

1981/24. Gravity survey of the Que River deposit, western Tasmania.

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Abstract

Gravity methods have been evaluated in a study of the Que River Cu-Pb-Zn ore deposit in western Tasmania. The deposit is representative of many deposits within the Mt Read Volcanics, but none have ever been covered by a fully corrected gravity survey. This survey demonstrates that the method is viable and can assess whether a prospect is economic at an early stage of exploration.

At Que River more than 20 million tonnes of mineralisation has been indicated with the bulk of the material at depths of 50-300 m. Relatively simple processing - smoothing and profile review - was adequate, but gradient analysis is likely to prove valuable in more complex situations.

INTRODUCTION

The Que River Cu-Pb-Zn deposit is located at the edge of an elevated plateau in western Tasmania. Terrain of low relief with the Que River and its tributaries lies to the west while the major dissection of the Mackintosh River and tributaries lies to the east. Location and local terrain are shown in Figures 1 and 2. The area is densely vegetated.

Geochemical anomalies provided the initial impetus for exploration and were evaluated by geochemical (C horizon) and geophysical surveys. The programme has been summarised by Webster and Skey (1979). Geophysical methods were generally lacking in definition, although airborne EM was regarded as providing the prime confirmatory focus. IP results were influenced by ore type and nearness to surface. In the authors' view no electrical method positively identified ore - rather a footwall. Certainly only one lens system was suggested by geophysical surveys (PQ to the east) whereas geochemistry provided the best indication of broad mineralisation and both lens systems. A gravity survey was begun but neither completed, corrected, or published.

The grid prepared for the exploration programme is about three kilometres by one kilometre. Few lines extend the full width due to slope, access and vegetation conditions. A range of methods was applied initially (Webster and Skey, 1979) and other methods have been evaluated subsequently for deposit signature. Of the common methods, only gravity had not been evaluated and the present work sought to redress this deficiency. The mineralisation is fairly typical for the Mt Read Volcanics province and it was considered important that the deposit, method, or province signatures be noted.

This survey was intended as an evaluation of the method in a realistic test with a typical and far from ideal grid, difficult terrain, small bodies, and complex host rocks. The data has been subjected to an abnormally comprehensive processing sequence in order to identify useful treatments. Previous gravity surveys in this province have lacked adequate coverage, terrain correction, or even residual separation in order to define or describe deposits or structures.

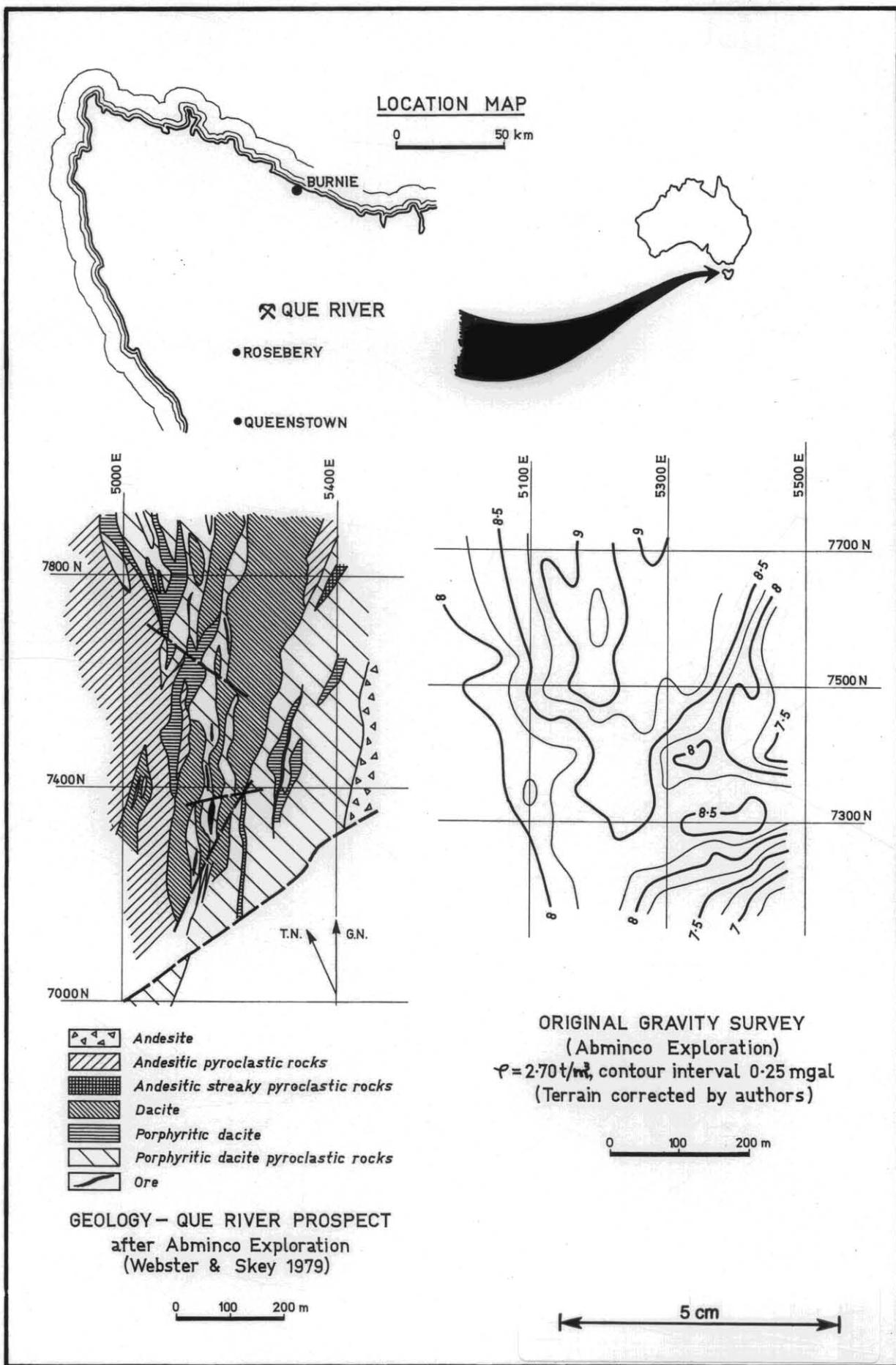


Figure 1.

GEOLOGY

Exposure in the upper reaches of the Que River is poor and most detailed geological data is based on drilling results or costeans (see Webster and Skey, 1979). The general geology of the region is indicated by Barton et al. (1966) and Collins et al. (1981). Several units have been recognised in the suite of volcanic rocks. All are Cambrian in age and belong to the Mt Read Volcanics. The geological summary (fig. 1) and ore outlines (figs. 1 and 5) are based on maps provided by Abminco Exploration and published by Webster and Skey (1979).

The volcanic sequence consists of andesitic pyroclastic rocks with some sphalerite and galena, porphyritic dacite, pyritic dacitic pyroclastic rocks with disseminated sulphides, barren dacite, mineralised pyroclastic rocks with major sphalerite-galena lenses, and andesitic pyroclastic rocks. The eastern ore lens system contains pyrite with galena, sphalerite, and chalcopyrite. In part this lens is of pyrite and chalcopyrite only. The western lenses contain only minor chalcopyrite in bands of pyrite, sphalerite, and galena.

GRAVITY SURVEYS

The original minor survey of the grid heart is reproduced from a map provided by Abminco Exploration (fig. 1); an $r = 20$ km terrain correction has been incorporated using corrections calculated for the new survey. Station spacing was 25 m, line spacing 50 m, reduction density 2.70 t/m^3 , elevation accuracy 10 mm. The reference base is unknown. An ill-defined positive anomaly is indicated with closure to the south near 7300N.

The new survey utilised the entire grid. The station distribution and topography are shown in Figure 2. Many lines are 100 m apart and pegged at 50 m intervals. No new pegging was undertaken and all extant levelled and pegged sites were occupied. It was assumed that pegs retained true positions, although the grid was some seven years old, except where mine development had disturbed the area. A few positions were resurveyed in the grid centre in order to restore coverage lost from this cause.

Overall survey precision is uncertain due to the possibility of minor peg shifts, multiple observers and meters (Worden 273, 913) and variable ground conditions, but is probably better than 0.10-0.15 mgal including 0.05 mgal terrain correction margin.

Observed gravity values are based on Bureau of Mineral Resources Isogal tie stations at Smithton and Strahan (see Richardson, 1981a). A density of 2.67 t/m^3 was used for the Bouguer reduction and all stations terrain corrected to zone M (Hammer, 1939). The terrain is such that only at this radius do variations across the grid reduce to less than 0.05 mgal. Corrections range from 0.83-3.80 mgal; zones A-D, 0.03-1.13 mgal; zones E-I, 0.39-2.92 mgal; zones J-M, 0.19-0.39 mgal. The ranges show that substantial errors would be introduced by partial or omitted corrections.

Corrected and uncorrected Bouguer anomalies are shown in Figure 3.

DATA TREATMENT

Figure 3, though somewhat cluttered, gives a true impression of the nature of the anomalies observed. The effect of terrain corrections is not obviously severe, which probably reflects the gross quasi-regular effect of the plateau edge. A dissected terrain within a grid would be more

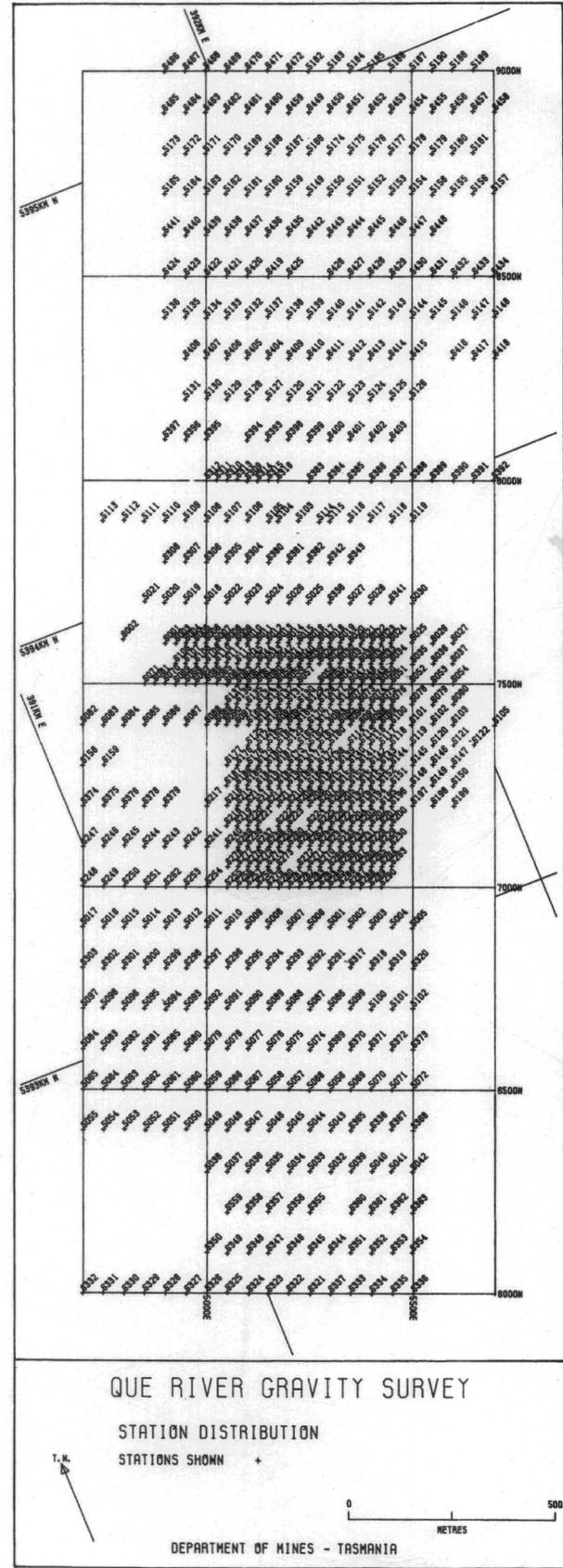
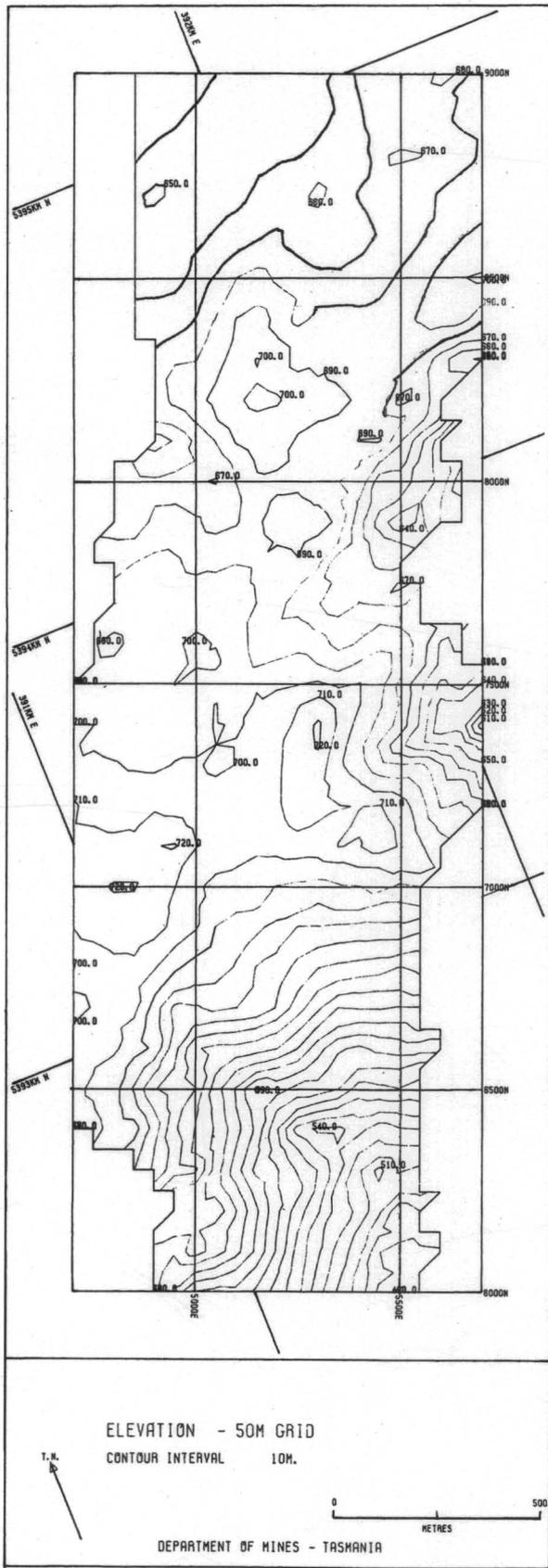
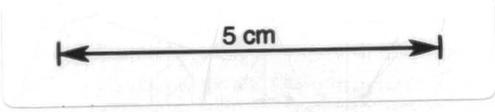


Figure 2.



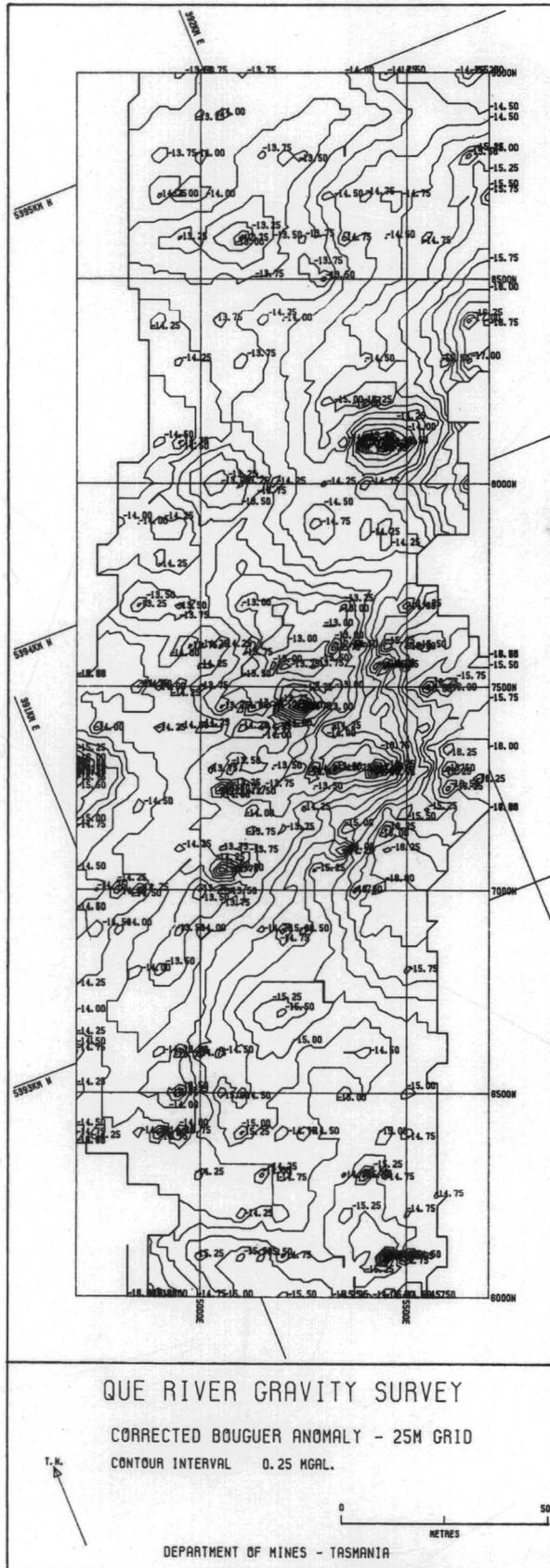
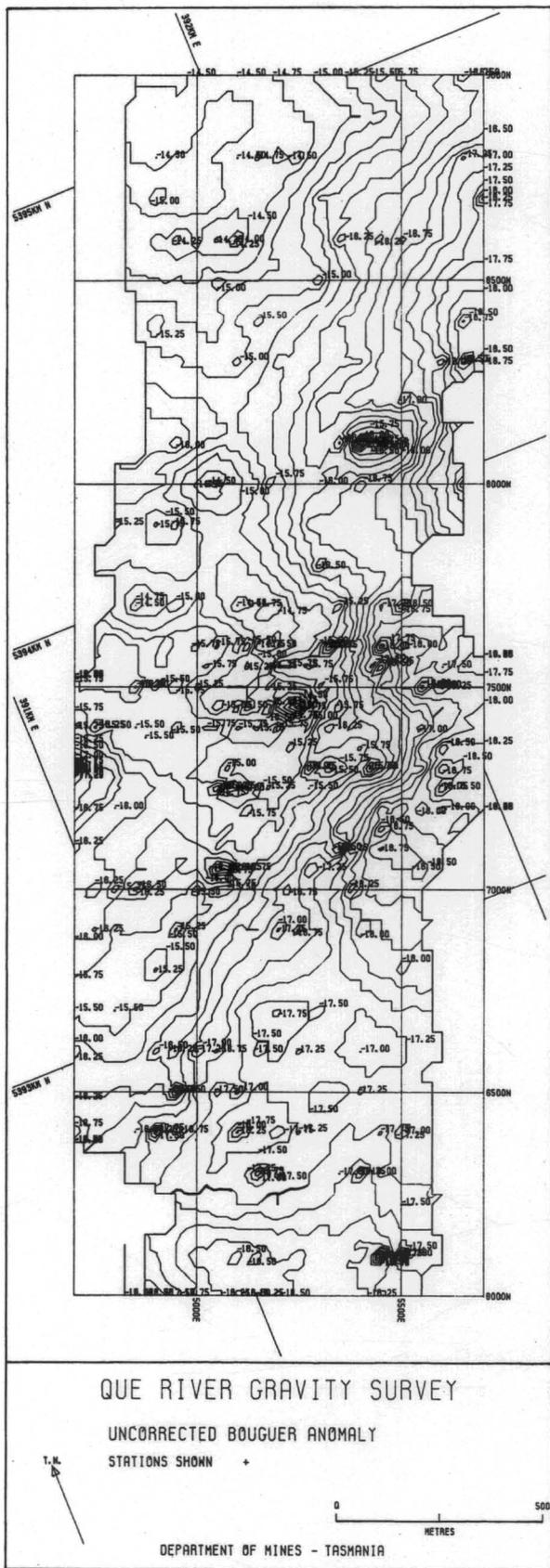
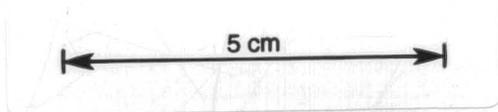


Figure 3.



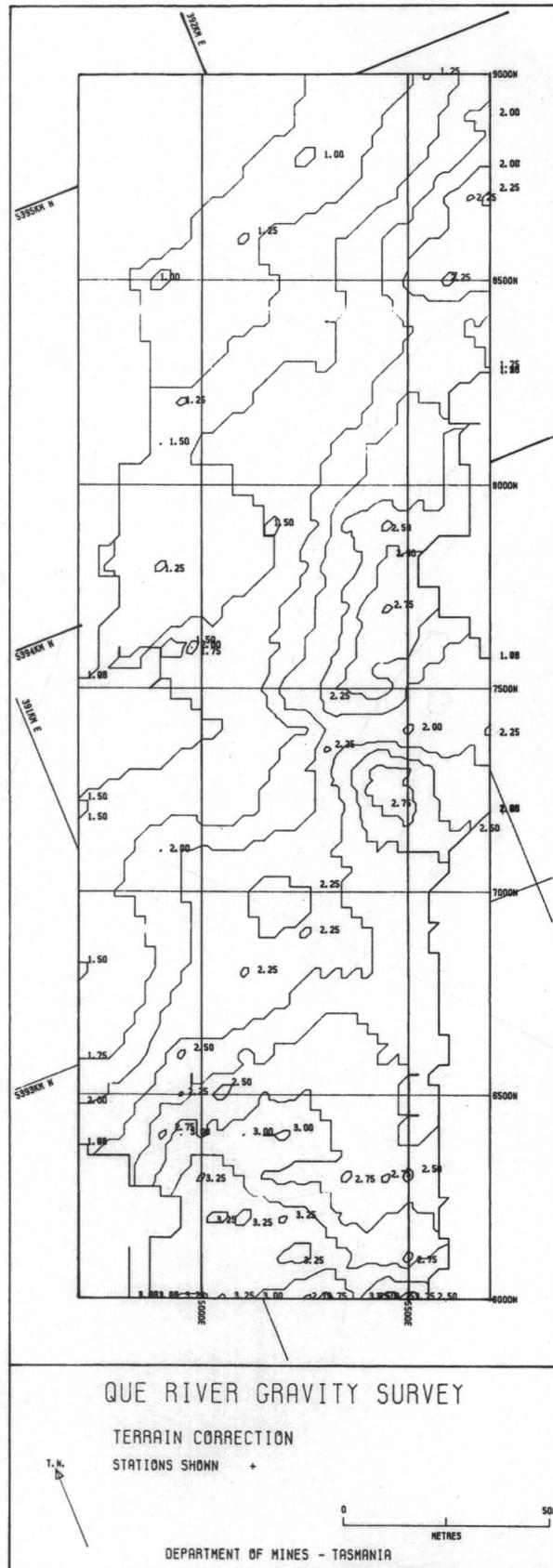
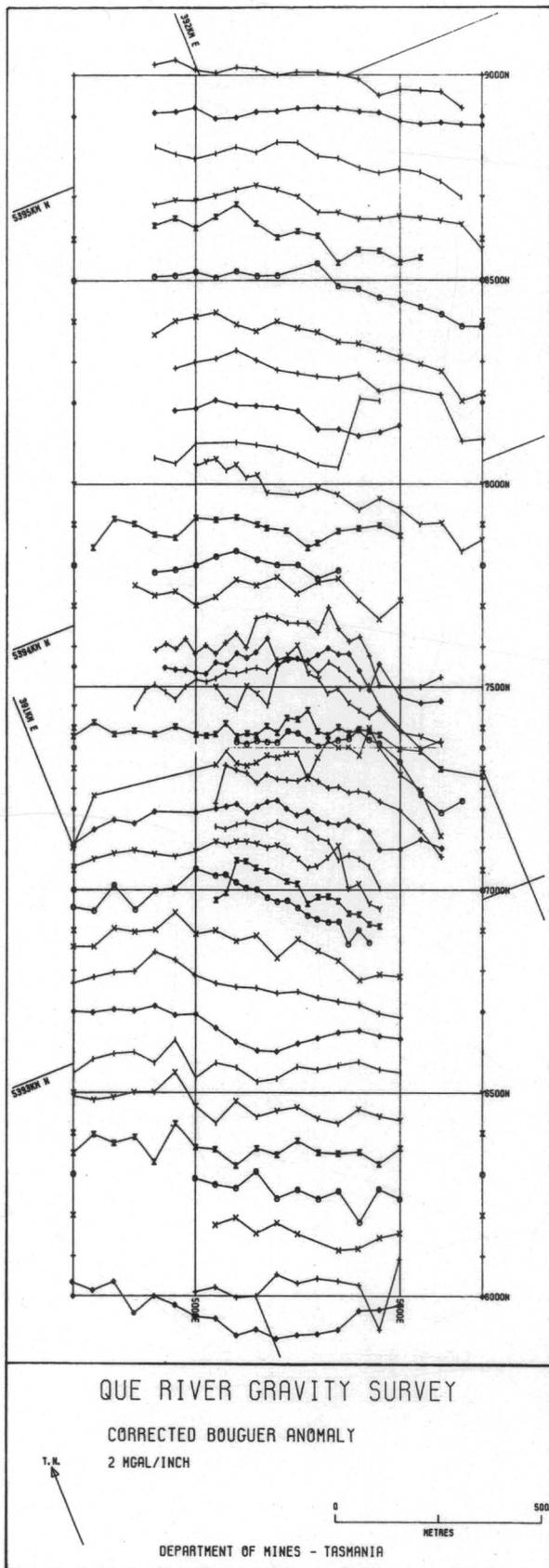
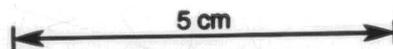


Figure 4.



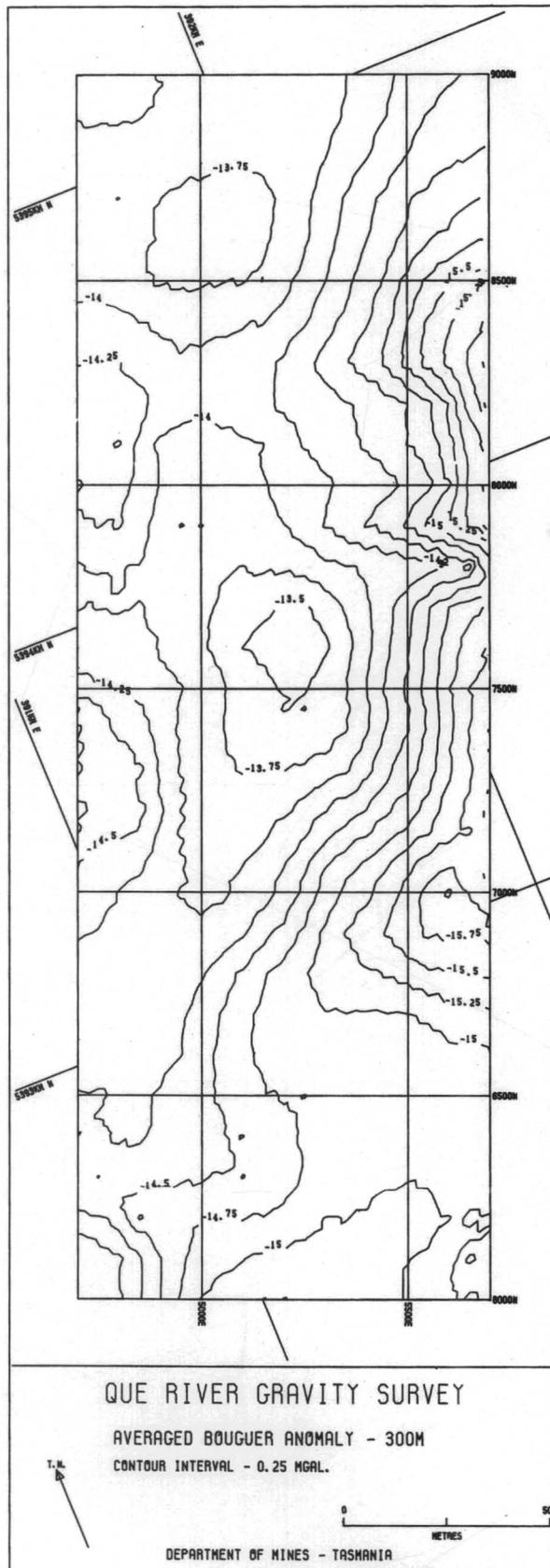
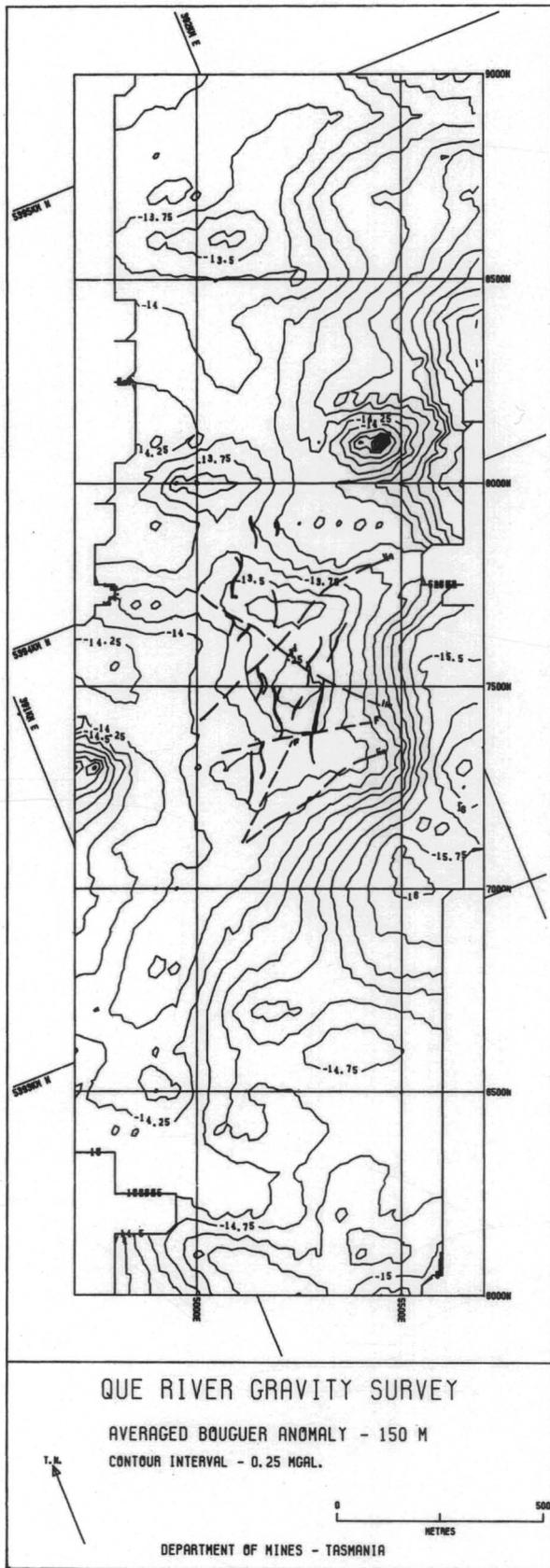


Figure 5.

5 cm

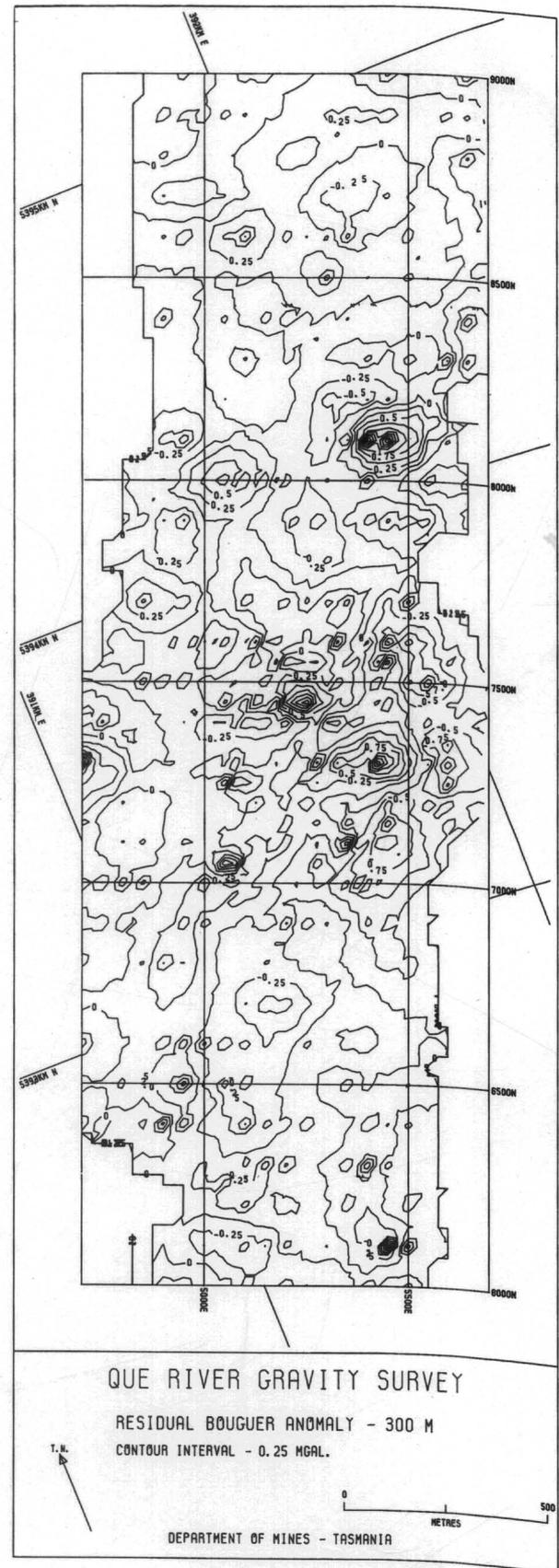
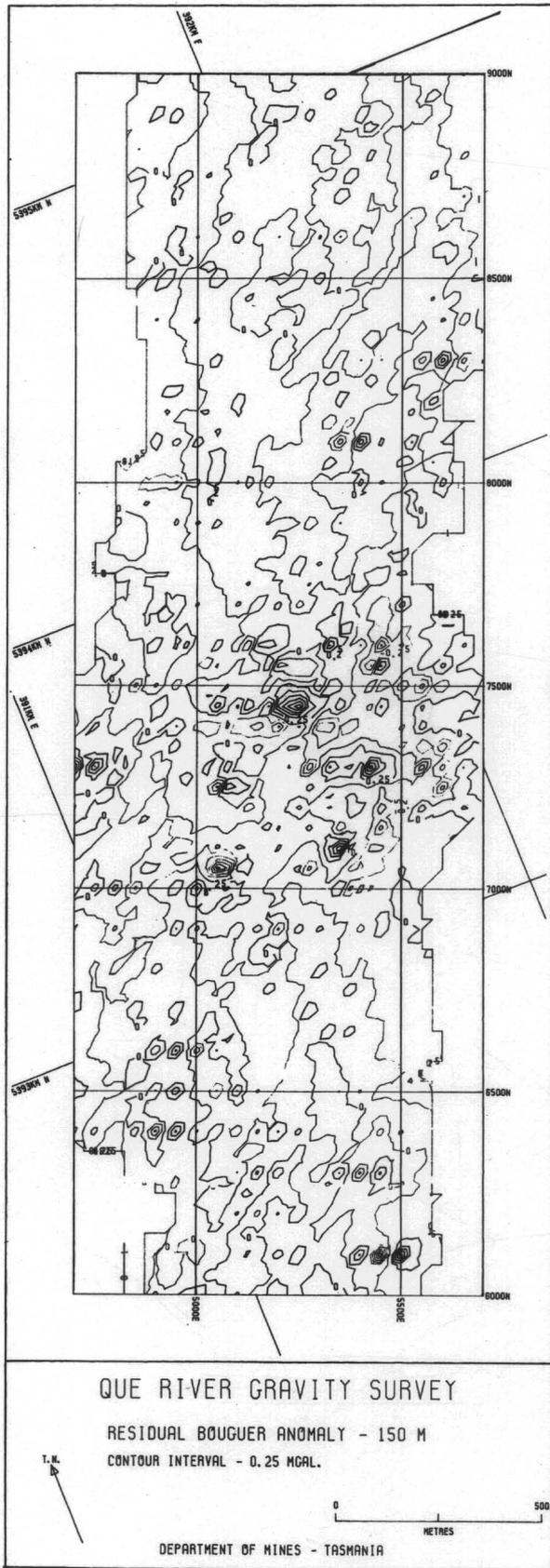
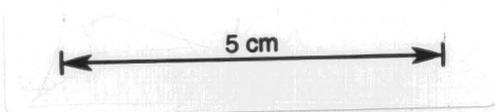


Figure 6.



apparent. The correction is, however, large and cannot be ignored.

Contouring throughout the treatment has been attempted using a range of sample or contour intervals. Most direct working on the data is based on multiples of 55 m units, but all calculated grids (e.g. from continuations) use 25 m units. The 55 m unit is necessary to ensure data point inclusion in moving averages, since some stations are 50 m apart on lines 100 m apart.

Profiles, from which Figure 3 is derived, are shown in Figure 4. The Bouguer anomalies appear noisy, but the coarse spacings and near-surface exposure of small bodies is consistent with the observations.

Two processes have been employed to examine the frequency spectrum represented by the anomalies in Figure 3. Both operate directly on the observed anomalies.

The first is a classical regional-residual separation undertaken at a range of filter cut-off frequencies. The data has been examined by moving averages with aperture sizes of 120, 150, 200, 250, 300, and 400 m. Larger sizes result in excessive data loss. These have the effect of removing wavelengths less than about one-third of the aperture size. The averaged Bouguer anomalies may be regarded as regionals with reducing definition of near-surface influences. Two are shown in Figure 5. Residual Bouguer anomalies may be derived from them (e.g. fig. 6) and these retain the high frequency components of the field.

The second approach to processing is continuation, which permits topographic or source contributions to be placed in perspective. In addition it provides a guide to causative mass and an horizon for modelling purposes if required (very little modelling was undertaken in this project due to little need and restricted funding - all processing was undertaken externally at the University of Tasmania computing centre by a Burroughs B6700). In this case, a set of equivalent masses were calculated at $h = 400$ m, about 200 m below the average elevation, to optimise the procedure which is based on the method of Dampney (1969) as revised by the authors (Leaman and Richardson, 1981; Richardson, 1981b). The process effectively removes spurious or surficial effects and can be used to produce regionals and residuals based on the gross effects of the source masses. Continuations have been produced for $h = 500, 600, 650, 700, 720, 725, 730, 750, 800, 1000, 1500,$ and 2000 m (samples, figs 7, 8). Where $h \gg 1000$ m the effect may be considered regional and residuals may be derived (e.g. 725-1000, see fig. 9). Or, other levels may be differenced (e.g. 650-725, see fig. 10). Both approaches allow a clearer review of components in, and sources of, the gravity field, which may be reconstituted for comparison at the actual observation points (compare figs. 3 and 5 with fig. 11).

Gradients and second derivatives have been calculated from the observed anomalies, averaged anomalies ($h = 120, 150, 300$ m), and continuations in the range $h = 720-730$ m (the lowest surfaces free of geology). Vertical and total horizontal gradients for 720-725 m and 725 m are shown in Figure 12. The resultant is given in Figure 11. Horizontal vector directions and the vertical angle are shown in Figure 13. Second derivatives are presented in Figure 14. Samples of gradients derived from observed anomalies are shown in Figure 15. Most show a herringbone texture such as suggested in Figure 15 (E-W) and may be affected by data reliability, placement, or contouring problems. The horizontal angle variation and vector have been calculated for anomalies present in the 120, 150, and 300 m averages. An attempt was made to calculate gradients and angles from the

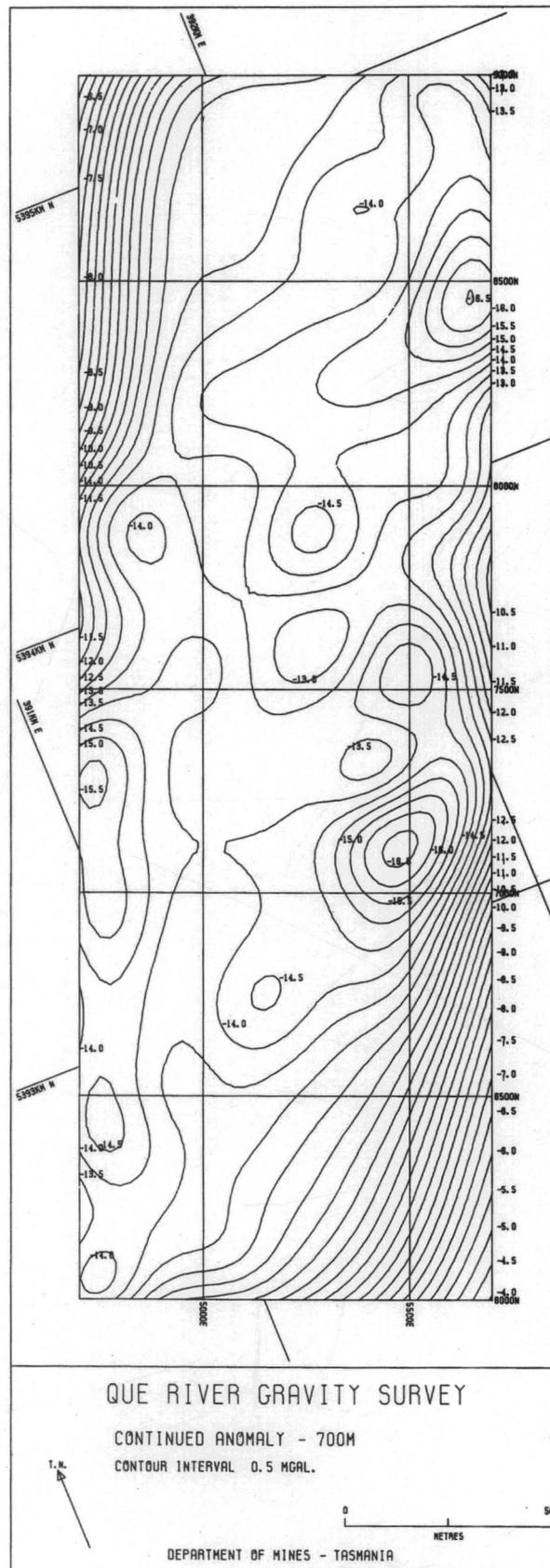
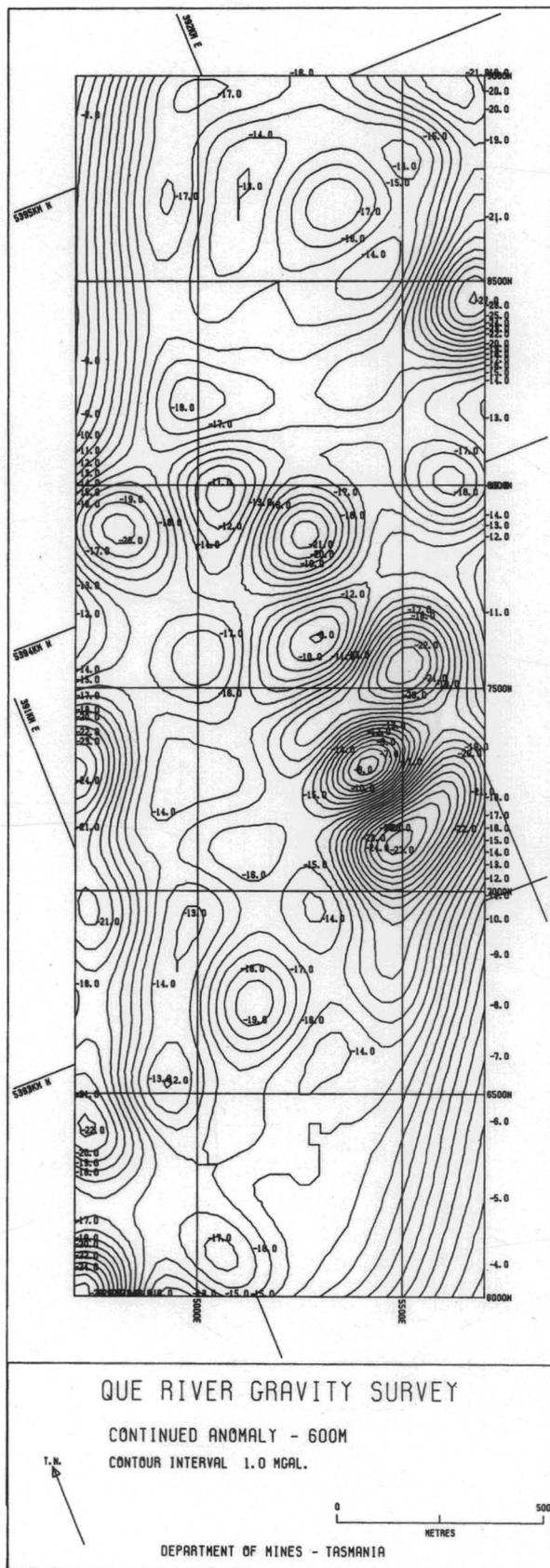
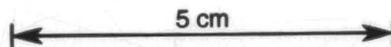


Figure 7.



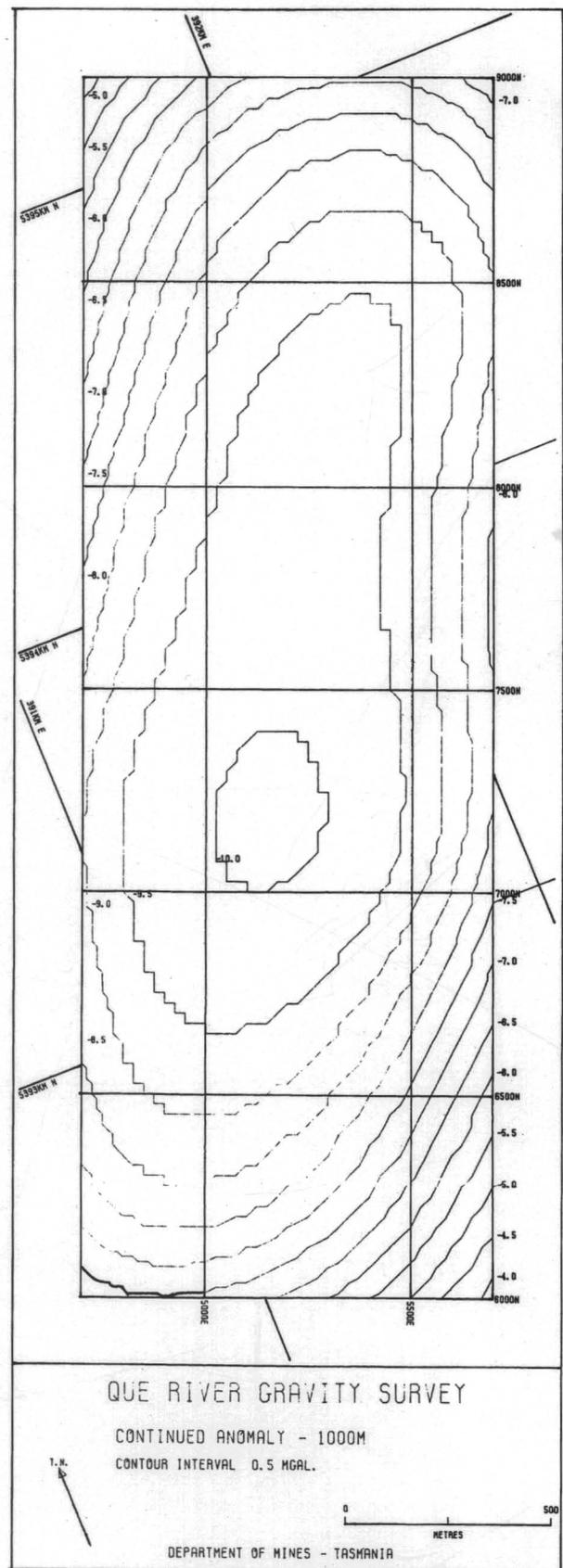
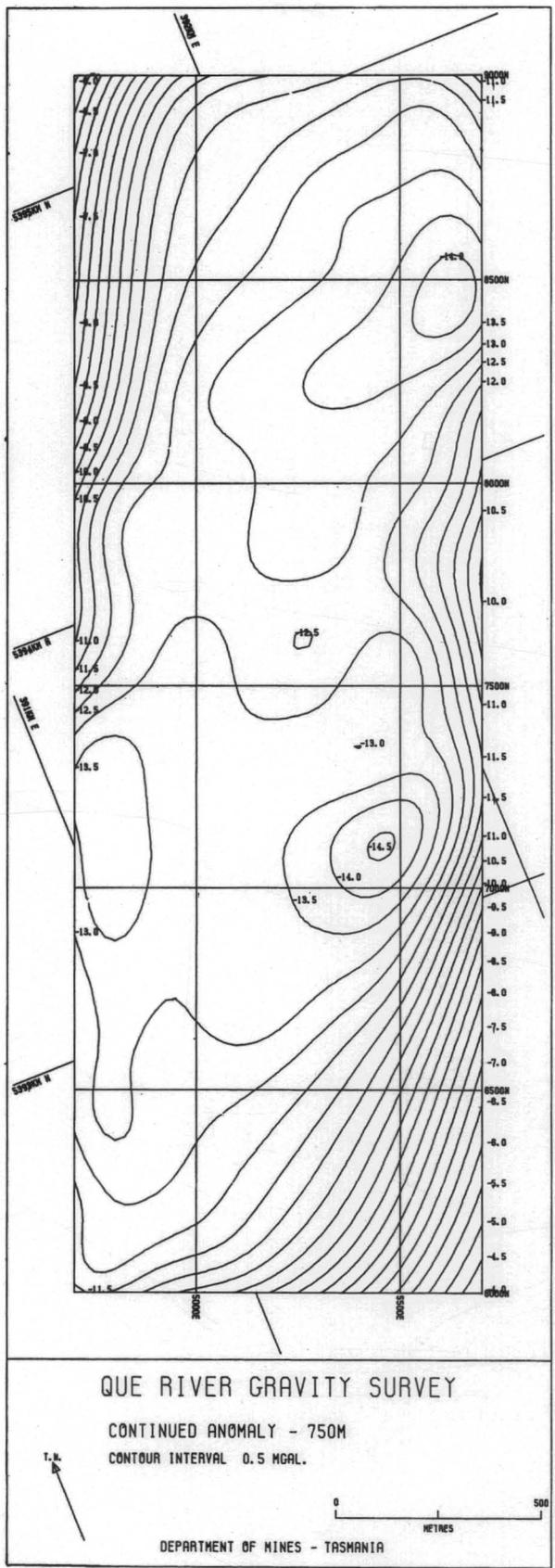
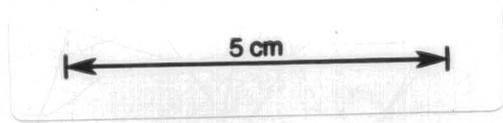


Figure 8.



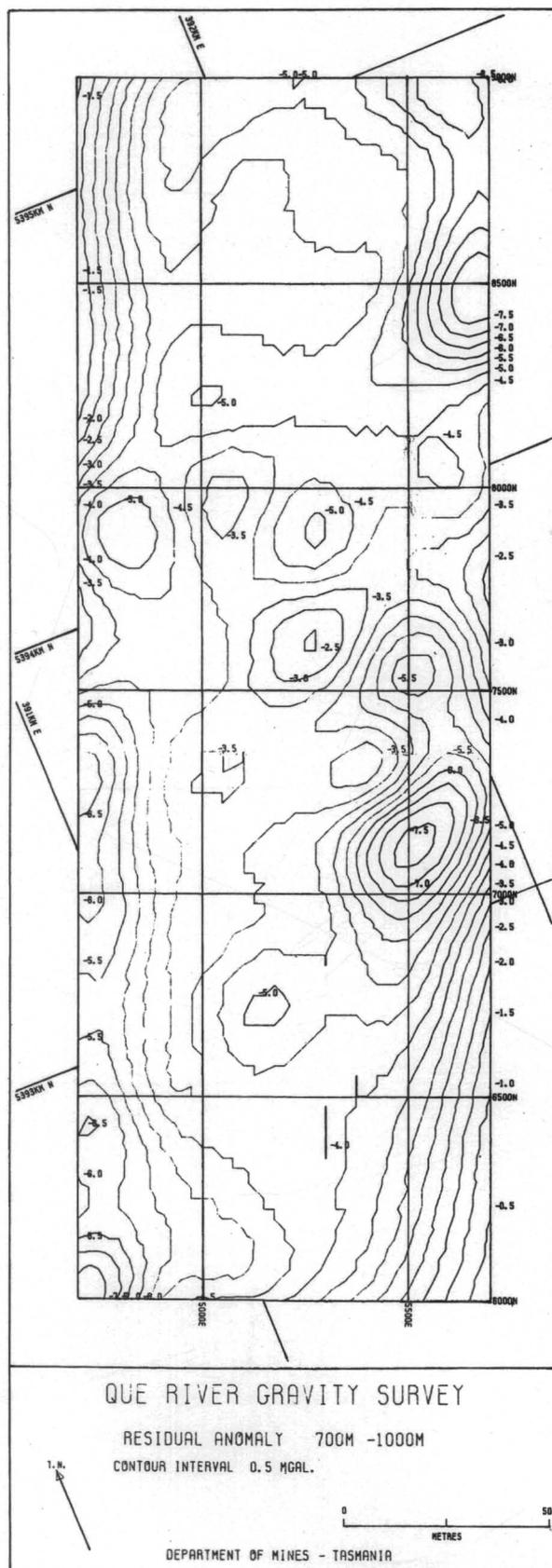
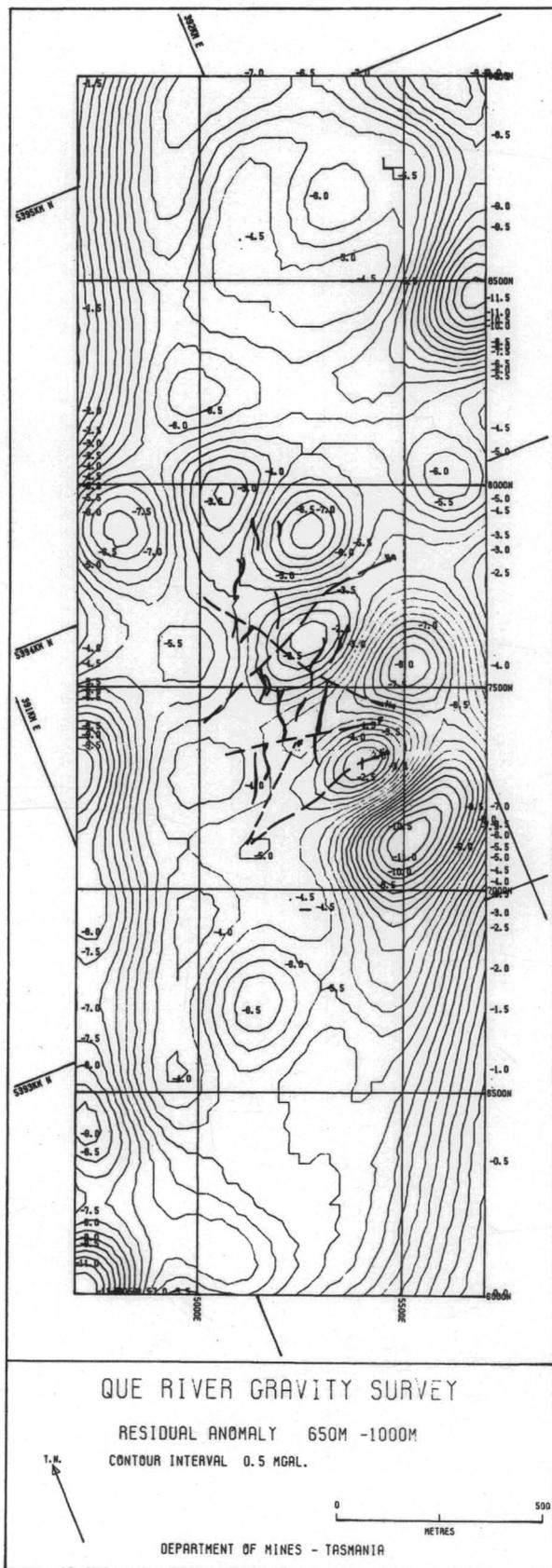
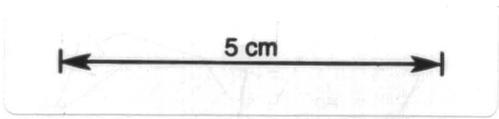


Figure 9.



observed data but was curtailed due to cost of processing. The observed field, unfiltered, is too complex for rapid computation.

The treatment outlined includes all possible forms of presentation of the gravity field. Edge effects are apparent in many plots, especially continuation derivations, and the elongate grid has induced some of the problems.

Figures 5-15 are a selection for interpretation purposes. Other treatments are given in the appendix for review purposes.

DENSITIES

Few density determinations have been recorded for units of the Mt Read Volcanics, but a range of 2.60-2.85 t/m³ has been implied for unweathered but unspecified lithologies (e.g. Leaman, 1973). Samples provided by Abminco from core have been measured and the results tabulated with ore data.

Table 1. DENSITY VALUES IN t/m³

Minerals: pyrite 5.0	sphalerite 3.75	(from Telford et al., 1976)
chalcopyrite 4.2	galena 7.5	
Que River ore: P-Q lenses	3.81 average (3.25-4.85)	
S lenses	3.80 average (overall, Cu-Pb-Zn)	
	4.09 average (Pb-Zn section)	(courtesy Abminco)
Que River ore margins:	dacitic pyroclastic rocks average 2.97 (2.90-3.09)	
	porphyritic dacite average 3.09 (3.06-3.18)	
	other pyroclastic rocks average 2.96 (2.94-2.98)	
	reworked tuff average 3.23 (3.22-3.24)	(courtesy Abminco)
Host rocks: andesite	-	
	andesitic pyroclastic rocks average 2.75	
	streaky pyroclastic rocks average 3.07 (3.03-3.10)	
	dacite average 2.86 (2.80-2.92)	
	porphyritic dacite average 2.91 (2.74-3.22)	
	dacitic pyroclastic rocks average 2.93 (2.81-3.22)	
	porphyritic dacitic pyroclastic rocks average 3.04 (2.85-3.26)	
	reworked dacitic tuff average 3.04 (2.93-3.25)	

Base densities of the rocks present are in the range of 2.75-2.85 t/m³. Many units contain some mineralisation, especially pyrite, and the density is directly related. Ten per cent pyrite in a host with densities 2.75, 2.80, and 3.00 t/m³ yields a resultant of 2.97, 3.02, and 3.20 t/m³.

Base metal, or pyritic, mineralisation increases rock density.

ANOMALIES

The observed anomalies (fig. 3) appear confusing but do reveal a large area of positive anomaly centred on 5250E, 7500N with offset extensions to 4900E, 6700N and 5000E, 8000N. These broad features are clearly seen in Figure 5. Localised 'pimple' type anomalies are more common and are visible in residuals (fig. 6). Table 2 lists many of the positive anomalies, i.e. those related to mineralisation. Many anomalies are best

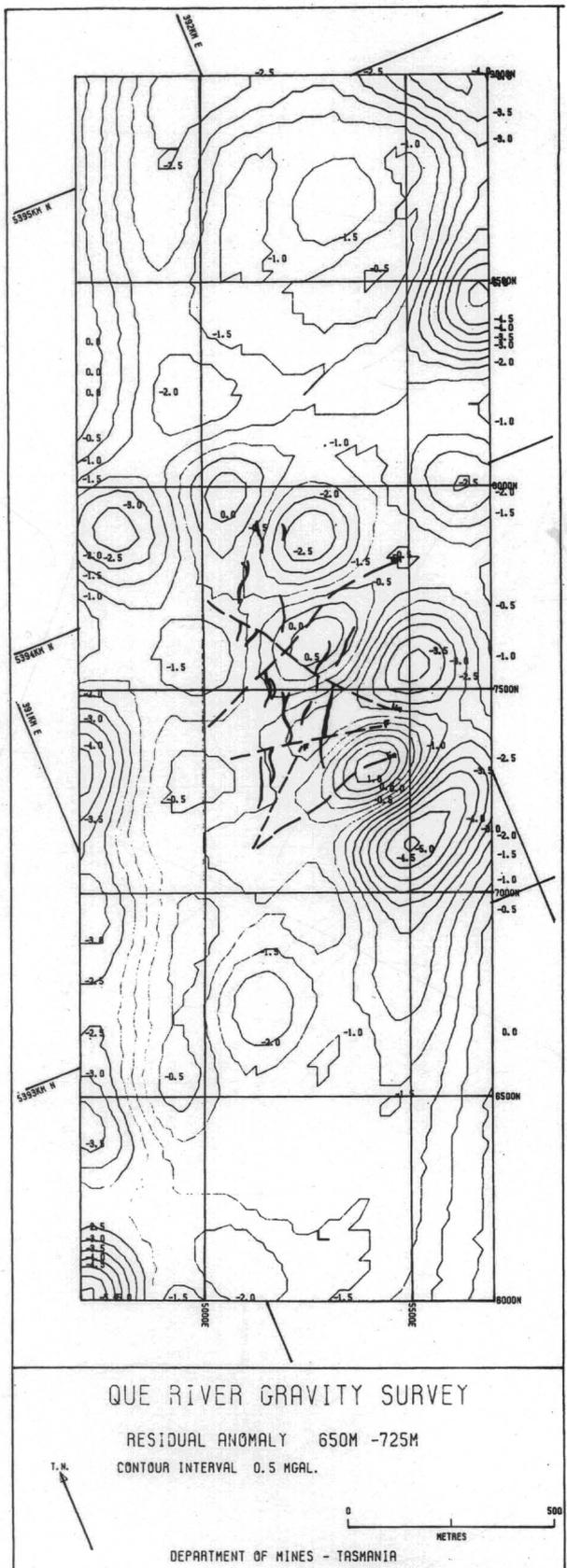
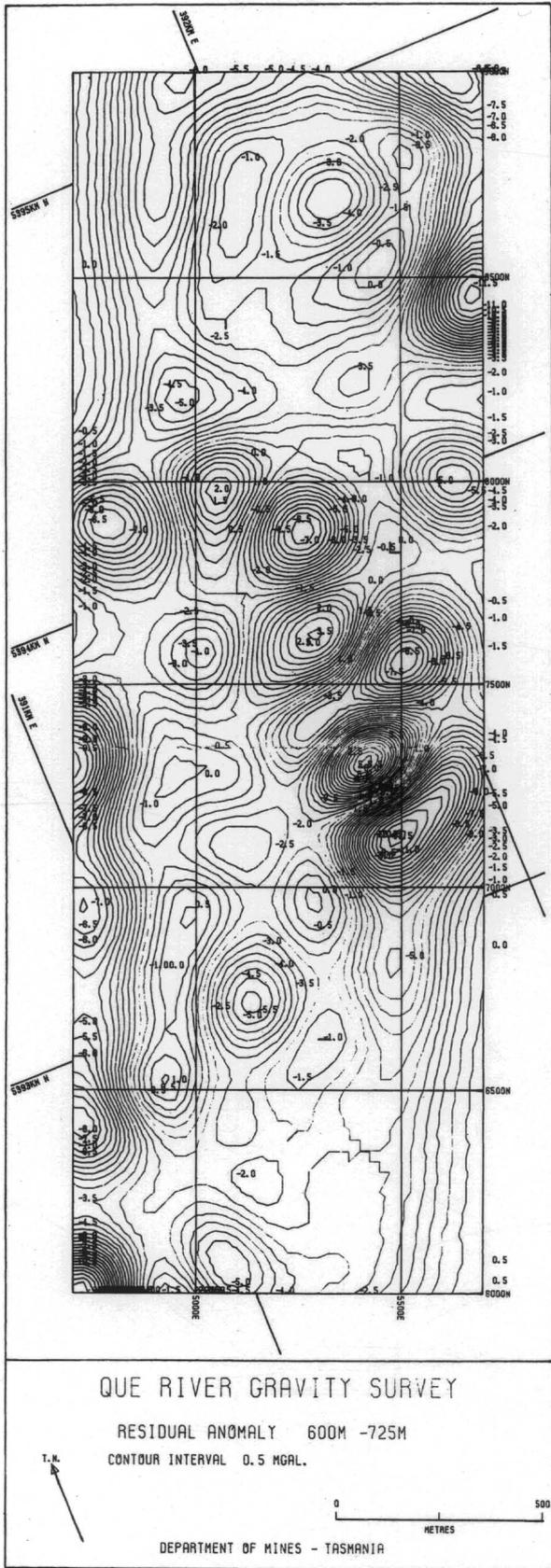


Figure 10.

5 cm

evaluated in profile form (fig. 4) since several features are compound. Not all features are included in the table. Major anomalies with significant sources are clearly identified in the reconstituted Bouguer anomalies (fig. 11) and with only one exception form the basis of mass computations (Table 3).

Table 2. PRINCIPAL POSITIVE ANOMALIES

Position (±25 m)	Representation			
	300 m residual	700-1000 residual	600-725 difference	profile
5100E, 8600N	0.75 mgal	<0.5 mgal	1.00 mgal	>0.75
5300E, 8500N	0.50	<0.5	1.50 (5400)	>0.50
54/5500E, 8100N	1.50 average	nil	0.75	>2.00
5050E, 8100N	0.50	0.75	2.50	>0.50
50/5100E, 7900N*	<0.25	>0.50	gradient	~1.00
5350E, 7700N*	>0.50	gradient	gradient	1.00
5200E, 7600N	<0.25	>1.00	>2.00	1.00
5450E, 7550N	0.75	gradient	gradient	1.00
5150E, 7550N*	0.50	1.00	3.50	1.00
5255E, 7450N*	1.00	0.50	>-1.00	>1.50
5275E, 7400N	<0.5	gradient	gradient	0.75
5100E, 7300N*	0.75	0.50	1.50	0.50
53/5500E, 7300N*	0.75-1.50	0.50	8.50	>1.00
5350E, 7100N	0.50	gradient	2.00 (7000)	>1.50
4800E, 7000N	0.50	gradient	gradient	1.00
49/4950E, 6800N	0.50	gradient	>1.00	1.00
4950E, 6600N	>0.50	gradient	>1.00	1.00
4950E, 64-6500N	0.50-0.75	>0.50	3.00	1.00

* - Anomalies directly related to known surface ore exposures.

Many profiles reveal a broad positive effect with a number of minor peaks. The low frequency anomaly has an amplitude of up to 2 mgal and high frequency anomalies have amplitudes of 0.5-1.0 mgal. The observation interval of 25 or 50 m is inadequate to properly define high frequency effects.

INTERPRETATION

Most anomalies are isolated and there is no definite suggestion of coherent structure-lithology trends within the surveyed area, although the negative anomalies in the eastern edge of the grid may be related to increased amounts of andesitic rocks. If the position of known ore lenses as shown in Figure 1 is overlaid with the averaged anomalies (e.g. fig. 5) it is clear that all fall within the broad central positive area and that the anomaly is related directly to mineralisation.

Many small spiky anomalies can be directly correlated with ore lenses (see Table 2, fig. 4) and must be related to small, shallow bodies - generally less than two metres deep, less than 5-8 m wide, and a depth extension of 50-75 m. Few bodies over five metres thick extend to within five metres of the surface. Broader effects are due either to disseminated mineralisation or thicker and deeper bodies. Surface expression of all 'lenses' is likely to represent a minor indication of the subsurface continuity and scale.

Two profiles have been examined in detail (fig. 4). 7400N suggests up to eight thin near-surface exposures of ore and some larger deeper bodies. The gross form of the profile implies either considerable pyrite accumula-

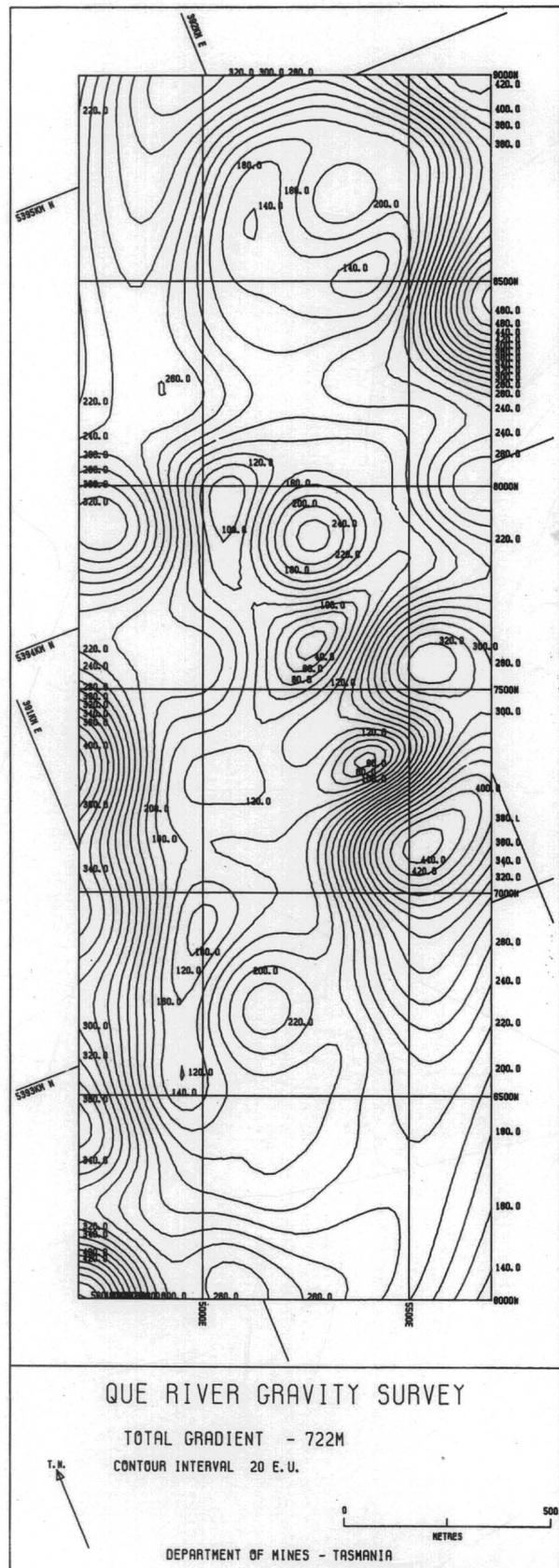
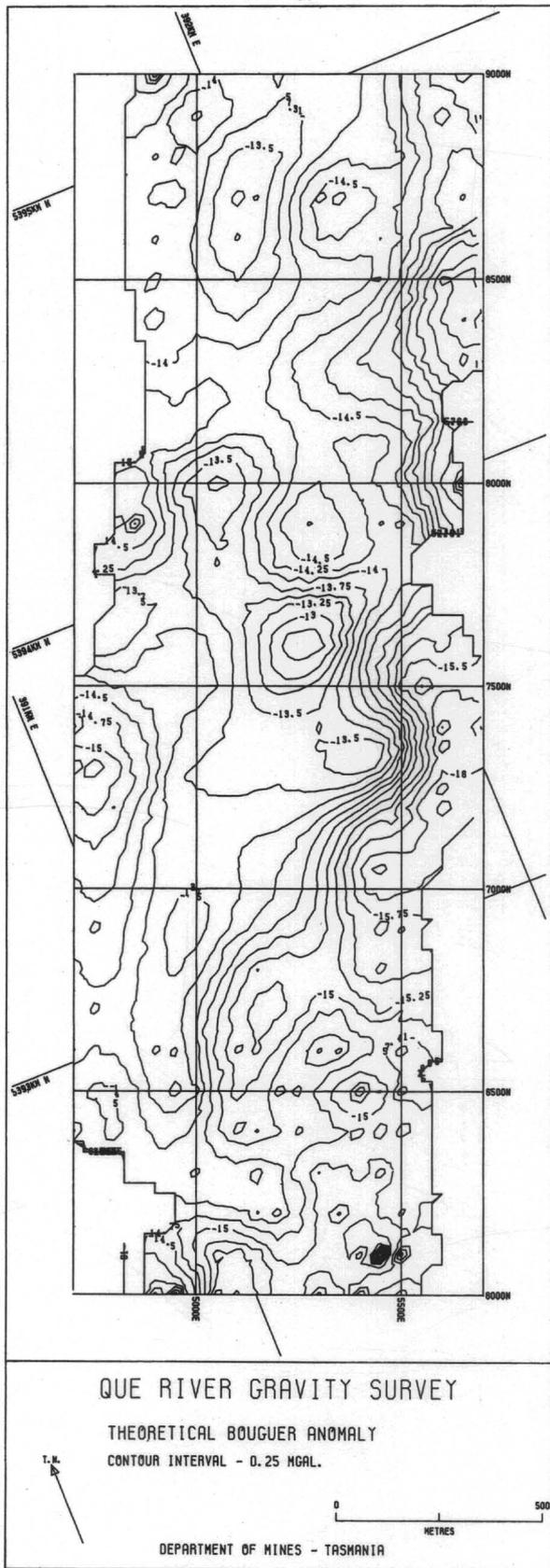
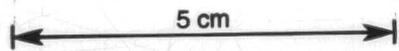


Figure 11.



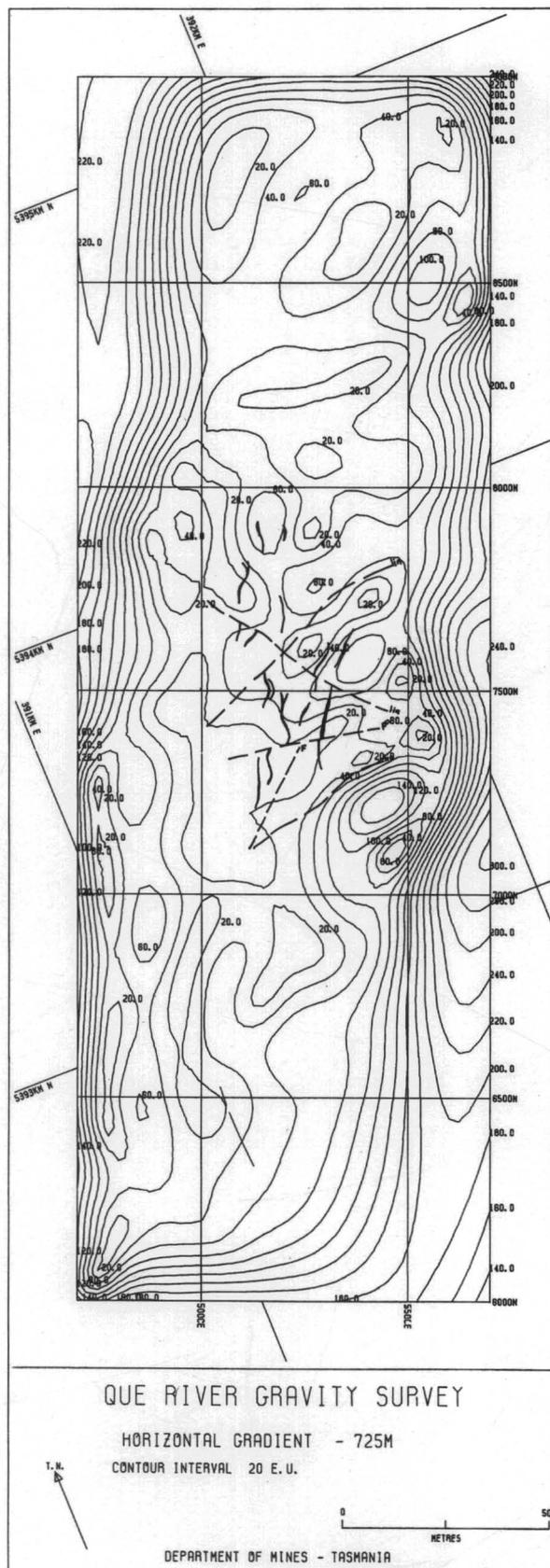
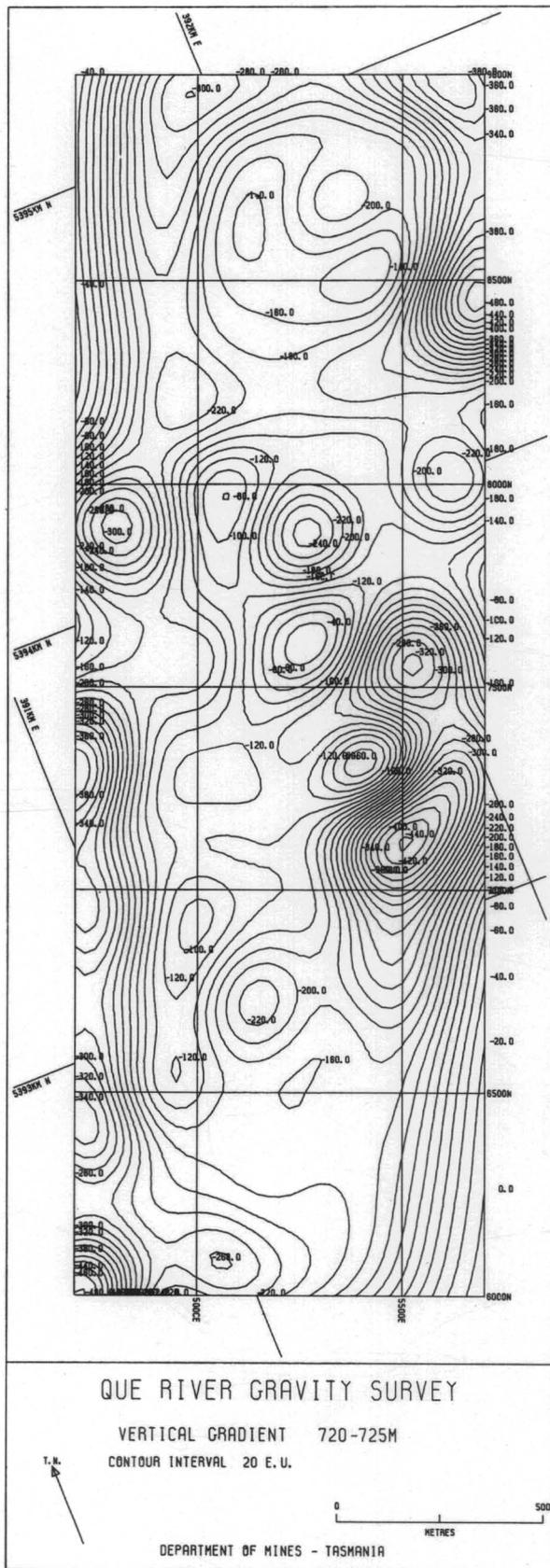


Figure 12.

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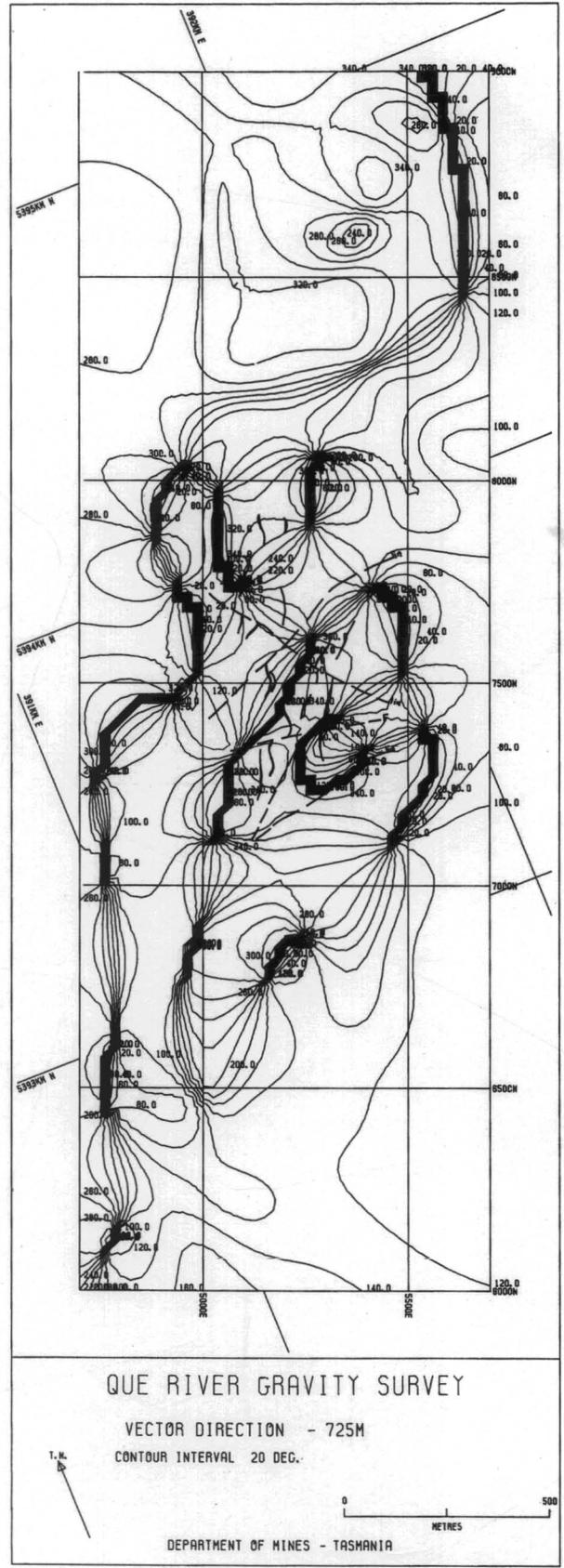
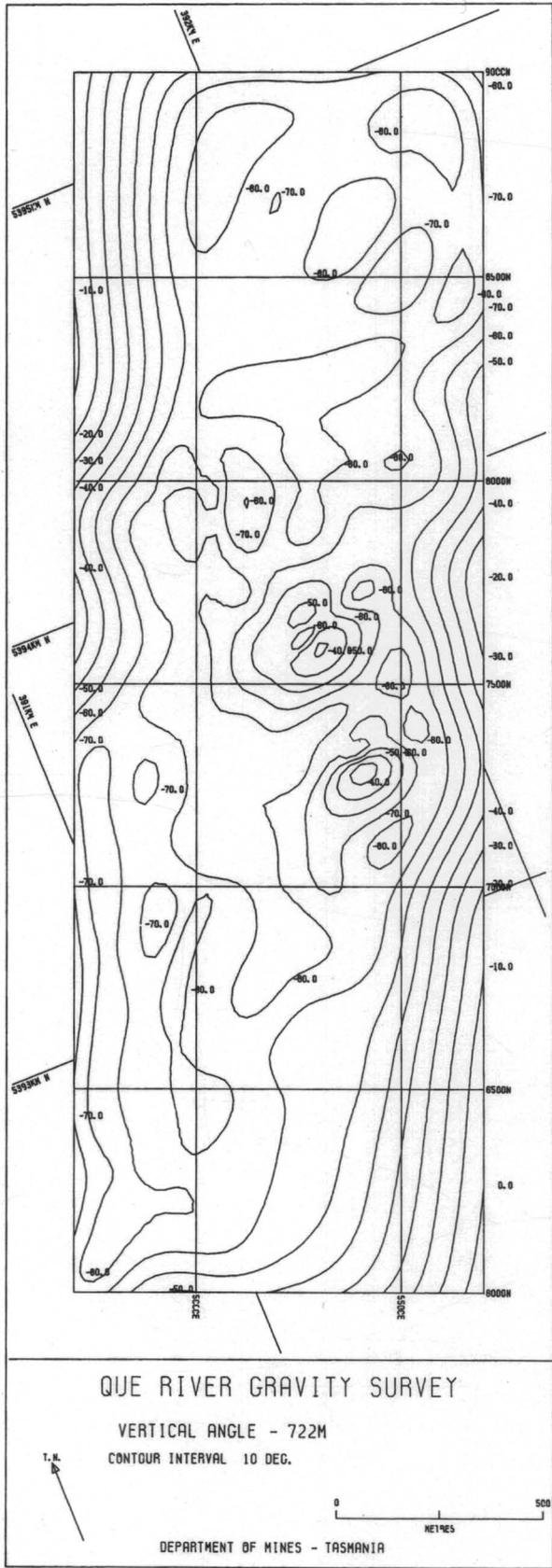
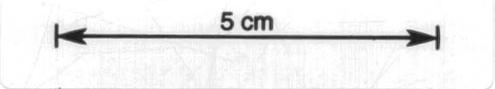


Figure 13.



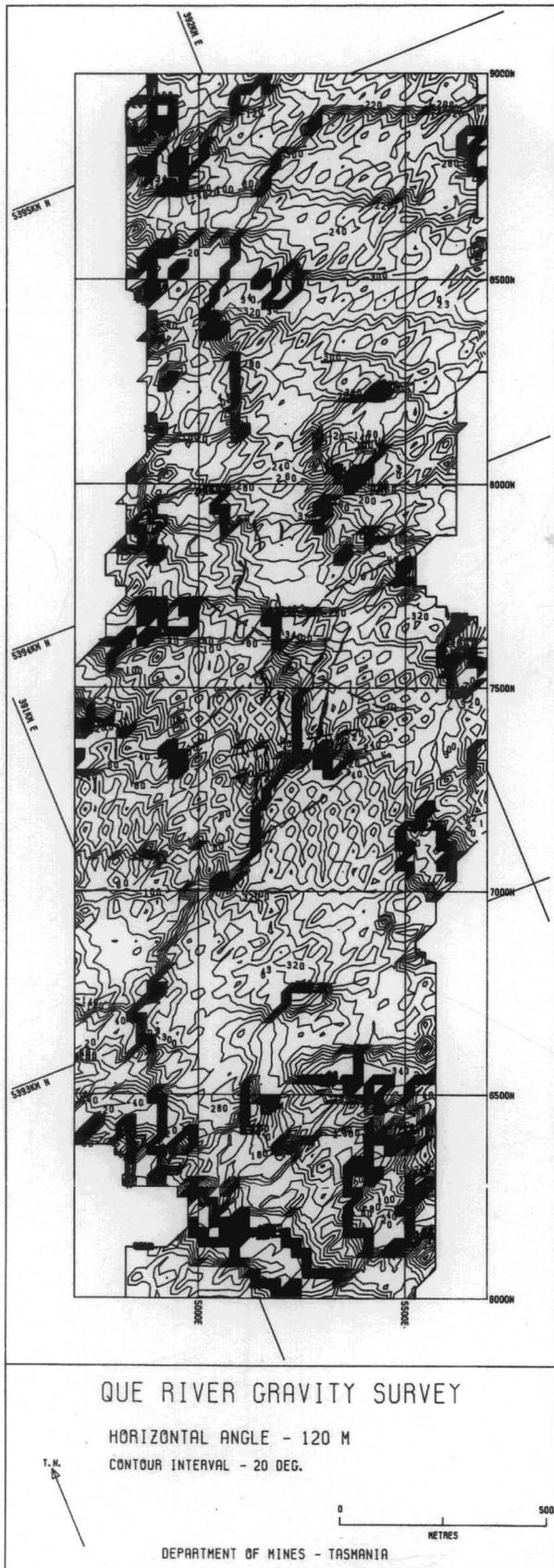
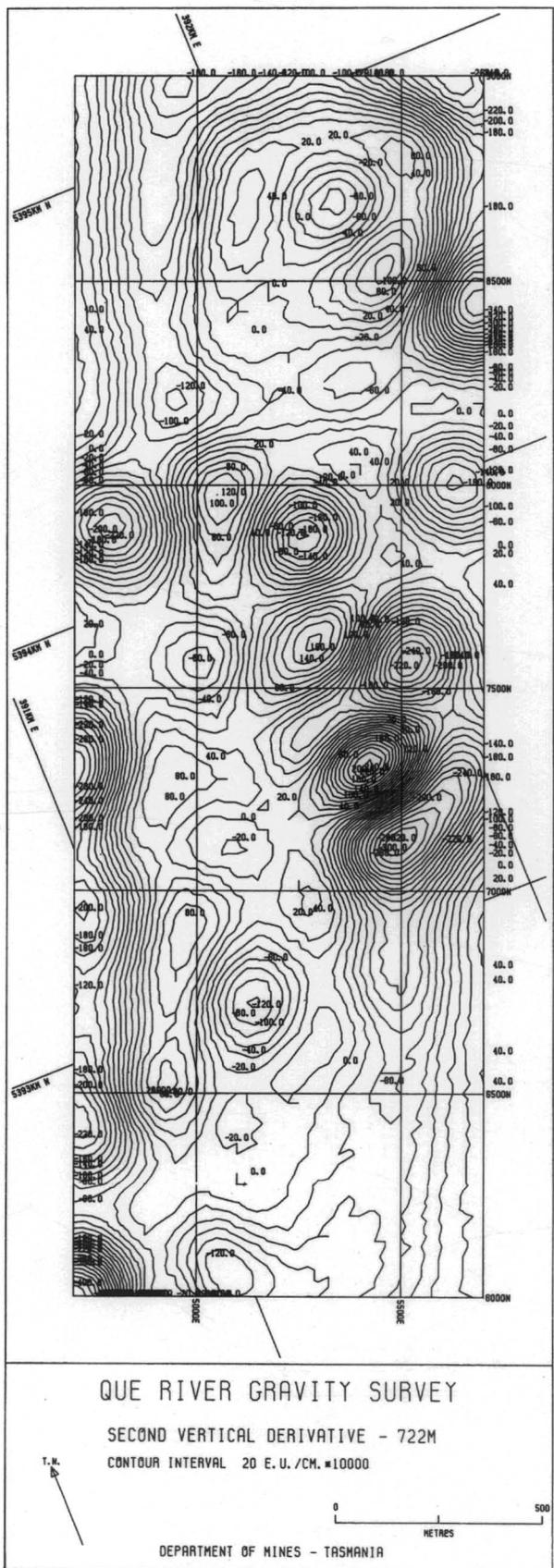
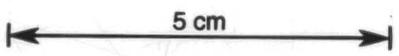


Figure 14.



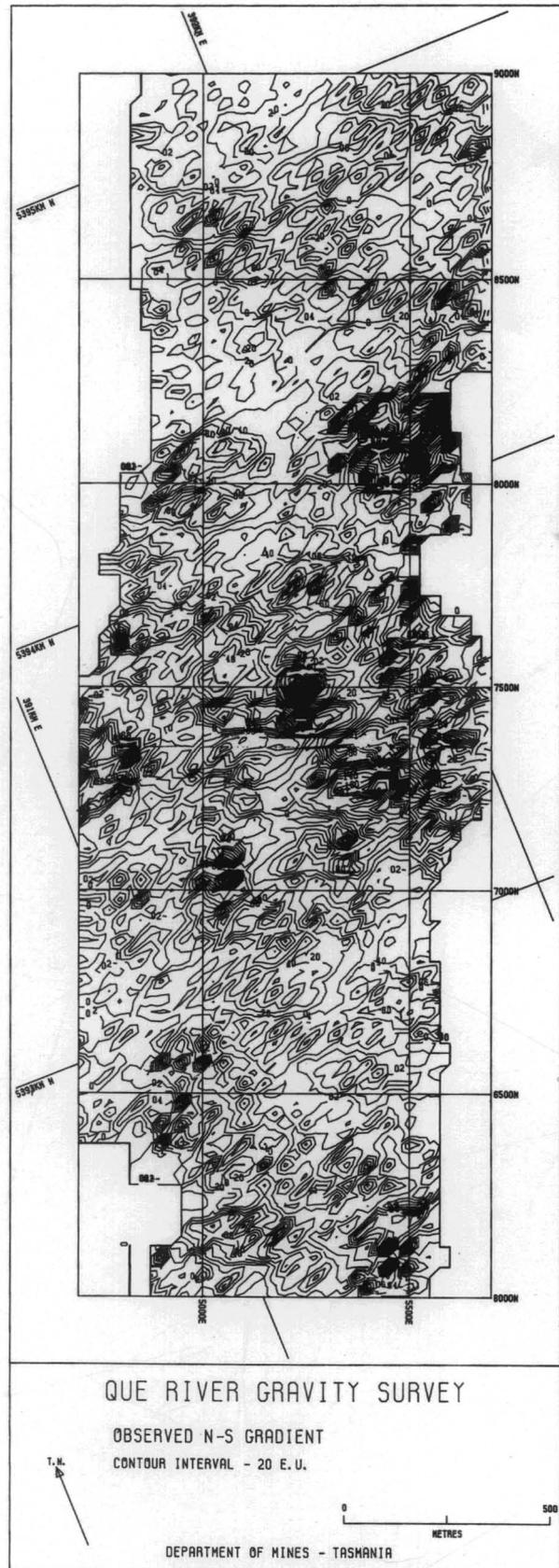
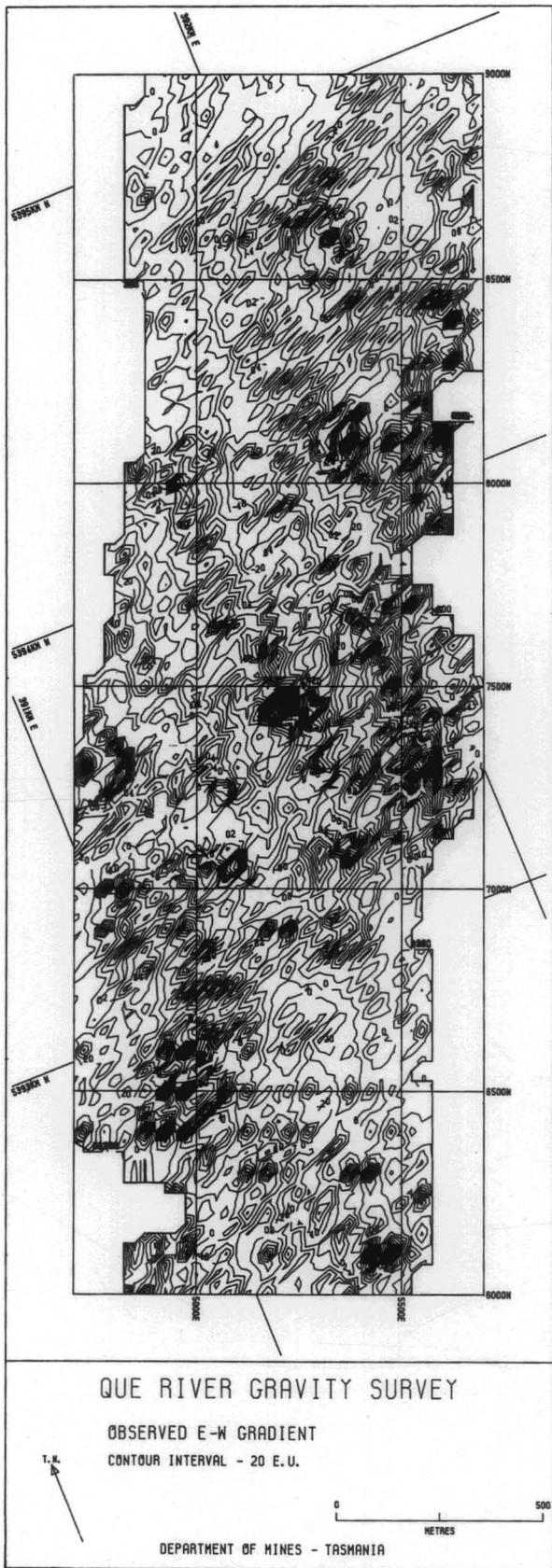
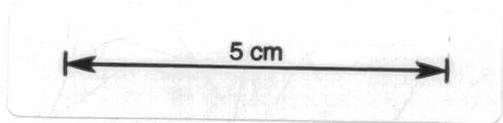


Figure 15.



tions (not proven by drilling) or bodies extending to 250-300 m. About 75% of the mass is below 50 m depth. Profile 7450N is an extreme example of the mass distribution. The large anomaly at 5250E dominates the Bouguer anomalies. It is very localised and clearly the result of much dense ore at shallow depth. A minimum of three outcropping thin (5-12 m) bodies could produce the effect, but some must extend to 200 m or more and thicken substantially at shallow depth (to in excess of 20-25 m). Two dimensional models do not readily account for the general anomaly features but can approximate near-surface sources.

The absence of many localised anomalies outside the central area may be related to coverage, but the few gross anomalies imply either reduced mineralisation, much deeper sources, or dispersed pyrite. Limited test drilling is suggested. The nature of mass distribution is suggested by review of some treatments. The averaged Bouguer anomalies (regionals) and residuals suggest that little mass occurs in the upper 50-100 m (note the 300 m regional, residual). The 700-1000 continuation residual shows that the lenses are peripheral to the bulk positive. However, if the ore lenses are related to the 650-725 differences (fig. 10) there is also a fair correlation with lineaments. This suggests that most features recognised by other exploration methods are at shallow depth since the 650-725 slice represents contributions from material at an average depth of about 30 m. Some trends apparent in the 700-1000 m residual are extended. Mine development indicates some variable structural trends in the upper levels. The 650-1000 m continuation residual contains more geological information than the 700-1000 m residual. Ore lenses may be associated with inflexions on either side of the central positive anomaly with fair correlation of other lineaments. The 'V' distribution of lenses is reflected. If the correlation is sound, other bodies could be located along 4950E from 6500-7300N, or 5400E, 7300N, 5050E, 8000N. The 600-725 continuation difference separates large and small mass distributions which might yield comparable surface responses depending on their depth. Few masses are significant.

Individual gradients have yielded no specific correlations. The resultant gradient is comparable to the observed anomalies (figs. 3, 5, 11) and the vertical gradient contains comparable information to the continuation differences (figs. 10, 12). The total horizontal gradient correlates with trends and lenses - low Eötvös values and inflexions (fig. 12). The horizontal vector changes may prove to be a useful guide in other surveys. Similar relationships are suggested in the second derivatives (fig. 14) although all equivalent mass continuations are affected by the 300 m depth of the masses. Horizontal gradients derived directly from observed anomalies are too complicated to be usable (e.g. fig. 15), whether derived from total or averaged anomalies. All show a herringbone texture which might, if no data or plotting imperfections are significant, reflect overall strike trends. However, the horizontal angle, at least for higher frequency anomalies - e.g. 120 m average, provides clear relationships with structures and ore lenses (fig. 14). Inspection of the angle changes at 300 m suggests that the SSW trending fault dips westward and extends, with a trend change, along 5200E from 7400-7600N. 5200E, 7600N is the point of intersection of the northern lineaments.

Comparison of known positions of ore lenses and the anomaly distribution shown in the Bouguer anomalies or averages and the deeper mass distribution (figs. 7, 10; h = 600, 600-725) shows that there are dip offset effects. These may partly reflect disseminated mineralisation.

The patchy, localised anomalies are suggestive of mineralised zones rather than structural features. This is supported by the geochemical

anomalies (Webster and Skey, 1979) and subsequently by clearing and mining. Few zones could be considered attractive, or highly prospective, on the basis of this survey or geochemistry, with the exception of the central anomaly.

The significant positive anomalies may be assessed in terms of anomalous mass and possible ore mass. Following the method of Hammer (1945), anomalous mass (A.M.) = 23.9 $\Sigma(\Delta g \times \Delta s)$ tonnes where Δs is the area occupied by an anomaly increment of Δg , and

ore mass = A.M. x $\rho_2 / \rho_2 - \rho_1$ where ρ_2 is ore density, ρ_1 is host density.

The residual anomalies may be used as a guide to anomaly scale and form and the anomalous mass possibly related to the four principal anomalies is tabulated below.

Table 3. ANOMALOUS MASS (NOT ORE MASS) OF MAIN ANOMALIES.

Northern anomaly (from 5100E, 8500N)	: 1.39 x 10 ⁶ t
NE anomaly (5500E, 8100N)	: 3.06 x 10 ⁵ t
E anomaly (5400E, 7300N)	: 3.75 x 10 ⁵ t (estimated)
	(included in main anomaly)
Main anomaly : (centred 5200E, 7600N), calculated between 7100N, 7900N	: 5.10 x 10 ⁶ t
NW extension (to 5000E, 8000N)	: 5.30 x 10 ⁵ t
SW extension (to 4900E, 6700N)	: 2.50 x 10 ⁵ t

The estimates given in Table 3 have been verified using the small-average regional maps, since these give a clearer guide to gross form but underestimate the mass as a result of smoothing. In the case of the main anomaly, up to one quarter of the mass is at less than 50 m depth.

The values of anomalous mass may be converted into estimates of ore mass using the density data of Table 1. Uncertainty persists throughout these calculations since:

- (1) the host rocks are variable - hence the contrasts are variable;
- (2) the mineralogical proportions vary producing major contrast changes;
- (3) it is not possible to predict the relative proportion of valuable minerals (galena, sphalerite etc.) to gangue (pyrite, barite etc.)

A major source of host variation is the general dissemination of pyrite. However, limits may be placed on the conversion factor ($\rho_2 / \rho_2 - \rho_1$).

- (1) If it is assumed that the base density for the bulk of the country rocks is 2.80 t/m³ and that the average ore density is 3.80 t/m³; $\rho_2 / \rho_2 - \rho_1 = 3.8$
- (2) If it is assumed that the base density for the bulk of the country rocks is 3.00 t/m³ (due to 5-10% disseminated pyrite), ore density average of 3.80 t/m³; $\rho_2 / \rho_2 - \rho_1 = 4.75$
- (3) Country rocks at 3.20 t/m³ (much pyrite, all units) and ore average of 3.80 t/m³; $\rho_2 / \rho_2 - \rho_1 = 6.3$

- (4) Country rocks at 2.80 t/m³, ore at 4.2 t/m³; $\rho_2/\rho_2-\rho_1 = 3.0$
(compare case 1).

Although pyrite is widespread and leads to density increases in host or country rocks, the values observed adjacent to ore lenses or for the whole suite suggest that the bulk density is probably a little less than 3.00 t/m³, including pyritic zones. Thus allowing for ore variations about the average, the conversion factor will be 4.50-5.00. Thus a slightly optimistic estimate of ore mass can be based on a factor of five. The main anomaly suggests a maximum ore tonnage of about 25 million tonnes overall. Some pyrite is presumably included, the amount must be estimated from ore counts. This estimate is larger than that published and based on drilling results, but the area included in the calculation is larger than that thoroughly drilled and some bodies are probably deeper than most drilling to date.

EXPLORATION SIGNIFICANCE

This gravity survey has shown the method to be viable in the difficult conditions confronting mineral exploration in western Tasmania although several comments may be made.

- (a) The method should not be applied without a firm suggestion of mineralisation by other means (alteration, geochemistry). At Que River the sequence geochemistry-gravity-drilling would have been most effective. Electrical methods were misleading or ineffective. A similar result was established at Oliver Hill (Leaman, 1974).
- (b) Anomaly scale is a function of body geometry, mass, depth, and density contrast. A minimum economic mass should be prescribed for the site and the attraction calculated for a range of depths and dispersions using a nominal contrast of about 1.00 t/m³ relative to the Mt Read Volcanics suite. This will suggest survey precision and result factors.
- (c) Coverage must be adequate to ensure identification and definition of anomalies and avoid loss during filtering. The original Que River survey was too restricted.
- (d) Station and line spacing depend on crucial compromises, but for any reasonable target tonnage (>3 million tonnes) spacings of 25-50 m are adequate, if not ideal. Line spacing should be of similar scale. In the present case some along-line bias was introduced by the 50-100 m line spacings. Spacings extant at Que River were appropriate for large bodies or simple accumulations. Definition of small units may require five metre spacings and could well have formed a follow-up stage on parts of lines 7300-7800N, given the superimposed local effects. Detail of this type would have made electrical methods redundant.
- (e) Line positions should be located to within ten metres (to allow accurate transformation from usually odd grids to geographic coordinates) and all sites levelled to 10-25 mm. Observation precision of about 0.02 mgal is possible and all stations must be terrain corrected (in Tasmania).
- (f) Simple filtering followed by a review of both regional and residual should locate significant zones. The process should use a range of filters. Where modelling is required extended treatment is

recommended. Full treatments are capable of yielding much about a deposit and more cheaply than by drilling in the initial stages.

Cost benefit may be assessed by reviewing the costs of this survey. Being a secondary or tertiary approach, the cost of line preparation is not a charge. Table 4 indicates the scale of costs for this survey (actual), a survey by in-house staff including meter hire or by commercial contract at prevailing rates.

Table 4. SURVEY COSTS.

Item	This survey	Regular	Contractor
Crew: wages, expenses	4 000	4 000	6 000
Meter hire/insurance	-	2 000	-
Levelling	-	4 000	6 000
Data preparation	1 000	1 000	1 200
Terrain corrections	1 000	1 000	3 000
Reduction, filtering	1 000	- +	1 000* #
Interpretation	1 000	1 000	1 000†
Extended computing for guide	23 000†	- +	-
	<hr/> 31 000	<hr/> 13 000+	<hr/> 18 200+

All values in 1980/81 Australian dollars

+ depends on in-house computer. All computing in this project was external at commercial rates.

* cost of this item often included in preparation charge.

dependent on consultant rates.

† about half of item related to continuation establishment which would be necessary for 3D modelling purposes. Modelling is estimated at >\$5000 for a project like this. Not undertaken here due to lack of funds.

Any of the totals shown in Table 4 are competitive with drilling costs, being equivalent to only 160-600 m of drilling at prevailing average rates.

CONCLUSION

Gravity surveys of prospects within the Cambrian Mt Read Volcanics province of western Tasmania are likely to prove a realistic and economic means of confirming and describing target areas. Since the method is not an initial application approach it is also relatively inexpensive when compared with drilling for similar information.

Surveys must be carefully observed, levelled, terrain-corrected, and filtered. Although extended processing was not essential in this example, but was undertaken for guidance and evaluation purposes, it is essential to sound modelling and interpretation procedures and may be required elsewhere.

Such a survey at Que River would have proven profitable at an early stage in exploration. The correlation with geochemistry and the sizeable estimate of mineralisation would surely have boosted confidence and minimised other exploration costs. Once the nature of mineralisation was established some detailed work would have pinpointed the near-surface bodies.

A failure to find anomalies or correlations with other procedures would have implied either very deep or uneconomic quantities of ore.

The evaluation also suggests that gradient and vector analysis identifies principal structures as a precursor to modelling.

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[11 May 1981]

APPENDIX 1

Density determinations, core samples

Hole	Depth (m)	Unit*	Density (t/m ³)
QR 3	33.5	PD	2.90
QR 7	34.2	DRWT	2.93
	57.9	PDP	2.91
	100.06	DP	2.86
	105.0	DP	2.91
QR 8	69.4	DP	2.87
	87.6	DRWT	3.01
	150.0	SP	3.03
QR 10	32.8	D	2.92
	55.5	D	2.90
	200.1	PDP	3.04
QR 11	75.8	PD	2.87
	92.4	PD	2.83
QR 12	46.9	PD	2.74
QR 13	40.5	AP	2.75
	65.3	AP	2.75
	181.7	DRWT	2.97
	248.0	SP	3.07
QR 55	57.2	DRWT	3.25
QR 57	162.7	SP	3.10
QR 60	224.1	PDP	3.01
QR 85	38.0	D	2.80
QR 92	54.3	DRWT	3.00
QR 94	262.2	SP	3.10
QR126	28.3	PDP	3.20
QR181	55.5	DP	2.89
QR185	24.3	DP	2.81
QR233	46.9	D	2.81
QR234	31.0	DP	3.22
QR235	35.7	DTL	2.67
QR238	71.4	DRWT	3.11
QR241	6.9	DRWT	3.01
QR242	92.0	PD	2.90
QR251	38.9	PDP	2.85
QR255	28.2	DTL	2.78
QR259	30.0	PD	3.22
	56.7	PDP	3.26
QR268	39.0	PDP	3.02
QR275	50.5	DSHT	3.44

- * A = Andesite
- AP = Andesitic pyroclastic rocks
- SP = Andesitic streaky pyroclastic rocks
- D = Dacite
- DTL = Dacitic tuff lava
- DP = Dacitic pyroclastic rocks
- PD = Porphyritic dacite
- PDP = Porphyritic dacitic pyroclastic rocks
- DRWT = Dacitic reworked tuff
- DSHT = Dacitic shaly tuff

APPENDIX 2

Further samples of processing

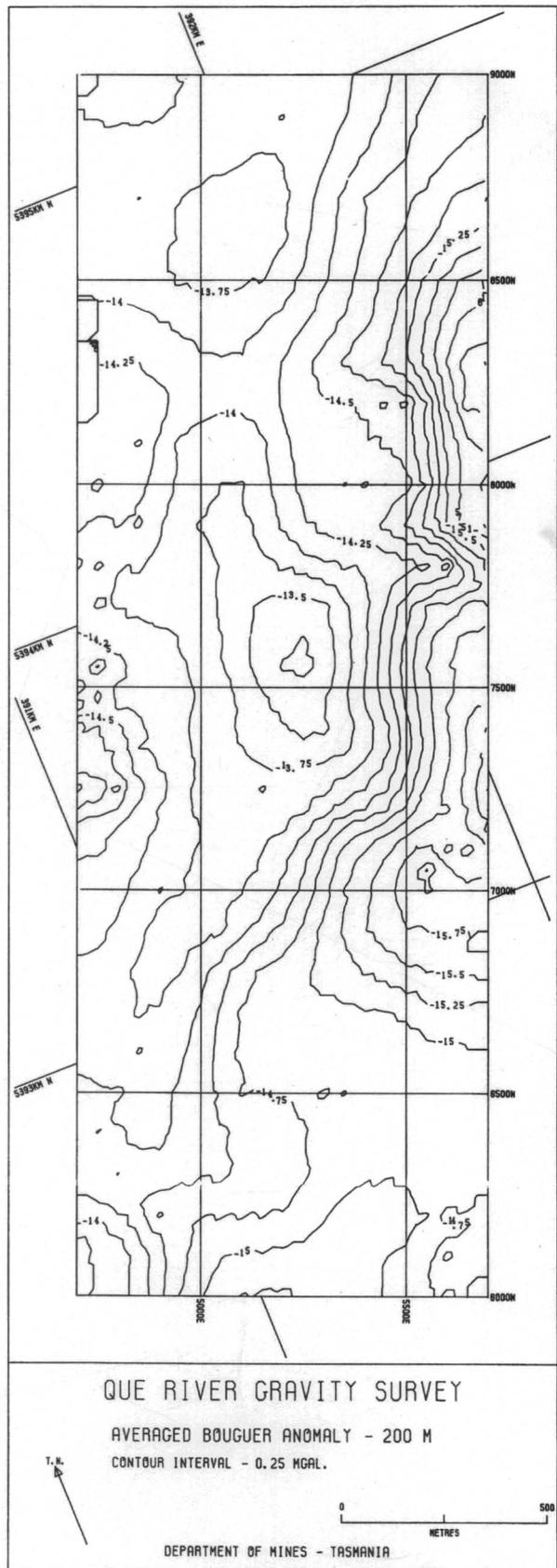
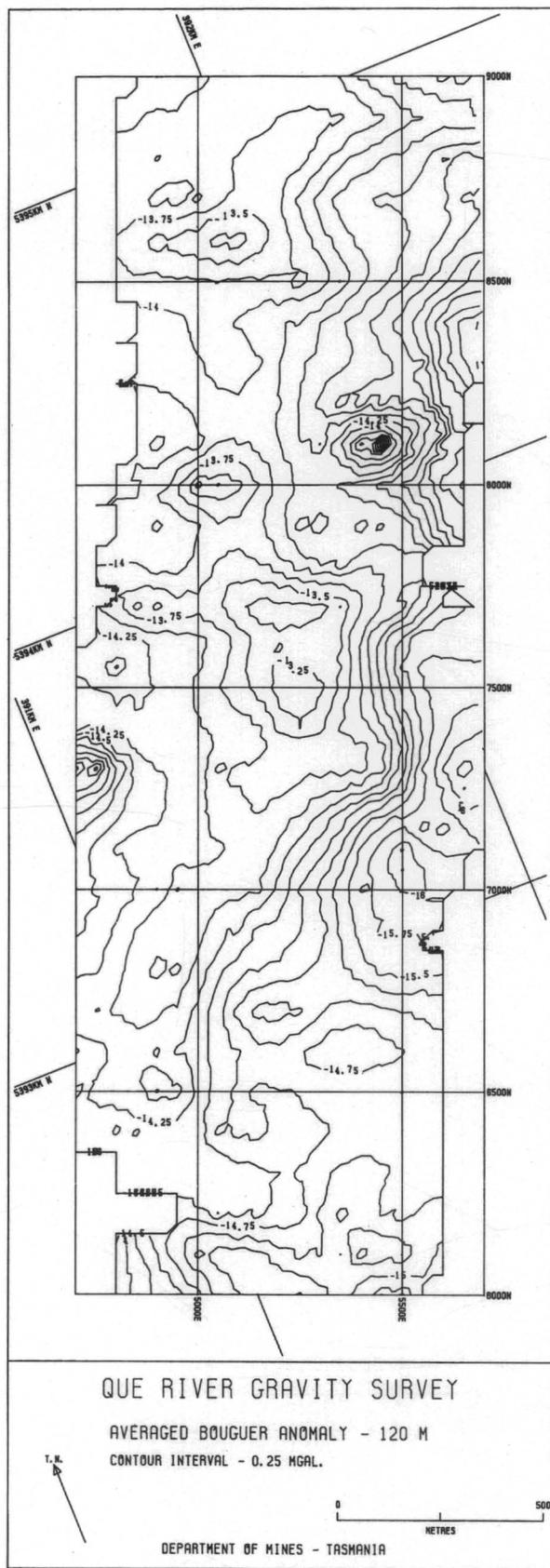
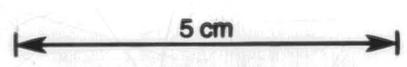


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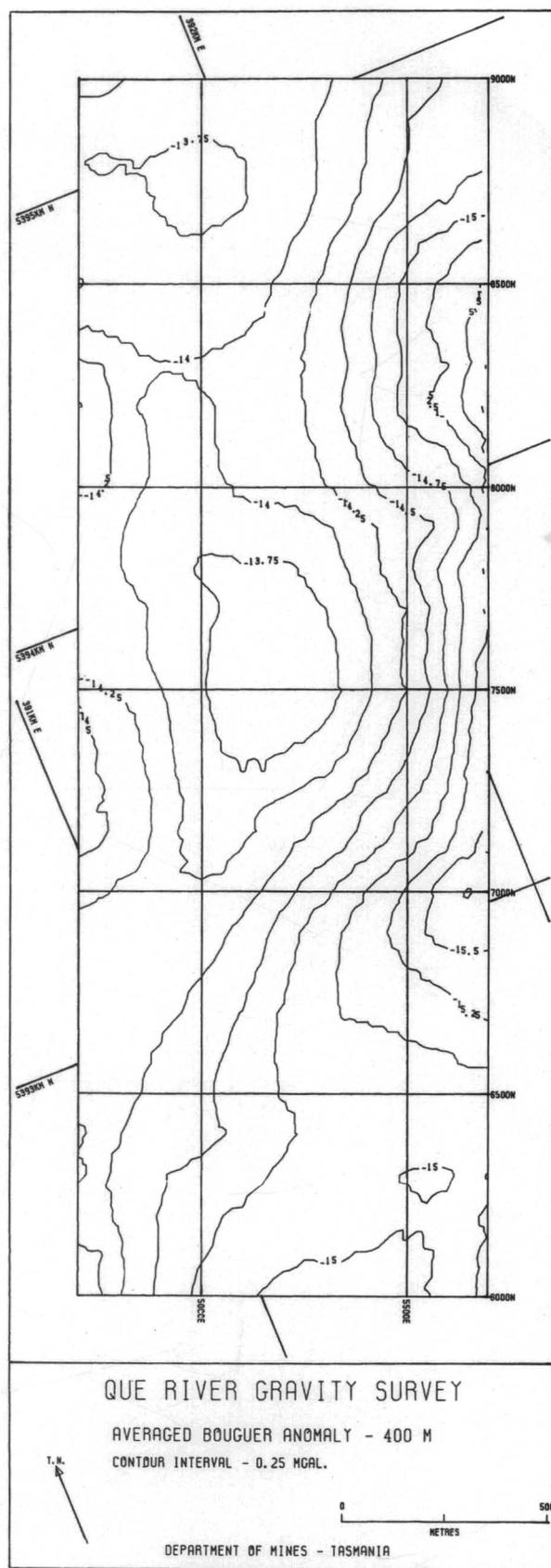
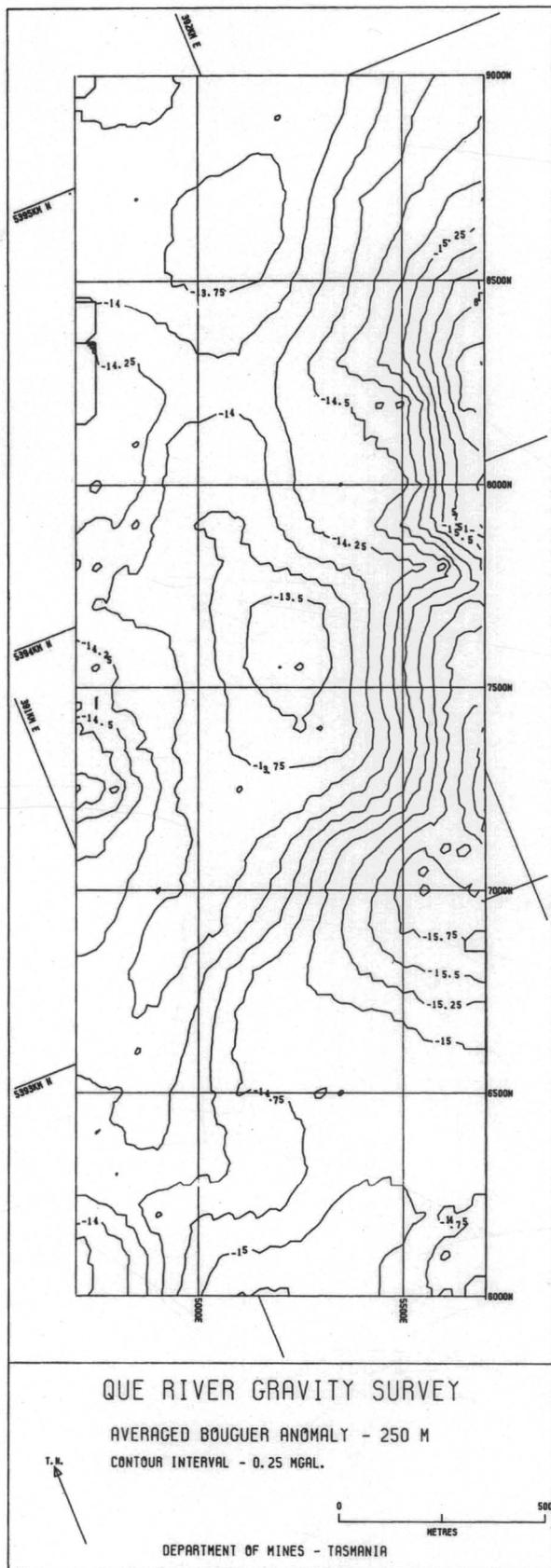
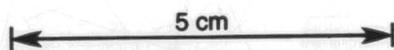


Figure 17.



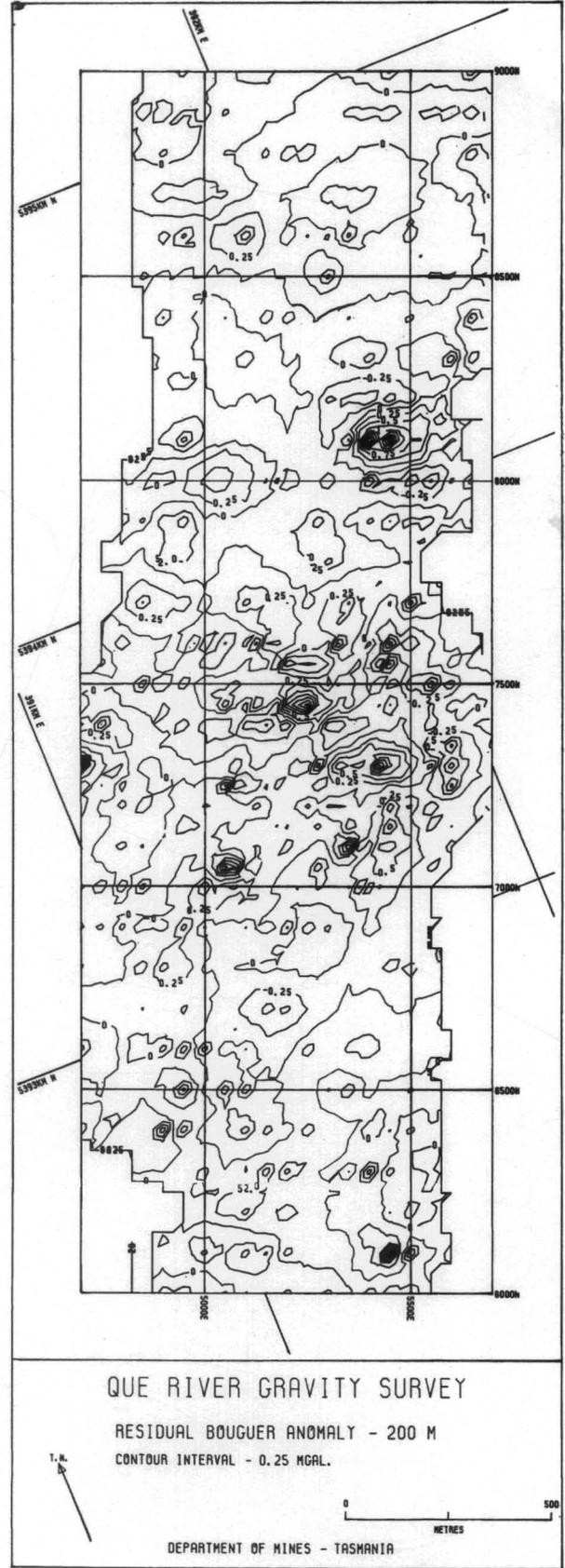
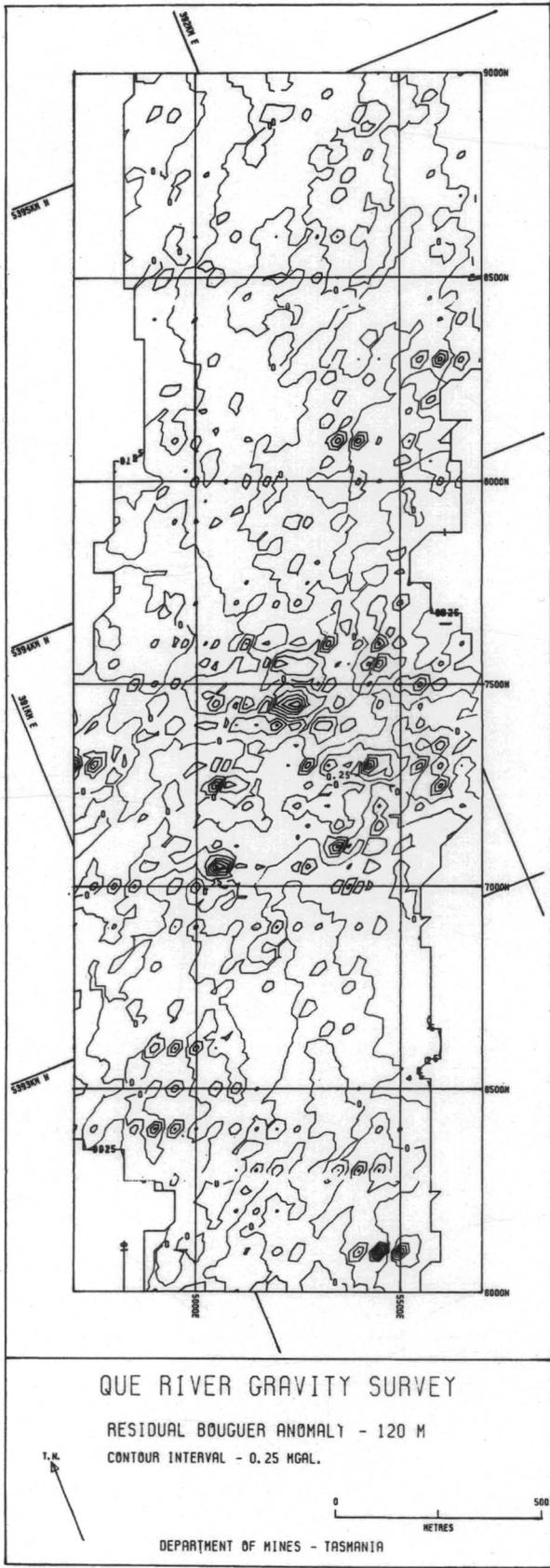


Figure 18.

5 cm

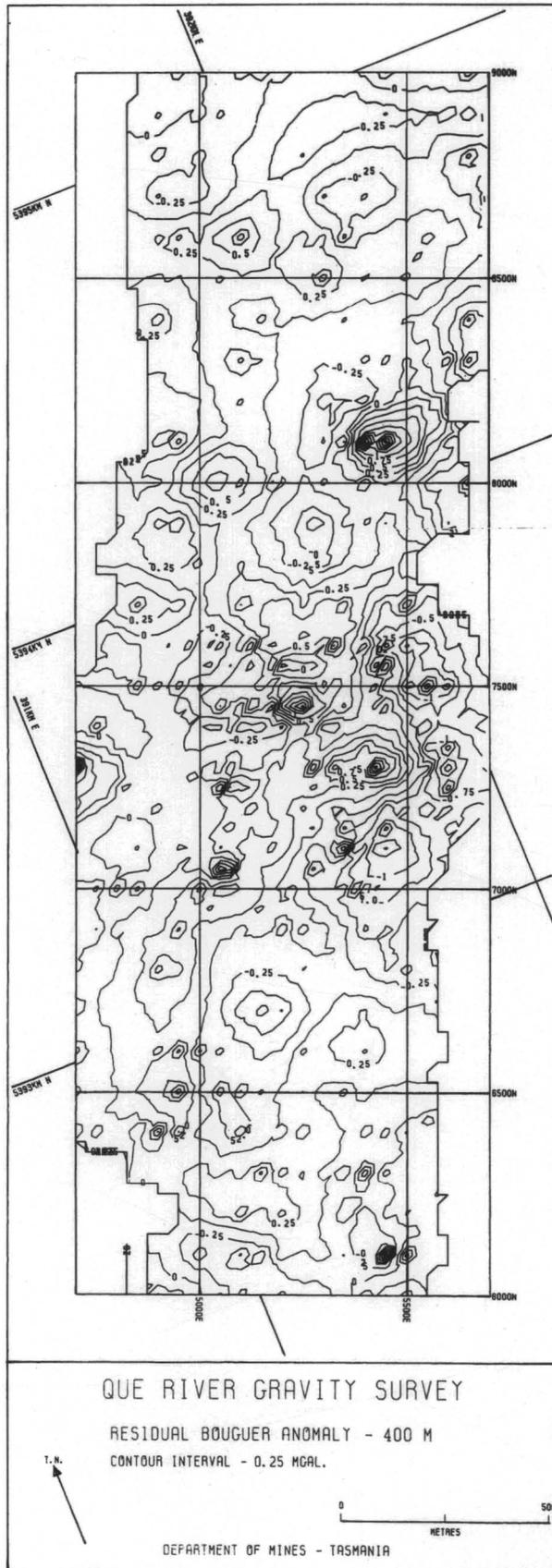
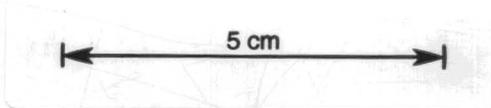


Figure 19.



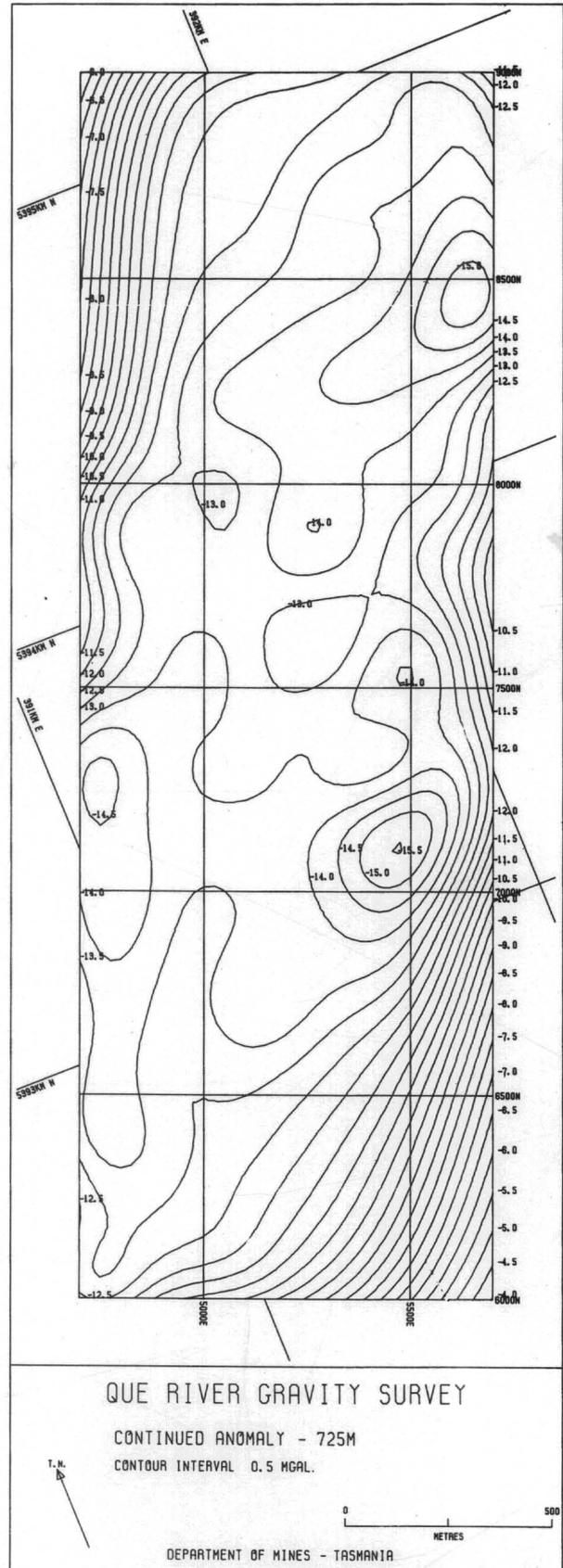
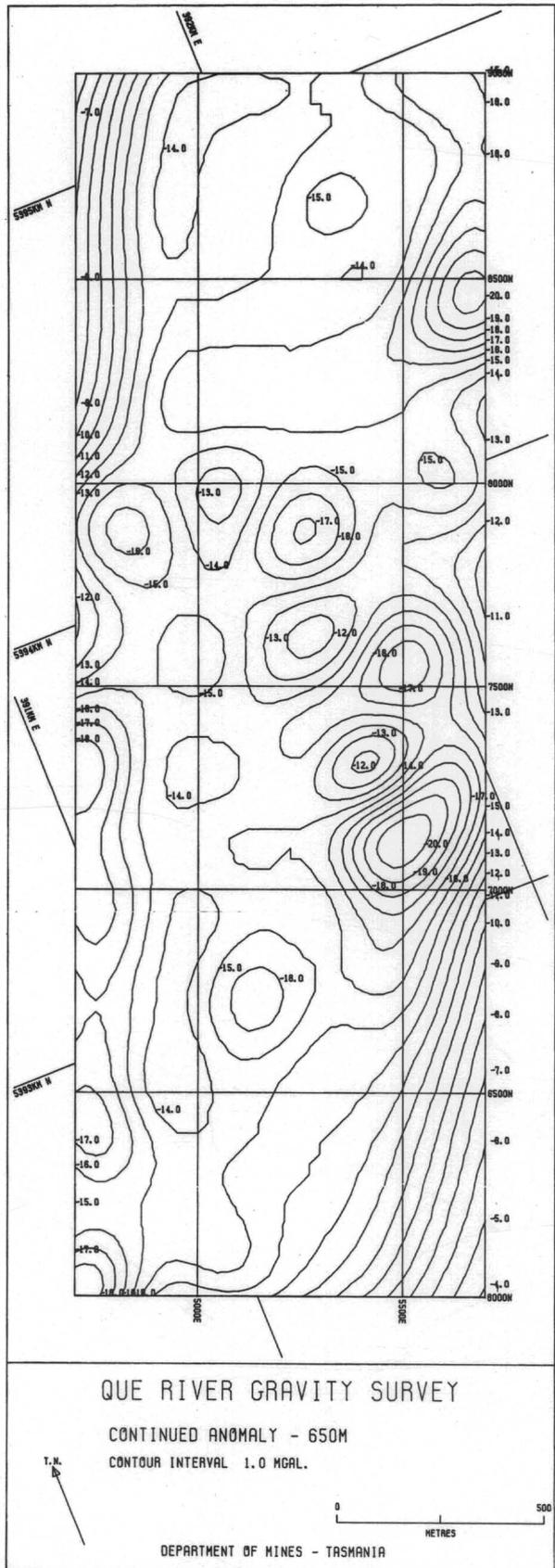
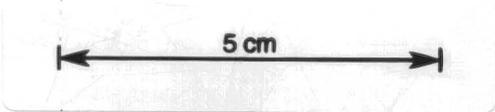


Figure 20.



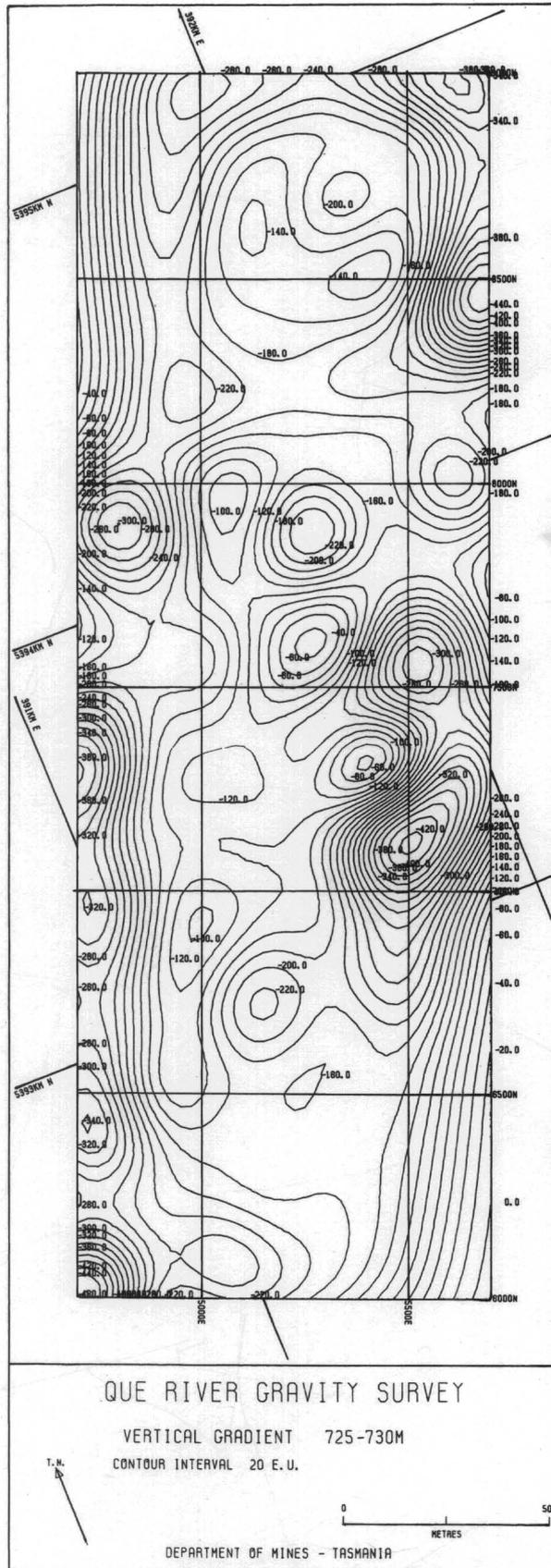
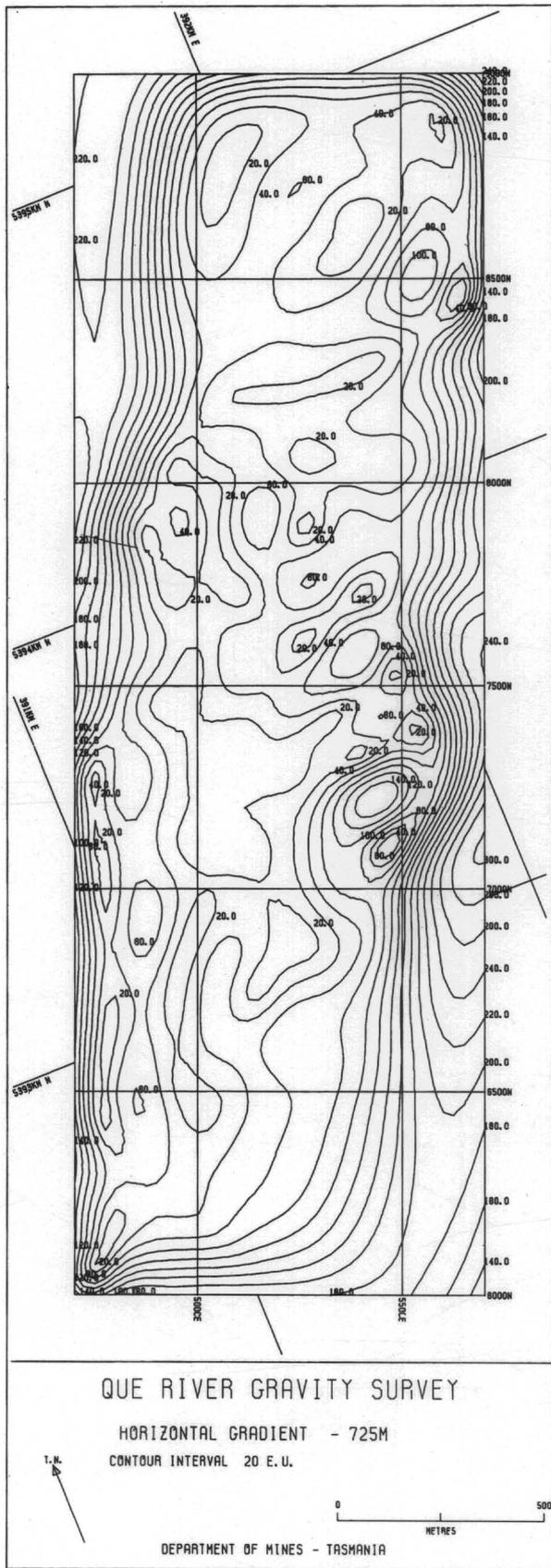


Figure 21.

