complex of granitic intrusions is focussed at the junction of the N-S and E-W Cambrian troughs which occurs southeast of Waratah. The intrusions near Pieman Heads are probably of the same type as Granite Tor at shallow depth but since they may have intruded into the trough beneath the Rocky Cape cover may be more widespread at greater depths.
Detailed definition of the form of the roof of this complex intrusion may be of considerable exploration value. The models provide only the most rudimentary guidance in this respect and present smoothed estimates of shape only. The available data could be used to define the intrusions but 3D methods and very large tracts of the survey must be employed.

3. AXES OF CAMBRIAN DEPOSITION:

There are two facets to this topic; the first geographic and the second genetic. Whatever structural variant is imposed or selected from the interpretation there is little doubt that the thickest Cambrian sequences lie N-S near, or west of, 370 000 mE or E-W across NW Tasmania at about 5420 000 mN (Figures 30, 31). The section, presuming conservative density contrasts, is at least 12 to 15 km thick in W Tasmania and 10 to 12 km thick in NW Tasmania. Since the step anomalies observed are normally one-sided the width of the troughs occupied by this material is unknown but must exceed 25 to 30 km. Limited data occasionally suggest maxima of this order but independent (magnetic or seismic) review or wider gravity coverage is needed to confirm this.

The nature of the troughs has been the subject of some debate. The models in this report suggest a tensional rift origin but others have proposed various types of plate and subduction models. A series of models were attempted which proposed lower crust and mantle distributions and the crustal angular relationships as required by the proponents of subduction (although few authors will provide natural scale propositions for test). The gravity method is ideally suited to the resolution of many of these issues - especially when the interfaces are within or beneath continental crust. The models provided present the simplest and, in most cases, only lower crustal or basement distributions feasible and none are immediately compatible with plate tectonics theory. All are consistent with simple continental rifting with a compound junction near Guildford. The potential problem of contrast loss within the crust, usually at depths of 10 to 20 km, is not significant since the contrast between continental materials is generally less than 0.1 t/cu m - considerably less than the difference between oceanic and continental crust.

The interpretation thus supports the conclusions of Brown (1986) and Brown et al (1980) and not Corbett and Lees (1986) concerning trough development - it was most probably a continental rift. It is consistent with petrological data provided it be presumed that the mafic parts of the sequence were formed at shallow crustal depths while the rift was developing. This does not preclude their temporary deeper burial subsequently prior to uplift, dislocation or remobilisation.

The gravity field is definitive with respect to the location and relationships of various volcanic lithologies. The Mount Read Volcanics - acid and intermediate suites - were deposited high on the eastern shoulder of the rift and were clearly sourced from Tyennan basement. The basic rocks lie to the west and all lie in zone where the section is at least 4 to 6 km thick and where the relationships also imply greater age. The volume of mafic rocks generally has not been adequately assessed due to survey emphasis

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upon the Mount Read Volcanics rather than the entire Cambrian series but large masses are implied and most now lie at considerable depth within the folded troughs. It is possible that underestimation of the content of such material has led to overestimation of trough depth. Locally thick pods are certainly present near Heazlewood and south of Strahan but further survey may show that these are not exceptional. It may of course be very significant that the basic complex near Cleveland lies near the centroid of massive Devonian granite emplacement. A hot spot might be implied.

The magnetic variations in Mainwaring Group (see Leaman, 1986b) indicate that the section may be gradational in mafic content tending from predominantly igneous to predominantly sedimentary with time. Ultramafic rocks are of no gravimetric significance as presently distributed and there is no evidence of large slabs of comparable material anywhere in the upper crust. The relationship between mafic rocks and trough, the gradational variation and the lateral location of andesites and silicic rocks is wholly consistent with rift development as argued by Brown (1986). The precise location of the Mount Read Volcanics was affected by mid Cambrian structuring (below) and the final confusing juxtapostions of these rocks and the older trough sequence was completed in late Cambrian times (implied in Figure 41).

4. STRUCTURES WITHIN THE CAMBRIAN RIFT TROUGH

Several large structures with a Cambrian component have been defined by many authors. These include the Rosebery, Lyell and Henty Fault systems. Several models were designed to review each of these structures. The Rosebery Fault may be compound but contains significant east - dipping elements. As noted earlier, and as concluded by Corbett and Lees (1986), it is possibly the top of an underthrust block (from the west) although this is conditional on the presence of a junction between Rocky Cape and Tyennan type basement nearby. See discussion for section 1 above. The preferred magnetic model for 5362 000 mN certainly supports this view (Figure 38). The other faults dip quite steeply (at crustal scale) west and were originally Cambrian thrusts from the west. All such faults are located near the rift margin in the zone where the section thins rapidly onto the rift shoulder and all have been rejuvenated. Some strike movements cannot be excluded but in all cases examined the faults raised, or tore off, the basal wedges at the trough margins. Thus the Henty Fault may juxtapose very different parts of the section but not imply large lateral movements. Structures of this type were probably initiated when the rift failed, possibly by wrenching.

Devonian movements have been superimposed but the critical movement was clearly late Cambrian. The carriage of the Rocky Cape Group thrust sheet(s) probably also occurred at this time although some earlier movement is possible and all this activity preceded the deposition of the basal Ordovician units. Indeed, it provided

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highlands, scarps and basins along the line of the present range in which wedges of conglomerate were collected.

Magnetic data suggest that the physical properties of the units high on the rift shoulders are less altered than other units and it is possible that rift development was at least partly aborted prior to much of the later volcanism now represented by the upper parts of the Mount Read Volcanics and Tyndall Group and that the process was complete early in the Ordovician. Subsequent deposition then reflected gentle sagging above the original trough and local depressions between the Lyell-Henty uplift zone and the Tyennan basement.

Some apparently contradictory structures are also suggested by the models (e.g., Figures 16, 17, 21, 23). In general, these are east rather than west dipping. Two points must be noted; the role of Devonian re-arrangements cannot be overestimated and the models are themselves gross simplifications.

It has been suggested that the Precambrian material at Cape Sorell is of Tyennan type, although this has been disputed. If this is so, and it has been overthrust, then the margins of the block must conceal a thrust surface which originally dipped east. The more easterly Precambrian block which has a face with ultramafics present would oppose this sense. The situation is simpler if both blocks are of Rocky Cape Group type but the models show either option to be possible.

The entire Cape Sorell region is cut off by large structures along the N side of Macquarie Harbour (this report and Leaman, 1986a). While the present level of interpretation cannot resolve offsets reliably it does appear that the trough margin might have been displaced at least 10 km to the NW. This movement is mirrored as far east as the Elliott Range where all pre Devonian rocks are "embayed" and structured (Figure 30). Some of the vertical movement, which was considerable, appears to have been taken up along N-S structures along Birch Inlet. Some models imply the gross Devonian overthrusting or wrenching this concept requires - namely westward movement of a very large portion of central W Tasmania. Thrusting is a feasible solution - especially if the structure is largely the curved side of a thrust sheet. There is no doubt that a tectonic concept embodying both rift and opposing thrust movements (if of widely differing ages) is complex and that structural resolution using the simple methods employed is limited at the depths these alternatives are either inferred or superimposed. The compound solution, however, best satisfies Occam's Razor when all factors are considered.

Williams (1978) suggested disruption of the Tyennan core during Devonian tectonism. This interpretation suggests where it occurred, what moved and the nature of the movements.

The structural style of the Cape Sorell Block may be repeated along structures between Pt Hibbs and Moores Valley although many of these are now concealed by Tertiary sediments (also magnetics, Leaman, 1986b). The western edge of such a structure appears to

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terminate or turn the older (ultramafic bearing) dislocation to the SE (see Figure 30).

The complex structuring between Macquarie Harbour and Zeehan lies above the side of the deep rift and reflects extension and distortion induced by the gross movements implied above. The presence of substantial E-W elements is also explained in this way. The prevalent Devonian structural orientations within this zone indicate displacements from the NE which is consistent with inferences on large thrust movements described above. The E-W features are rejuvenated deep basement controls and have influenced all subsequent structuring - and probably mineralisation as well. Critical trend changes, offsets or introduction of subsidiary structures can be associated with intersections of major rift or thrust features and marked E-W trends (see especially magnetic data, Figure 32 and Leaman, 1986a).

The Cape Sorell - Elliott Bay Block can be shown to be essentially in place in that, although disrupted, it still retains its position near the edge of the rift. It is not a terrane which has been moved a great distance. The gravity field merely reflects a rift fill in which mafic rocks are common and whose margins are simple.

Structural inferences derived from gravity and, where relevant, magnetic interpretation are summarised in Figures 30 and 31.

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D: TRENDS

Limitations in terms of data coverage and detail restrict reliable evaluation of lineaments and anomaly trends. Most of those features with clear geological correlations have been noted in qualitative discussions. Previous magnetic interpretations (Leaman, 1986a, b), based on more widespread and even data coverages, offered some surprising conclusions and indicated that E-W features are dominant (Figure 32 from Leaman, 1986a). Several such features are unambiguously recognised within the gravity data (Figure 33). The Moina and Tor fracture granites are elongated in this sense and several other features can be identified which correspond approximately to many magnetic features. The problem of trend continuity is apparent in Figure 32 and this presented a problem for the original magnetic interpretation. This study has shown, however, that the break in continuity reflects the zone carrying the structural front which displaced much of the rift and carried in the Rocky Cape Group. A break should occur if the E-W features are old (pre Cambrian) but possibly rejuvenated. Other trend patterns (NW-SE, NE-SW) are younger and probably Devonian and all encompassing. The trend set pair so evident in the magnetic data, and often in exposed geology, is most clearly seen in the region between Mt Darwin and Tullah out to the edge of the Cambrian rift.

Neither magnetic or gravity data have been quantitatively assessed for lineament length or frequency factors since coverage (gravity) and processing needs (magnetics) have not yet been met. Even at the subjective level offered in Figures 32 and 33 there is strong correlation between the two methods and detailed review including an appraisal of features not obvious in surface mapping seems worthwhile.

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MINERALISATION AND THE GRAVITY FIELD

With few exceptions the extant gravity data base is not well suited to detailed assessment of mineralisation signatures or prospect studies. Available examples have been reviewed in some detail by me in Bishop et al (1986) but it may be stated here that the gravity method is a viable, cost effective prospect evaluation tool. It should not be used as a first pass method.

This report considers only the gross relationships between mineralisation and the first order structural interpretation which are consistent with the general level of coverage. More detailed review is included in Bishop et al (1986). A consolidated plot of mineralised sites, based on data from the Mines Department Mount Read data base, has been superimposed on the gravity field contour and atrend plot (Figure 34). This Figure that most sites are clustered above the granite roof spine between Granite Tor and Mt Heemskirk or are associated with particular lithological units within the Cambrian succession. The Figure shows all prospects or mines - past and present - irrespective of grade, mineralisation or production.

There appear to be two granite associations, in the roof and wall rocks around Devonian plutons and in the vicinity of Cambrian granites. The first association is evident near Zeehan, Moina, River Forth (east side of the Tor pluton), Mt Ramsay and Waratah while the second is evident at Elliott Bay, Mt Darwin, Mt Murchison and Cethana. In the Mt Murchison area the two styles may overlap but the deposit clusters do have a possible source relationship even though the Cambrian granites were volumetrically minor. There is also a possible association near the Lyell E-W lineaments since initial magnetic interpretations imply Cambrian granite at relatively shallow depth (Leaman, 1986a). Other Cambrian granites may have been related to basement E-W control and mineralisation could have been disposed about these loci by more local fluid transfer.

Some other trend correlations do emerge, even at the scale presented, although trend interpretation is very subjective at this stage. Some NW-SE and NE-SW alignments may be noted which are not immediately correlated with current surface mapping but which are readily related to gravity features. Several examples occur north and west of Rosebery. It would be possible to insert other possible trends and associations in Figures 33 or 34 but this has been resisted to avoid clutter and is not justified in the absence of detailed analysis.

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CONCLUSIONS

This work has shown that regional structural patterns are generally soluble two dimensionally but treatment of more specific features - especially where sources are less than 2 or 3 km deep - will generally require three dimensional analysis. While this need is not as critical as in the magnetics case (e.g. Leaman, 1986a) neglect of three dimensional effects is liable to lead to serious error within any less regional treatment. Such effects have been recognised in this analysis but the interaction and impact of 3D effects have not been assessed. Certain classes of ambiguous 2D solutions may be resolved by a 3D treatment based on 2D sections linked to constraints provided by surface exposure.

The interpretation shows that

1. Cambrian units fill a deep continental rift and are up to 15 km thick. Two rift arms may be inferred, one N-S in W Tasmania and the other E-W in NW Tasmania. The west or north sides of the rifts have not been confirmed.

2. The greatest accumulations of Cambrian basic rocks and intrusion of Devonian granites occurred near the intersection of the rift arms at Waratah. A long term hot spot is implied.

3. Within the survey area only parts of the Tyennan Precambrian Block are of continental thickness and some of this block has been disrupted and overthrust to the west.
   Precambrian blocks south of Cape Sorell, in the region of the Arthur Lineament, Waratah, Dundas and Forth River are of variable thickness and parts of disrupted thrust sheets from the NW concealing much of the Cambrian section. It is possible that the Dundas and Ramsay R. pieces were locally detached from the east but this requires an old suture (or onlap) between Tyennan and Rocky Cape Group lithologies near the present position of the Lyell-Henty Fault System. Gravity data suggest this to be possible since the east side of the rift is nearby.

4. The Great Lyell and Henty Faults appear to be folded thrusts of Middle to/and Late Cambrian age which have offset and raised materials along the east side of the rift. These older materials have been juxtaposed with the younger rift shoulder accumulation of Mt Read Volcanics.

5. Movement on Cambrian detachments appears to be universally west to east. The detachments have intersected, mobilised or aided movement of ultramafics and these gravimetrically insignificant bodies define the approximate position of the detached zone and parallel the outline of the Precambrian blocks from west of the rift. The Oonah Formation (detached basement) carries the

western Lower Cambrian successsion upon it. There is no evidence that the ultramafics represent parts of slabs detached from, or of, oceanic crust but were localised accumulations or intrusions within the rift sequence originally.

6. Cambrian granites are small, depth limited bodies consistent in form with localised magma chambers beneath the Mt Read Volcanics.

7. Post Cambrian deposition has been controlled by continued sagging along the rifts and by local relief and structuring east of the Lyell-Henty uplift zone. Up to 5 km of post Ordovician rocks may be inferred in the rift zone. Deposition elsewhere was patchy and onlapped to basement.

8. The inferred structural patterns imply major Cambrian tectonism.

9. All Cambrian structures have been disrupted by Devonian folding, faulting and thrusting. The scale of displacements are demonstrated by the offsets along the north side of Macquarie Harbour. This feature terminates the Cape Sorell thrust blocks. Structure north of the Harbour implies compression and movement from the NE and this is consistent with entire block movement along the Harbour. A large thrust block with its steep side along the Harbour is suggested. A similar, sub parallel structure may be inferred within the Cape Sorell block at the northing of Moores Valley. While some of the dislocation can be recognised within the Tyennan basement much of the movement appears to have passed along the rift margin south from Birch Inlet.
   Subsequent Tertiary extension has reopened these weaknesses in a classic NW-SE en echelon pattern linked by the N-S zone.

10. E-W structuring inferred from magnetic data can be identified. Such structures appear to be of crustal origin and control both mineralisation and many subsequent features or block rotations. Many granites are elongated E-W and the Cambrian bodies may also be related to such features.

11. Devonian granites are massive bodies and may be interconnected at depth. Only small parts of the roof are exposed. There is evidence that considerable alteration has taken place in the roof rocks.

12. Much mineralisation can be related to roof or wall rocks to major Devonian plutons, or the vicinity of known or inferred Cambrian granites. Where the granites were fracture controlled (e.g. Moina) E-W trends are reflected in mineralisation but elsewhere such trends seem to have been guides for emplacement and fluid passage. Other trends, NW-SE and NE-SW, often with no known surface expression, have controlled mineralisation in many areas.

RECOMMENDATIONS

This report cannot be considered an adequate analysis of the gravity data within the TASGRAV data base and merely represents an initial interpretation using basic methods in order to evaluate the scale of sources and gross relationships. Many points have been noted within the text where uncertainty is expressed and where refined methods should be applied to resolve features. Given the limitations of coverage and spacing the interpretation does form the basis for detailed infill or three dimensional modelling of particular structures. Many examples could be cited where application of whole geology, weighted contrast, structural array correlated methods would be of general and economic interest. Possibilities soluble at second order level with the present data include the form of the Rosebery structures, the depth and character of roof forms to the granite masses, configuration of the Lyell Fault zone and disposition and property variation of units beneath it, the Moores Valley zone and structuring south of Mt Darwin. Future interpretation must incorporate the effects of sources within the topography and could usefully aim to refine definition of major lineaments and zones of density alteration. Leaman Geophysics possesses the necessary interactive software and experience to provide 3D structural interpretations of this type.

While the above comments provide a general recommendation concerning the interpretive potential of the survey the most obvious need is an extension to the west and north to allow definition of the other side of the rifts, examine the Rocky Cape Group and the shape and potential of the Heazlewood Complex. Such an extension would allow complete appraisal of both the Meredith and Heemskirk Granites and their relationship to each other and mineralisation. This survey demonstrates that reasonably detailed interpretations can be made from a 1 km spacing and that any regional extensions should be on this scale. More detailed prospect or specific structural studies will require spacings of 250 m or less. The 1 km spacing provides a sound basis for definition of local "regional" fields where explorers undertake gravity surveys on licence areas.

Attention should also be directed to correction and full use of the available offshore data. This has only been used in a very limited manner here, but data across the continental shelf may be of considerable value.

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APPENDIX 1

CORRELATION WITH MAGNETIC INTERPRETATION OF 1981 AND 1985 REGIONAL MAGNETIC SURVEYS

This report is my third interpretation report contribution to the Mt Read Volcanics Project. The final report is devoted to specific mineralisation signatures. Although commissioned simply to provide an initial interpretation of the data available I have attempted to provide both appraisal of the data and its value as well as a skeletal structural and mineralisation assessment. Readers who have perused all three reports will know that many issues discussed are rarely raised in interpretation reports and that there is a structural bias. There is also an evolution of structural concepts and presentation of many controversial topics. Each report was intended to stimulate discussion, review past and present exploration concepts and place limits on future concepts. These issues reflect my interest and objectives as well as a desire to travel paths which might open new avenues for exploration. The structural bias in all interpretations also reflects the coverage and resolution of the data sets used. Neither were ideally suited to prospect or small area analysis and such studies were beyond the general scope of this sub-project as defined.

As data was acquired, corrected and reviewed over a period of several months it was inevitable that there should be some evolution in the ideas presented - especially as gravity data was not available until after completion of the magnetic interpretations. This appendix considers those aspects of each interpretation which ,in retrospect, conflict with or extend the views of earlier reports.

Matters of presentation and resolution:

The regional magnetic data, as presented by Leaman (1986a, b), are dominated by near surface sources and are equivalent to a residual gravity map. Consequently interpretation of the profiles was depth limited to 3 to 5 km. Continuation and correction of this data as outlined (op cit) would enhance the more regional components of the magnetic field and make it analogous with the gravity field as presented in this report. Larger and deeper source relationships could then be appraised in validation of some elements of this gravity interpretation.

The gravity field, as observed, is generated by sources in the 1 to 20 km range although there are minor contributions from mantle sources and some high contrast shallow sources. The latter are not well defined by a 1 km spacing. The survey provides an excellent basis for detailed infill for prospect or tenement evaluation without need for concern about more regional contributions.

The two data sets, in their present forms, have a relatively thin band of interpretive overlap; 1 to 5 km deep. This has been sufficient in many areas for the gravity model to incorporate, or test, concepts developed in magnetic interpretation. In every case where it was possible to do so the structural relationships implied magnetically formed the heart of the initial gravity model. It must also be recognised that magnetic interpretation tends to be more selective since there are usually more density contrasts available. Fortunately some units which lack a density contrast possess a magnetic contrast and others possess both.

Further work using either data set may now be fully interlocked since there exists a basis for the more involved models required. If the full potential of the potential field data is to be realised the two methods must be used in equal cooperation and that means presentation equivalence with respect to the sources evaluated, correction and modelling of sources in the terrain (partly done here and in Leaman, 1986a), and three dimensional techniques. Leaman Geophysics has the experience and interactive software necessary to create, iterate and evaluate complex and complete geological models.

Correlations and differences:

1. Trend studies.

Several trend sets were clearly recognised in observed magnetic data. Others were revealed, and many enhanced, by elimination of terrain effects. While most of the features described are shallowly sourced (at least) two were shown to be crustal in origin (Rosebery and Comstock) when corrected. These quantitative reviews did not encompass the entire survey (Leaman, 1986a).

The magnetic interpretation emphasized E-W trends for two reasons; they are clearly present and they were unexpected given the predominance of N-S structuring and strikes. In Figure 32 (a sample of magnetic interpretation) it was suggested that many trends were not continuous between the Tyennan core and the coast. This could not be explained. The gravity interpretation resolves this difficulty. Although the location of the discontinuity could only be subjectively defined magnetically (pending correction of the entire survey) it lies near the structural front defined by the ultramafics and parallels the exposure of the primary Cambrian thrust zone. This correlation adds weight to the view that the lineaments reflect fracture and alteration zones of perennial and crustal character. They must predate the Cambrian orogeny and yet were still able to control fluid movement, intrusion and fracture control during the Devonian orogeny. There are many controversial potential implications which might be discussed concerning mineralisation and lineaments. One is that the dislocated western zone is unlikely to carry any Cambrian mineralisation at economic depths but will have late Devonian granite-related or remobilised deposits.

2. Attitude of the Tyndall Gp and Tyennan basement.

Several profiles were interpreted magnetically across the margin of the Tyennan Precambrian basement east of the West Coast Range. No consistent solution was found for the attitude of the

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Cambrian-Precambrian boundary. It was variously interpreted as dipping east or west. All gravity interpretations are clear. The boundary dips west but is folded and sometimes faulted in regions where the Tyndall Group varies in thickness or onlaps basement. This coupling of structures and the strong magnetisation of the Tyndall Group makes magnetic definition of the boundary most uncertain on a regional scale due to source variability factors. Thus where the situation is simplest the west dipping view is dominant. The gravity interpretation offered permits revision of this part of the magnetic models and thus better resolution of the extent and form of the Tyndall Group.

3. The displaced Precambrian blocks.

The magnetic interpretations dealt with two examples of such blocks; Cape Sorell and the Ramsay River - Rosebery - Dundas zones (refer classes 2 and 3, page 33). In Leaman (1986a) it was merely suggested that the Cape Sorell Block may not have been in place since the idea was considered radical and there was insufficient evidence or coverage to confirm it. The nature of the fault zone carrying the ultramafics was studied carefully. Extension of the survey southward led to clear inferences that both blocks on Cape Sorell were thin and displaced (Leaman, 1986b). The second report appears confusing since more than one thrust or thrusting of differing ages and senses was inferred. This report confirms these implications beyond any reasonable doubt and the only issues pending relate to the actual thickness of the blocks and the attitudes of their faulted thrust margins.

The Dundas and Ramsay River blocks were interpreted by Leaman (1986a) as being faulted and shallowly east dipping slices clearly detached from basement. This study confirms that view. The relationships between basement blocks and their point of detachment remain obscure and it is possible that these blocks were torn from basement at shallow depth near the Lyell - Henty Fault System should Oonah type basement abut or overlap Tyennan basement in this zone. Careful reappraisal of surface units is needed and this would be assisted by more detailed gravity and magnetic interpretation to define near surface relationships. Compare Figures 20 to 23, 38.

Unprocessed magnetic data cannot be used to assess the Rocky Cape Block due to its thickness. Further gravity data are also required.

4. The Lyell - Henty Fault System.

These faults appear near vertical in magnetic interpretations but a steep westward dip was inferred. Deeper gravimetric perspective confirms that this is so and that the dip probably shallows with depth.

5. The ultramafics.

These, and certain other Lower Cambrian units including the Crimson Creek Formation, are strongly magnetised. The resultant anomalies tend to dominate the magnetic field. The magnetisation is complex and the body size and configuration is not easily determined. Gravimetrically, however, the ultramafics are seen to be trivial bodies but critically located in terms of structural interpretation. Their volume is small, they are not united in depth and they can nowhere be related to chunks of "oceanic crust" or "subduction" zones. They were largely in place as structural shards or structure surface sheets by late Cambrian times since magnetic data show that one mass was eroded and folded into the Huskisson Syncline beneath Ordovician rocks (Figure 39).

6. The granites.

The Devonian granites are represented by non anomalous areas in the magnetic field. This pattern mirrors exposure although there are halo effects (Leaman, 1986a) which are clearly identified where the intrusion roof is within 1 to 2 km of the surface. Gravity data offer the potential to better define entire shapes. The Cambrian granites are magnetically distinctive but gravitationally inconsequential bodies.

7. The basalt covered areas.

Tertiary basalts contribute much to the character of the magnetic field in NW Tasmania. A measure of filtering is possible and when this is done deeper sources and the presence of thick Cambrian sequences can be inferred (e.g. Figures 4-E-6 in Leaman, 1986a). The spacing of the gravity coverage is such that the effects of Tertiary materials are generally smoothed or absent. An exception is evident in Figure 29.

8. The Mount Read Volcanics.

The low magnetic contrasts of the Mount Read Volcanics has led to reasonable estimates of the Tyndall Group but overestimates of the Cambrian section beneath in those areas marginal to basement. While the interpreted section along the axis of the Range is comparable in gravity and magnetic views it is too thick and given dubious attitudes in magnetic models further east (also 2 above).

Leaman (1986b) accepted, for purposes of magnetic interpretation, the stratigraphic section suggested by Geopeko (e.g. Hermann, 1985). A sequence of up to 7 km of Lewis River Volcanics were said to be overlain by Mainwaring Group and Dundas Group near Elliott Bay. Magnetic interpretation showed that the section could not be so thick but was biassed by the sectional assumptions and could not define many other relationships. The gravity interpretation, by defining the volumes and shapes of many more units, shows that the sequence proposed cannot be correct. Rather the style of the models along the length of W Tasmania indicate the same structural patterns and origins and that the Lewis River Volcanics are equivalent to the Mount Read Volcanics east of the Lyell Fault. The Mainwaring Gp and overlying units are much older but juxtaposed by large thrust faults.

9. Effect of Tertiary sediments and basins.

Although the coverage of this survey is not able to fully define the Macquarie Harbour and Moores Valley Tertiary basins or the structure linking them gross aspects have been described. The most important ramifications lie in the region of Moores Valley where the assessment of the magnetic units and contrasts was based on a much thinner Tertiary section than appears to be present. The Moores Valley basin appears to be discrete, but structurally linked to Macquarie Harbour. The linking structure, a possible half graben or even an eroded fault zone, can not be shown to be more than 400 to 500 m deep on present data whereas the NW-SE en enchelon tensional pods at Strahan and Moores Valley are in excess of 800 m thick.

APPENDIX 2

DETAILS OF TIE STATIONS

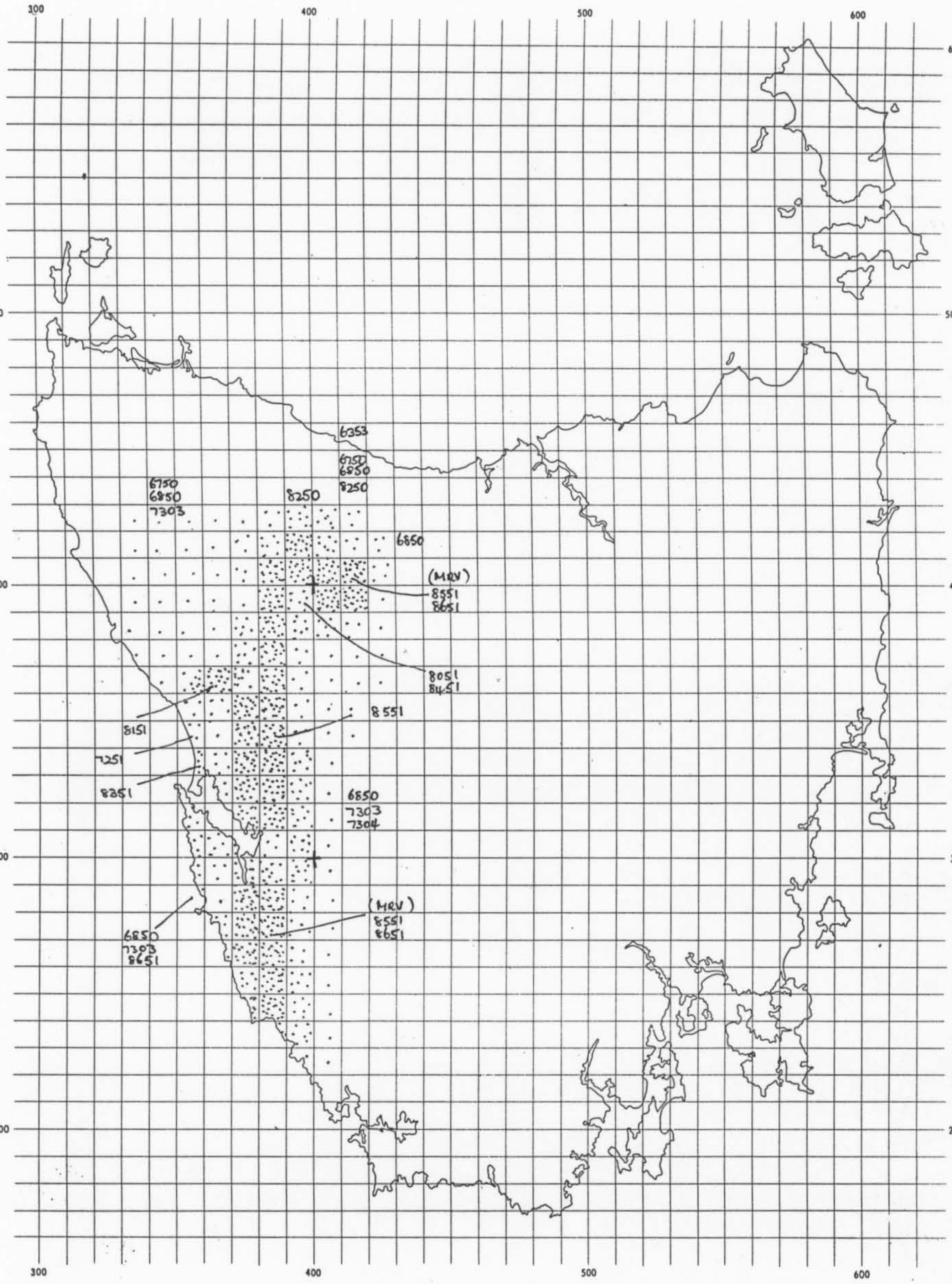
The primary reference point for the Mount Read Volcanics Project surveys was at Queenstown. The table presents observed gravity and numbering details. Stations marked # were described and located by Richardson (1985). New stations at Cradle, Crotty, Mt McCutcheon and Moores Valley are briefly described below.

CRADLE. NW corner Cradle Mt Lodge adjacent to verandah.
CROTTY. N end of path to Crotty site office. Nail set 50 cm from path end.
MT McCUTCHEON. Small indentation mark in centre concrete slab adjacent NW side helipad.
MOORES VALLEY. At front right side door of hut at airstrip.

Station name	number	observed gravity
CRADLE	-	980141.12
CROTTY	-	980312.34
GORMANSTON #	8051.9905	980274.16
alternate	8551.9975	980274.23
MT MCCUTCHEON	-	980306.60
MOORES VALLEY	-	980397.10
QUE RIVER #	8451.9012	980177.97
alternate	8551.9976	980177.50
QUEENSTOWN #	8451.9010	980305.27
ROSEBERY #	8051.9906	980281.24
STRAHAN #	6491.9136	980371.69
TULLAH #	8051.9902	980274.83
WARATAH #	8451.9013	980182.00
ZEEHAN #	8051.9902	980274.83

5 cm

027056



GRAVITY DATA
SURVEY SOURCES AND COVERAGE
(data base file codes)

See also Leaman (1980) for source references

FIGURE 1

027057

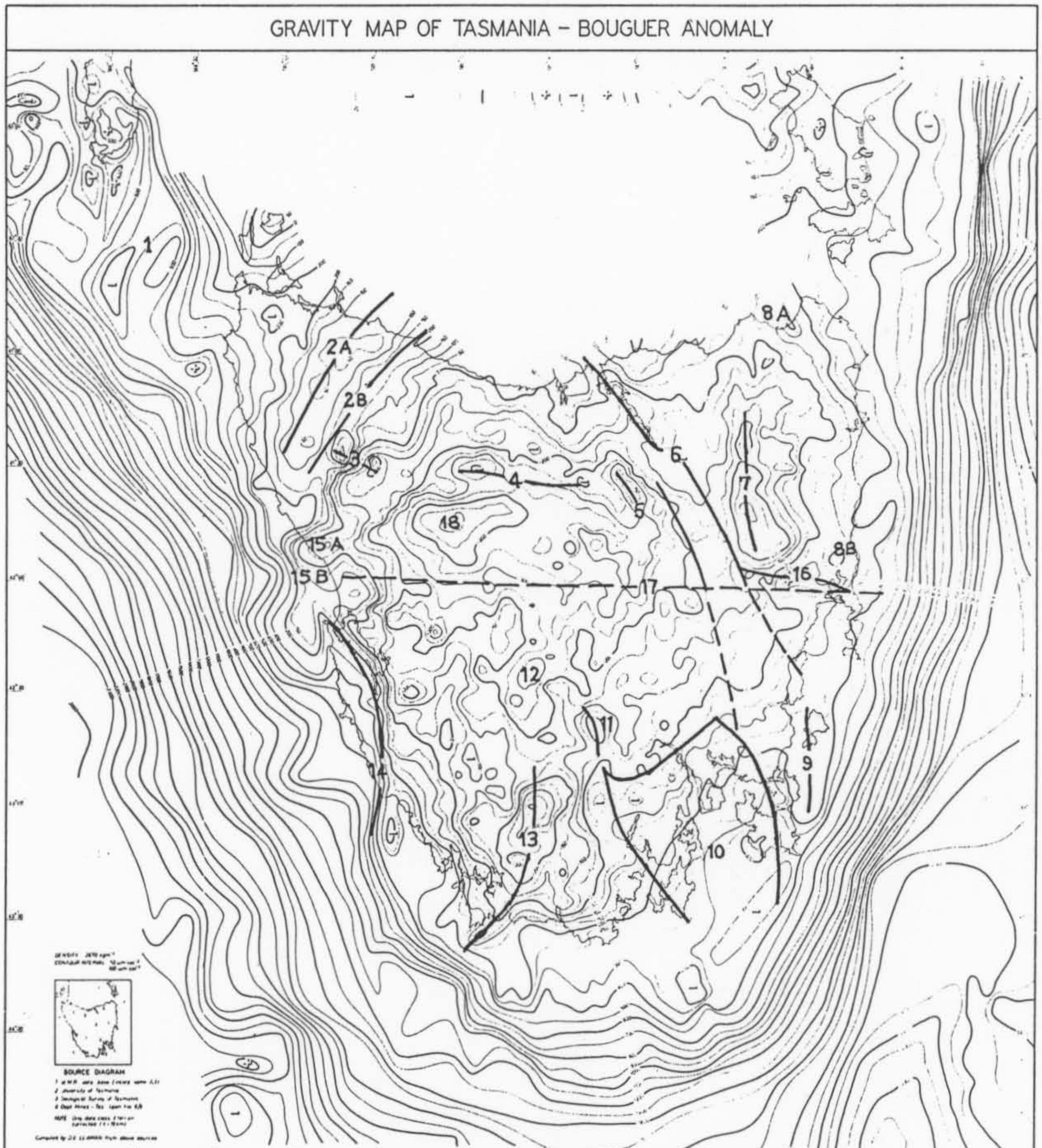
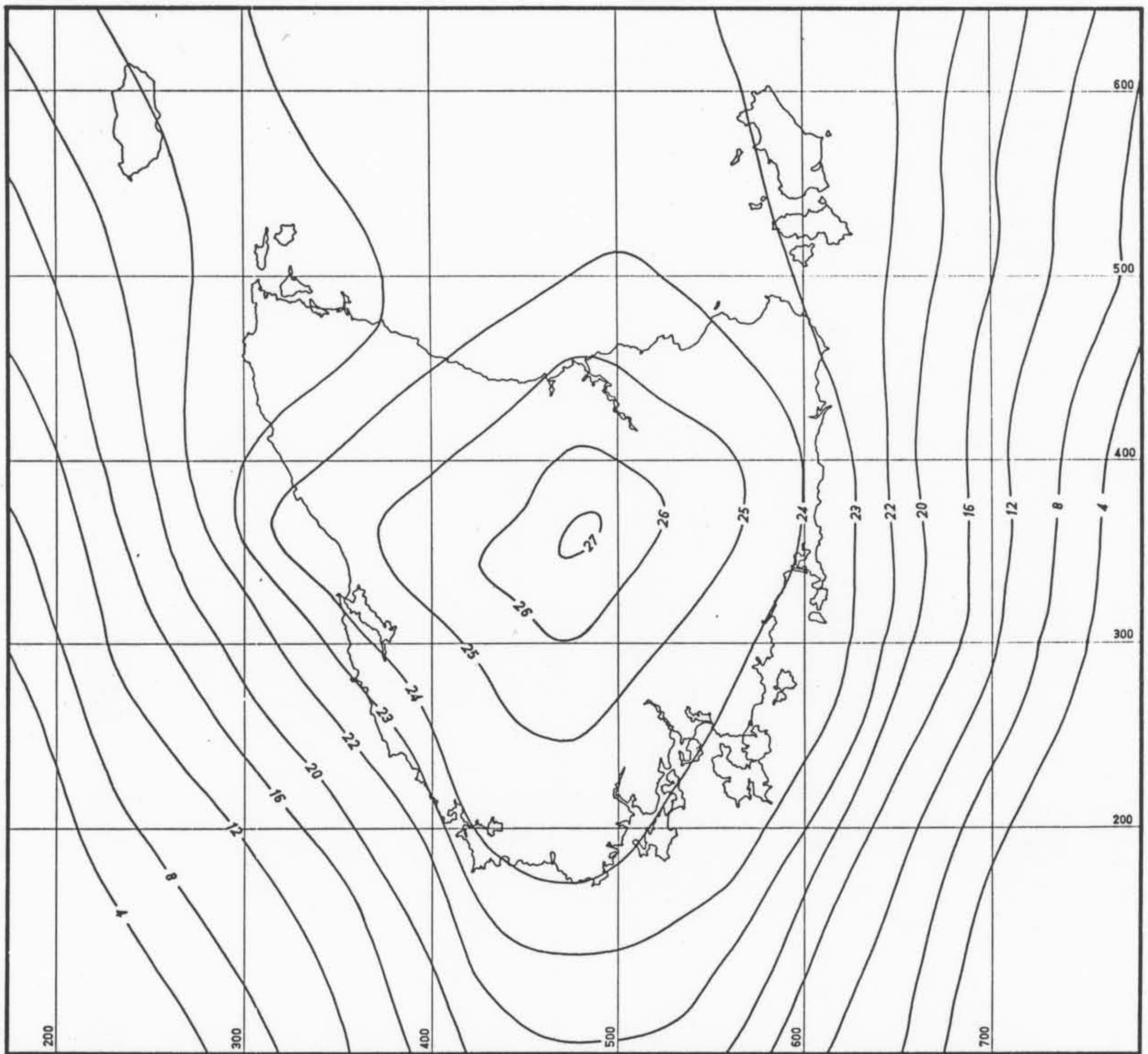


Figure 2. *Gross features of the Bouguer anomalies*
(after Leaman et al, 1980)

5 cm

FIGURE 2

0 2 7 0 5 8



MODEL OF CRUST-MOHO SURFACE

CRUST DENSITY 2·74 t/m³
MANTLE DENSITY 3·34 t/m³

Figure 7. (of Leaman et al, 1980)

5 cm

FIGURE 3

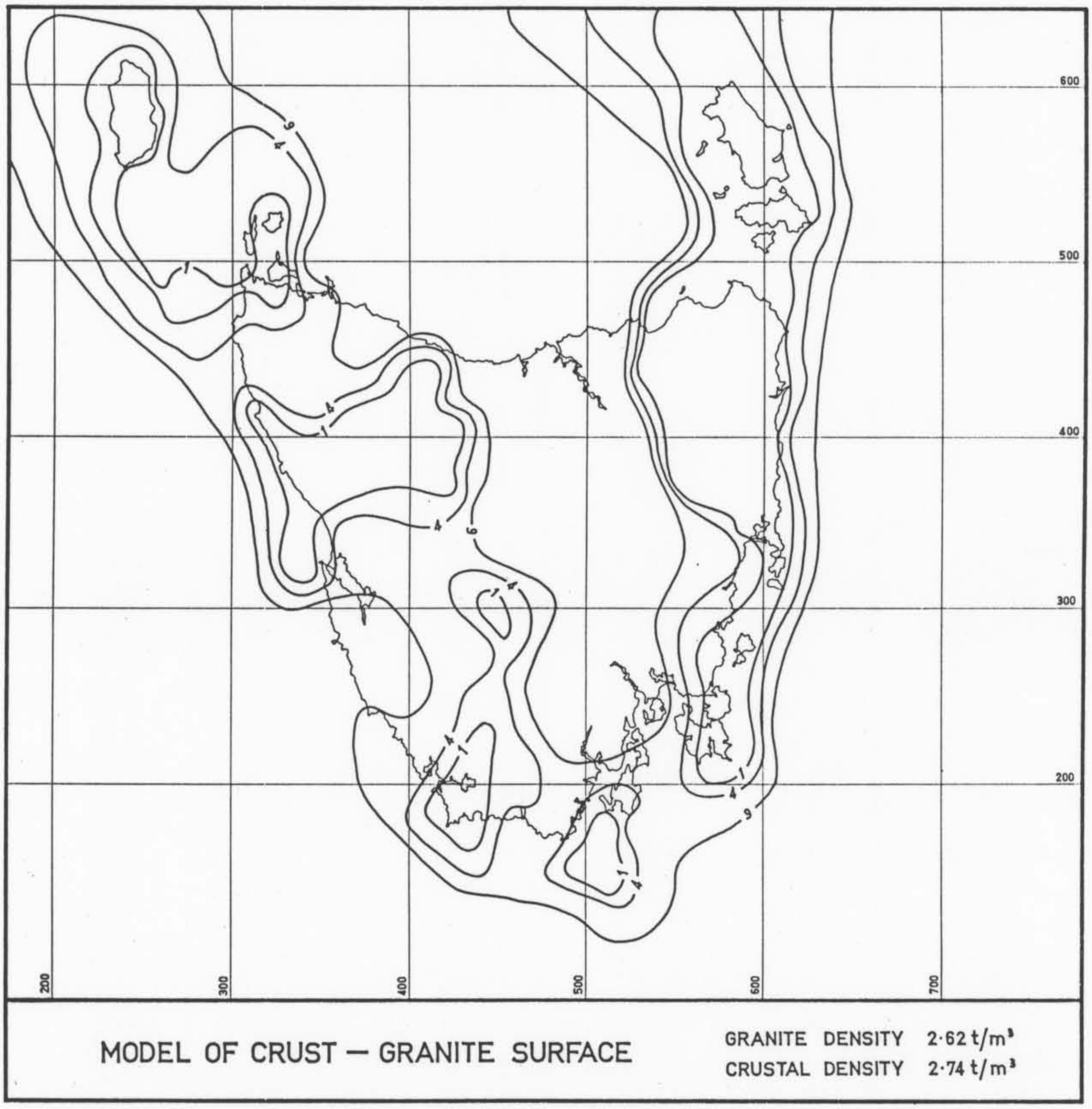
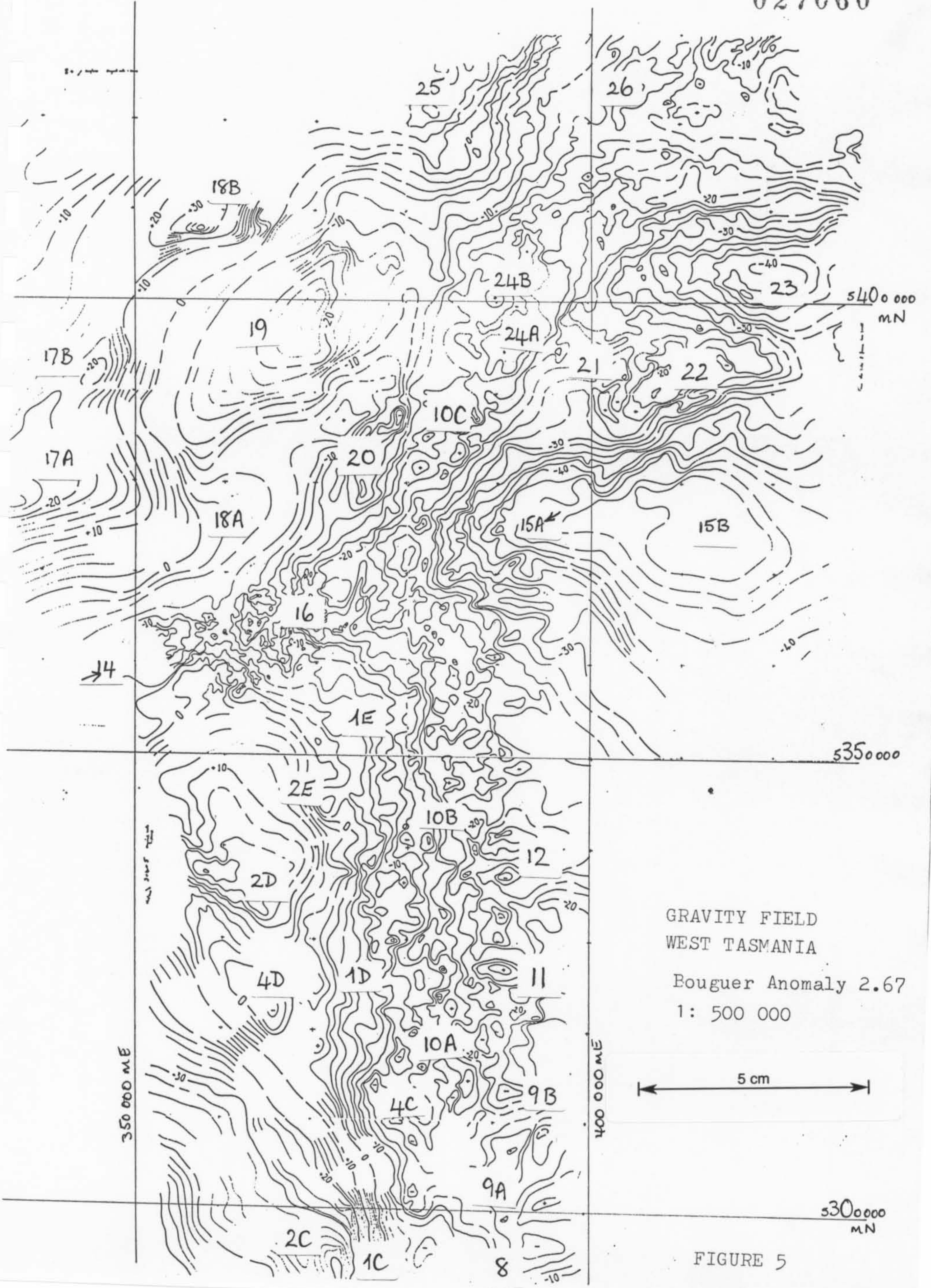


Figure 8. (of Leaman et al, 1980)

FIGURE 4

027060

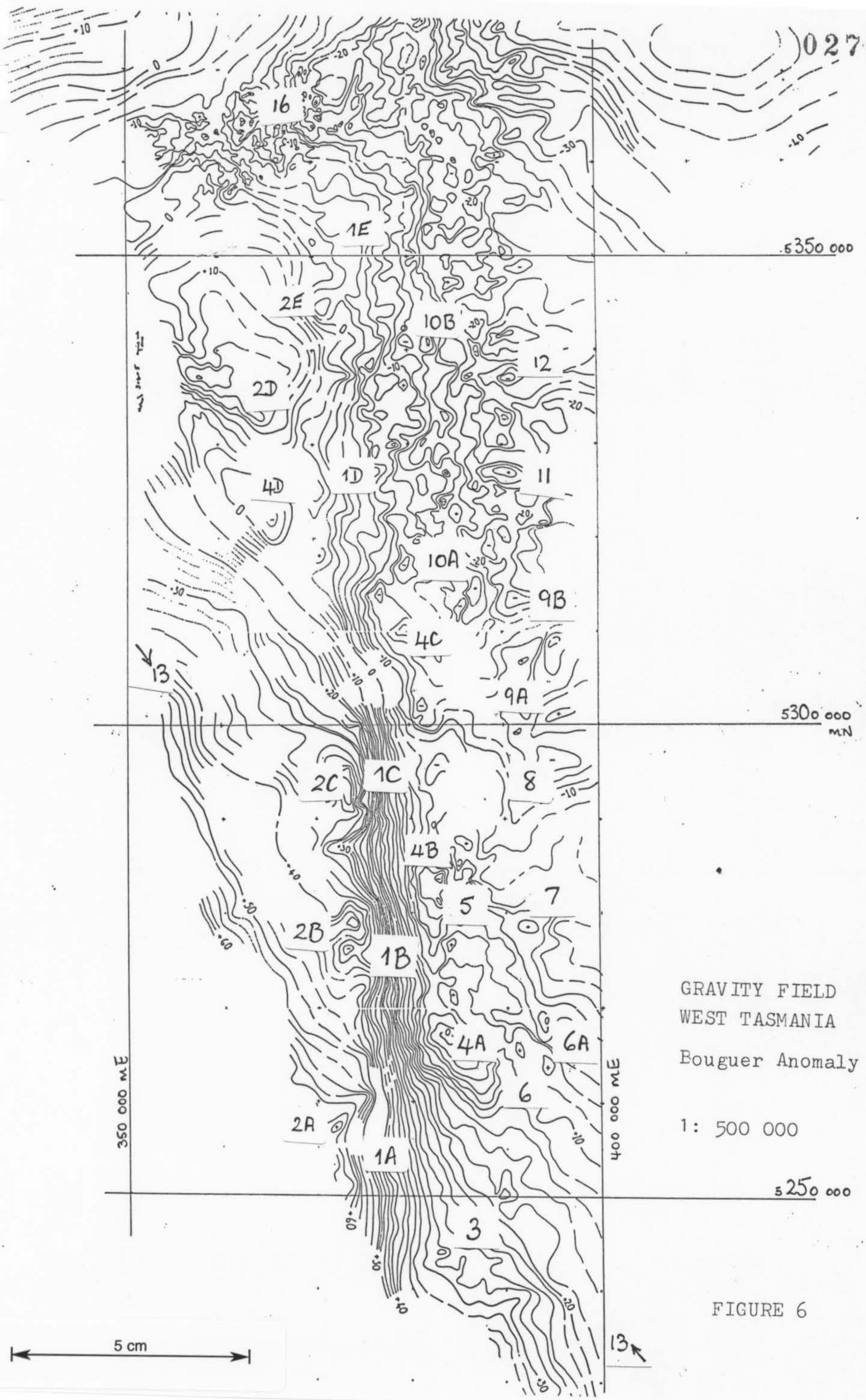


GRAVITY FIELD
WEST TASMANIA

Bouguer Anomaly 2.67
1: 500 000

FIGURE 5

027061



GRAVITY FIELD
WEST TASMANIA

Bouguer Anomaly 2.67

1: 500 000

FIGURE 6

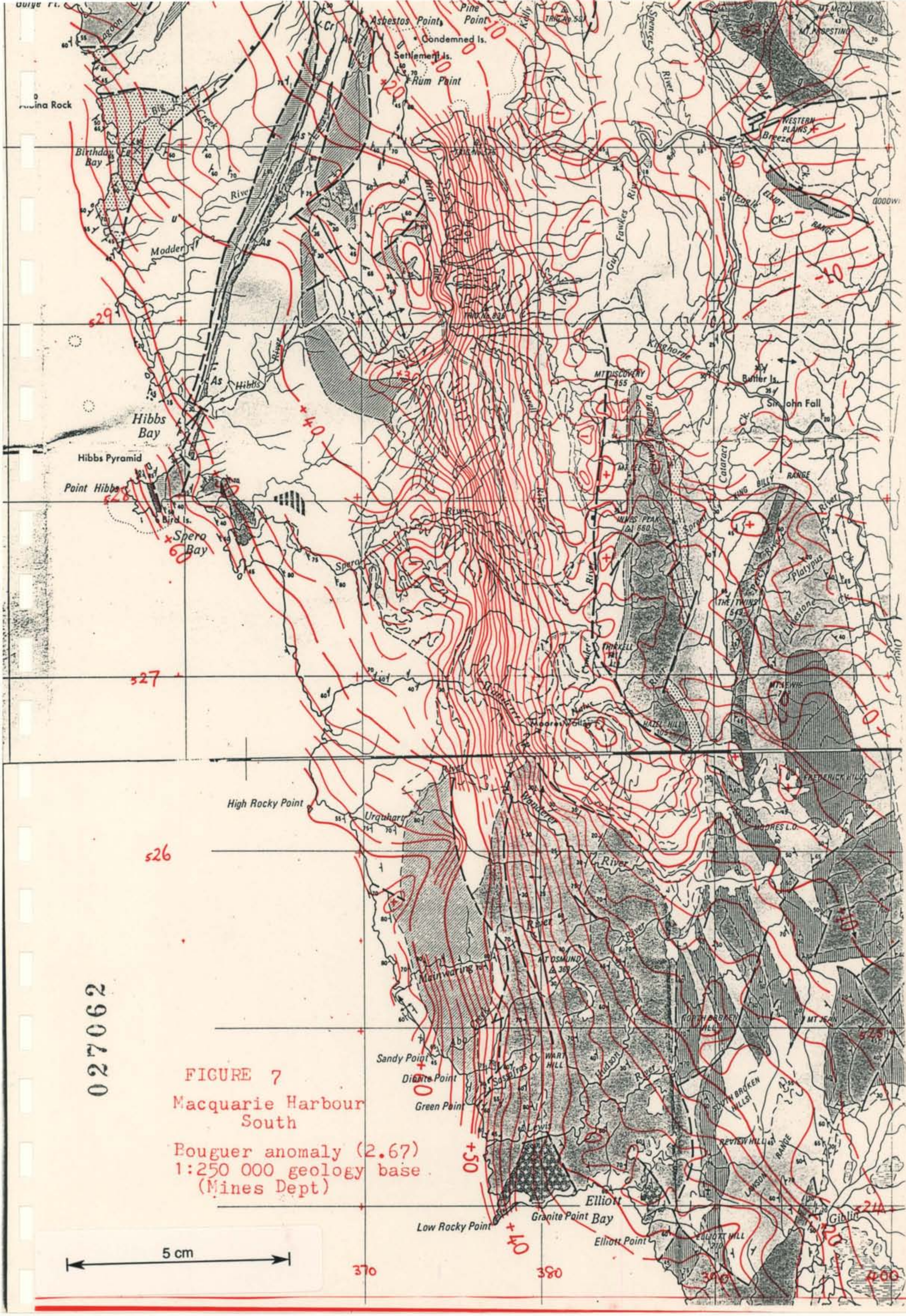


FIGURE 7
Macquarie Harbour South

Bouguer anomaly (2.67)
1:250 000 geology base
(Mines Dept)

027062

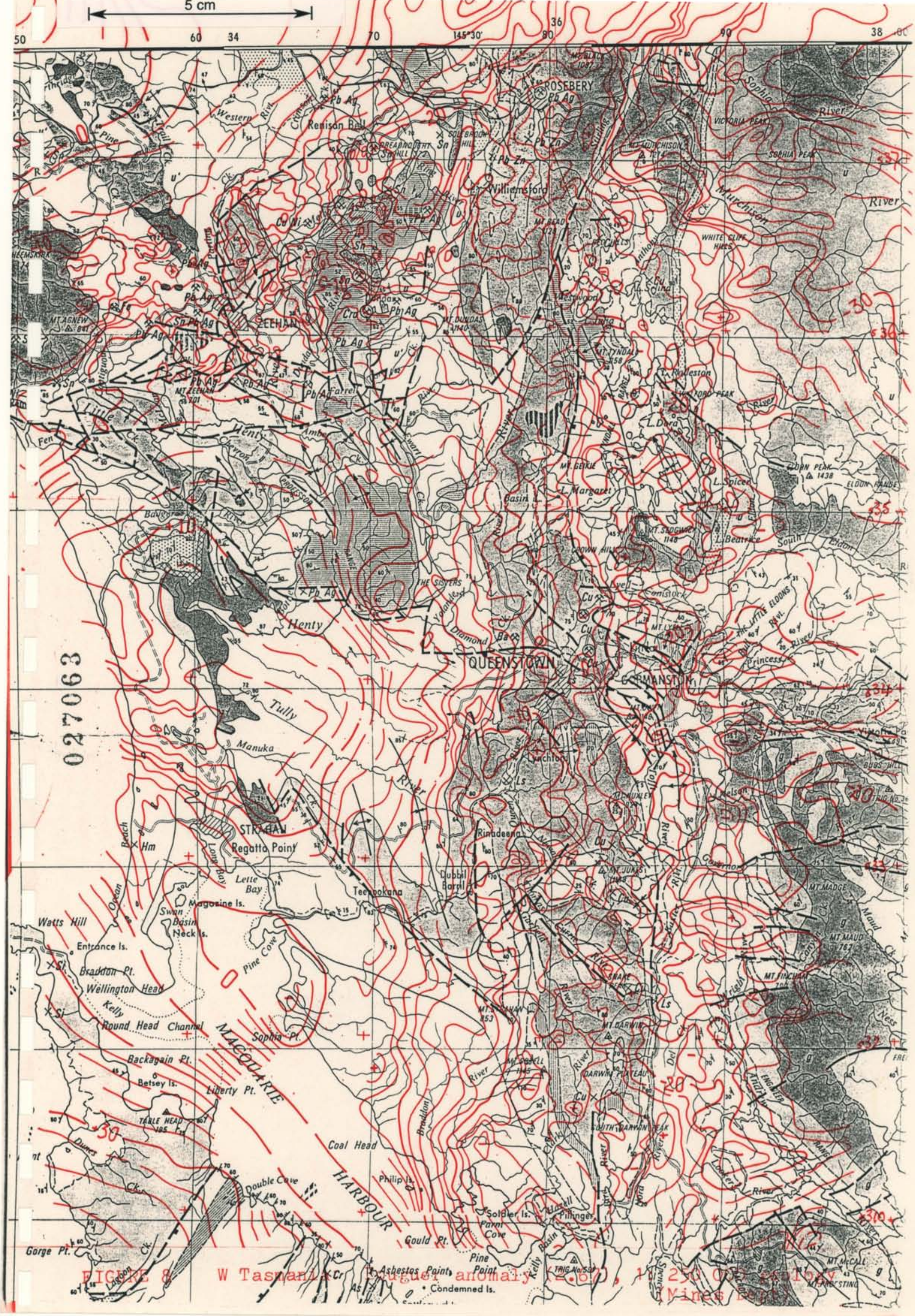
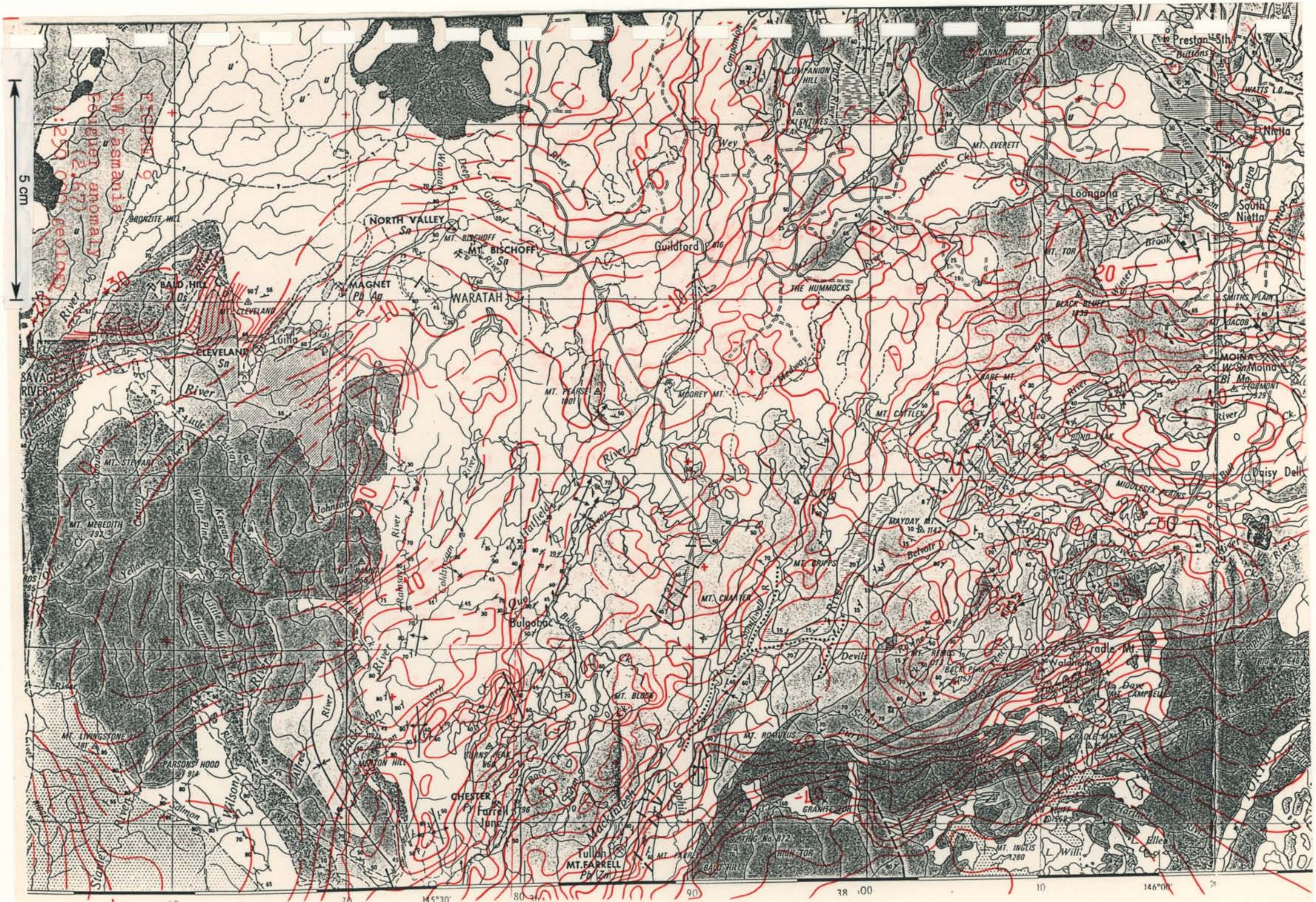


FIGURE 8   W Tasmania Bouguer anomaly (2.67), 1:250 000 geology (Mines Dept)


5 cm
NORTH VALLEY
MT. BISCHOFF
WARATAH
MAGNET
Guildford
BALD HILL
CLEVELAND
Luina
SAVAGE RIVER
MT. STEWART
MT. MEREDITH
MT. LIVINGSTONE
PARSONS HOOD
CHESTER
Farrell Junc
Tullah
MT. FARRELL
Bulgobac
MT. PEARSE
MOOREY MT.
THE HUMMOCKS
MT. EVERETT
COMPANION HILL
Loongana
MT. TOR
BLACK BLUFF
SMITHS PLAIN
MOINA
Nietta
South Nietta
Preston
Daisy Dell
MIDDLESEX PLAINS
MAYDAY MT.
MT. CRIPPS
MT. CHARTER
MT. BLOCK
MT. ROMULUS
Cradle Mt.
MT. INGLIS
145°30'
146°00'

027064

027065

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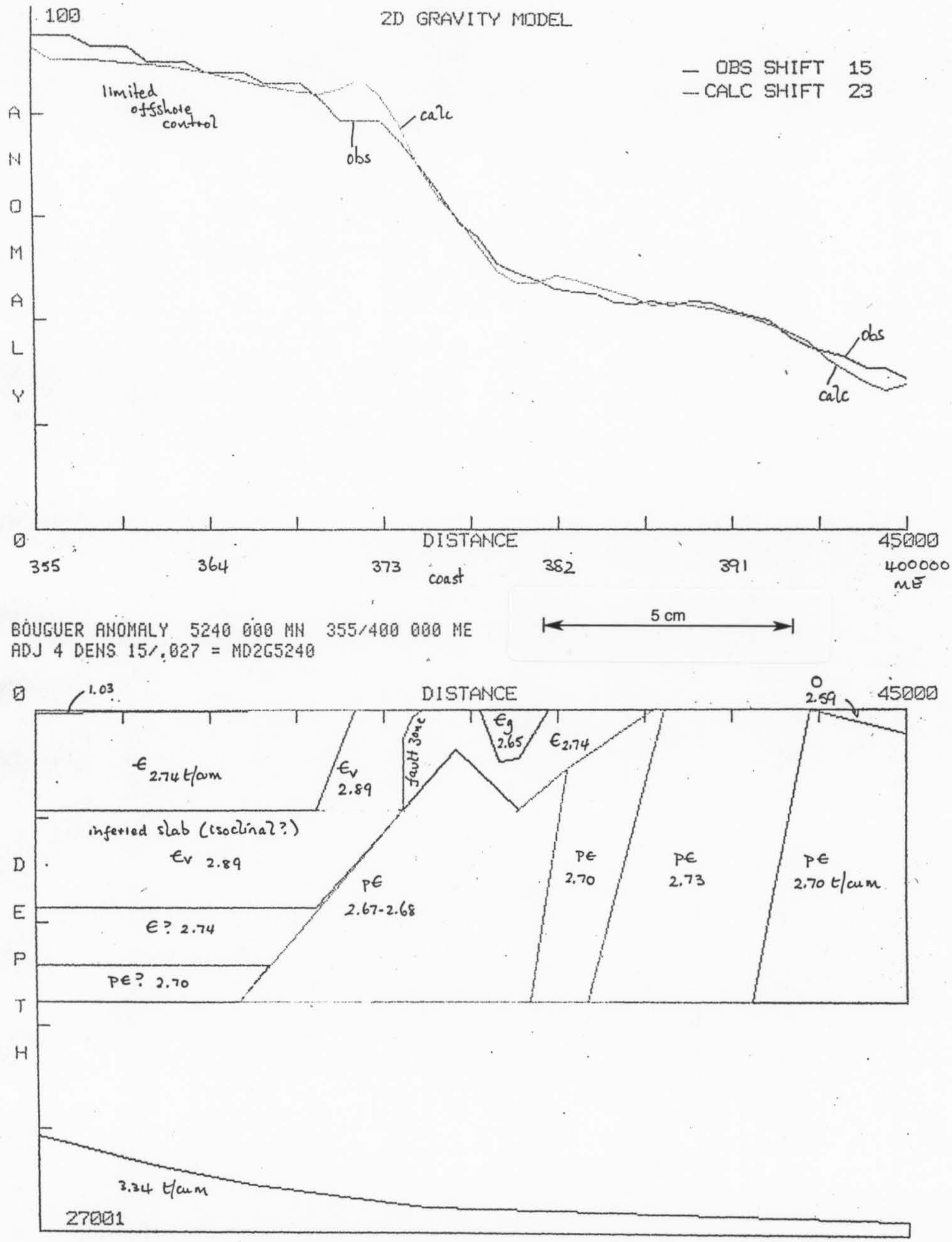

MODEL PROFILES: 5240 000 mN FIGURE 10

027066

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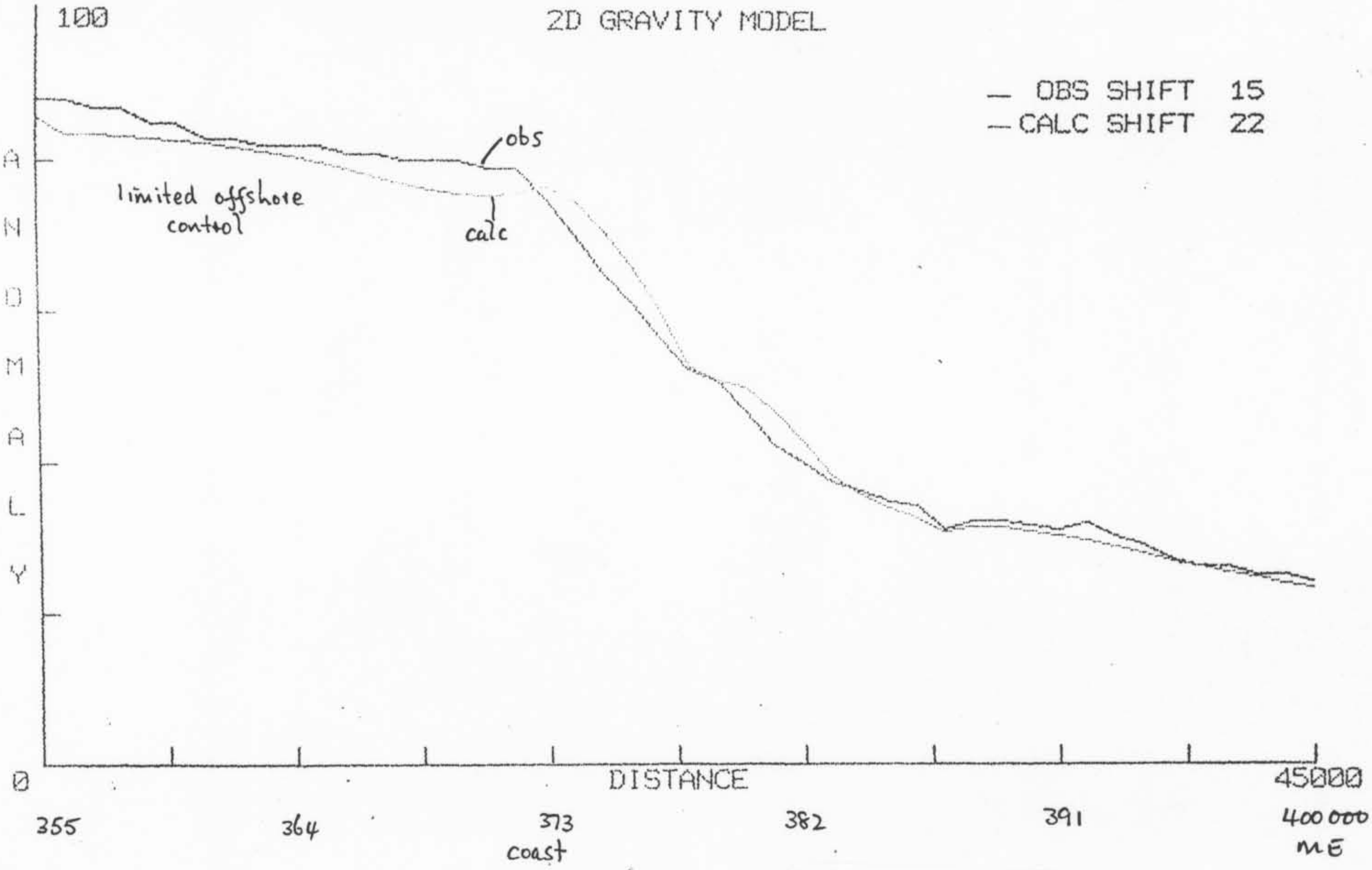
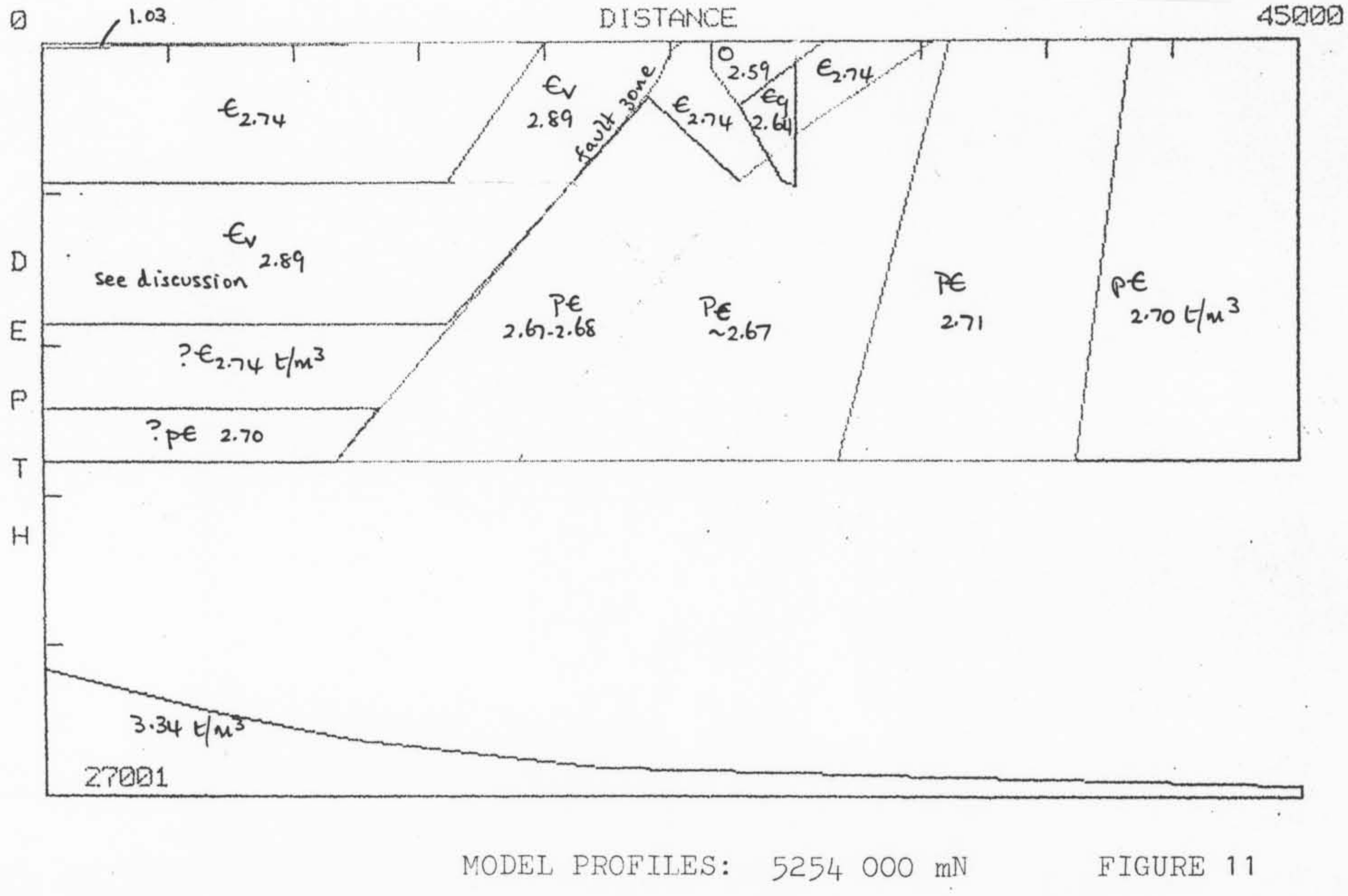


BOUGUER ANOMALY 5254 000 MN 355/400 000 ME
ADJ 1 4 =MD4G5254

5 cm



MODEL PROFILES: 5254 000 mN FIGURE 11

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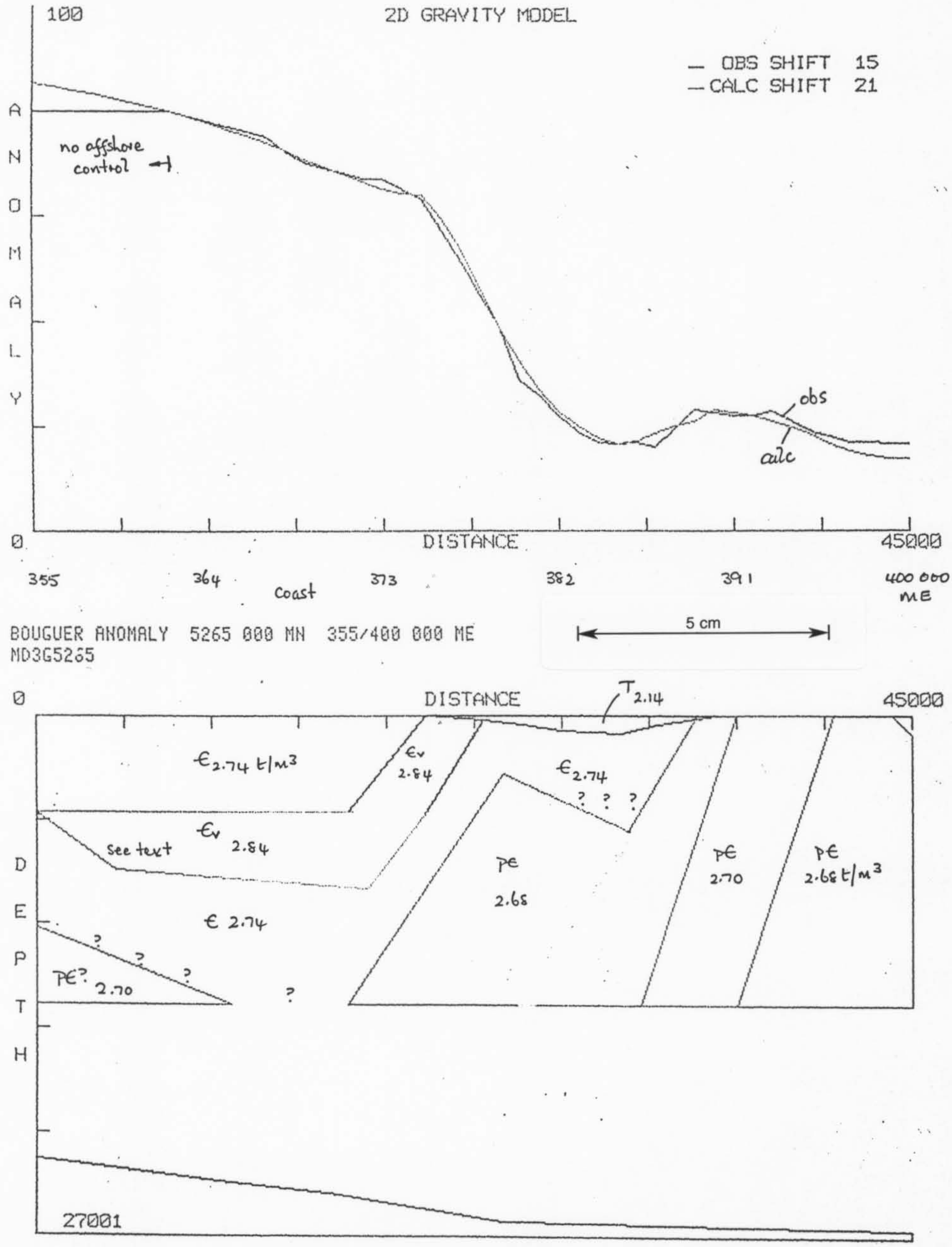

MODEL PROFILES: 5265 000 mN FIGURE 12

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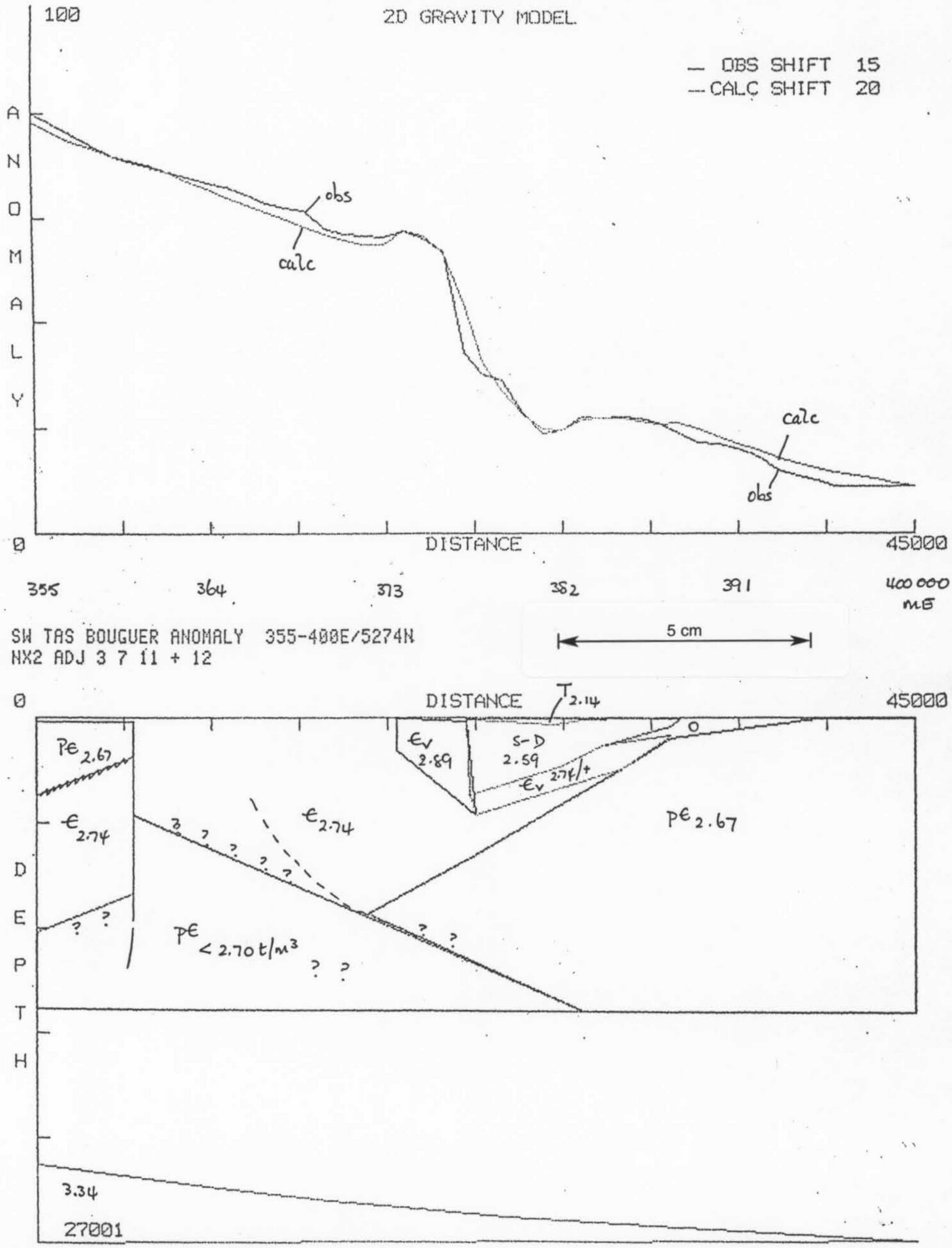

MODEL PROFILES: 5274 000 mN FIGURE 13

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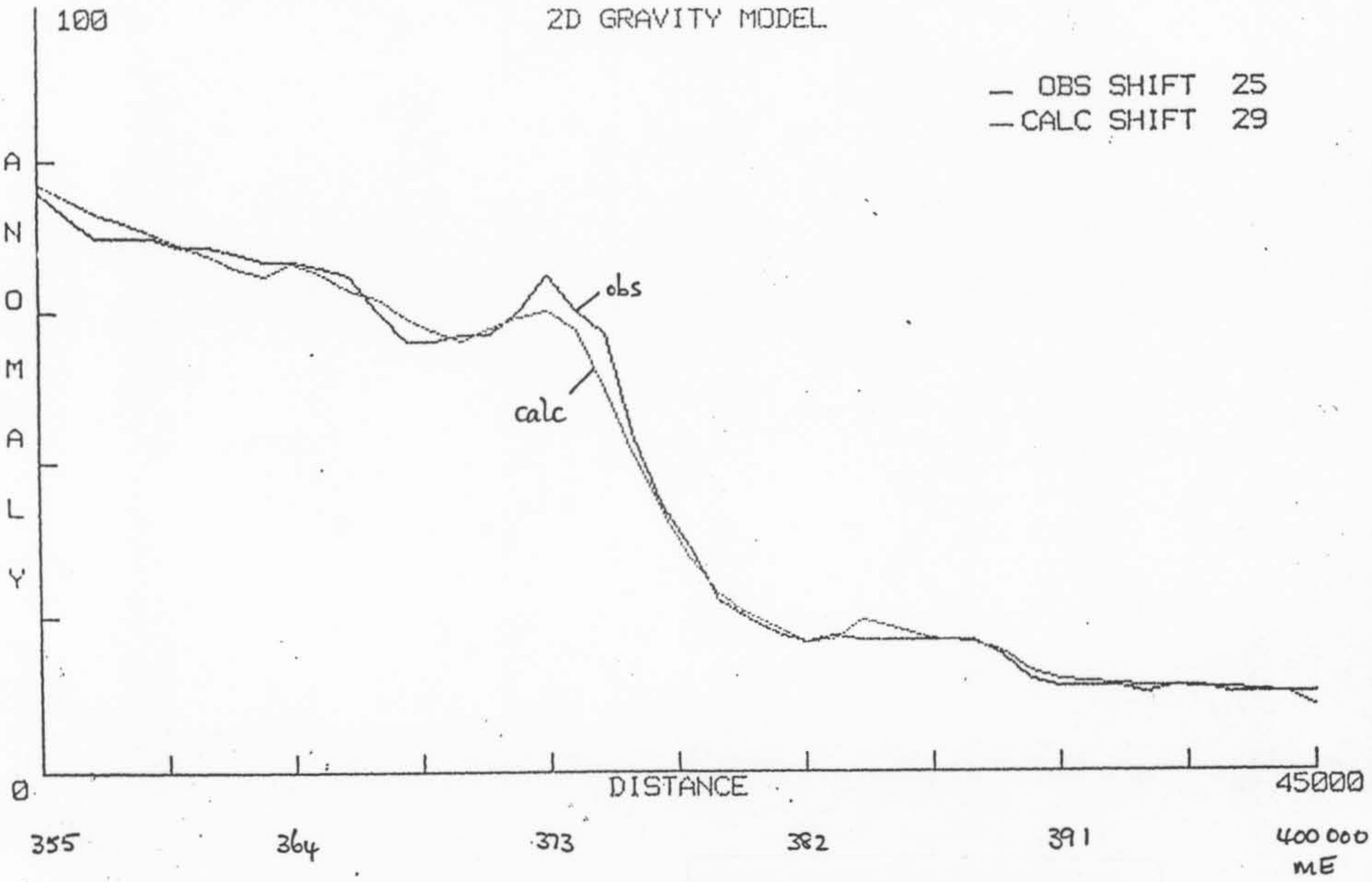
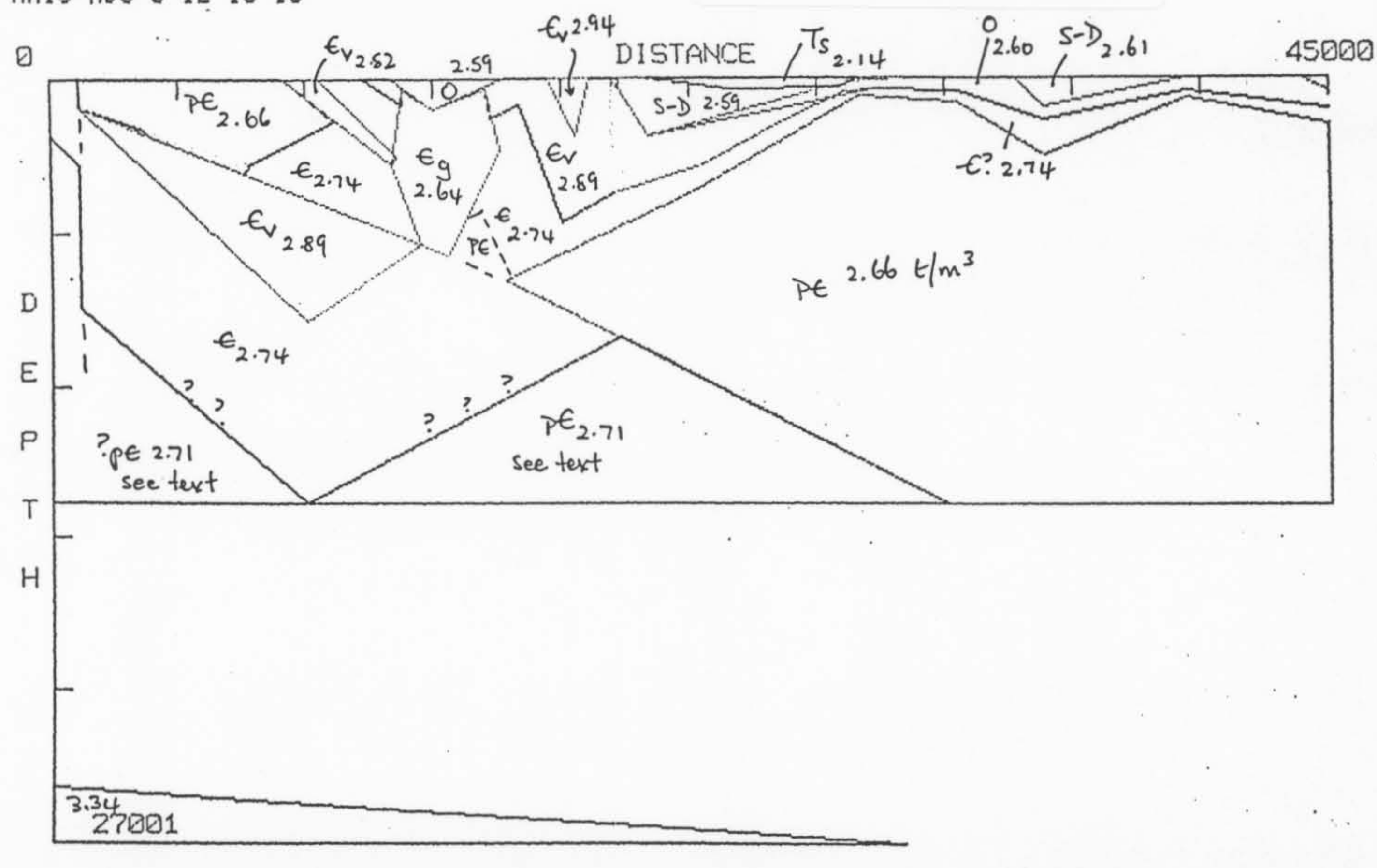


SW TAS BOUGUER ANOMALY 355-400E/5295N .
NX10 ADJ 3 12 15 18



MODEL PROFILES: 5295 000 mN

FIGURE 14

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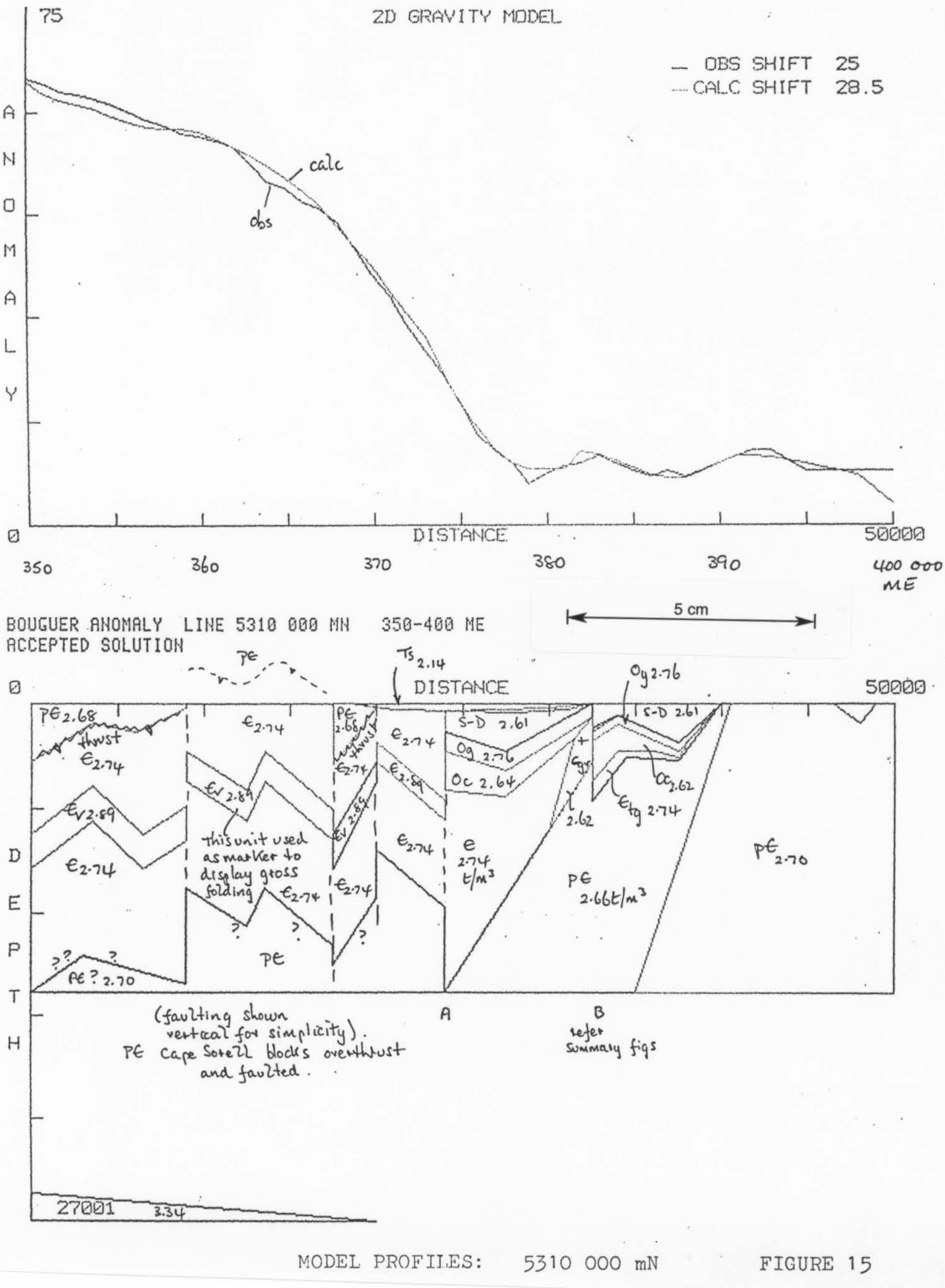

MODEL PROFILES: 5310 000 mN FIGURE 15

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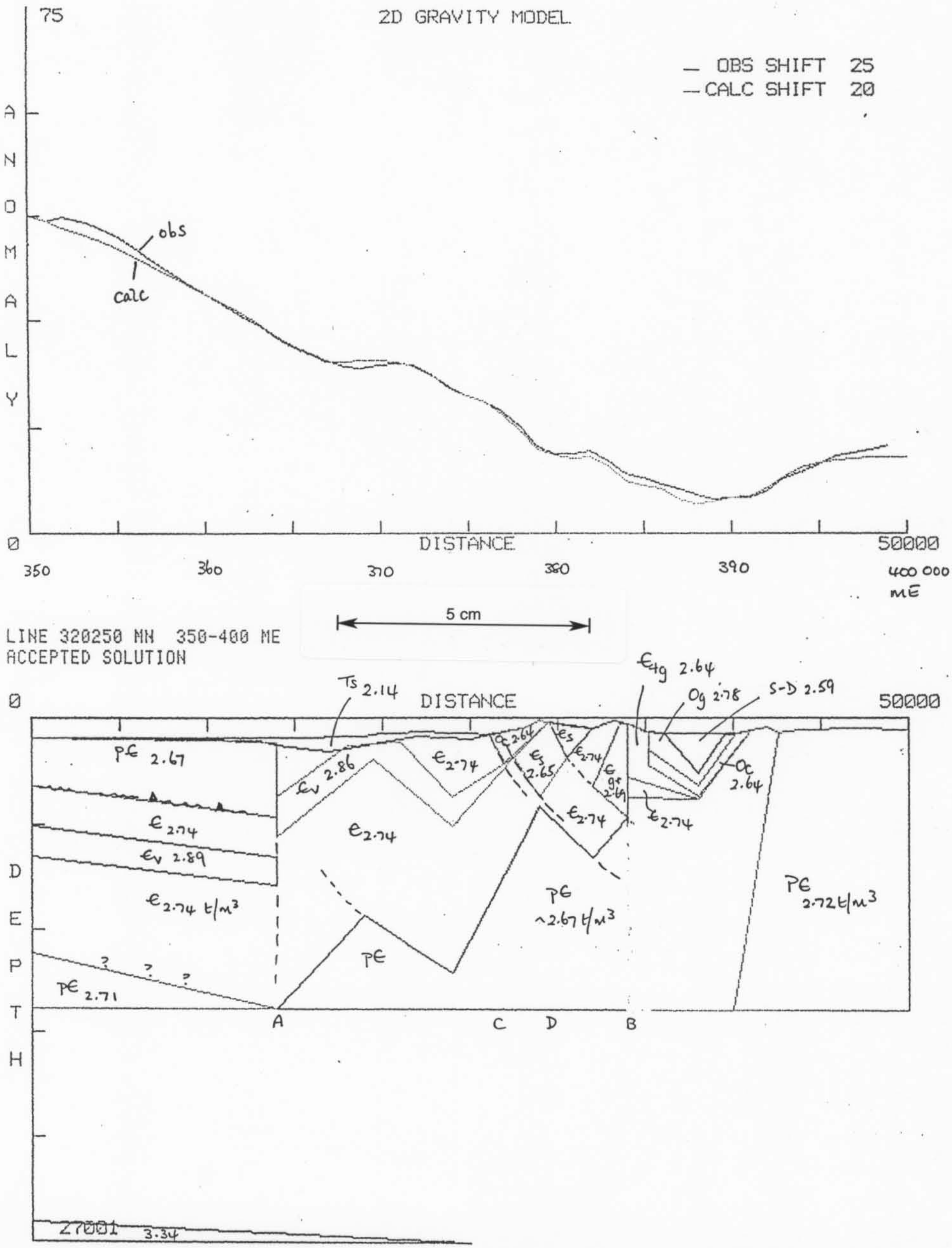

MODEL PROFILES: 5320 250 mN FIGURE 16

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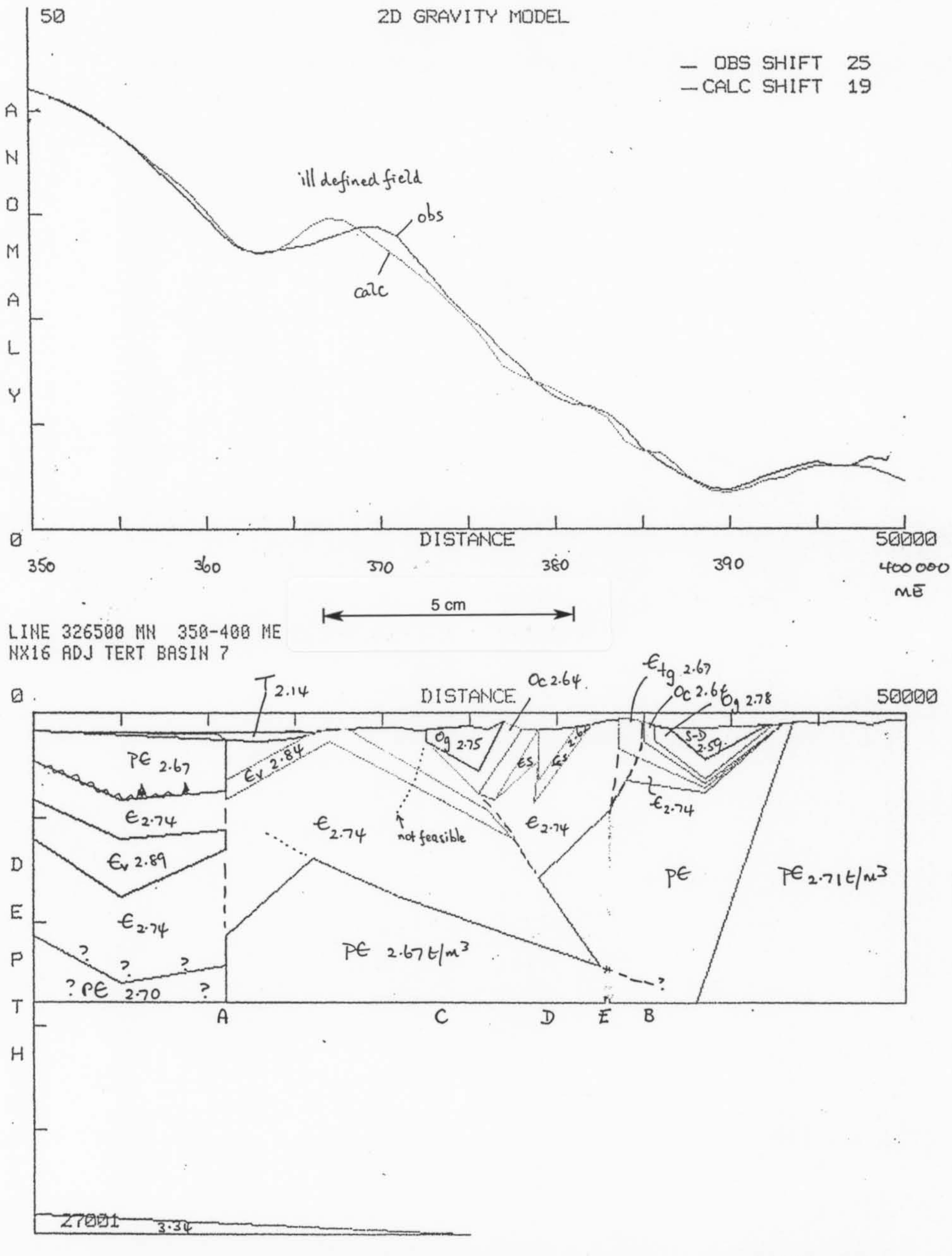

MODEL PROFILES: 5326 500 mN

FIGURE 17

LEAMAN GEOPHYSICS

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Wide Experience Most Methods
Specialties:- Gravity, Magnetics, Seismic Methods

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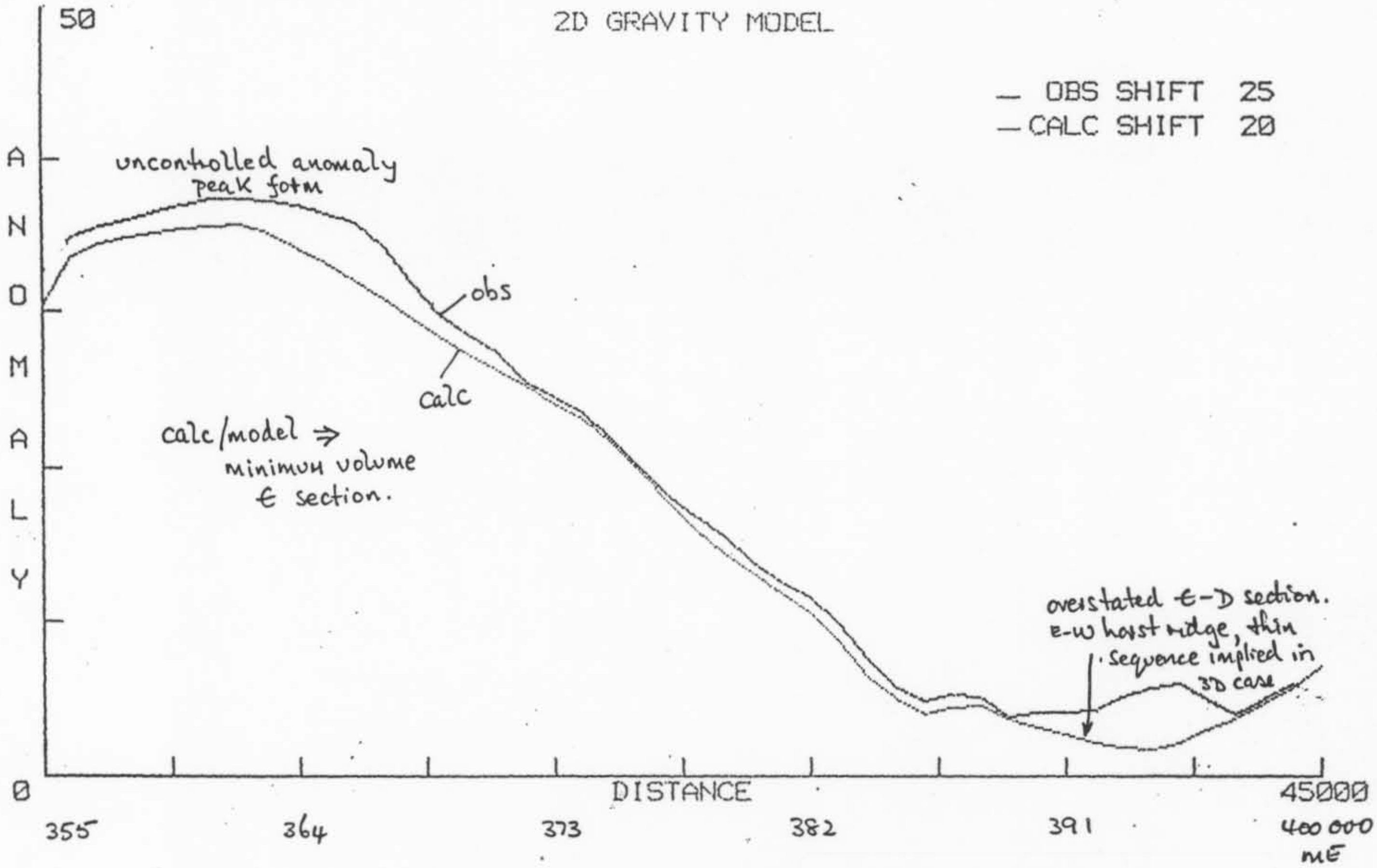
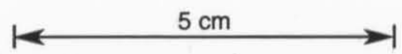
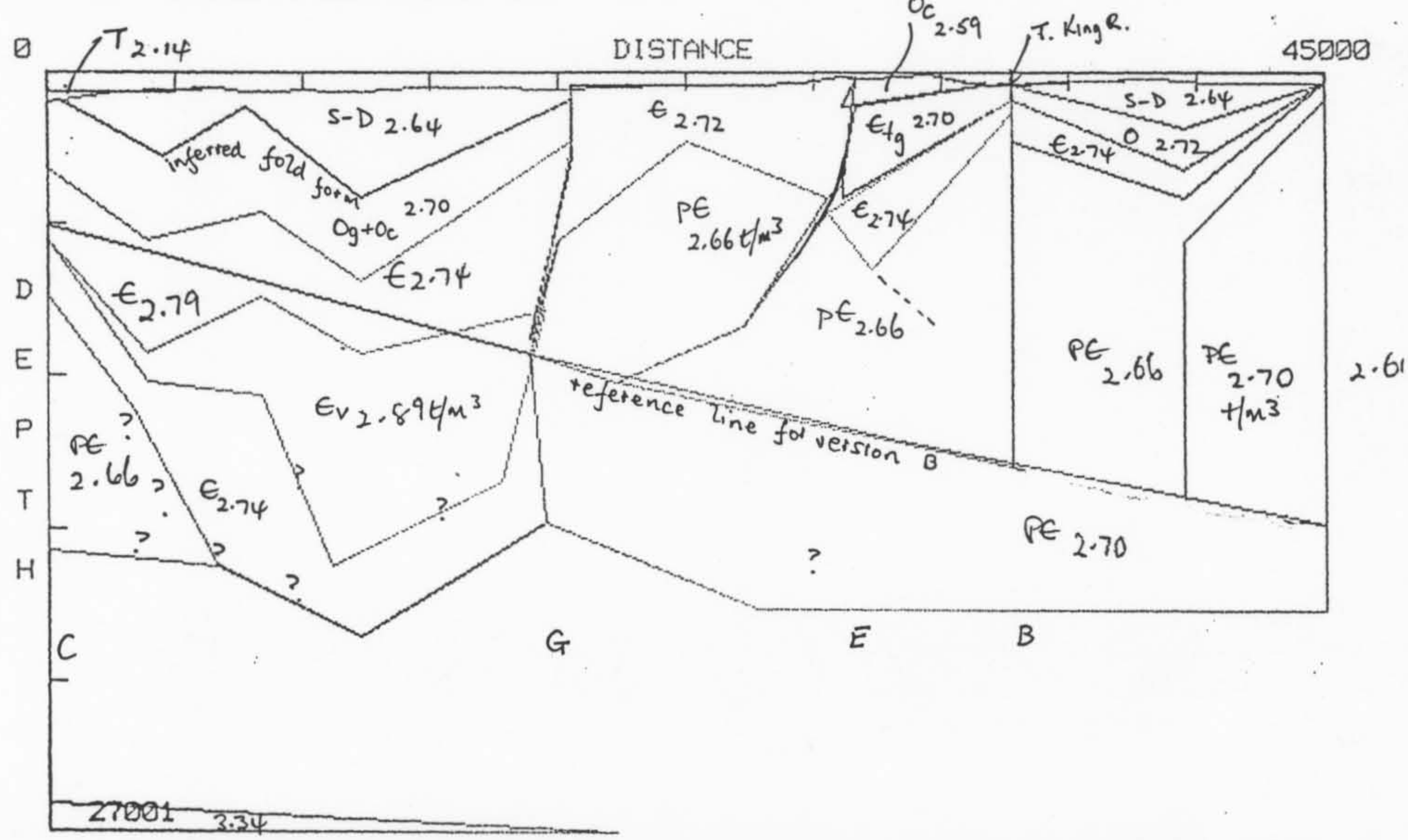




BOUGUER ANOMALY 700M LINE 343N 355-400E LYELL
NX13 MOD4VAR DEEP E TRO ADJ 14 ONLY



MODEL PROFILES: 5343 000 mN version a FIGURE 18

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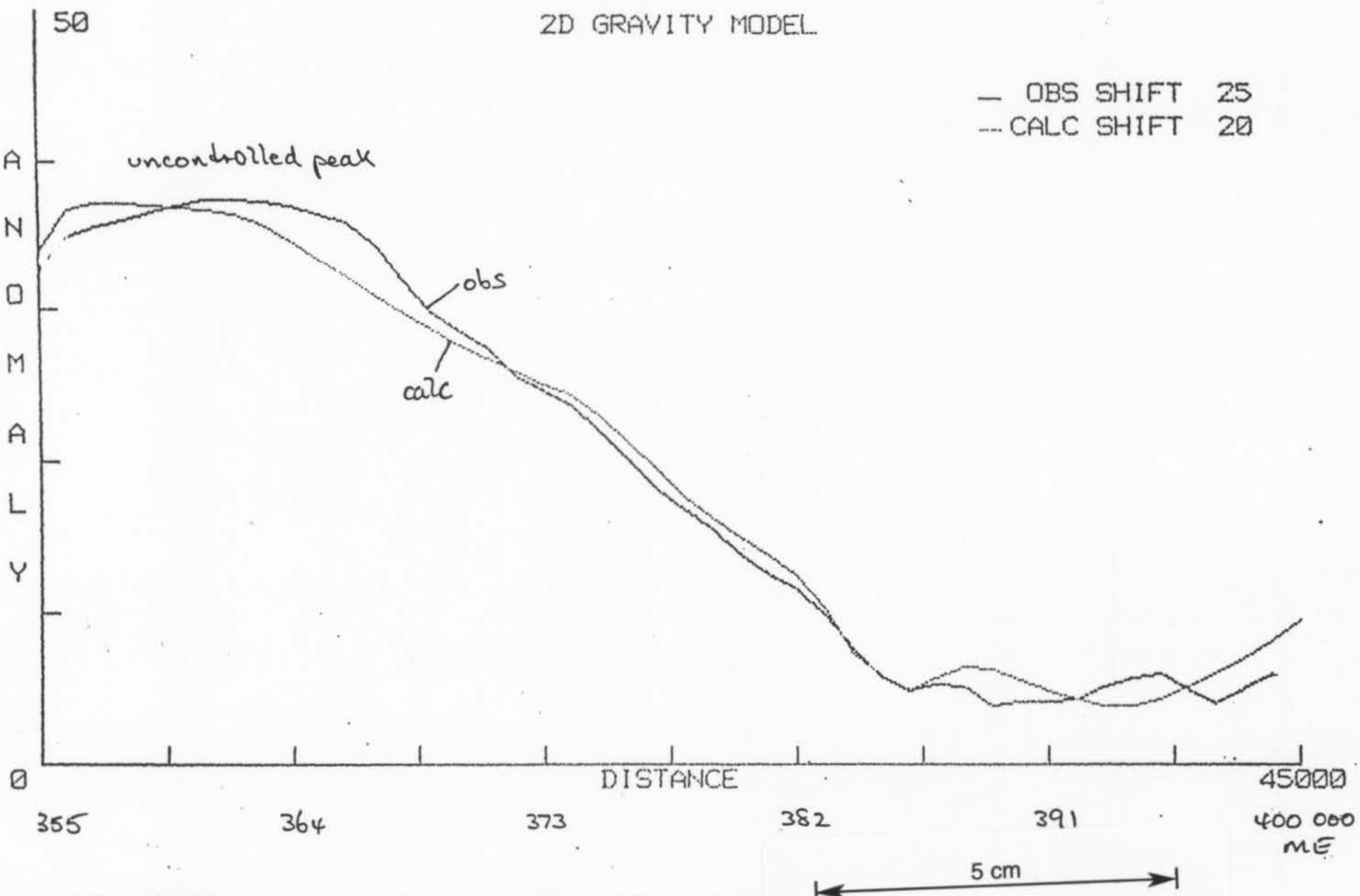
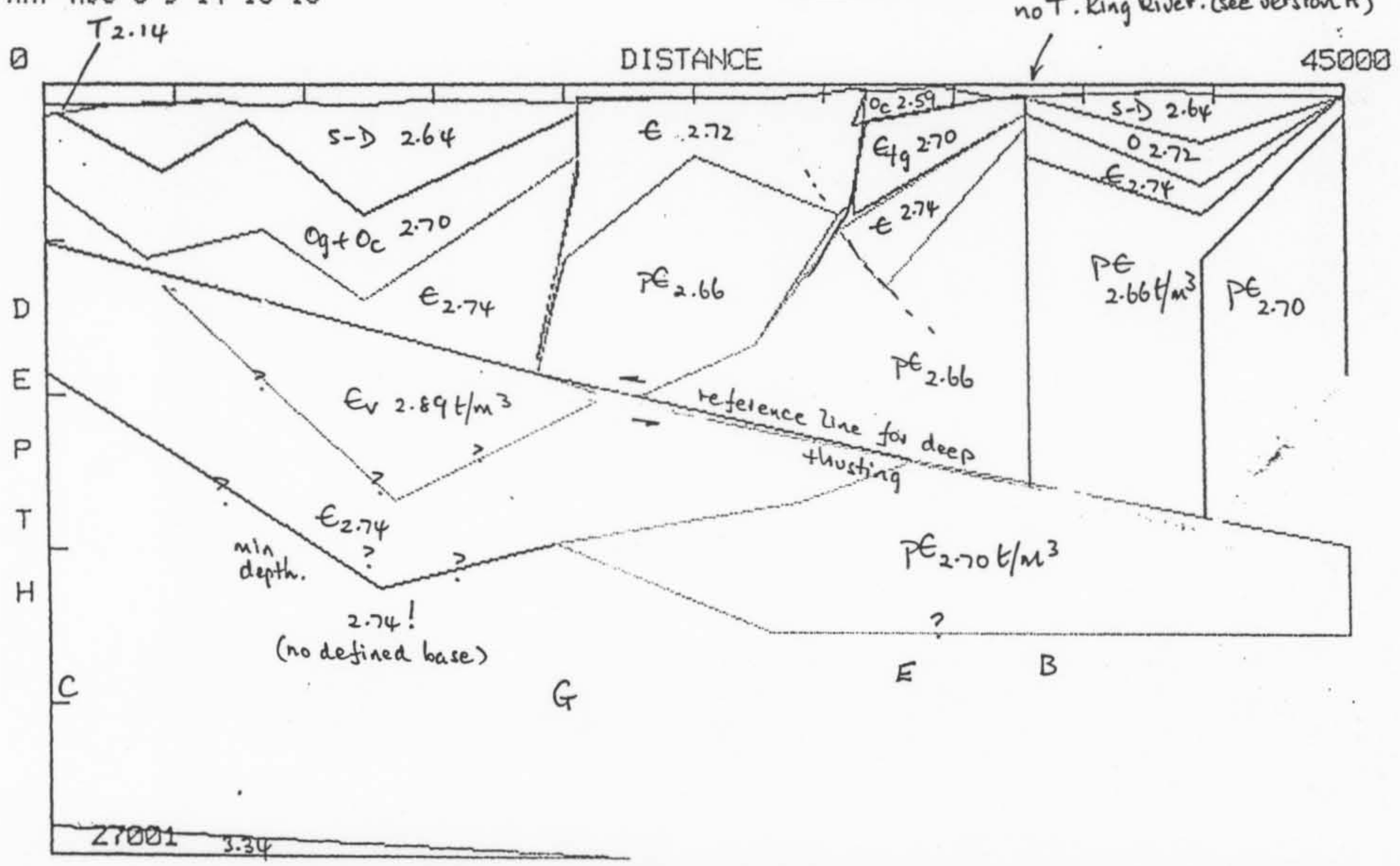


BOUGUER ANOMALY 700M LINE 343N 355-400E LYELL
NX7 ADJ 5 9 14 15 18



MODEL PROFILES: 5343 000 mN version b FIGURE 19

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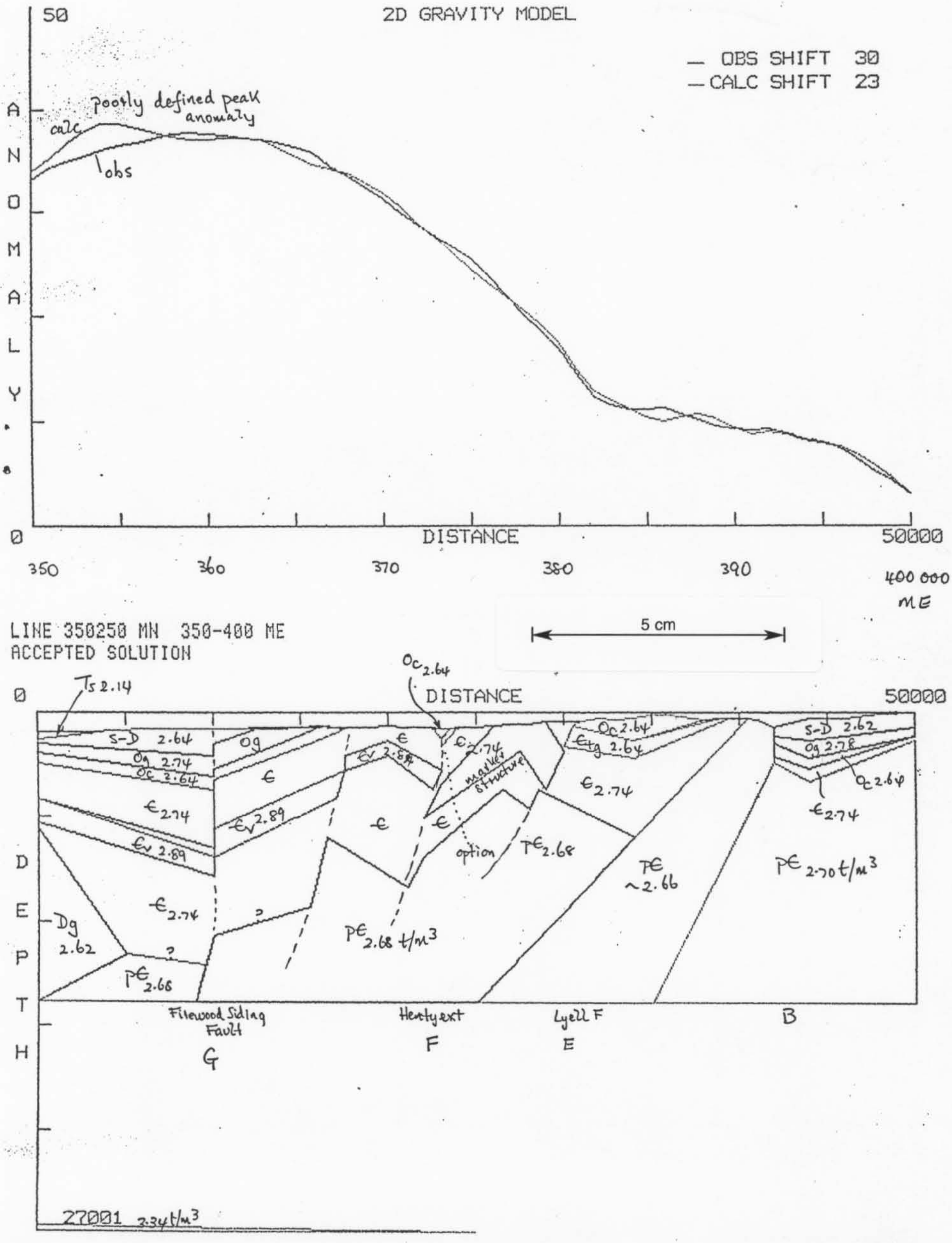

MODEL PROFILES: 5350 250 mN FIGURE 20

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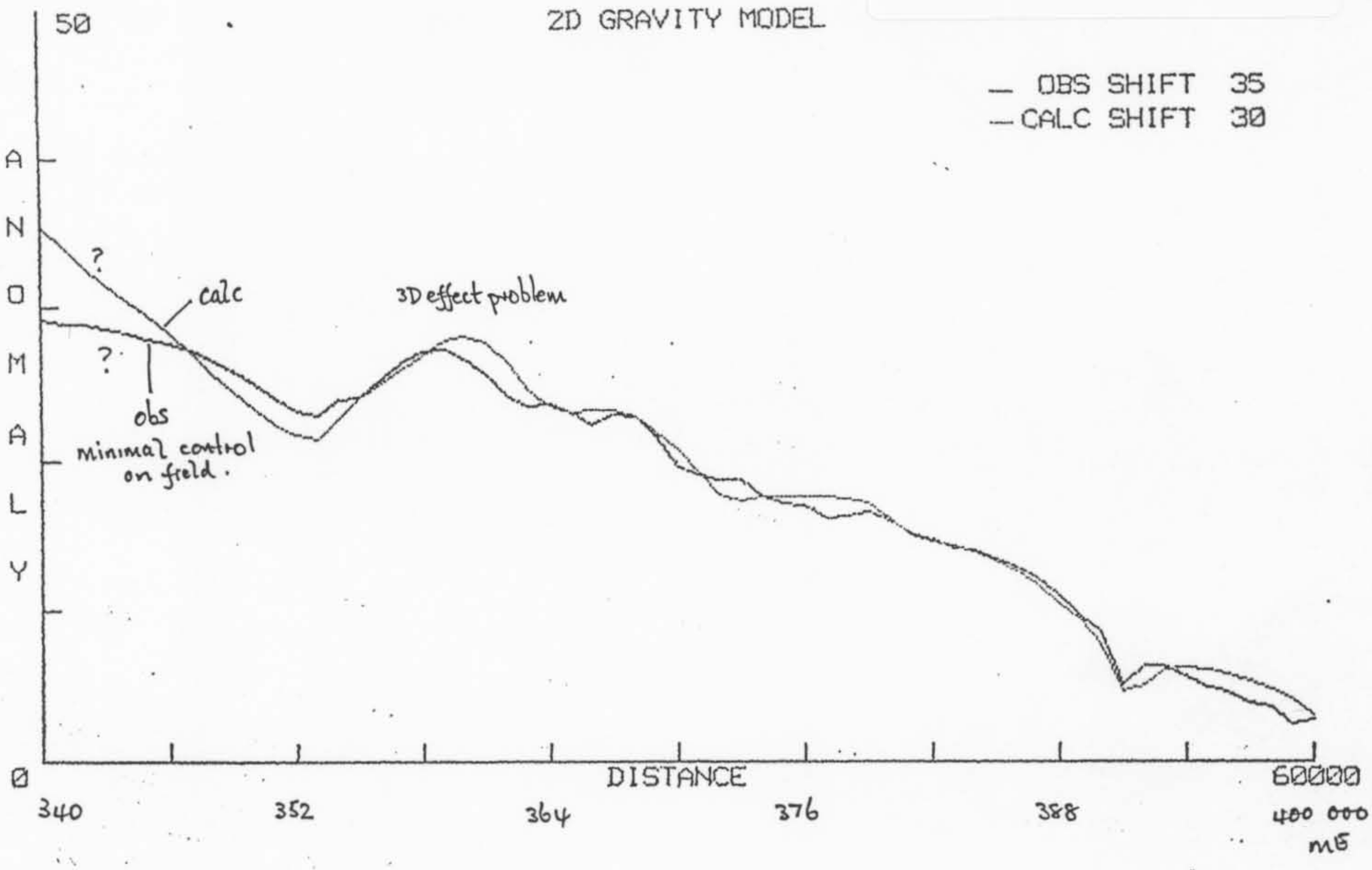
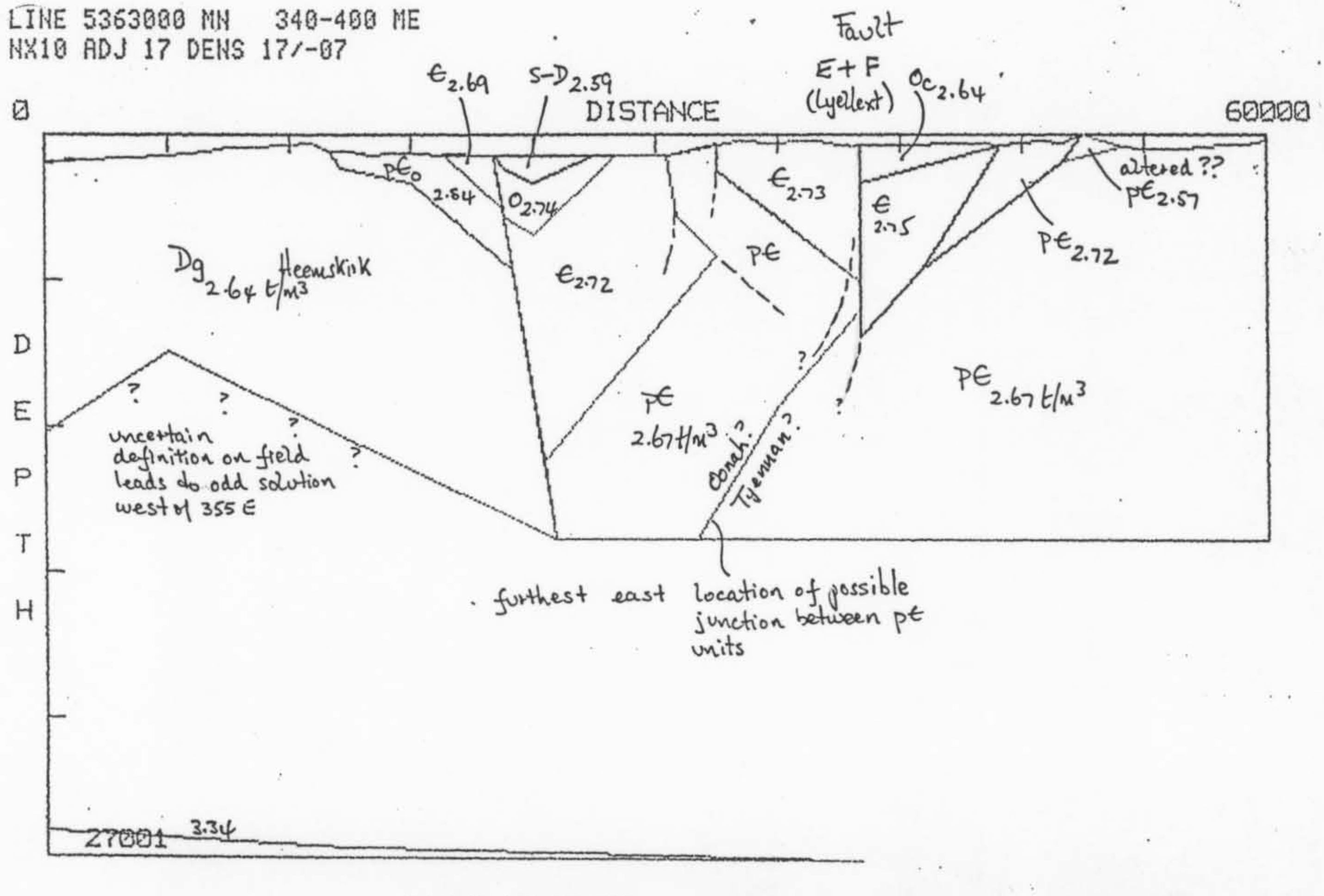
5 cm



LINE 5363000 MN 340-400 ME
NX10 ADJ 17 DENS 17/-07



MODEL PROFILES: 5363 000 mN

FIGURE 21

027077

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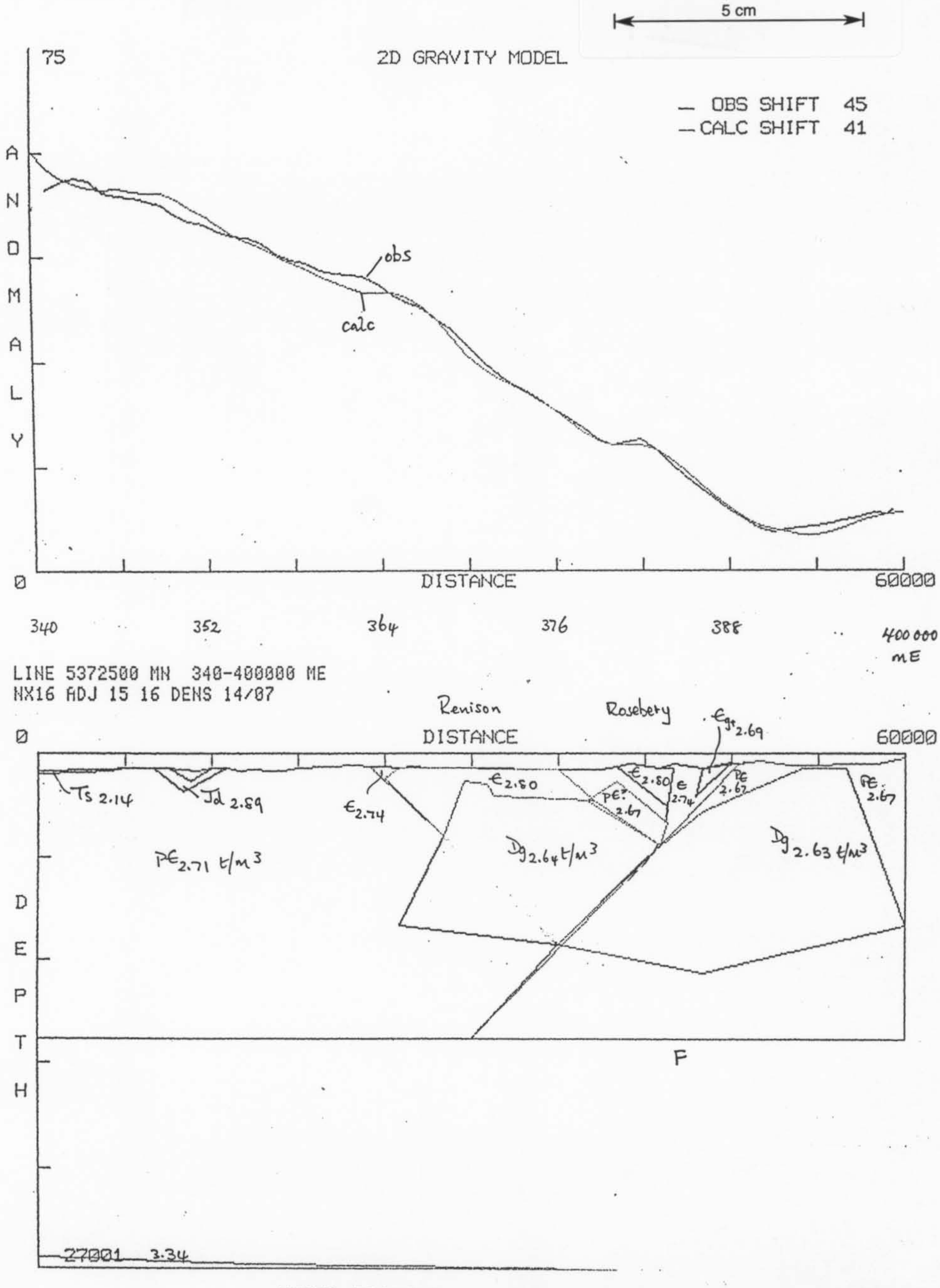

MODEL PROFILES: 5372 500 mN version a FIGURE 22

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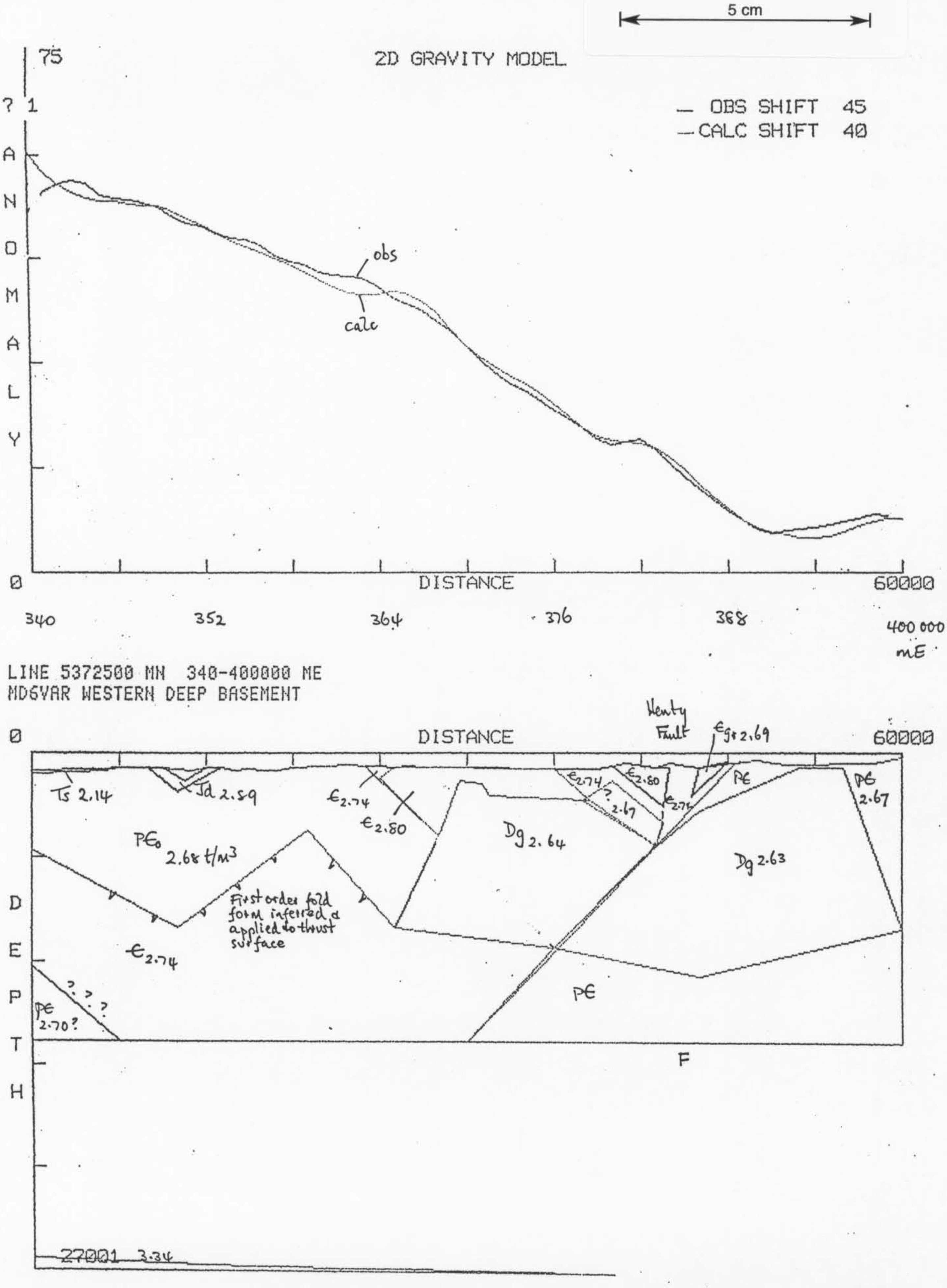

MODEL PROFILES: 5372 500 mN version b FIGURE 23

027079

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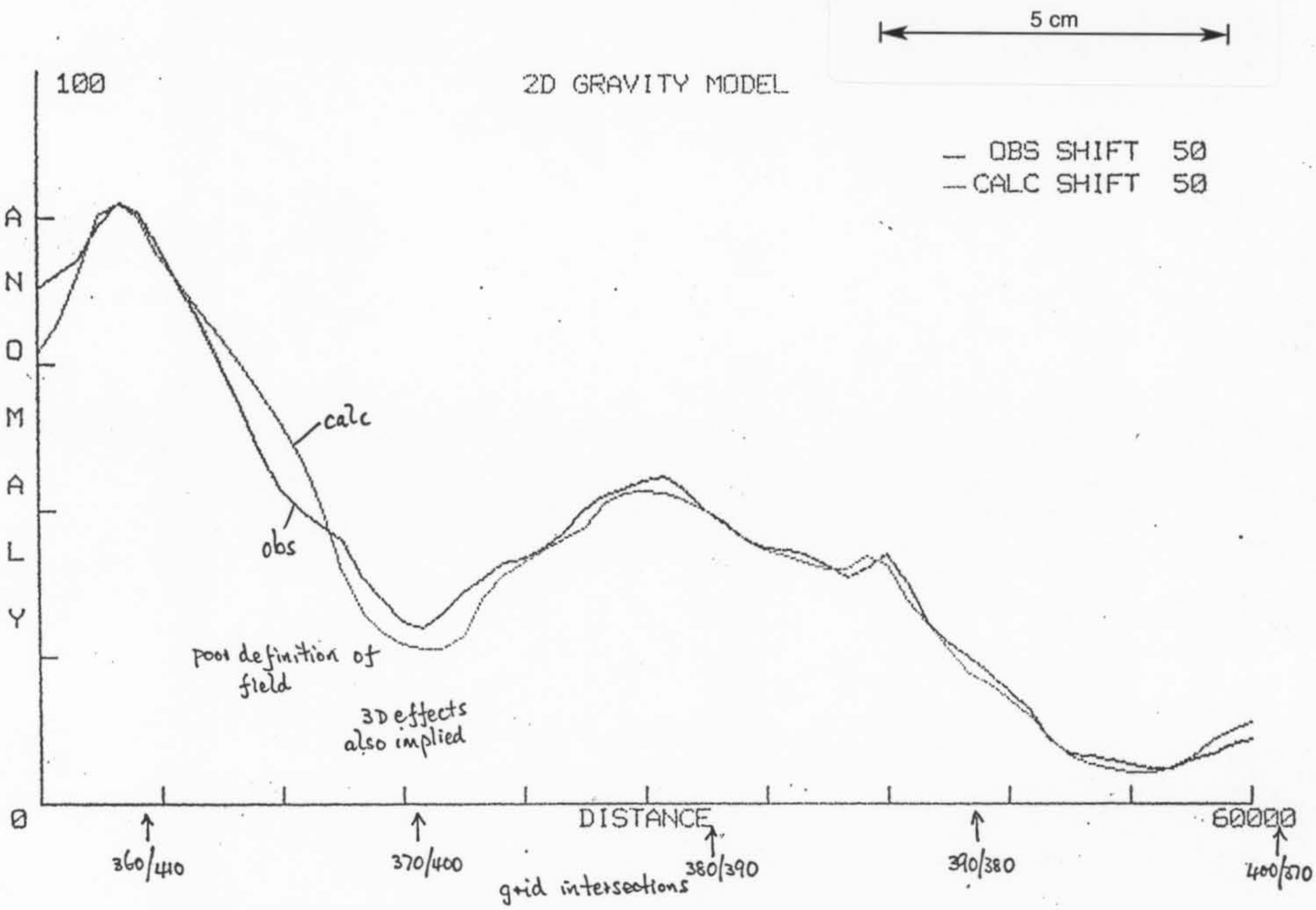
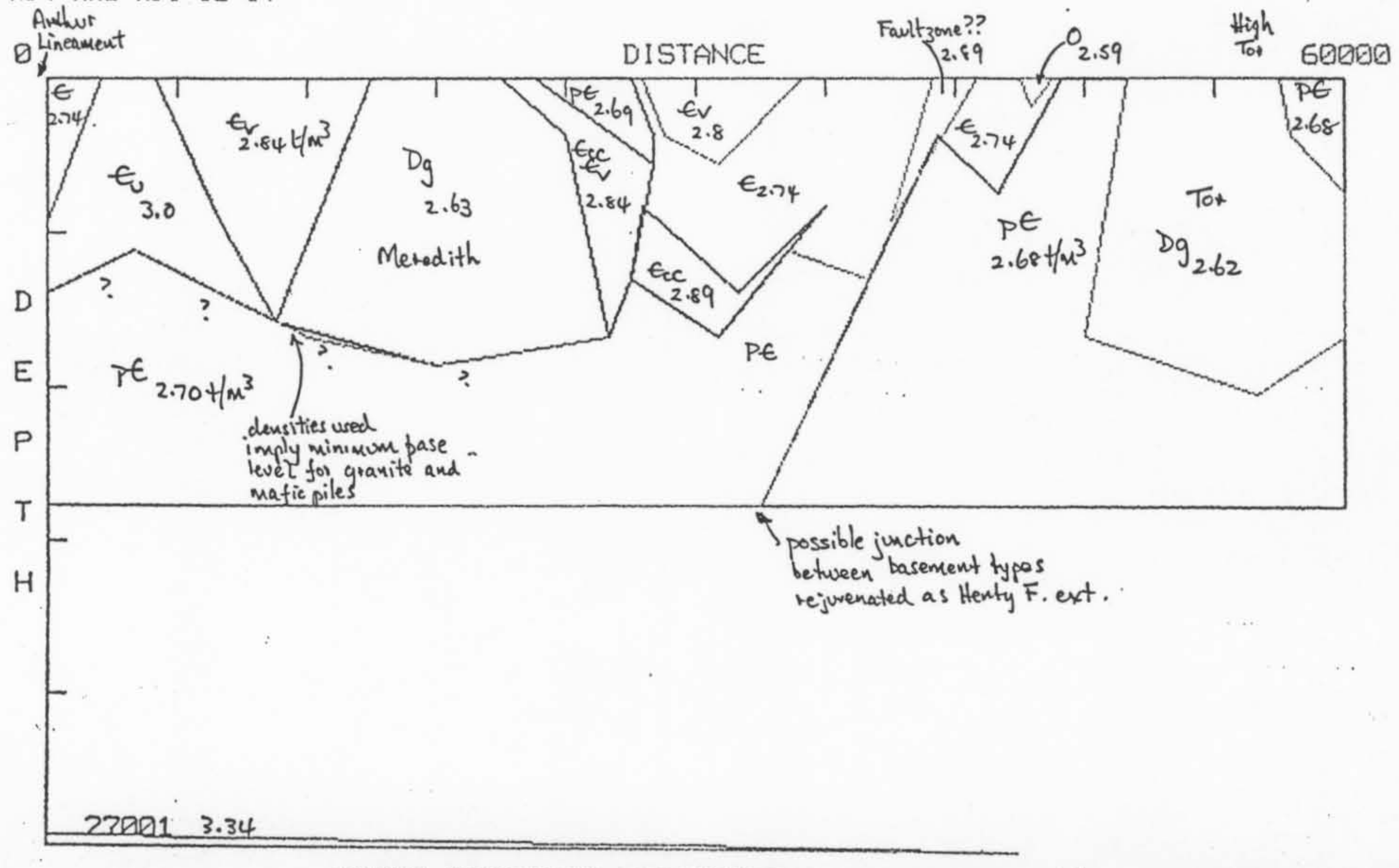


BOUGUER ANOMALY BRONZITE HILL 3565/4135 TO HIGH TOR 399/371
MD4 NX2 ADJ 12 14



MODEL PROFILES: BRONZITE HILL TO HIGH TOR FIGURE 24

027080

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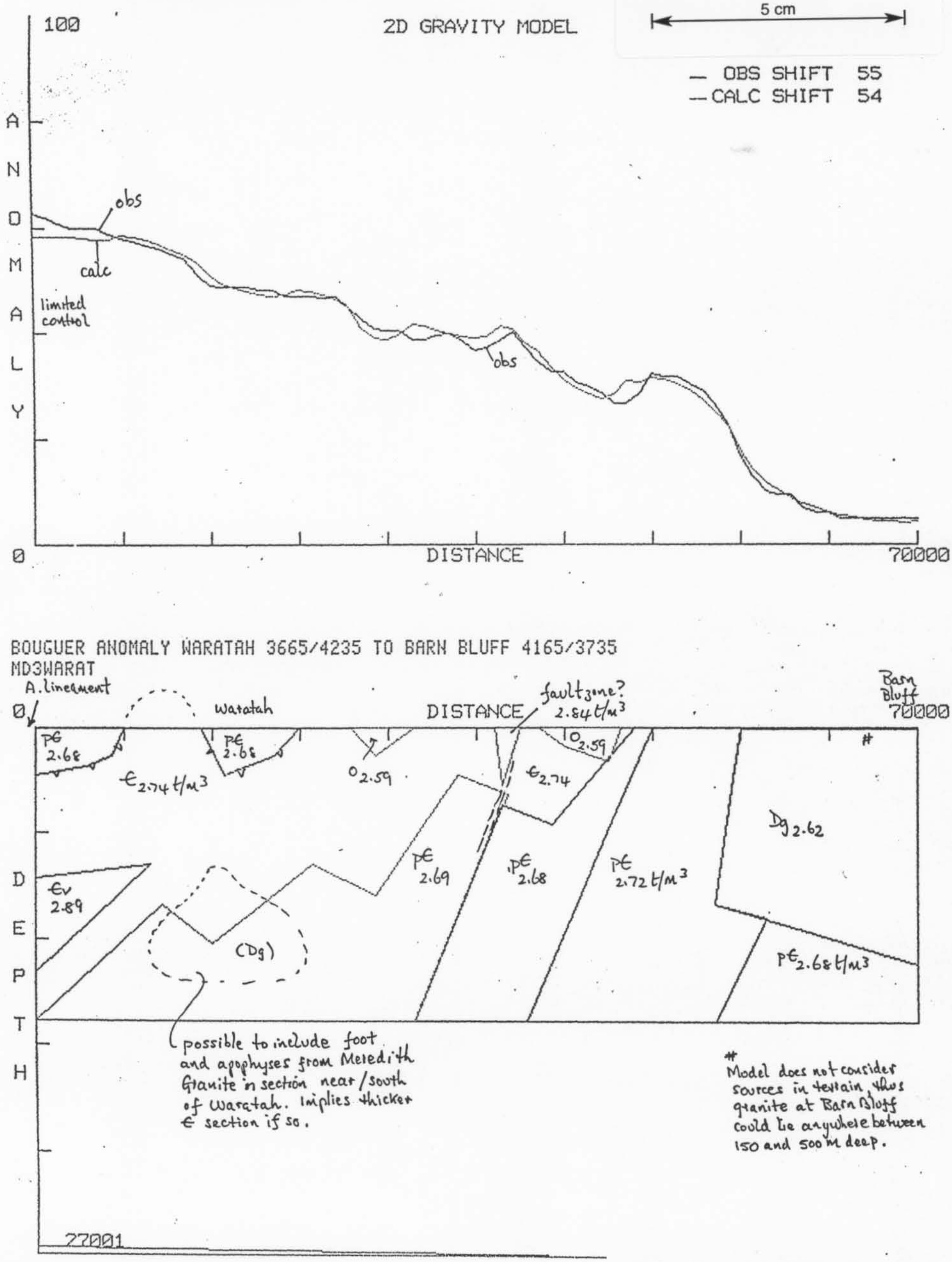

MODEL PROFILES: WARATAH TO BARN BLUFF FIGURE 25

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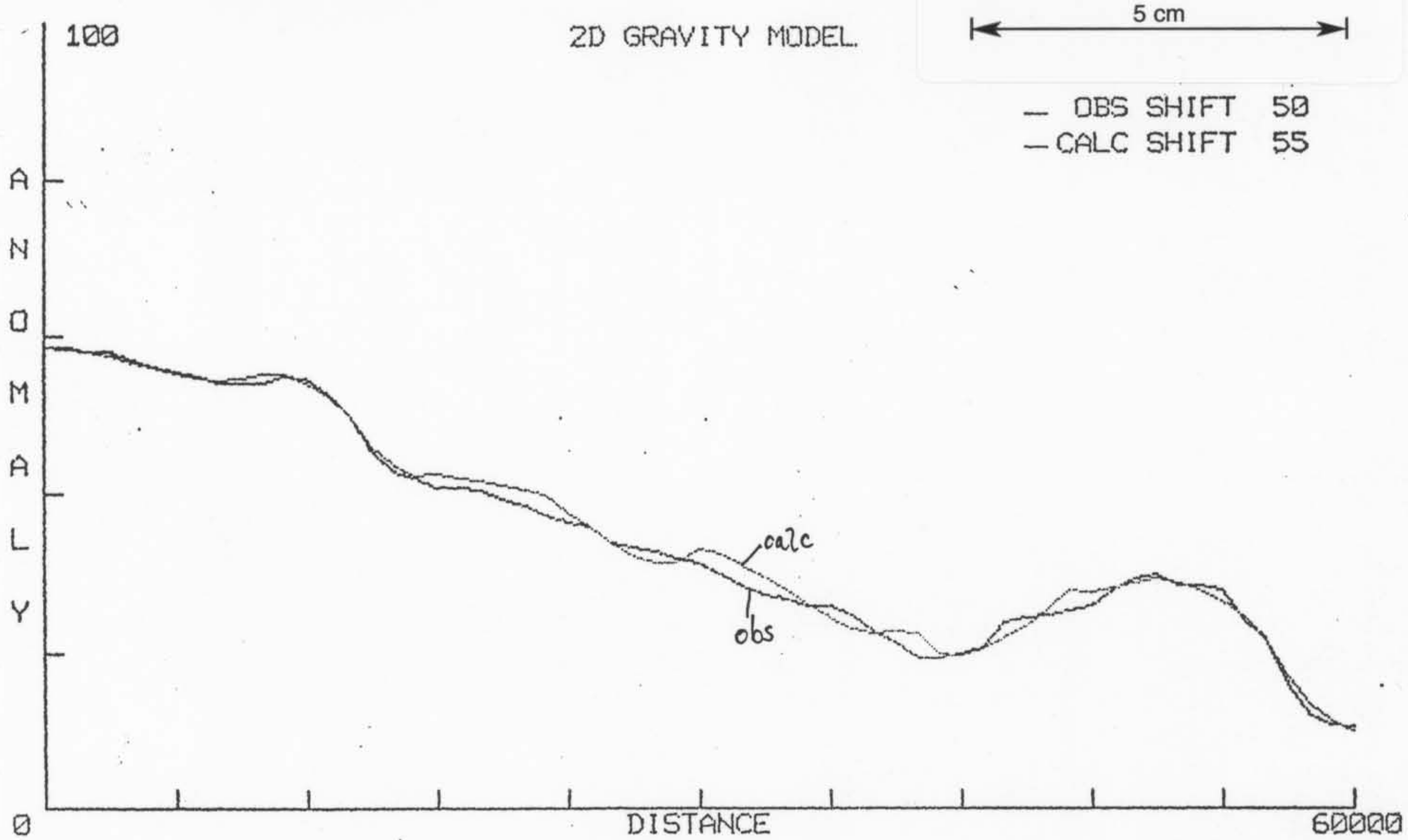
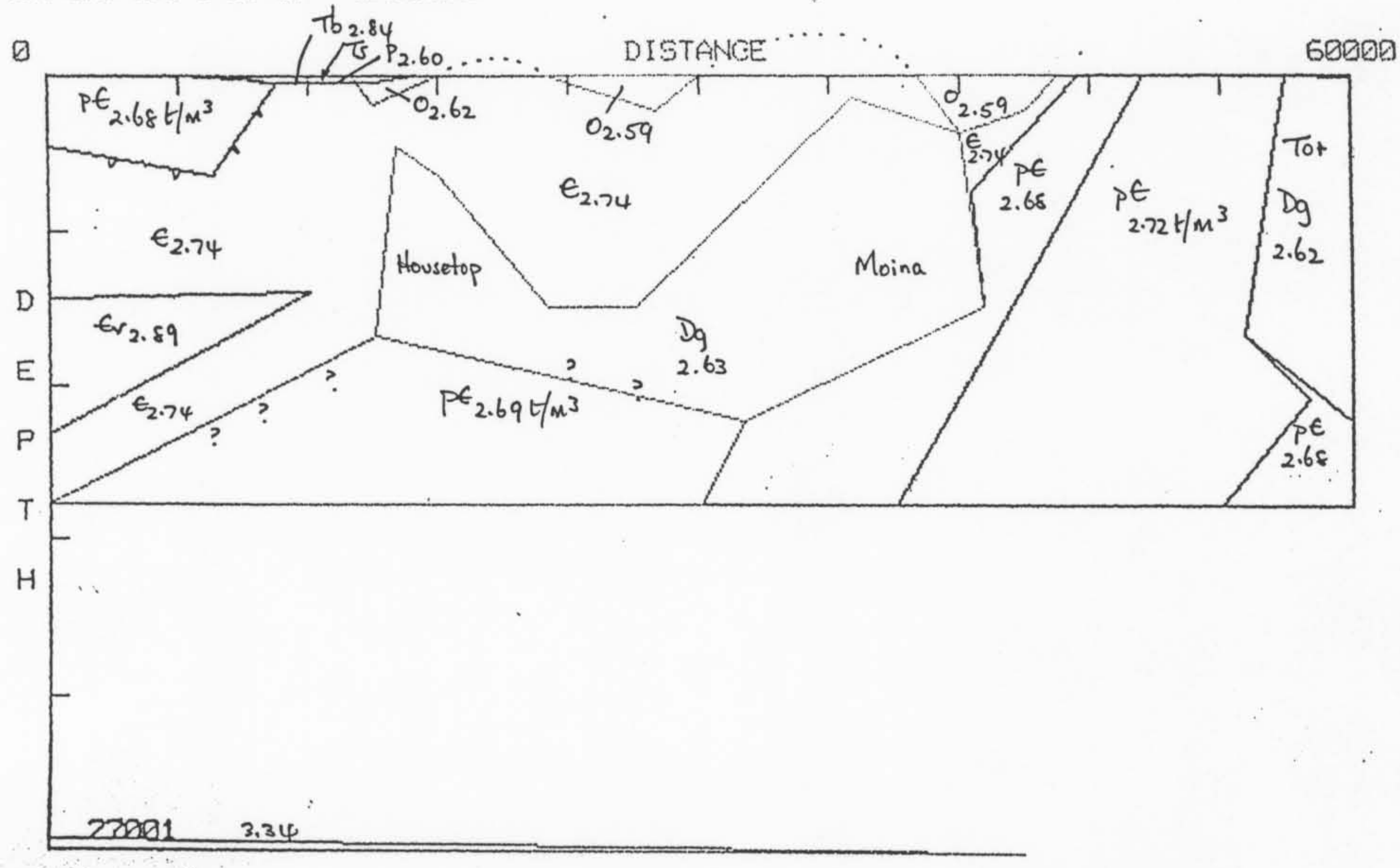


Henrietta
BOUGUER ANOMALY HENRIETTA 3855/439 TO CRADLE MTN
MD1 NX5 ADJ 1 15 19 = MD2CRADL

Cradle Mtn



MODEL PROFILES: HENRIETTA TO CRADLE MTN

FIGURE 26

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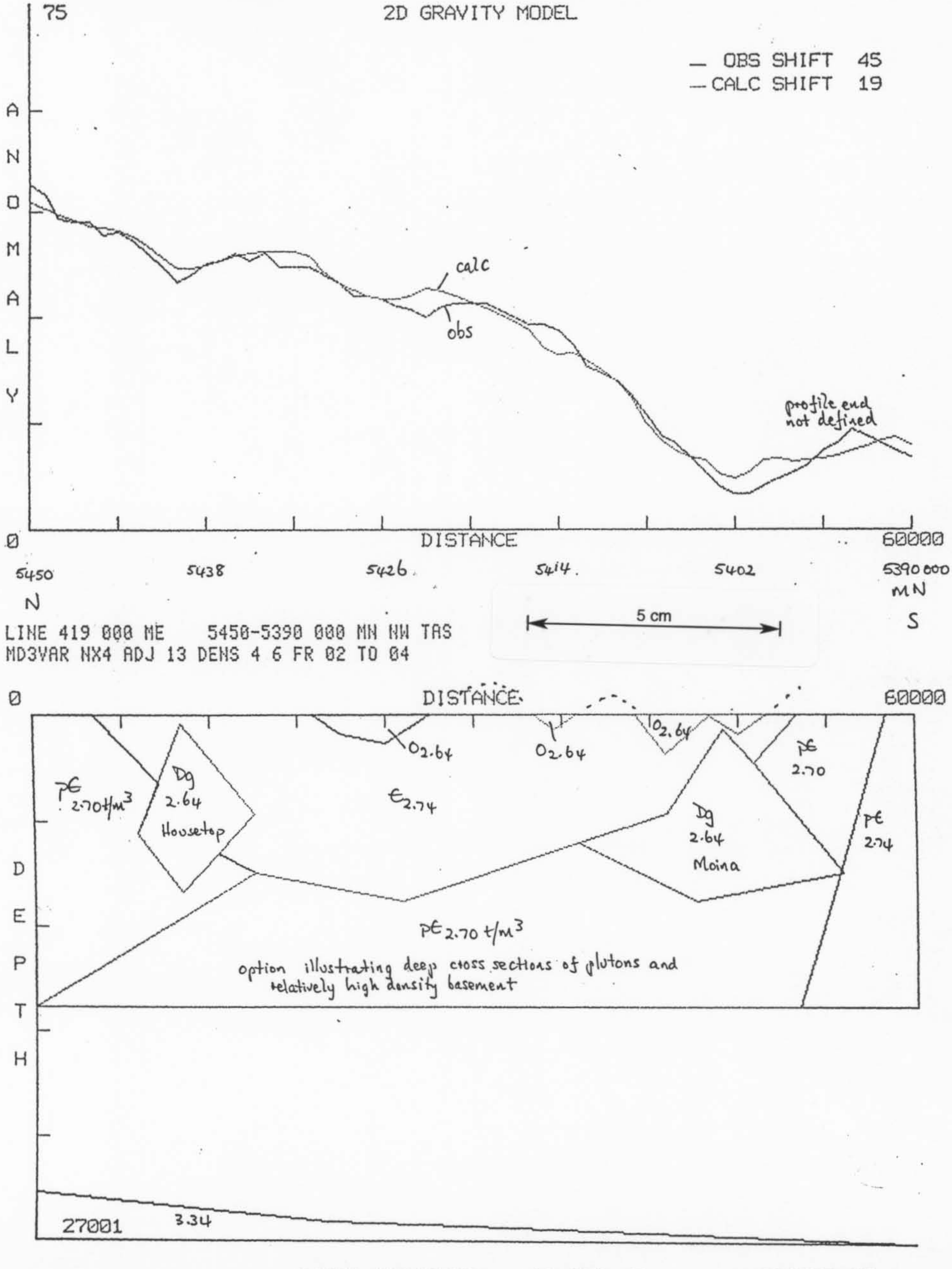

MODEL PROFILES: 419 000 mE FIGURE 27
version a

027083

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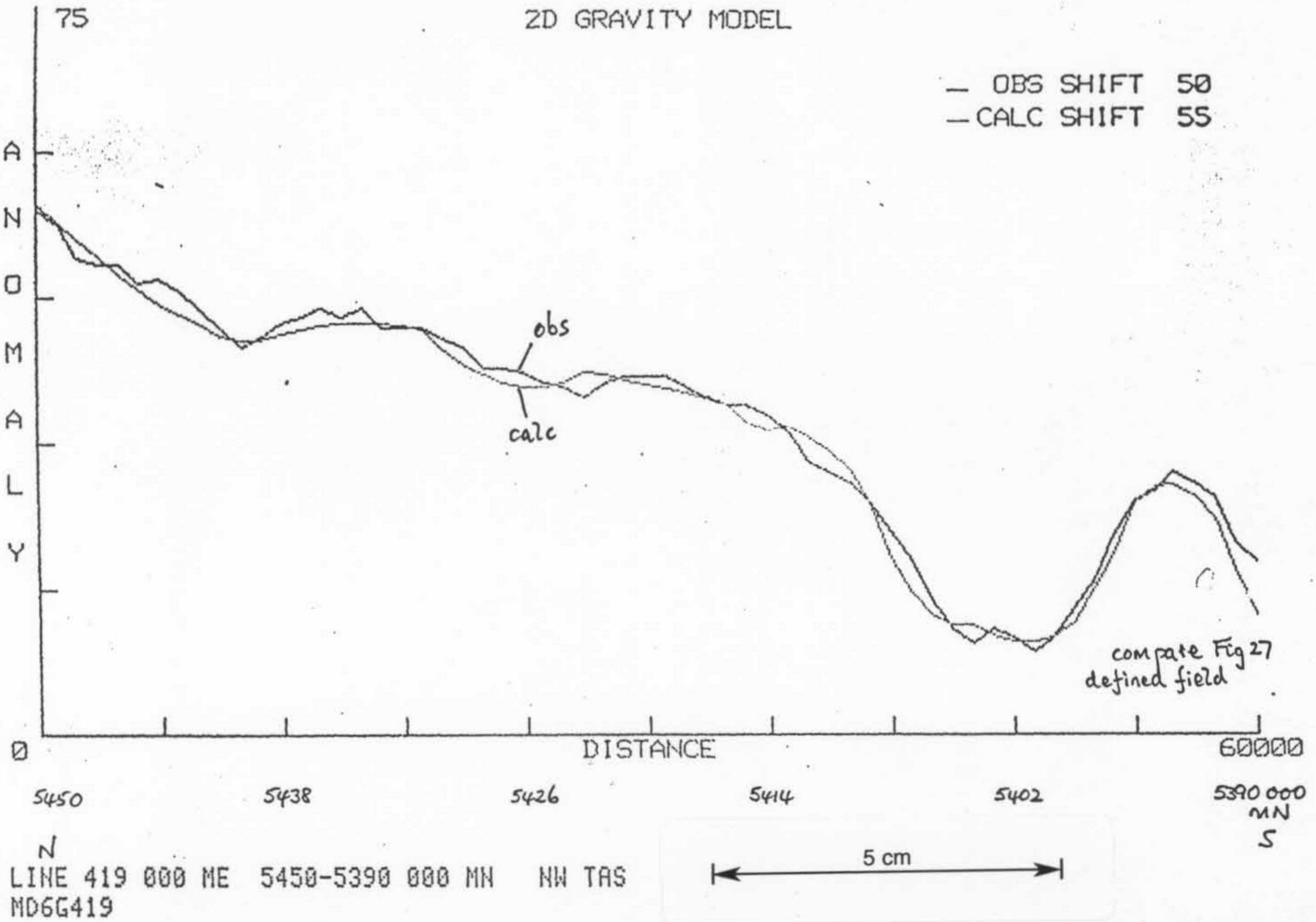

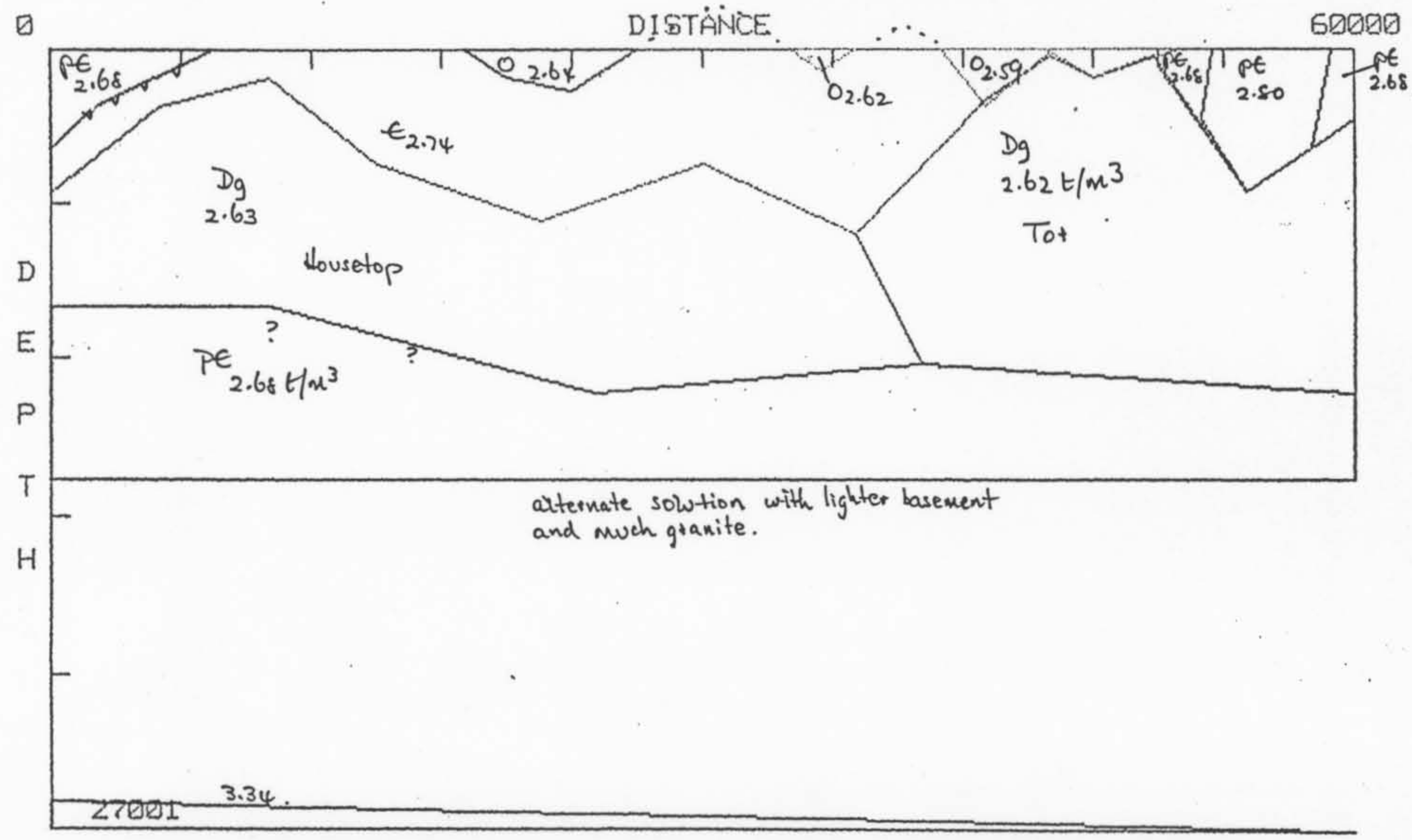

MODEL PROFILES: 419 000 mE version b FIGURE 28

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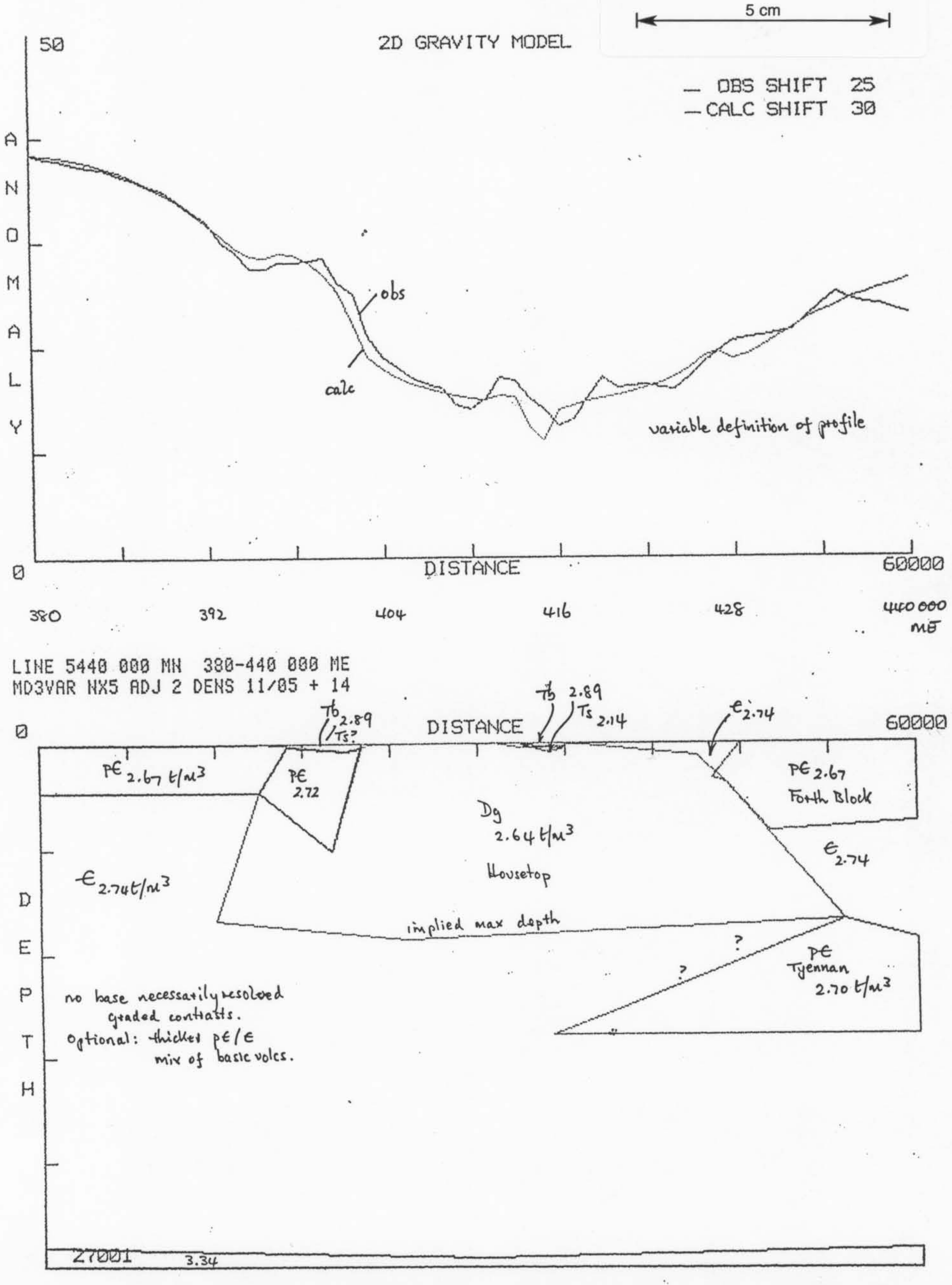
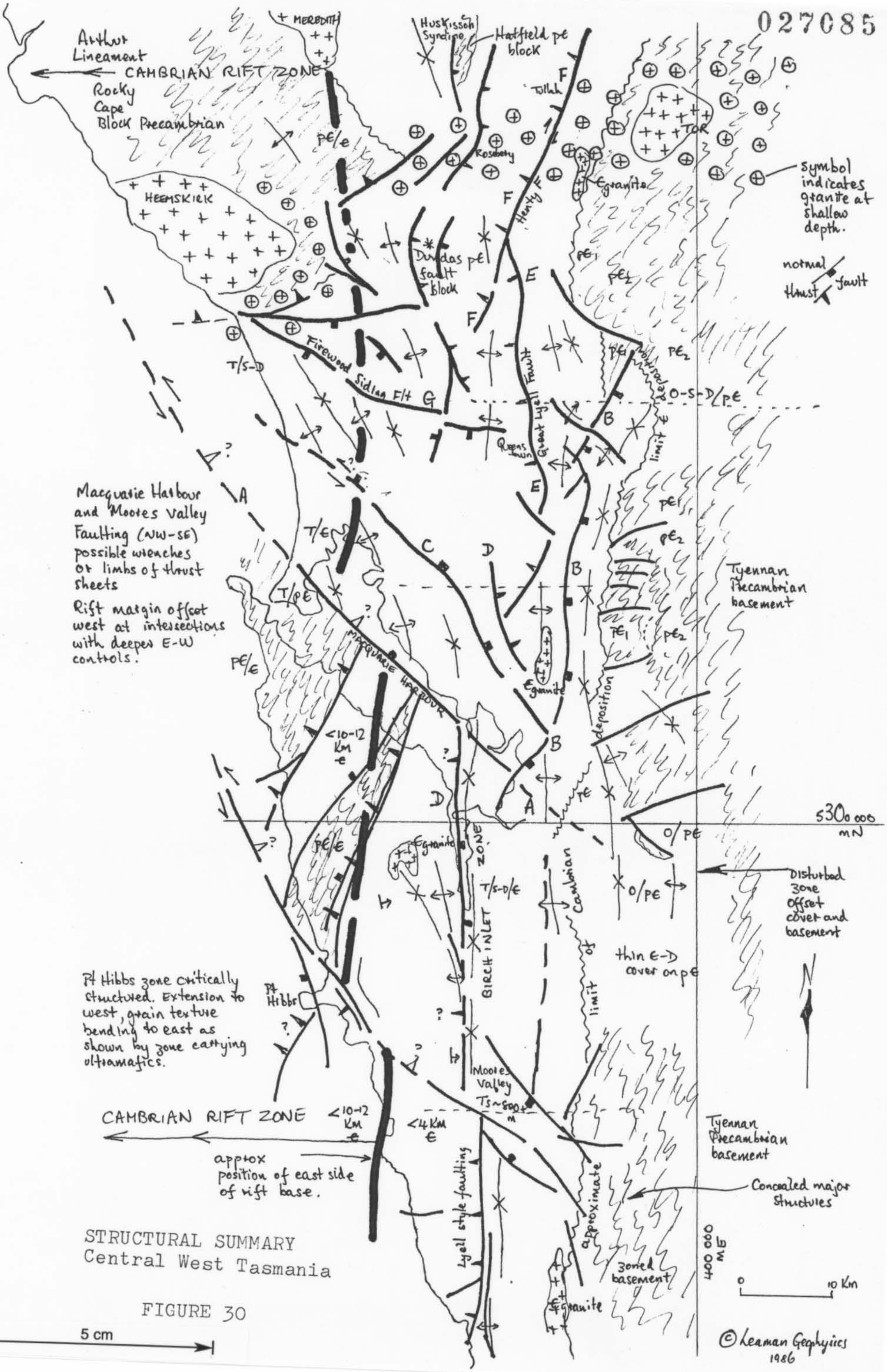


MODEL PROFILES: 5440 000 mN FIGURE 29

027085



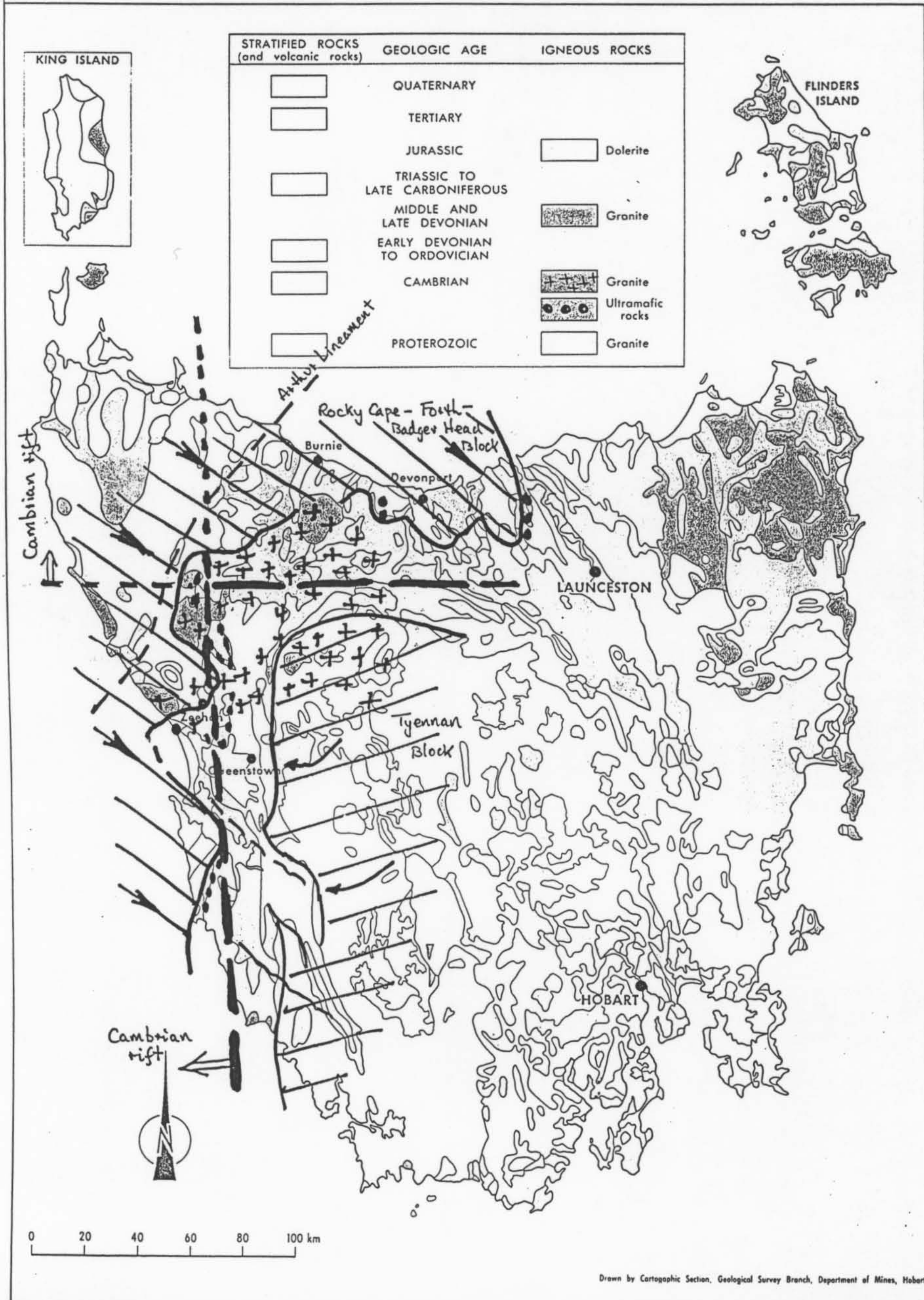
STRUCTURAL SUMMARY
Central West Tasmania

FIGURE 30

5 cm

5 cm

SIMPLIFIED GEOLOGY OF TASMANIA



STRUCTURAL BLOCKS AND ASSOCIATION OF ULTRAMAFICS AND GRANITE: FIGURE 31

027087

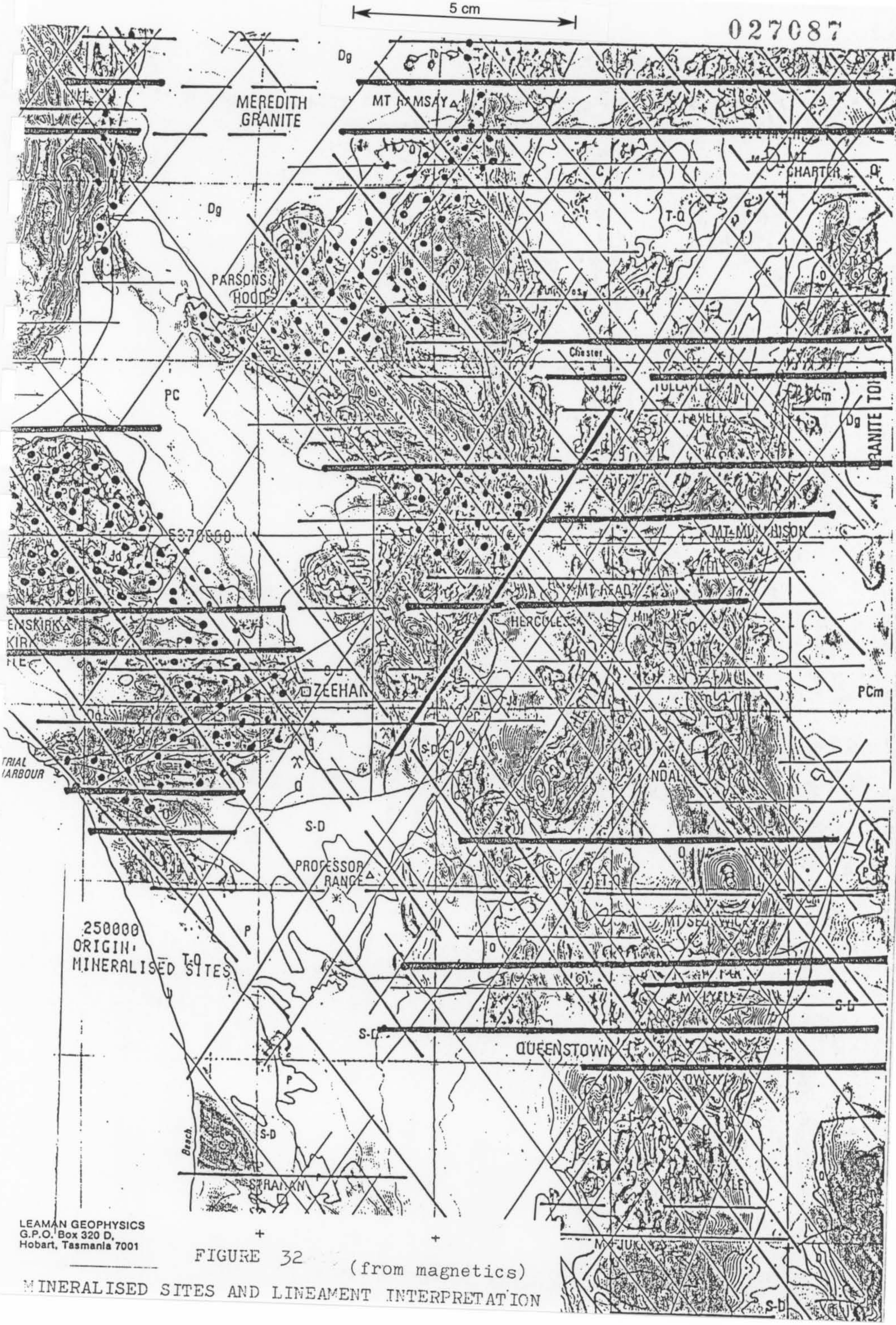


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FIGURE 32 (from magnetics)

MINERALISED SITES AND LINEAMENT INTERPRETATION

027088

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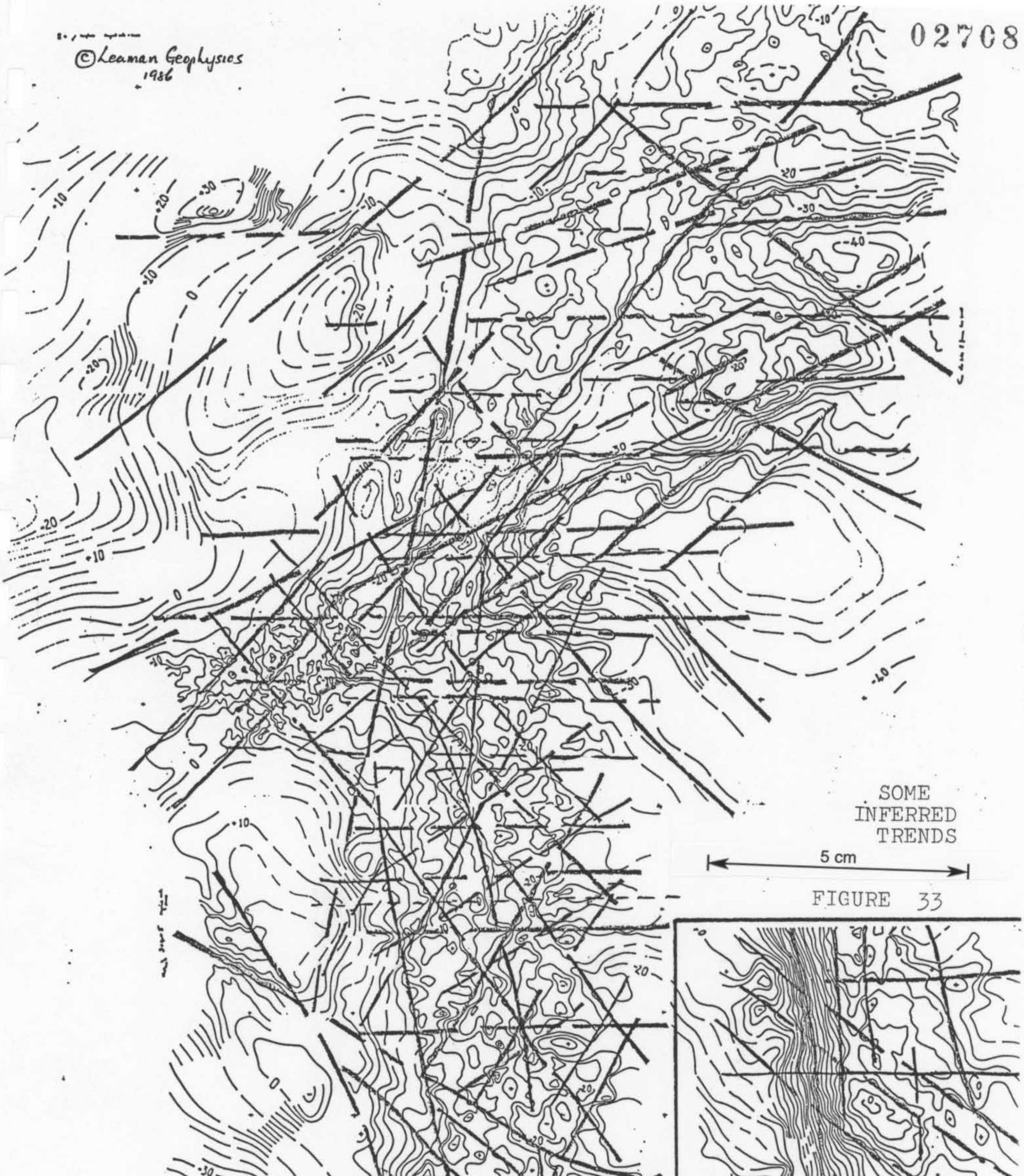
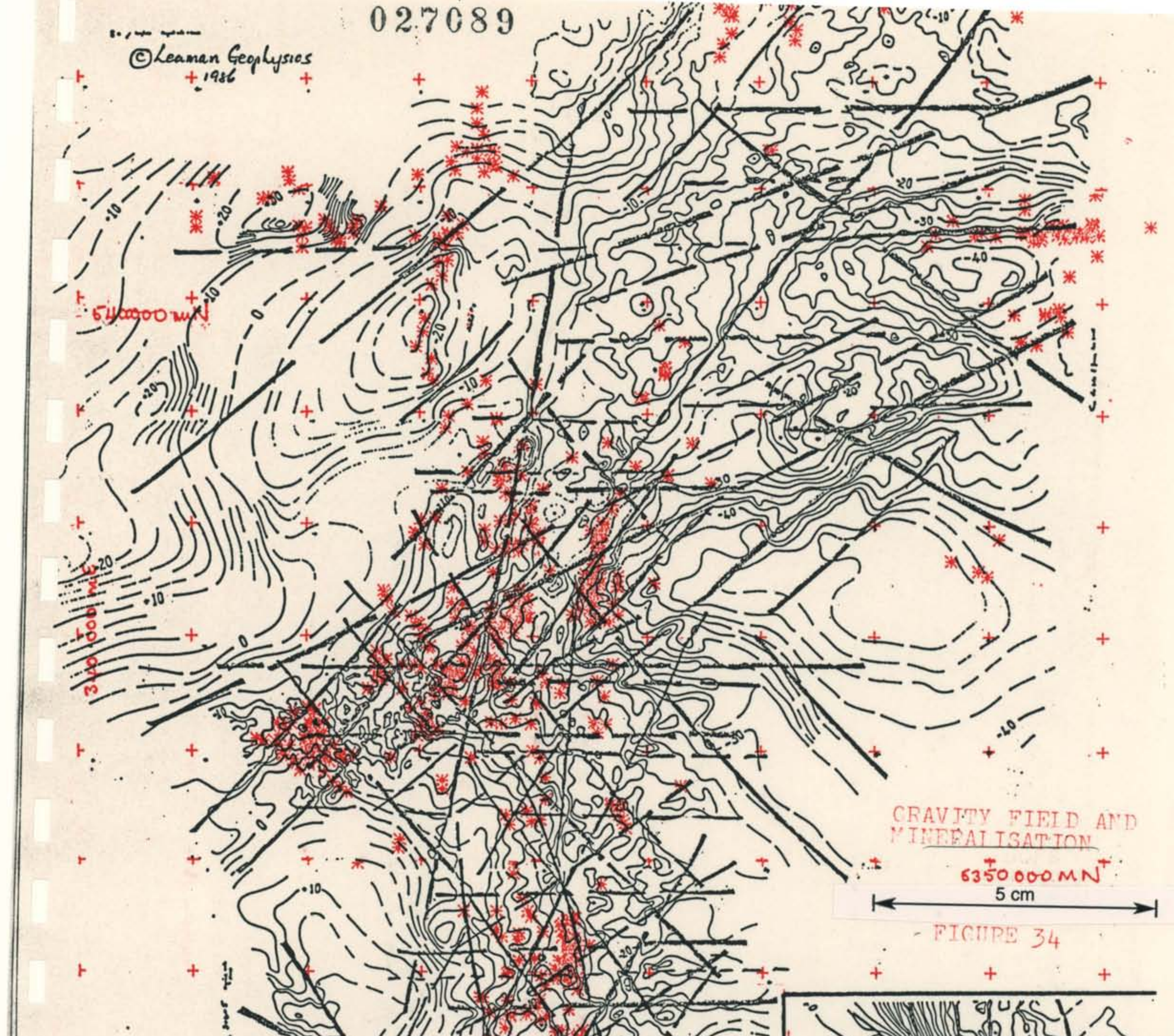


SOME
INFERRED
TRENDS

FIGURE 33

027089



GRAVITY FIELD AND MINERALISATION

FIGURE 34

027090

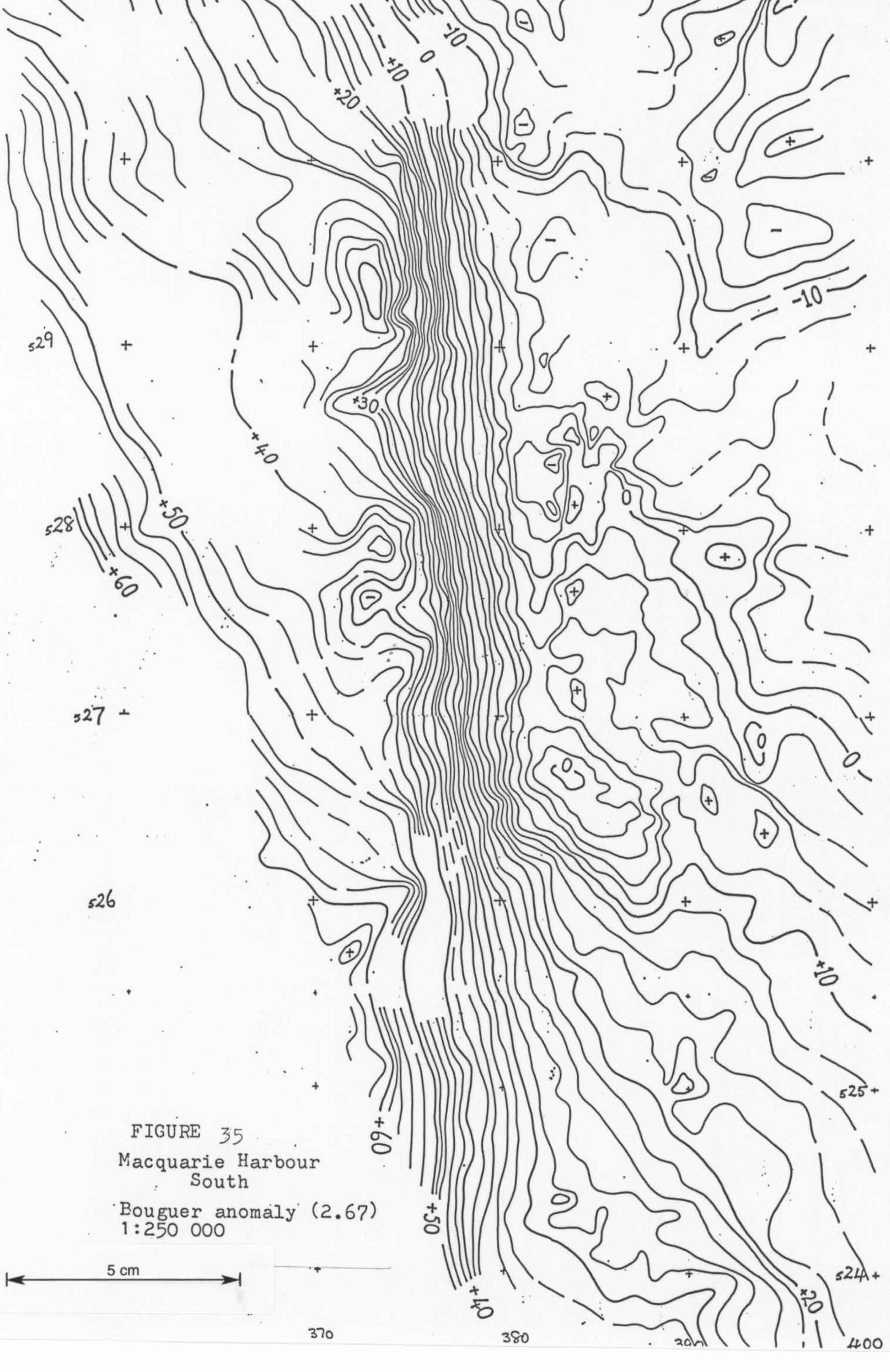


FIGURE 35
Macquarie Harbour
South
Bouguer anomaly (2.67)
1:250 000

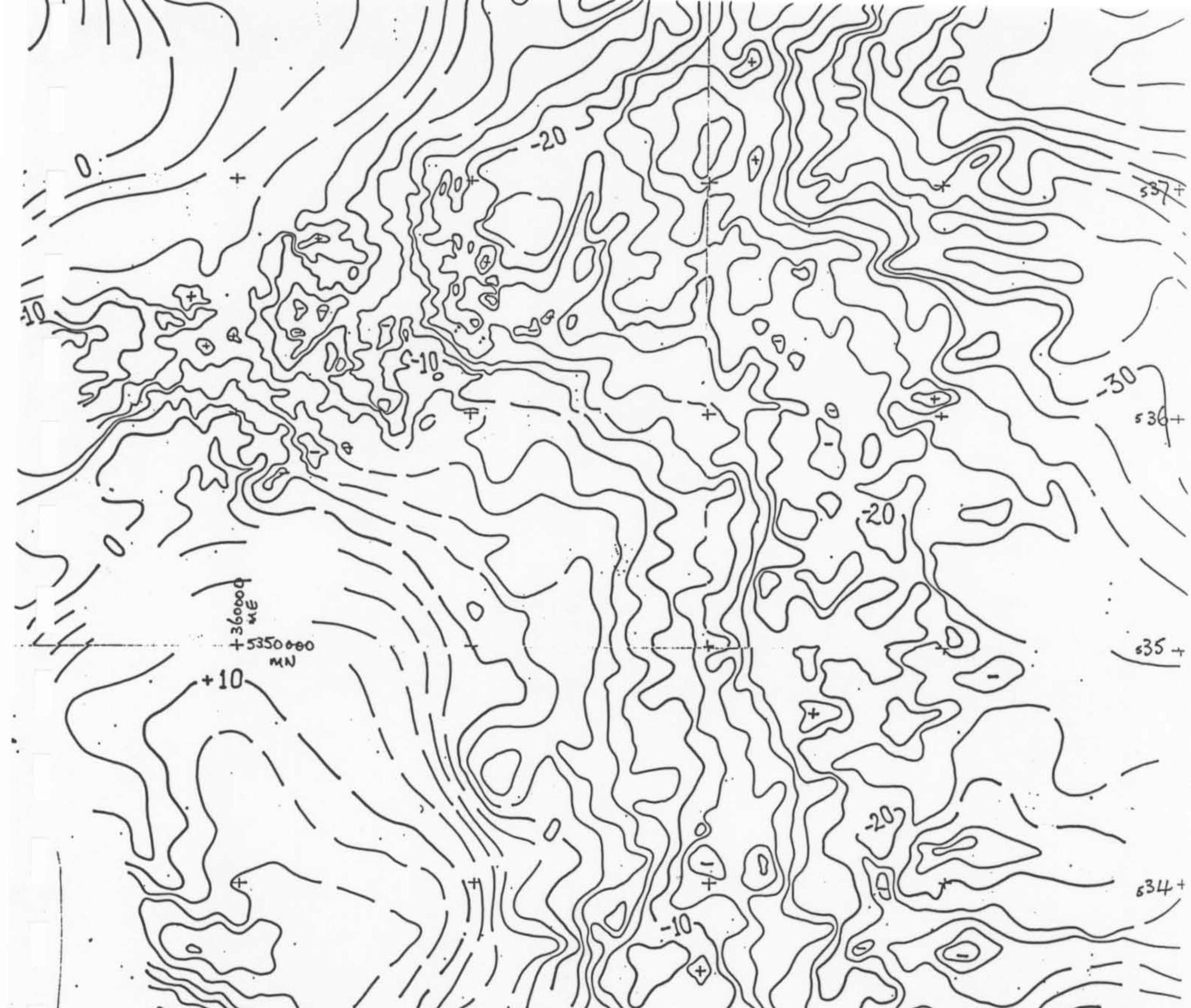


FIGURE 36 W Tasmania: Bouguer anomaly (2.67), 1: 250 000

5 cm

027091

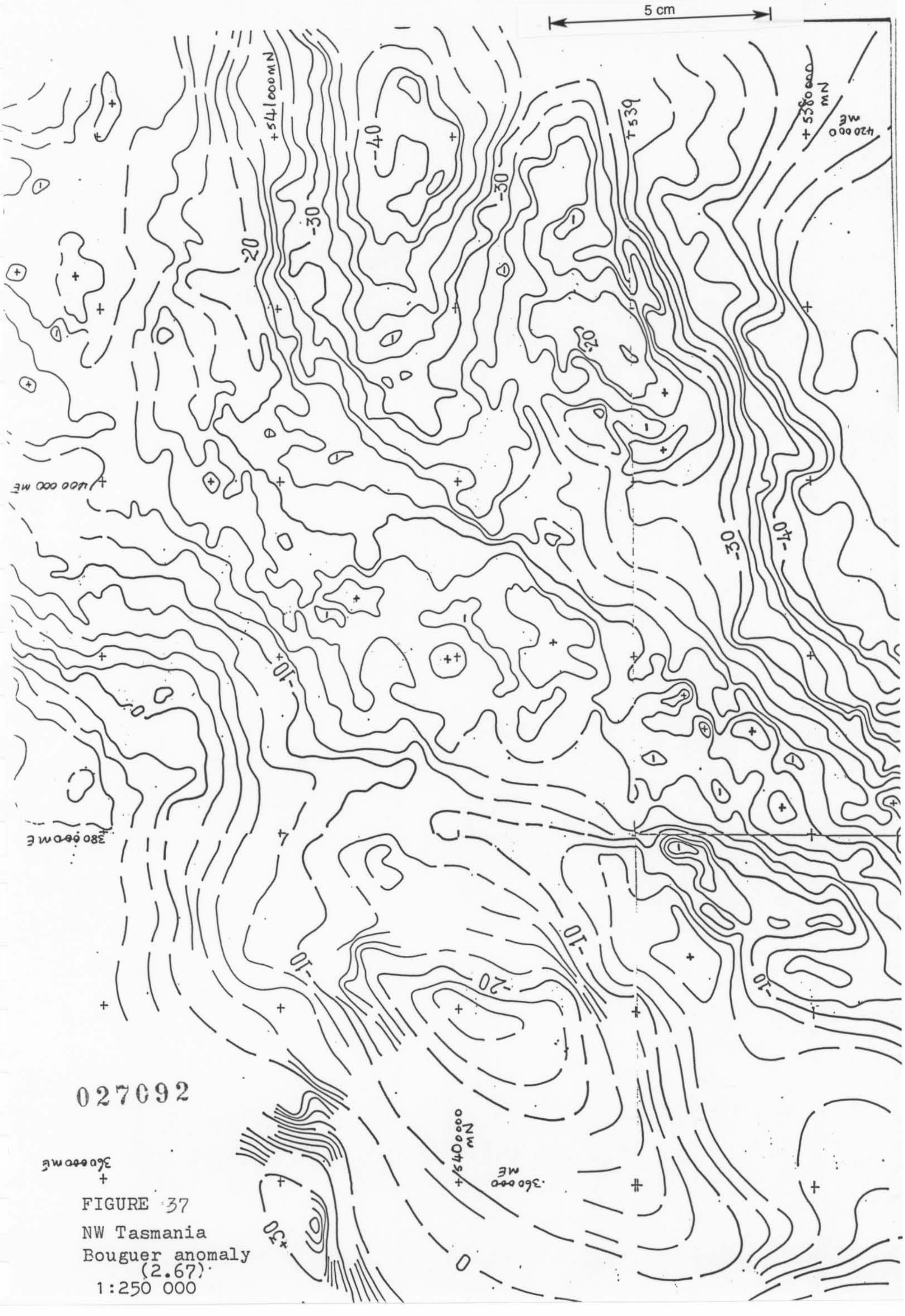


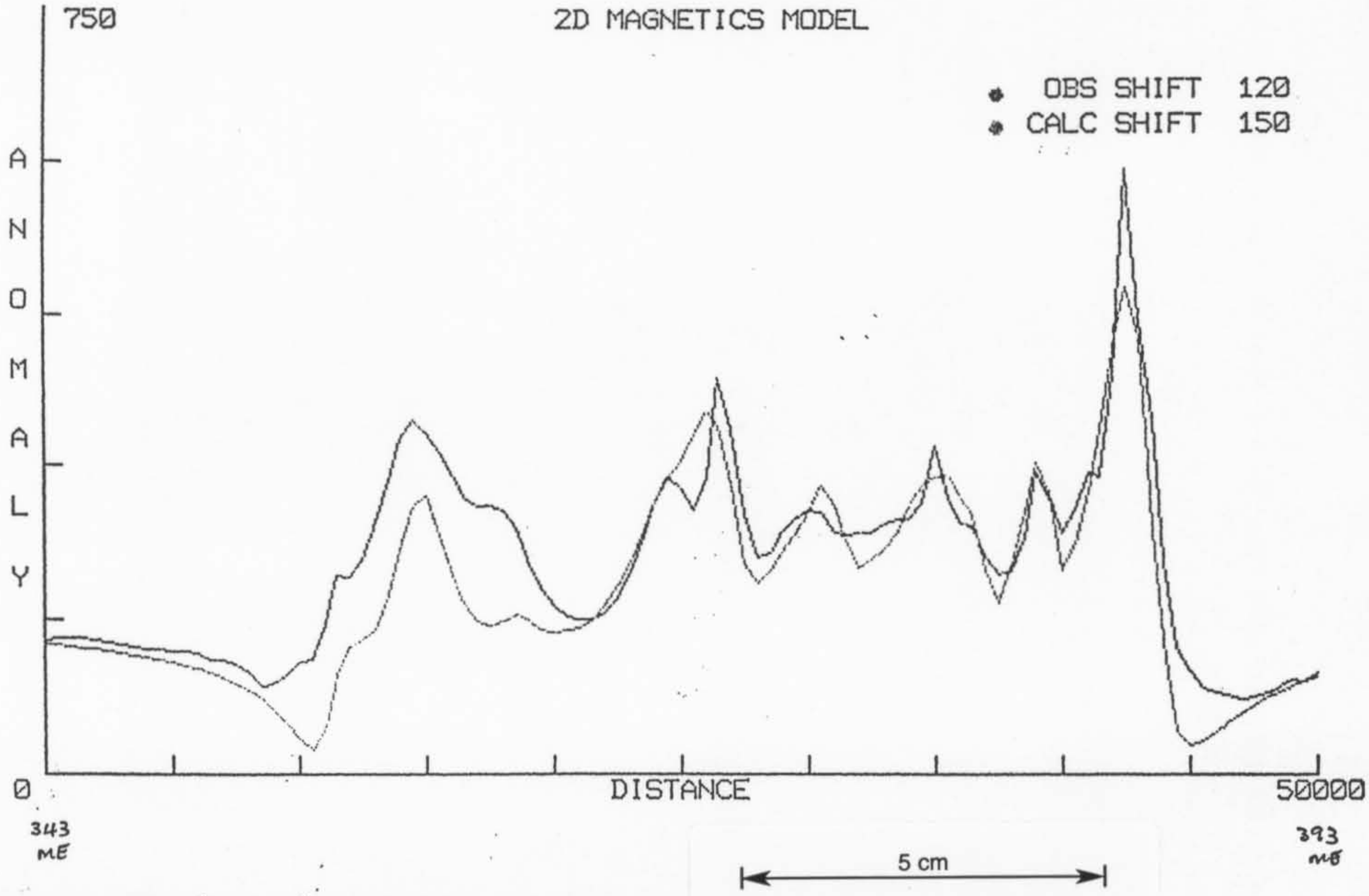
FIGURE 37

NW Tasmania

Bouguer anomaly
(2.67)

1:250 000

LINE PARAMETERS - ORIGIN,LIMIT,INCR : 0 50000 500



W TAS MAGNETICS LINE 1260+1280 REF 1000M

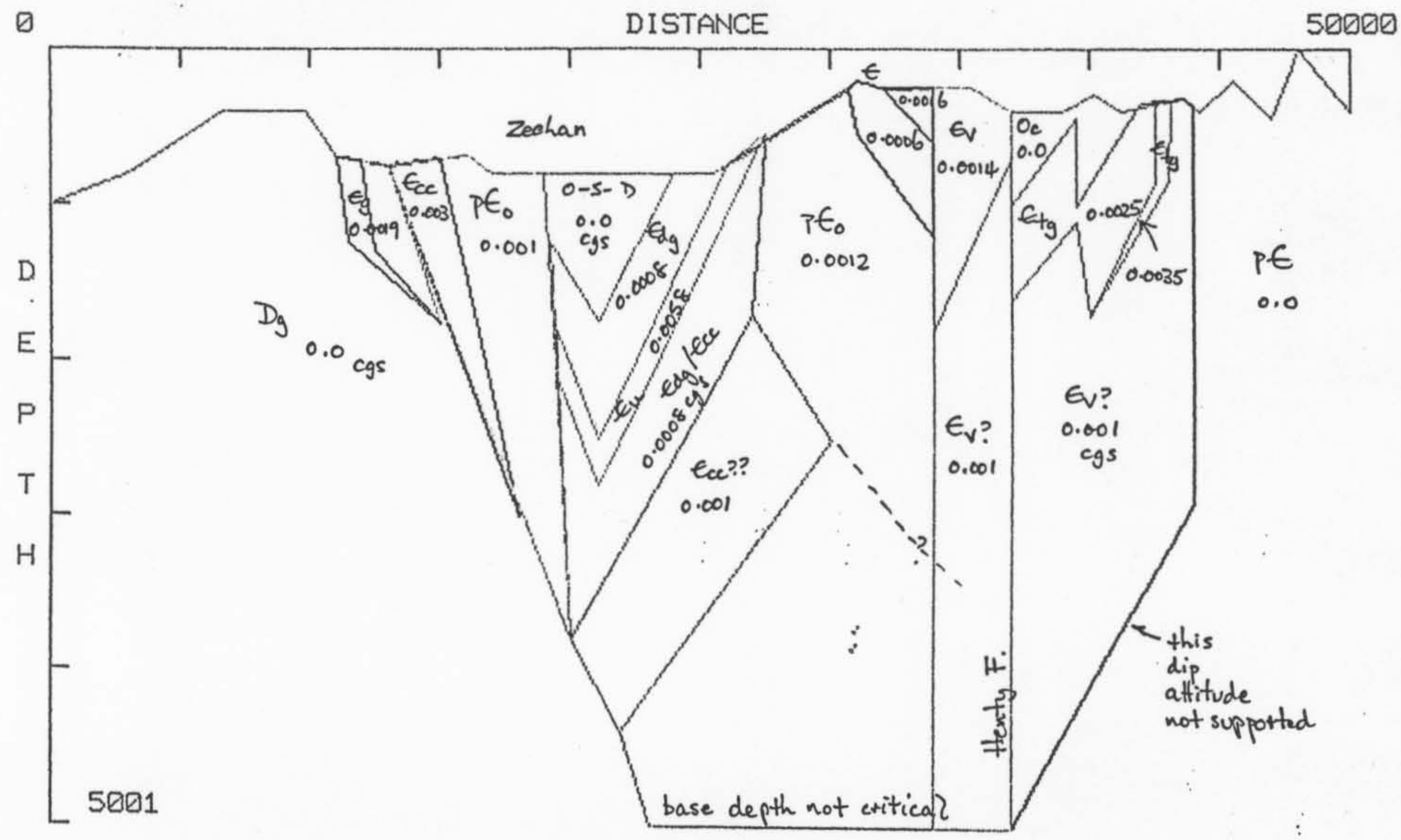


FIGURE 4-F-6

LINE 1260/80 - 2D REGIONAL INTERPRETATION version 1

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MAGNETIC MODEL: 5363 000 mN FIGURE 38

LINE PARAMETERS - ORIGIN,LIMIT,INCR : 0 45000 500

027094

95

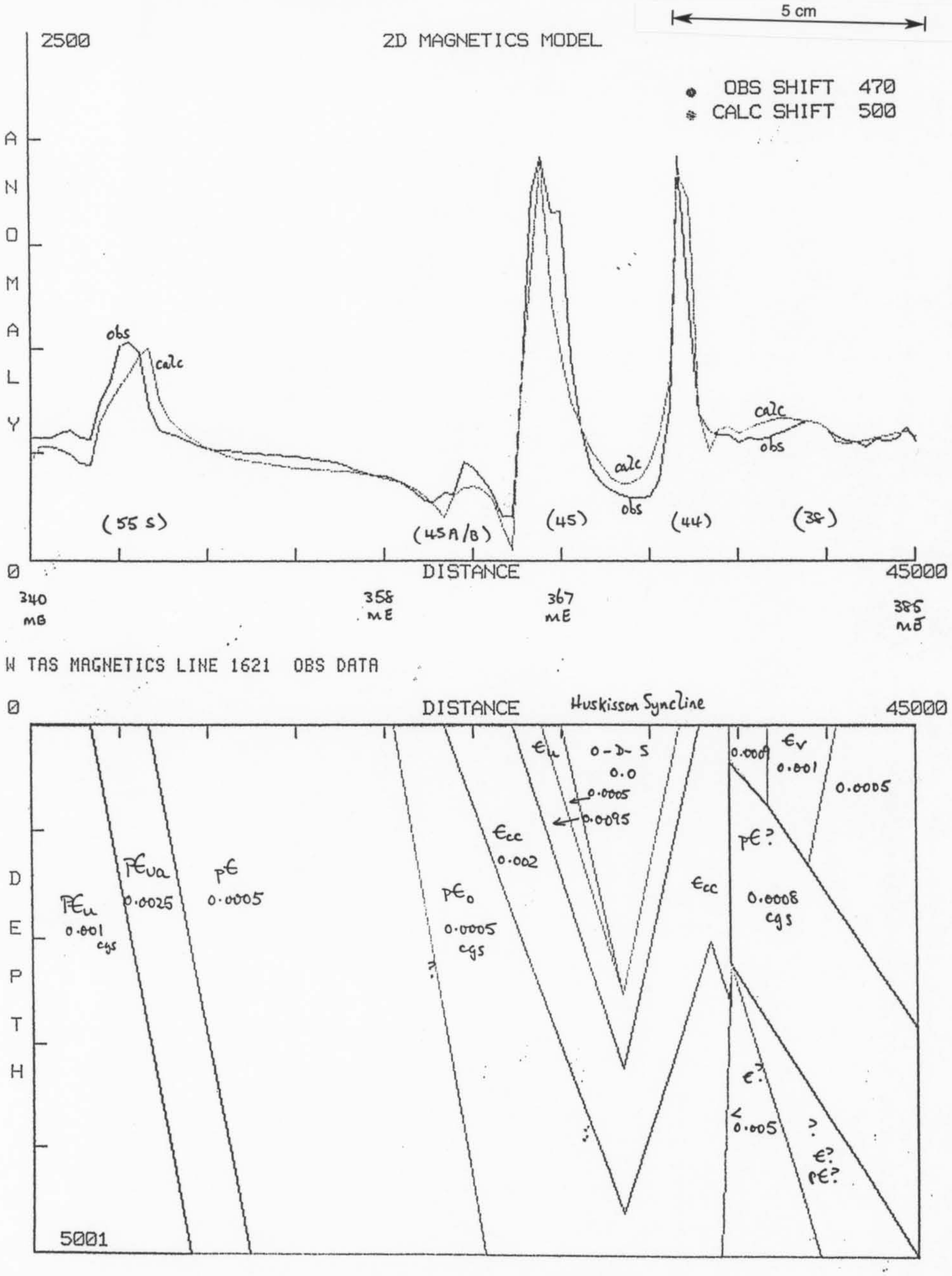

FIGURE 4-F-8

LINE 1621 - 2D REGIONAL INTERPRETATION

MAGNETIC MODEL: 5380 000 mN FIGURE 39

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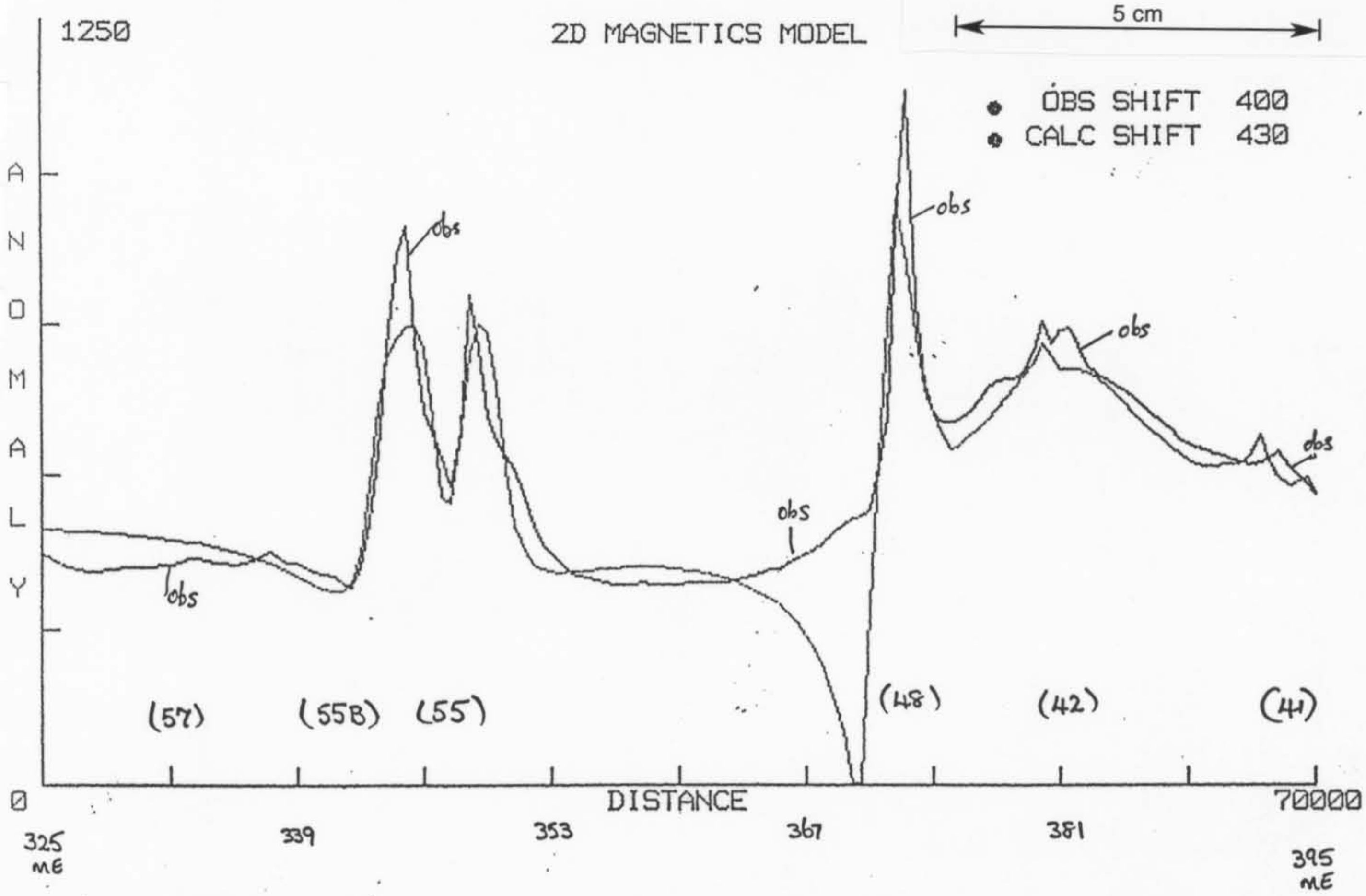
LINE PARAMETERS - ORIGIN,LIMIT,INCR : 0 70000 500



REGIONAL INTERPRETATION LINE 1890 (FROM 325E - REF 800M)

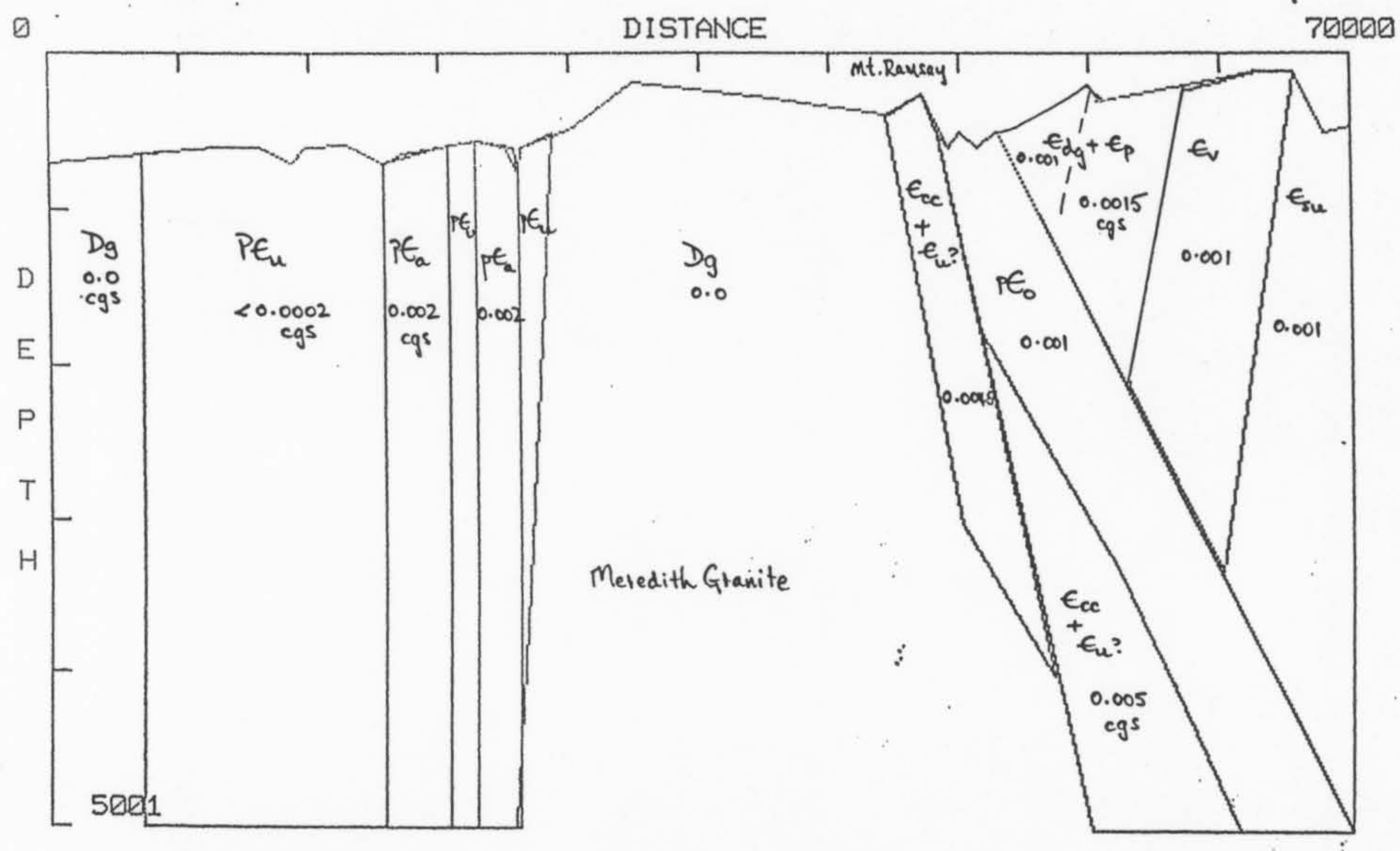


FIGURE 4-F-9

LINE 1890 - 2D REGIONAL INTERPRETATION

MAGNETIC MODEL: 5393 000 mN

FIGURE 40

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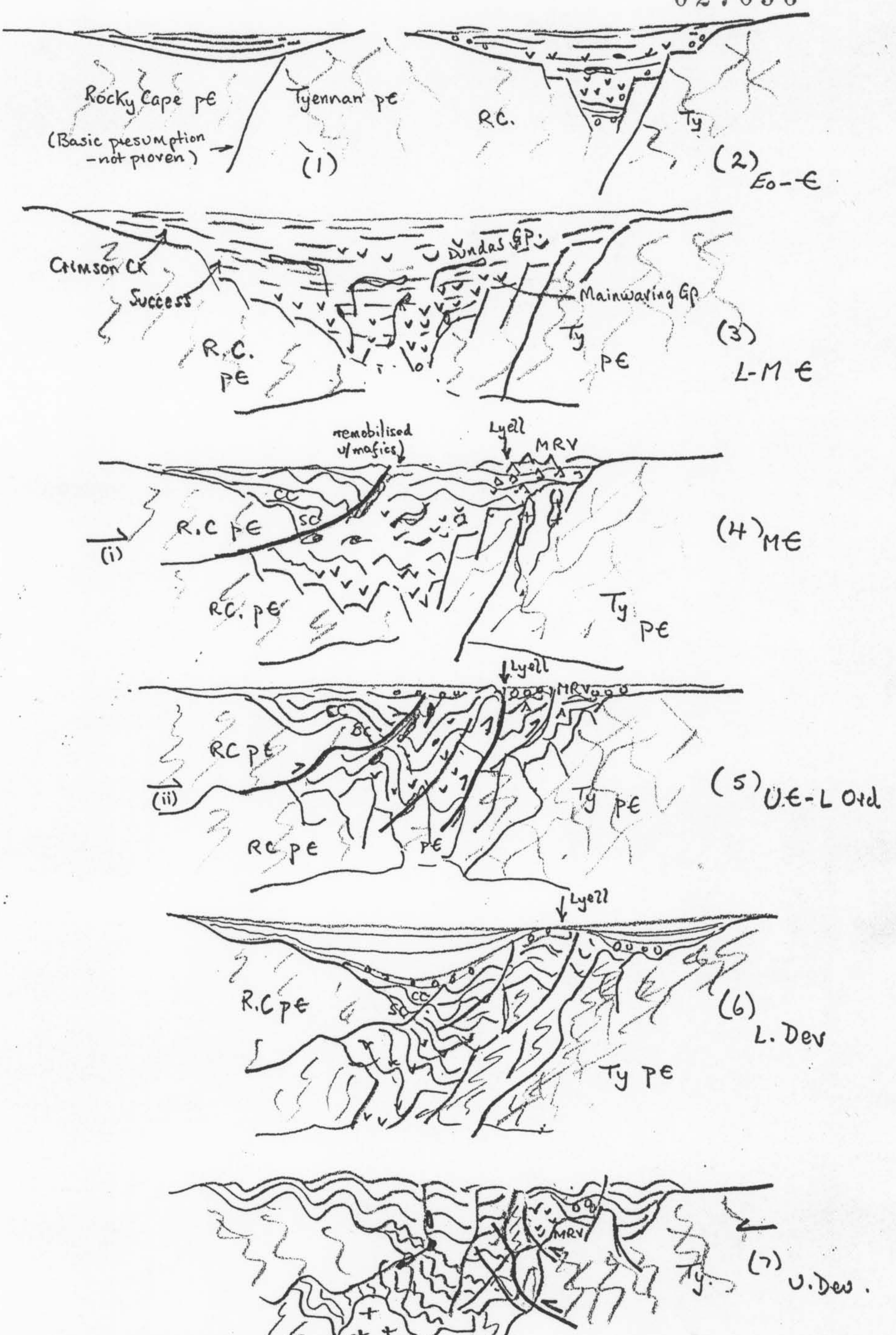

SKETCH: INFERRED EVOLUTION OF STRUCTURES FIGURE 41