DEPARTMENT OF MINES AND ENERGY
SOUTH AUSTRALIA

REPORT BOOK NO 89/72

# TEROWIE GRAVITY AND GEOCHEMICAL SURVEY 1988

GEOLOGICAL SURVEY

by

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&

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OCTOBER 1989

DME 86/89

D00053

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DEPARTMENT OF MINES AND ENERGY
SOUTH AUSTRALIA

REPT. BK. NO. 89/
D.M.E. NO.
D00053

# TEROWIE GRAVITY AND GEOCHEMICAL SURVEY 1988


## ABSTRACT

A gravity survey has located an area of anomalous low gravity values adjacent to the township of Terowie.

The gravity low is located at the intersection of linear NW-SE and N-S trending gravity minima and is interpreted to be caused by a shallow, steep sided, low density body of rock with surface dimensions of 500 m x 1200 m and depth extent of 2000 m coincident with a NW trending LANDSAT lineament.

Anomalous Nb, Cr and Ni values from one bedrock auger hole indicated the presence of a kimberlite dyke or sill which may represent an apophysis of a kimberlite pipe.

Alternatively a diapir could be the source which would give the area potential for base metal mineralisation. A 300 m deep drill hole is recommended to test the source of the gravity anomaly.


## INTRODUCTION

At the request of the Mineral Resources Section a gravity survey was conducted in the Terowie area 230 kms north of Adelaide during 1988 (Fig. 1).

The survey was originally designed to be a regular 0.5 km grid centred on Hiles Lagoon, 5 kms south-east of Terowie, to test the possibility that the lagoon is the site of a kimberlite pipe.

Evidence in favour of the presence of a kimberlitic body is:

- Hiles Lagoon is a roughly circular depression with radial internal drainage.
- the area is within a known kimberlitic province.
- a northwesterly trending LANDSAT photo-lineament passes through the lagoon.
- aeromagnetic contours (Dampier Mining Co Ltd, 1981a) show a strongly discordant negative zone over Hiles Lagoon (Gerdes SADME pers comm, 1988).

If the gravity survey proved successful in locating a target a diamond drill hole would be located in the centre of the anomaly.

## PREVIOUS EXPLORATION

Exploration for diamonds in the Terowie area began in 1969 with the granting of Special Mining Lease 301 to Stockdale Prospecting Ltd.

Intensive stream and loam sampling by this company for heavy minerals such as chrome pyrope, picro-ilmenite and chrome diopside which are all indicative of a kimberlitic source, located a number of kimberlite dykes and diatremes. Within the area however, it is recognized that many of the indicated anomalies are the result of fossil drainage systems and alluvial fans which are re-exposed and dispersed by present day erosion.

Fracture and lineament analysis has been conducted (Savata Pty Ltd 1981 and Jingellic Minerals N.L. 1980) in order to locate clusters and intersections of fractures that may control the emplacement of kimberlite pipes and dykes.

Geochemical analysis of soil samples has been used extensively by Western Queen (S.A.) Pty Ltd, 1981, Savata Pty Ltd, 1980 and Jingellic Minerals N.L. 1980). Samples were generally analysed for anomalous concentrations of Niobium, Nickel and Chromium but it was also found that Strontium was a useful pathfinder for kimberlites.

Detailed aeromagnetic surveys have also been flown over a large portion of the area by Dampier Mining Co Ltd. 1980, 1981a, b, c, 1982; C.R.A. Exploration Pty Ltd, 1983, 1986a, b, as the known kimberlite pipes have discrete magnetic anomalies associated with them. Drilling has not only confirmed that some of the magnetic anomalies are due to kimberlitic pipes or dykes, but also due to basic intrusions and surface concentrations of magnetic minerals in drainage systems.

Kimberlites found to date are all heavily weathered and poorly exposed.

## REGIONAL GEOLOGY

Terowie is located in the hinge zone of the Nackara Arc, near the eastern margin of the Adelaide Geosyncline, where the regional trend of Adelaidean sediments swing from north-south to northeasterly. The sediments are folded into series of broad regional synclines and laterally compressed anticlines. Burra Group sediments, comprising shale and siltstone with dolomite and sandstone interbeds, are confined to the cores of

anticlines and overlain unconformably by glacial-interglacial sediments of the Umberatana Group. This part of the Nackara Arc is recognised as a kimberlite province following the discovery of numerous micaceous kimberlite pipes and dykes in 1969 (Colchester, 1972 and Ferguson, 1980). The kimberlites, of Jurassic age, generally intrude Burra or Umberatana Group sediments near the hinge zones of regional anticlines (Fig. 2). The largest pipe recorded here is 6.35 ha in area.

LANDSAT MSS and TM imagery show northwesterly trending lineaments crossing the Nackara Arc and some of the known kimberlites are associated with them. A northwesterly trending linear zone crosses the area of investigation (Fig. 2).

Hiles Lagoon is a large depression 1.5 km across with internal radial drainage and may represent an underlying kimberlite pipe. A detailed aeromagnetic survey by Dampier Mining Co. Ltd. (1981a) shows a disruption of a northwesterly magnetic trend over the lagoon.

## SURVEY PROCEDURE

Initially a semi detailed gravity survey comprising 56 stations was established on a roughly 1 kilometre square grid during May 1988.

Optical levelling of these newly established stations was completed by the Survey Section during September 1988 with the addition of a further 15 stations to complete the gravity coverage over an area of 11 x 8 kilometres. Vertical control was provided by Lands Department Benchmarks 1962, 1963 located on the Barrier Highway which runs through the area.

A further 100 stations were established over 4 detailed traverses, with station spacing ranging from 100-250 metres located near the township of Terowie during December 1988.

All gravity readings were taken with a SODIN model No. 420 gravity meter and all readings were tied to base station 67I0.0037 located at the Terowie Railway Station. A subsequent tie was made to stations 67I0.0036, 67E0.0285 and .0375 to confirm previous values.

Calibration Factor for the meter was 0.1001.

Corrections for instrumental drift, earth tide variations and latitude effect were applied to the field date using a field data reduction programme on the TEKTRONIX 4052 desk top computer, and absolute gravity values produced. The absolute gravity values were then corrected to Om AHD using a Bouguer density of 2.67 gms/cc, which is the mean value of the Adelaidean Supergroup metasediments.

## RESULTS AND INTERPRETATION

The dominant feature of the Bouguer gravity contours is a 4-5 milligal gravity low, (the Terowie Gravity Low, (TGL)) adjacent to the township of Terowie. The TGL is elliptical in shape, with 2.25 km N-S major axis and a 1.25 km E-W minor axis, indicative of a 2.81 $km^2$ subsurface body. The geological data indicates that the Adelaidean rocks in this area are very near surface and are covered by a thin veneer of Cainozoic sediments. There is a narrow thin Tertiary channel containing loose sands. The gravity response derived from this channel is small and does not explain the source of this anomaly.

The TGL is interpreted as a near vertical prism or elliptical cylinder with N-S and E-W dimensions of 2 and 1 km respectively. The upper surface of the source is shallower than 0.375 km, based on half max-min distant values. Computer modelling reported later indicates a much shallower depth.

The TGL is located at the intersection of a linear NW-SE gravity low, which has a width and strike length of 2 and at least 11 km respectively and a N-S gravity low. The density discontinuities (Figure 5) shows the boundaries of these low density zones.

The NW-SE gravity low is discordant to the regional N-S to NE-SW geological fabric, as outlined on the BURRA 1:250,000 geological map sheet. There are no surface geological features mapped to explain this discordant trend, as it occurs beneath a shallow Cainozoic basin. Drilling data indicate that this basin is less than 50 m deep. The NW-SE linear gravity low is interpreted as a finite low density zone at 500 m below ground level (bgl), extending to at least 1.25 km bgl. It appears to correspond to a complex fracture zone containing numerous faults and possible shears. This zone is coincident with a major NW-SE LANDSAT lineament corridor as shown in Figure 2. Hiles Lagoon is located northeast of this linear gravity zone and no appreciable gravity response was found to coincide with this drainage feature.

The N-S gravity low extending across the TGL is interpreted to originate from a source 0.25 km bgl and is coincident and parallel to an anticline of Burra Group metasediments. There is another linear low density zone south of the TGL, which may be a continuation of this feature. If this assumption is correct, the NW-SE fault system indicates a lateral displacement of 2 km.

The composite N-S and NE-SW density fabric (Figure 5), (positive and minor negative gravity trends) corresponds to the lithological fabric of the Adelaidean rocks in the area.

Computer modelling was conducted on two of the detailed gravity traverses. The algorithm developed by Talwani et al., 1959 and adapted for use on the NEC III Personal Computer was used to compare the gravity response of theoretical models with the field data. Results of the modelling indicate a shallow body (possibly within 50 m of the surface) with a density contrast of -0.3 to -0.33gm/cc and having a vertical depth extent of some 2 km. The body is interpreted to be quite steep sided with a surface extent of approximately 500 m, E-W and 1200 m N-S, Figures 6 and 7.

Other minor variations on the residual gravity profile have been modelled as due to shallow, surface effects of limited depth and surface extent.

There exist strong comparisons between results from the current survey and interpretations by Iredale and Hough (1979) conducted on gravity measurements from the Round Hill Diapir at Quorn. A diapiric source for the gravity anomaly could therefore be possible.

## SITE GEOLOGY

The gravity anomaly is located near the hinge zone of a north-northeasterly trending domal structure (Figure 2). There are several exposures of bedrock at the surface and in small cuttings, but it is generally covered by about 1 m of silty clay soil and capped by a weak calcrete layer. Bedrock is mainly grey-green shale and feldspathic sandstone of the Burra Group, striking north-northeasterly with a well-developed axial plane cleavage. On auger traverse 1 between

holes 9 and 17 the rocks are disrupted by a possible northwesterly trending fracture zone that corresponds with a LANDSAT lineament (Fig. 8).

Samples of kimberlitic float material were found at two gateways (A and B) but their source is unknown, although the sample at site A may have originated from a Telecom trench.

## AUGER DRILLING

In an attempt to test the gravity low, two traverses of shallow auger holes (Figure 8) were drilled and logs are shown in Appendix A. Holes were spaced from 25 m to 100 m apart to a maximum depth of 9 m. Samples were collected over 1.5 m intervals and assayed by Analabs for Sr, Cr, Ni, Nb, Ba, La, Th, V, Zr, Co and Pb to determine the presence of kimberlite, results are shown in Appendix B. A sample of kimberlitic material found at locality A was also assayed (Sample 6631 RS 156).

Assays and logging of auger cuttings indicate the presence of a fine grained micaceous kimberlitic dyke or sill in hole T1/3 from 1.5 m to 4.5 m depth (Samples 6631 RS 129 and 6631 RS 130). These two samples have elevated Nb, Cr, Ni, Sr, Zr and V, indicative of kimberlitic rocks. This was the only kimberlitic material found in the drill holes and is adjacent to kimberlitic float found at locality B. This dyke or sill may represent an apophysis of a kimberlitic pipe indicated by the gravity low. Elsewhere bedrock consists of grey-green shale, silty sandstone and calcareous siltstone.

Anomalous lead values up to 2.22% Pb were detected in holes T2/15, T2/16 and T2/17 which may be due to contamination from the railways. However, anomalous lead values (up to

2248 ppm Pb) in holes T2/9 and T2/10 represent mineralised Burra Group sediments.

The drilling also showed the presence of an alluvial drainage channel, at least 9 m deep and probably trending northwesterly, at the end of the two auger traverses (Figure 8).

## CONCLUSIONS AND RECOMMENDATION

The possibility of a kimberlite pipe below Hiles Lagoon is unresolved as gravity stations could not be located across it. However, the survey has located a similar target adjacent to the township of Terowie. Interpretation of results indicates a shallow steep sided source of low density rock some 2000 m in depth extent with surface dimensions of 500 m x 1200 m and coincident with NW trending LANDSAT lineaments. Although there is no evidence at the surface of this low density source, and shallow bedrock auger sampling did not determine the source of the gravity low, the likelihood of a kimberlite body at depth is strengthened by:

- the area being in a kimberlite province
- lineaments crossing the area;
- the presence in drill hole T1/3 of a probable kimberlite sill or dyke which may be an apophysis of a larger body.

Because of the close proximity of the gravity anomaly to an anticlinal crest within Burra group sediments the possibility of a diapiric source should not be discounted. In view of the known association of mineralisation and diapirs the area may have potential for base metal concentrations.

A 300 m deep drill hole is recommended to test the source of the gravity anomaly.

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# APPENDIX A

## GEOLOGICAL LOGS FOR AUGER HOLES

# GEOLOGICAL LOGS - AUGER DRILLING

| Hole No. | Depth (m) | Sample No. | Log |
|---|---|---|---|
| T1/1 | 0-1.5 | 6631 RS 125 | Red-brown calc. soil to 1.2 m then weathered pink siltstone. |
| | 1.5-3.0 | 6631 RS 126 | Weathered pink-grey-green siltstone. |
| T1/2 | 0-1.5 | 6631 RS 127 | 20 cm of soil then weathered pink-grey-green siltstone. |
| T1/3 | 0-1.5 | 6631 RS 128 | 20 cm of calc. soil then buff silty-sandstone. |
| | 1.5-3.0 | 6631 RS 129 | Yellow-green weakly calcareous kimberlite? with traces of vein quartz. |
| | 3.0-4.5 | 5531 RS 130 | Yellow-green finely micaceous kimberlite? |
| T1/4 | 0-1.5 | 6631 RS 131 | 20 cm of calc. soil then weathered sandy siltstone, kaolinitic, calcareous. |
| | 1.5-2.5 | 6631 RS 132 | as above. |
| T1/5 | 0-1.5 | 6631 RS 133 | 30 cm of calc. soil then silty sandstone. |
| | 1.5-3.0 | 6631 RS 134 | as above. |
| T1/6 | 0-1.5 | 6631 RS 135 | 20 cm of calc. soil then cream silty sandstone. |
| T1/7 | 0-1.5 | 6631 RS 136 | 20 cm of calc. soil then cream silty sandstone. |
| T1/8 | 0-0.5 | 6631 RS 137 | silty sandstone. |
| T1/9 | 0-1.5 | 6631 RS 138 | 50 cm of calc. soil then yellow-cream silty sandstone, traces of vein quartz. |
| | 1.5-3.0 | 6631 RS 139 | as above to 2 m then yellow kaolinitic siltstone. |

| | | | |
|---|---|---|---|
| T1/10 | 0-1.5 | 6631 RS 140 | 1 m of calc. soil then orange silty sandstone. |
| | 1.5-3.0 | 6631 RS 141 | yellow silty clay. |
| | 3.0-4.5 | 6631 Rs 142 | yellow-brown silty clay. |
| T1/11 | 0-0.6 | 6631 RS 143 | red-brown calc. clay soil. |
| T1/12 | 0-1.5 | 6631 RS 144 | 20 cm calc. clay soil then yellow silty sandstone. |
| T1/13 | 0-1.5 | 6631 RS 145 | 1 m calc. soil then yellow silty sandstone. |
| T1/14 | 0-1.5 | 6631 RS 146 | 1 m calc. soil then yellow silty sandstone. |
| T1/15 | 0-1.5 | 6631 RS 147 | 1 m calc. soil then yellow siltstone, kaolinitic. |
| T1/16 | 0-1.5 | 6631 RS 148 | 1 m calc. soil then yellow clay siltstone. |
| T1/17 | 0-1.5 | 6631 RS 149 | 30 cm calc. soil then yellow clay siltstone. |
| T1/18 | 0-1.5 | 6631 RS 150 | 30 cm calc. soil, then weathered shale. |
| T1/19 | 0-1.5 | 6631 RS 161 | 1 m calc. soil, then weathered shale. |
| T1/20 | 0-1.5 | 6631 RS 152 | calc. soil and red-brown clay. |
| T1/21 | 0-1.5 | 6631 RS 153 | calc. soil then brown clay. |
| | 1.5-3.0 | 6631 RS 154 | red-brown alluvial clay. |
| | 3.0-4.5 | 6631 RS 155 | as above. |
| | 4.5-6.0 | no sample | as above to 5.5 m then yellow clay. |
| T1/22 | 0-1.5 | 6631 RS 157 | calc. soil then brown alluvial clay. |
| | 1.5-3.0 | 6631 RS 158 | as above. |
| | 3.0-4.5 | 6631 RS 159 | as above. |
| T1/23 | 0-1.5 | 6631 RS 160 | calc. soil then red-brown alluvial clay. |
| | 1.5-3.0 | 6631 RS 161 | as above. |
| | 3.0-4.5 | 6631 RS 162 | as above. |

| | | | |
|---|---|---|---|
| | 4.5-6.0 | 6631 RS 163 | brown-dark green alluvial clay. |
| | 6.0-7.5 | 6631 RS 164 | as above. |
| | 7.5-9.0 | 6631 RS 165 | as above. |
| T2/1 | 0-1.5 | 6631 RS 166 | 1 m calc. soil then brown clay. |
| | 1.5-3.0 | 6631 RS 167 | brown clay and weathered grey-green shale. |
| | 3.0-4.5 | 6631 RS 168 | as above. |
| T2/2 | 0-1.5 | 6631 RS 169 | brown calc. soil. |
| | 1.5-2.5 | 6631 RS 170 | brown clay then siltstone. |
| T2/3 | 0-1.5 | 6631 RS 171 | red-brown calc. soil. |
| | 1.5-3.0 | 6631 RS 172 | red-brown alluvial clay. |
| T2/4 | 0-1.5 | 6631 RS 173 | brown calc. soil. |
| | 1.5-3.0 | 6631 RS 174 | as above to 2 m then red-yellow weathered shale. |
| T2/5 | 0-1.5 | 6631 RS 175 | brown clayey calc. soil |
| | 1.5-3.0 | 6631 RS 176 | red-yellow weathered shale. |
| T2/6 | 0-1.5 | 6631 RS 177 | red-brown clayey calc. soil. |
| | 1.5-3.0 | 6631 RS 178 | red-yellow weathered shale. |
| T2/7 | 0-1.5 | 6631 RS 179 | red-brown clayey calc. soil. |
| | 1.5-3.0 | 6631 RS 180 | as above to 2.4 m then grey-green shale. |
| T2/8 | 0-1.5 | 6631 RS 181 | red-brown clayey calc-soil. |
| | 1.5-3.0 | 6631 RS 182 | as above to 2.0 m then weathered shale. |
| T2/9 | 0-1.5 | 6631 RS 183 | red-brown clayey calc-soil. |
| | 1.5-3.0 | 6631 RS 184 | as above to 2 m then calc. siltstone. |
| | 3.0-3.3 | 6631 RS 185 | calc. siltstone. |
| T2/10 | 0-1.5 | 6631 RS 186 | 30 cm of calc. soil then grey-green shale. |
| | 1.5-3.0 | 6631 RS 187 | as above. |

| | | | |
|---|---|---|---|
| T2/11 | 0-1.5 | 6631 RS 188 | brown calc.-soil. |
| | 1.5-3.0 | 6631 RS 189 | yellow-red weathered shale. |
| T2/12 | 0-1.5 | 6631 RS 190 | brown calc.-soil. |
| | 1.5-3.0 | 6631 RS 191 | as above to 2.5 m then red-yellow shale. |
| T2/13 | 0-1.5 | 6631 RS 192 | brown calc soil. |
| | 1.5-3.0 | 6631 RS 193 | red-yellow shale. |
| T2/14 | 0-1.5 | 6631 RS 194 | calc. soil to 1 m then yellow sandy siltstone. |
| T2/15 | 0-1.5 | 6631 RS 195 | 50 cm of calc. soil then sandy siltstone. |
| | 1.5-3.0 | 6631 RS 196 | yellow sandy siltstone. |
| T2/16 | 0-1.5 | 6631 RS 197 | 60 cm of calc. soil then yellow sandy siltstone. |
| T2/17 | 0-1.5 | 6631 RS 198 | brown calc. soil. |
| | 1.5-3.0 | 6631 RS 199 | brown alluvial clay. |
| | 3.0-4.5 | 6631 RS 200 | as above. |
| T2/18 | 0-1.5 | 6631 RS 201 | brown calc. soil. |
| | 1.5-3.0 | 6631 RS 202 | brown alluvial clay. |
| | 3.0-4.5 | 6631 RS 203 | as above. |

# APPENDIX B

## ASSAY RESULTS
## (ANALABS Report 185.0.06.02926)

# ANALABS

Services Inspection and Testing Services Australia Pty Ltd

MINERAL RESOURCE

## ANALYTICAL DATA

| SAMPLE PREFIX | REPORT NUMBER | REPORT DATE | CLIENT ORDER No. | PAGE |
|---|---|---|---|---|
| | 185.0.06.02926 | 18/04/89 | 12/03/333 | 1 OF 8 |

| TUBE No. | SAMPLE No. | V | Cr | Co | Ni | Sr | Zr | Nb | Ba | La |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | RS125 | 82 | 174 | 9 | 31 | 226 | 141 | 16 | 897 | 71 |
| 2 | RS126 | 67 | 164 | <5 | 28 | 50 | 238 | 16 | 246 | 51 |
| 3 | RS127 | 66 | 101 | 5 | 22 | 134 | 202 | 14 | 591 | 57 |
| 4 | RS128 | 72 | 249 | 11 | 59 | 388 | 112 | 24 | 226 | 55 |
| 5 | RS129 | 175 | 578 | 10 | 200 | 234 | 208 | 92 | 117 | 84 |
| 6 | RS130 | 147 | 477 | 8 | 159 | 66 | 226 | 91 | 86 | 54 |
| 7 | RS131 | 30 | 134 | 5 | 29 | 174 | 146 | <10 | 124 | 76 |
| 8 | RS132 | 26 | 156 | 5 | 28 | 134 | 157 | <10 | 155 | 88 |
| 9 | RS133 | 59 | 308 | 9 | 30 | 276 | 136 | <10 | 234 | 43 |
| 10 | RS134 | 58 | 249 | 8 | 36 | 90 | 175 | <10 | 220 | 73 |
| 11 | RS135 | 19 | 202 | 10 | 23 | 83 | 142 | <10 | 374 | 64 |
| 12 | RS136 | 67 | 139 | 7 | 22 | 226 | 161 | 10 | 975 | 80 |
| 13 | RS137 | 30 | 422 | 19 | 29 | 97 | 78 | <10 | 404 | 40 |
| 14 | RS138 | 45 | 533 | 26 | 32 | 90 | 64 | <10 | 397 | 28 |
| 15 | RS139 | 56 | 409 | 18 | 35 | 57 | 164 | 10 | 172 | 45 |
| 16 | RS140 | 59 | 238 | 16 | 33 | 181 | 144 | <10 | 405 | 39 |
| 17 | RS141 | 55 | 185 | 7 | 25 | 60 | 212 | 13 | 504 | 87 |
| 18 | RS142 | 77 | 194 | 10 | 29 | 135 | 237 | 14 | 1135 | 141 |
| 19 | RS143 | 106 | 402 | 18 | 38 | 84 | 117 | 10 | 1150 | 40 |
| 20 | RS144 | 54 | 325 | 11 | 23 | 223 | 135 | <10 | 1673 | 67 |
| 21 | RS145 | 67 | 176 | 8 | 18 | 128 | 164 | 12 | 877 | 104 |
| 22 | RS146 | 89 | 166 | 6 | 19 | 242 | 145 | <10 | 413 | 33 |
| 23 | RS147 | 60 | 155 | 8 | 19 | 211 | 159 | 11 | 824 | 60 |
| 24 | RS148 | 75 | 142 | 9 | 21 | 133 | 178 | <10 | 294 | 42 |
| 25 | RS149 | 68 | 66 | 12 | 27 | 338 | 107 | 11 | 598 | 26 |

Results in ppm unless otherwise specified
T = element present, but concentration too low to measure
X = element concentration is below detection limit
— = element not determined

AUTHORISED OFFICER

# ANALABS

A Division of Intersearch Laboratories and Technical Services (Australia) Pty. Ltd.

MINERAL RESOURCE

## ANALYTICAL DATA

SAMPLE PREFIX | REPORT NUMBER | REPORT DATE | CLIENT ORDER No. | PAGE

| | | 185.0.06.02926 | 18/04/89 | 12/03/333 | 2 OF 8 |
|---|---|---|---|---|---|

| TUBE No. | SAMPLE No. | V | Cr | Co | Ni | Sr | Zr | Nb | Ba | La |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | RS150 | 56 | 65 | 8 | 17 | 301 | 107 | <10 | 915 | 13 |
| 2 | RS151 | 61 | 77 | 16 | 27 | 269 | 56 | 10 | 605 | <5 |
| 3 | RS152 | 79 | 70 | 16 | 29 | 202 | 74 | <10 | 506 | 12 |
| 4 | RS153 | 77 | 70 | 16 | 28 | 178 | 70 | 10 | 276 | 7 |
| 5 | RS154 | 104 | 109 | 19 | 35 | 171 | 115 | 12 | 657 | 32 |
| 6 | RS155 | 157 | 197 | 23 | 37 | 126 | 106 | 10 | 762 | 38 |
| 7 | RS156 | 71 | 428 | 32 | 218 | 379 | 87 | 64 | 414 | 26 |
| 8 | RS157 | 101 | 115 | 21 | 40 | 176 | 86 | 10 | 605 | 23 |
| 9 | RS158 | 100 | 82 | 20 | 34 | 191 | 99 | 13 | 655 | 28 |
| 10 | RS159 | 103 | 85 | 19 | 31 | 185 | 112 | <10 | 471 | 34 |
| 11 | RS160 | 81 | 89 | 17 | 30 | 216 | 72 | <10 | 442 | 19 |
| 12 | RS161 | 83 | 89 | 18 | 29 | 217 | 79 | 10 | 1530 | 15 |
| 13 | RS162 | 103 | 123 | 19 | 31 | 188 | 101 | 10 | 980 | 31 |
| 14 | RS163 | 128 | 143 | 23 | 36 | 145 | 120 | 11 | 601 | 38 |
| 15 | RS164 | 107 | 150 | 20 | 32 | 131 | 124 | 11 | 675 | 42 |
| 16 | RS165 | 132 | 150 | 23 | 37 | 122 | 121 | <10 | 670 | 46 |
| 17 | RS166 | 83 | 137 | 16 | 31 | 133 | 77 | <10 | 224 | 19 |
| 18 | RS167 | 127 | 134 | 24 | 45 | 170 | 113 | 14 | 1535 | 31 |
| 19 | RS168 | 123 | 119 | 25 | 45 | 171 | 124 | 13 | 1026 | 41 |
| 20 | RS169 | 105 | 181 | 19 | 37 | 108 | 79 | 10 | 378 | 14 |
| 21 | RS170 | 107 | 132 | 26 | 36 | 176 | 91 | 10 | 1162 | 28 |
| 22 | RS171 | 102 | 168 | 20 | 44 | 161 | 95 | 11 | 595 | 28 |
| 23 | RS172 | 164 | 163 | 36 | 39 | 148 | 111 | 11 | 488 | 38 |
| 24 | RS173 | 86 | 155 | 17 | 33 | 137 | 84 | 11 | 234 | 19 |
| 25 | RS174 | 110 | 94 | 20 | 35 | 214 | 98 | 11 | 882 | 30 |

Results in ppm unless otherwise specified
T. = element present, but concentration too low to measure
X. = element concentration is below detection limit
— = element not determined

AUTHORISED OFFICER

# ANALABS

A Division of Brighton Inspection and Testing Services

## ANALYTICAL DATA

| SAMPLE PREFIX | REPORT NUMBER | REPORT DATE | CLIENT ORDER No. | PAGE |
|---|---|---|---|---|
| | 185.0.06.02926 | 18/04/89 | 12/03/333 | 3 of 8 |

| TUBE No. | SAMPLE No. | V | Cr | Co | Ni | Sr | Zr | Nb | Ba | La |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | RS175 | 129 | 111 | 26 | 35 | 193 | 88 | 11 | 420 | 28 |
| 2 | RS176 | 105 | 87 | 23 | 40 | 177 | 96 | 12 | 716 | 29 |
| 3 | RS177 | 93 | 162 | 16 | 34 | 163 | 88 | <10 | 336 | 24 |
| 4 | RS178 | 141 | 113 | 24 | 33 | 285 | 93 | <10 | 660 | 28 |
| 5 | RS179 | 103 | 166 | 19 | 37 | 138 | 88 | 10 | 503 | 23 |
| 6 | RS180 | 179 | 200 | 35 | 50 | 140 | 110 | 11 | 557 | 39 |
| 7 | RS181 | 129 | 125 | 17 | 37 | 141 | 90 | <10 | 556 | 23 |
| 8 | RS182 | 124 | 113 | 16 | 40 | 122 | 120 | 13 | 445 | 39 |
| 9 | RS183 | 88 | 90 | 19 | 34 | 138 | 81 | <10 | 1508 | 24 |
| 10 | RS184 | 97 | 72 | 23 | 49 | 141 | 122 | 13 | 1443 | 135 |
| 11 | RS185 | 106 | 92 | 48 | 41 | 160 | 131 | 13 | 1435 | 451 |
| 12 | RS186 | 82 | 52 | 19 | 35 | 198 | 97 | 11 | 2158 | 69 |
| 13 | RS187 | 87 | 69 | 13 | 27 | 166 | 123 | 15 | 890 | 110 |
| 14 | RS188 | 71 | 68 | 13 | 26 | 228 | 69 | <10 | 922 | 18 |
| 15 | RS189 | 63 | 51 | 9 | 25 | 212 | 87 | <10 | 468 | 25 |
| 16 | RS190 | 90 | 111 | 19 | 30 | 158 | 82 | <10 | 3653 | 27 |
| 17 | RS191 | 90 | 153 | 46 | 49 | 161 | 111 | 10 | 4260 | 80 |
| 18 | RS192 | 69 | 97 | 13 | 23 | 163 | 84 | <10 | 964 | 34 |
| 19 | RS193 | 62 | 68 | 8 | 38 | 165 | 131 | 12 | 978 | 79 |
| 20 | RS194 | 53 | 173 | 8 | 20 | 143 | 138 | <10 | 435 | 33 |
| 21 | RS195 | 68 | 356 | 18 | 25 | 186 | 87 | <10 | 508 | 36 |
| 22 | RS196 | 32 | 152 | <5 | 13 | 42 | 167 | <10 | 68 | 31 |
| 23 | RS197 | 56 | 245 | 21 | 37 | 257 | 56 | <10 | 378 | 13 |
| 24 | RS198 | 72 | 76 | 14 | 22 | 225 | 73 | <10 | 1279 | 13 |
| 25 | RS199 | 95 | 76 | 17 | 26 | 168 | 110 | <10 | 606 | 35 |

Results in ppm unless otherwise specified
T = element present, but concentration too low to measure
X = element concentration is below detection limit
— = element not determined

AUTHORISED OFFICER

# ANALABS

Environmental and Testing Services Australia Pty Ltd

MINERAL RESOURCES

## ANALYTICAL DATA

SAMPLE PREP'N | REPORT NUMBER | REPORT DATE | CLIENT ORDER No. | PAGE

| | | 185.0.06.02926 | 18/04/89 | 12/03/333 | 4 OF 8 |
|---|---|---|---|---|---|

| TUBE No. | SAMPLE No. | V | Cr | Co | Ni | Sr | Zr | Nb | Ba | La |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | RS200 | 120 | 199 | 18 | 34 | 208 | 116 | <10 | 657 | 39 |
| 2 | RS201 | 73 | 82 | 13 | 21 | 184 | 73 | <10 | 375 | 10 |
| 3 | RS202 | 81 | 91 | 16 | 23 | 161 | 105 | <10 | 472 | 29 |
| 4 | RS203 | 106 | 106 | 20 | 30 | 156 | 117 | <10 | 923 | 42 |
| 5 | QCRS140 | 59 | 249 | 16 | 28 | 177 | 143 | <10 | 433 | 50 |
| 6 | QCRS160 | 80 | 102 | 15 | 25 | 215 | 76 | <10 | 511 | 21 |
| 7 | QCRS180 | 165 | 190 | 31 | 44 | 128 | 103 | <10 | 538 | 40 |
| 8 | QCRS200 | 118 | 214 | 17 | 31 | 213 | 118 | <10 | 680 | 38 |
| 9 | | | | | | | | | | |
| 10 | | | | | | | | | | |
| 11 | | | | | | | | | | |
| 12 | | | | | | | | | | |
| 13 | | | | | | | | | | |
| 14 | | | | | | | | | | |
| 15 | | | | | | | | | | |
| 16 | | | | | | | | | | |
| 17 | | | | | | | | | | |
| 18 | | | | | | | | | | |
| 19 | | | | | | | | | | |
| 20 | | | | | | | | | | |
| 21 | | | | | | | | | | |
| 22 | | | | | | | | | | |
| 23 | DETECTION | 2 | 10 | 5 | 10 | 1 | 5 | 10 | 5 | 5 |
| 24 | UNITS | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm |
| 25 | METHOD | 201 | 201 | 201 | 201 | 201 | 201 | 201 | 201 | 201 |

Results in ppm unless otherwise specified
T = element present, but concentration too low to measure
X = element concentration is below detection limit
— = element not determined

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# ANALABS

A Division of Inchcape Inspection and Testing

## ANALYTICAL DATA

| SAMPLE PREFIX | REPORT NUMBER | REPORT DATE | CLIENT ORDER No. | PAGE |
|---|---|---|---|---|
| | 185.0.06.02926 | 18/04/89 | 12/03/333 | 5 OF 8 |

| TUBE No. | SAMPLE No. | Pb | Pb | Th |
|---|---|---|---|---|
| 1 | RS125 | – | <200 | 14 |
| 2 | RS126 | – | <200 | 17 |
| 3 | RS127 | – | <200 | 17 |
| 4 | RS128 | – | <200 | <10 |
| 5 | RS129 | – | <200 | 15 |
| 6 | RS130 | – | <200 | 11 |
| 7 | RS131 | – | <200 | 13 |
| 8 | RS132 | – | <200 | 11 |
| 9 | RS133 | – | <200 | <10 |
| 10 | RS134 | – | <200 | 15 |
| 11 | RS135 | – | <200 | <10 |
| 12 | RS136 | – | <200 | 13 |
| 13 | RS137 | – | <200 | <10 |
| 14 | RS138 | – | <200 | <10 |
| 15 | RS139 | – | <200 | 16 |
| 16 | RS140 | – | <200 | 12 |
| 17 | RS141 | – | <200 | 17 |
| 18 | RS142 | – | <200 | 20 |
| 19 | RS143 | – | <200 | 12 |
| 20 | RS144 | – | <200 | 11 |
| 21 | RS145 | – | <200 | 16 |
| 22 | RS146 | – | <200 | 12 |
| 23 | RS147 | – | <200 | 14 |
| 24 | RS148 | – | <200 | 14 |
| 25 | RS149 | – | <200 | <10 |

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# ANALABS

Mineral Resources Inspection and Testing Services Australia Pty. Ltd.

## ANALYTICAL DATA

| SAMPLE PREP | REPORT NUMBER | REPORT DATE | CLIENT ORDER No. | PAGE |
|---|---|---|---|---|
| | 185.0.06.02926 | 18/04/89 | 12/03/333 | 6 OF 8 |

| TUBE No. | SAMPLE No. | Pb | Pb | Th | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | RS150 | – | <200 | <10 | | | | | | |
| 2 | RS151 | – | <200 | <10 | | | | | | |
| 3 | RS152 | – | <200 | <10 | | | | | | |
| 4 | RS153 | – | <200 | <10 | | | | | | |
| 5 | RS154 | – | <200 | 11 | | | | | | |
| 6 | RS155 | – | <200 | 14 | | | | | | |
| 7 | RS156 | – | <200 | <10 | | | | | | |
| 8 | RS157 | – | <200 | <10 | | | | | | |
| 9 | RS158 | – | <200 | <10 | | | | | | |
| 10 | RS159 | – | <200 | 12 | | | | | | |
| 11 | RS160 | – | <200 | <10 | | | | | | |
| 12 | RS161 | – | <200 | <10 | | | | | | |
| 13 | RS162 | – | <200 | <10 | | | | | | |
| 14 | RS163 | – | <200 | 14 | | | | | | |
| 15 | RS164 | – | <200 | 15 | | | | | | |
| 16 | RS165 | – | <200 | 15 | | | | | | |
| 17 | RS166 | – | <200 | <10 | | | | | | |
| 18 | RS167 | – | <200 | <10 | | | | | | |
| 19 | RS168 | – | <200 | 13 | | | | | | |
| 20 | RS169 | – | <200 | <10 | | | | | | |
| 21 | RS170 | – | <200 | <10 | | | | | | |
| 22 | RS171 | – | <200 | <10 | | | | | | |
| 23 | RS172 | – | <200 | 12 | | | | | | |
| 24 | RS173 | – | <200 | <10 | | | | | | |
| 25 | RS174 | – | <200 | <10 | | | | | | |

Results in ppm unless otherwise specified
T = element present, but concentration too low to measure
X = element concentration is below detection limit
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# ANALABS

A Division of Mincom Inspection and Testing Services Pty Limited

## ANALYTICAL DATA

| SAMPLE PREFIX | REPORT NUMBER | REPORT DATE | ORDER NUMBER | PAGE |
|---|---|---|---|---|
| | 185.0.06.02926 | 18/04/89 | 12/03/333 | 7 OF 8 |

| TUBE No. | SAMPLE No. | Pb | Pb | Th | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | RS175 | - | <200 | <10 | | | | | | | |
| 2 | RS176 | - | <200 | <10 | | | | | | | |
| 3 | RS177 | - | <200 | <10 | | | | | | | |
| 4 | RS178 | - | <200 | <10 | | | | | | | |
| 5 | RS179 | - | <200 | <10 | | | | | | | |
| 6 | RS180 | - | <200 | 13 | | | | | | | |
| 7 | RS181 | - | <200 | <10 | | | | | | | |
| 8 | RS182 | - | <200 | 14 | | | | | | | |
| 9 | RS183 | - | <200 | <10 | | | | | | | |
| 10 | RS184 | - | 224 | 15 | | | | | | | |
| 11 | RS185 | - | 2248 | 24 | | | | | | | |
| 12 | RS186 | - | 402 | <10 | | | | | | | |
| 13 | RS187 | - | 507 | 18 | | | | | | | |
| 14 | RS188 | - | <200 | <10 | | | | | | | |
| 15 | RS189 | - | <200 | <10 | | | | | | | |
| 16 | RS190 | - | <200 | <10 | | | | | | | |
| 17 | RS191 | - | <200 | <10 | | | | | | | |
| 18 | RS192 | - | <200 | <10 | | | | | | | |
| 19 | RS193 | - | <200 | <10 | | | | | | | |
| 20 | RS194 | - | <200 | <10 | | | | | | | |
| 21 | RS195 | 2.22 | >10000 | <10 | | | | | | | |
| 22 | RS196 | - | 945 | 11 | | | | | | | |
| 23 | RS197 | - | 552 | <10 | | | | | | | |
| 24 | RS198 | - | 230 | <10 | | | | | | | |
| 25 | RS199 | - | 252 | <10 | | | | | | | |

Results in ppm unless otherwise specified
T = element present; but concentration too low to measure
X = element concentration is below detection limit
— = element not determined

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# ANALABS

Testing Services Australia Pty Ltd

## ANALYTICAL DATA

| SAMPLE TYPE | REPORT NUMBER | REPORT DATE | CLIENT ORDER No. | PAGE |
|---|---|---|---|---|
| | 185.0.06.02926 | 18/04/89 | 12/03/333 | 8 OF 8 |

| TUBE No | SAMPLE No | Pb | Pb | Th | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | RS200 | - | <200 | 12 | | | | | | |
| 2 | RS201 | - | <200 | <10 | | | | | | |
| 3 | RS202 | - | <200 | <10 | | | | | | |
| 4 | RS203 | - | <200 | 11 | | | | | | |
| 5 | QCRS140 | - | <200 | 11 | | | | | | |
| 6 | QCRS160 | - | <200 | <10 | | | | | | |
| 7 | QCRS180 | - | <200 | <10 | | | | | | |
| 8 | QCRS200 | - | <200 | <10 | | | | | | |
| 9 | | | | | | | | | | |
| 10 | | | | | | | | | | |
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| 19 | | | | | | | | | | |
| 20 | | | | | | | | | | |
| 21 | | | | | | | | | | |
| 22 | | | | | | | | | | |
| 23 | DETECTION | 0.01 | 200 | 10 | | | | | | |
| 24 | UNITS | % | ppm | ppm | | | | | | |
| 25 | METHOD | 104 | 201 | 201 | | | | | | |

- Results in ppm unless otherwise specified
T = element present; but concentration too low to measure
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AUTHORISED OFFICER

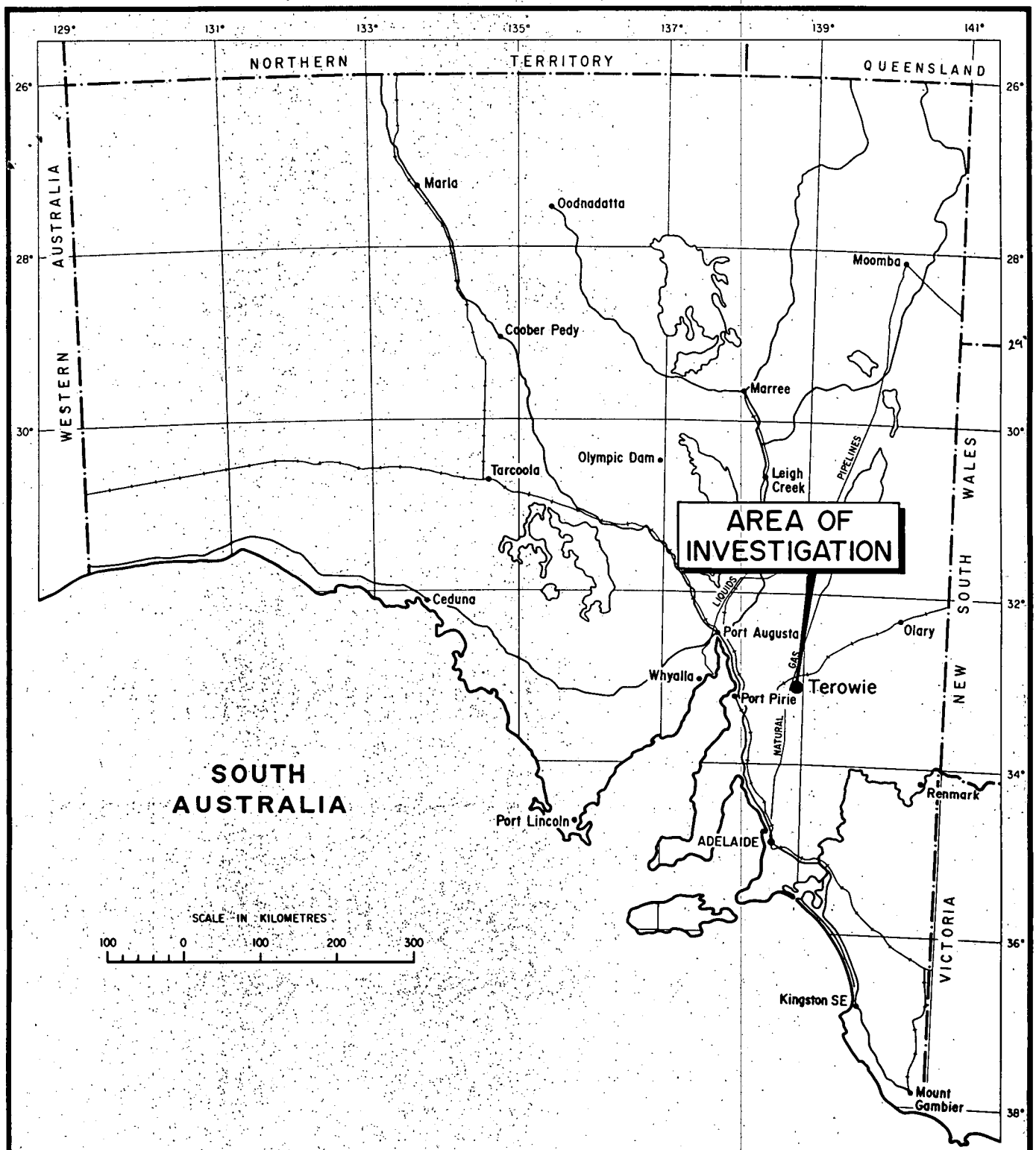



Figure 1

DEPARTMENT OF MINES AND ENERGY
SOUTH AUSTRALIA

| | |
|---|---|
| COMPILED LPH | C.D.O. 3·10·89 DATE |
| DRAWN | SCALE As shown |
| DATE Aug. 89 | PLAN NUMBER S 21017 |
| CHECKED | |

# TEROWIE GRAVITY AND GEOCHEMICAL SURVEY

## LOCALITY PLAN

4876

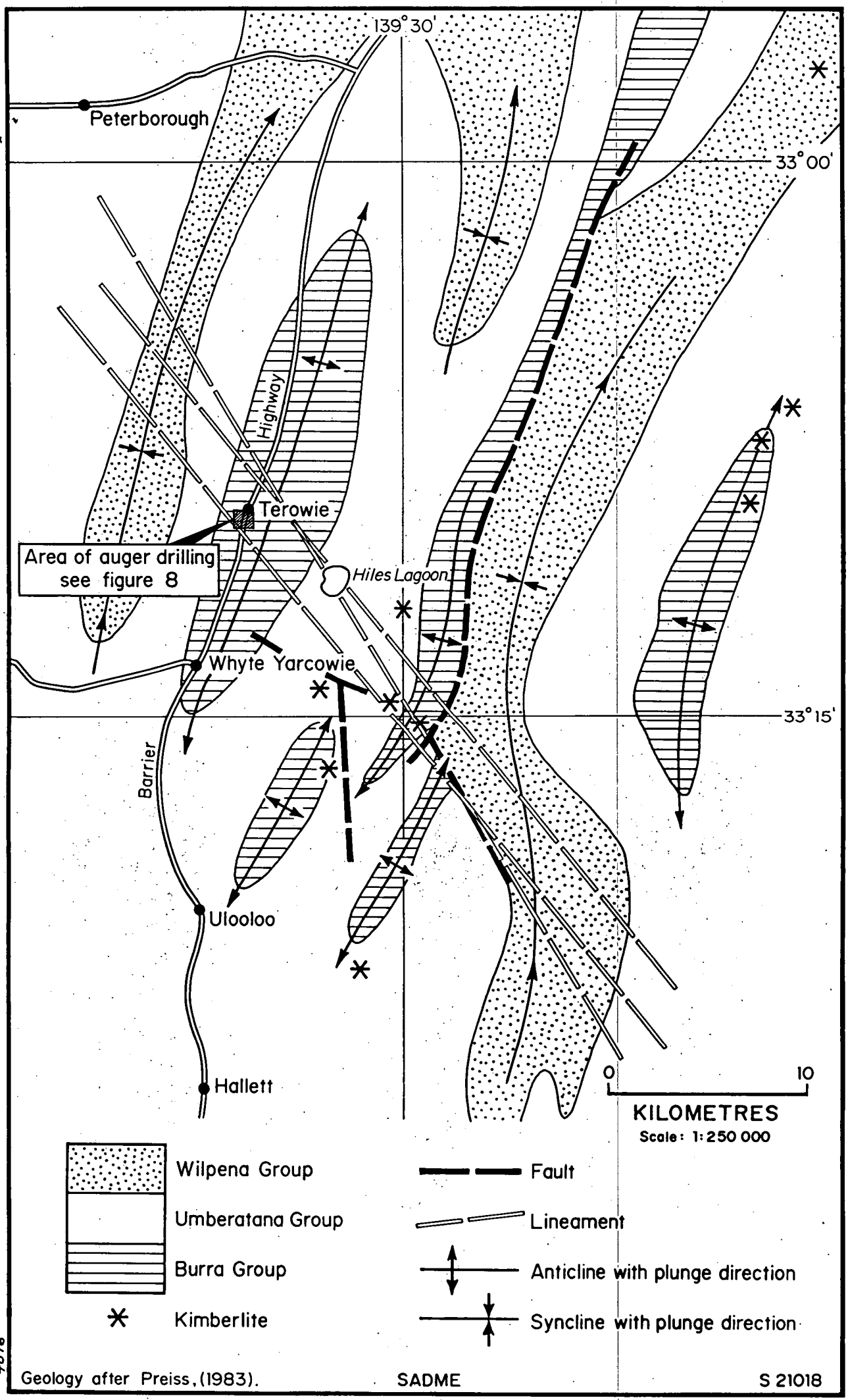
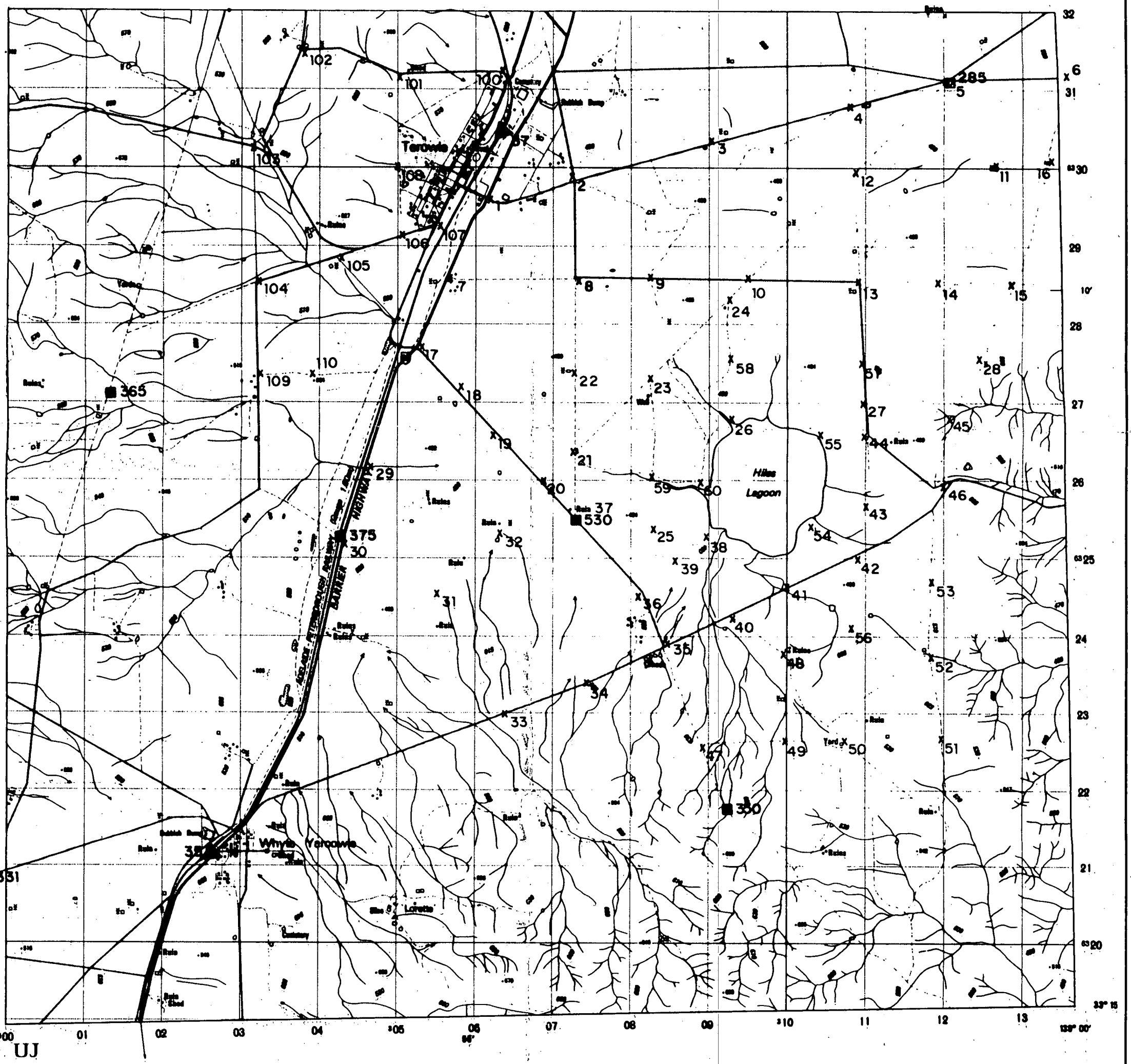



Figure 2. Regional geology and location of Terowie auger drilling.




Gravity Stations ..... X 21

Gravity Stations previously read ..... ▲ ■

SCALE 1:50 000

METRES 1000 0 1 2 3 4 5 KILOMETRES

Figure 3

DEPARTMENT OF MINES AND ENERGY
SOUTH AUSTRALIA

TEROWIE GRAVITY AND GEOCHEMICAL SURVEY

LOCATION OF GRAVITY STATIONS

| | |
|---|---|
| COMPILED P. HOUGH | WR 3·10·89 C.D.O. DATE |
| DRAWN D.S.L | SCALE 1:50,000 |
| DATE Sept. 89 | PLAN NUMBER 89-395 |
| CHECKED | |

4876

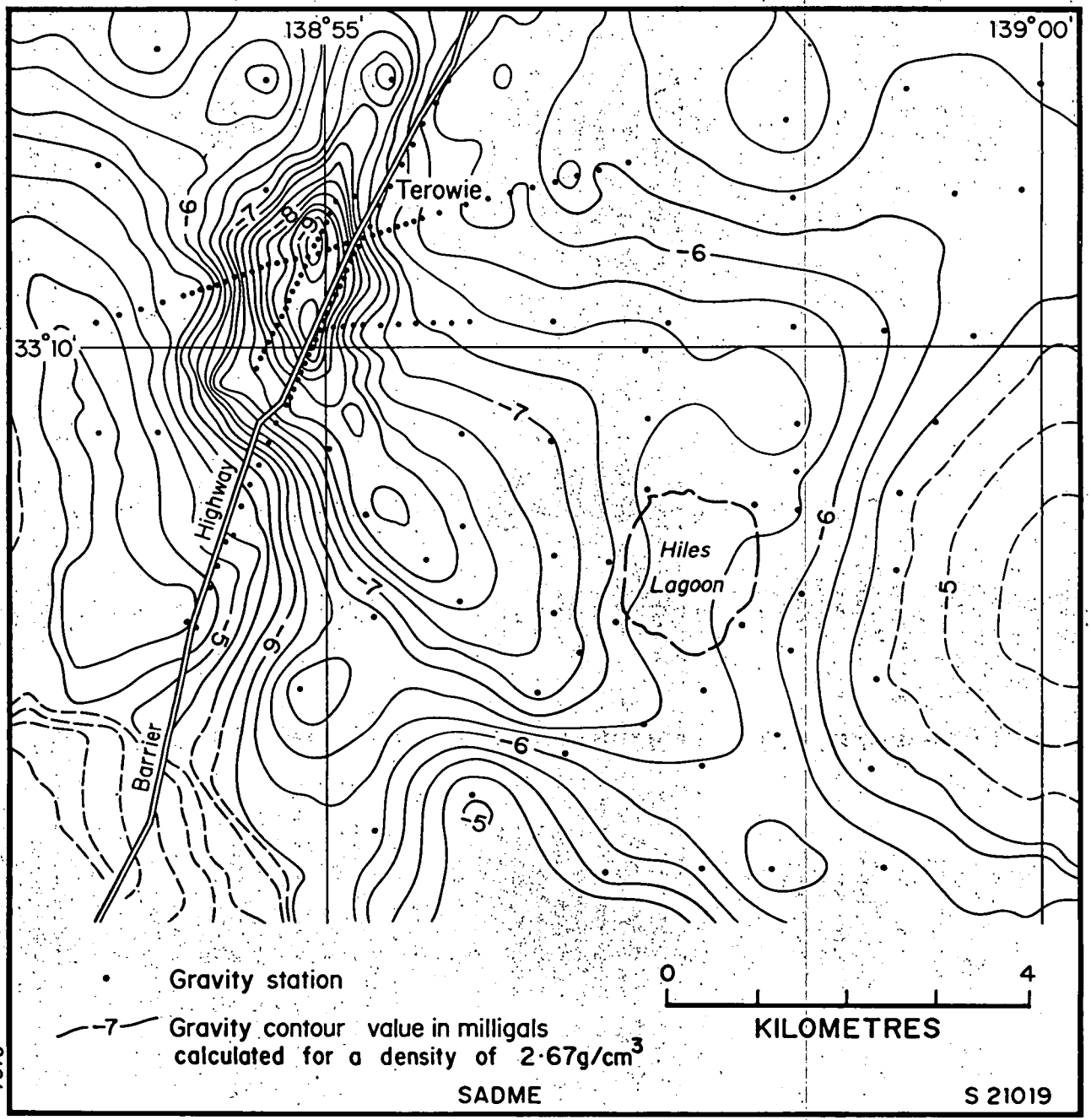



Figure 4. Bouguer gravity contours, Terowie area.

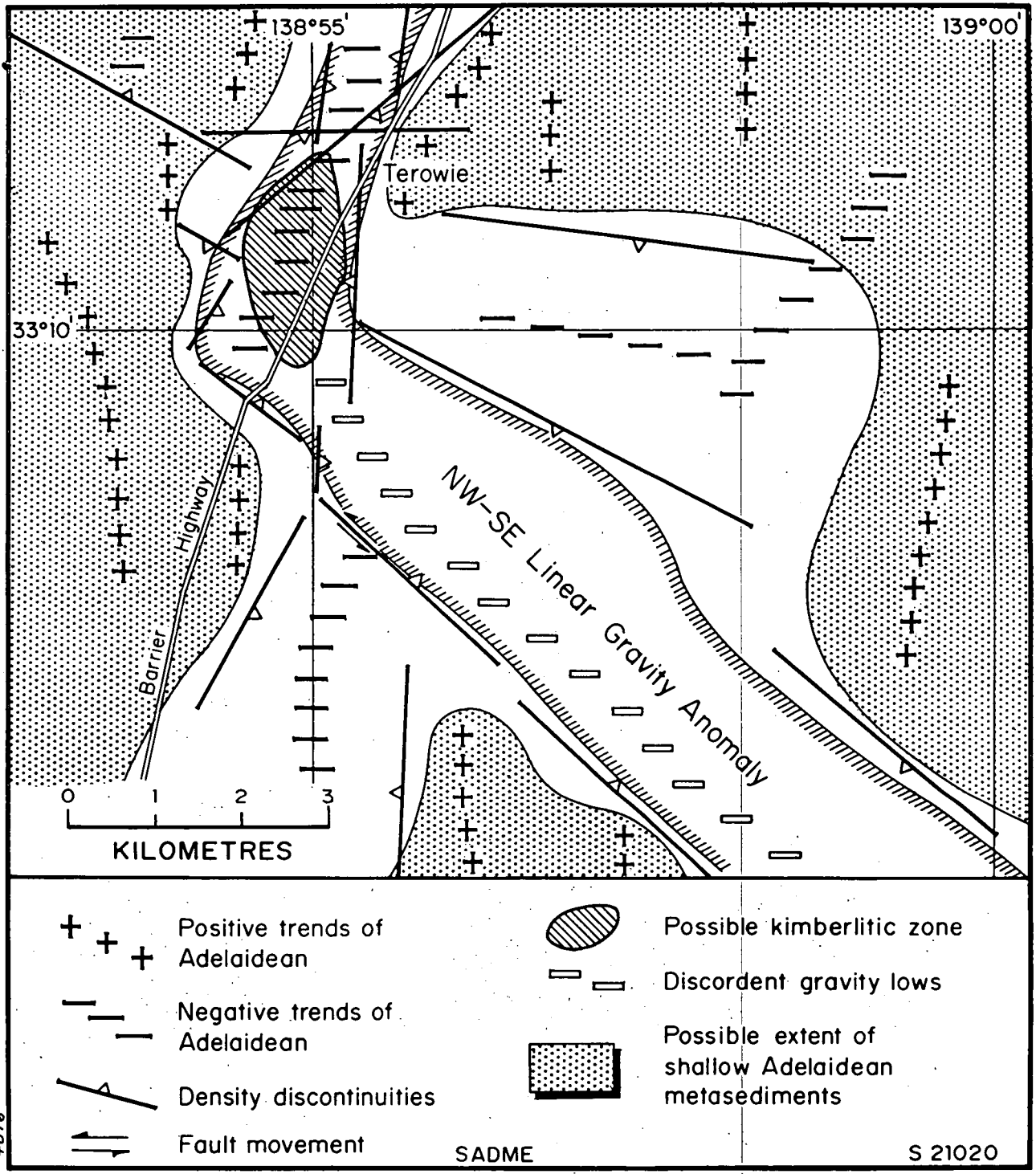



Figure 5. Trend analysis of Bouguer gravity values Terowie area.

RESIDUAL GRAVITY VALUES

COMPUTER MODEL VALUES

STATION NUMBERS

104 112 113 114 105 115 116 117 118 119 120 121 122 106 123 124 125 126 107 127 128 129 130 131 132 133 134 135 136 137 138 139 140 141 142 2 143 144 145 146 148

$\Delta p = +0.08 g/cm^3$

$\Delta p = +0.22 g/cm^3$

$\Delta p = -0.3 g/cm^3$

$\Delta p = -0.33 g/cm^3$

$\Delta p = -0.13 g/cm^3$

$\Delta p = -0.5 g/cm^3$

NOTE: $\Delta p$ = Density contrast in $g/cm^3$ compared with density of basement of $2.67 g/cm^3$

Residual Gravity (milligals)

0 -1 -2 -3 -4 -5

Depth Below Surface (metres)

0 500 1000 1500 2000 2500 3000

1000 2000 3000 4000 5000 6000

Distance (metres)

HORIZONTAL SCALE: 1:20,000

VERTICAL SCALE: 1:50,000

Figure 6

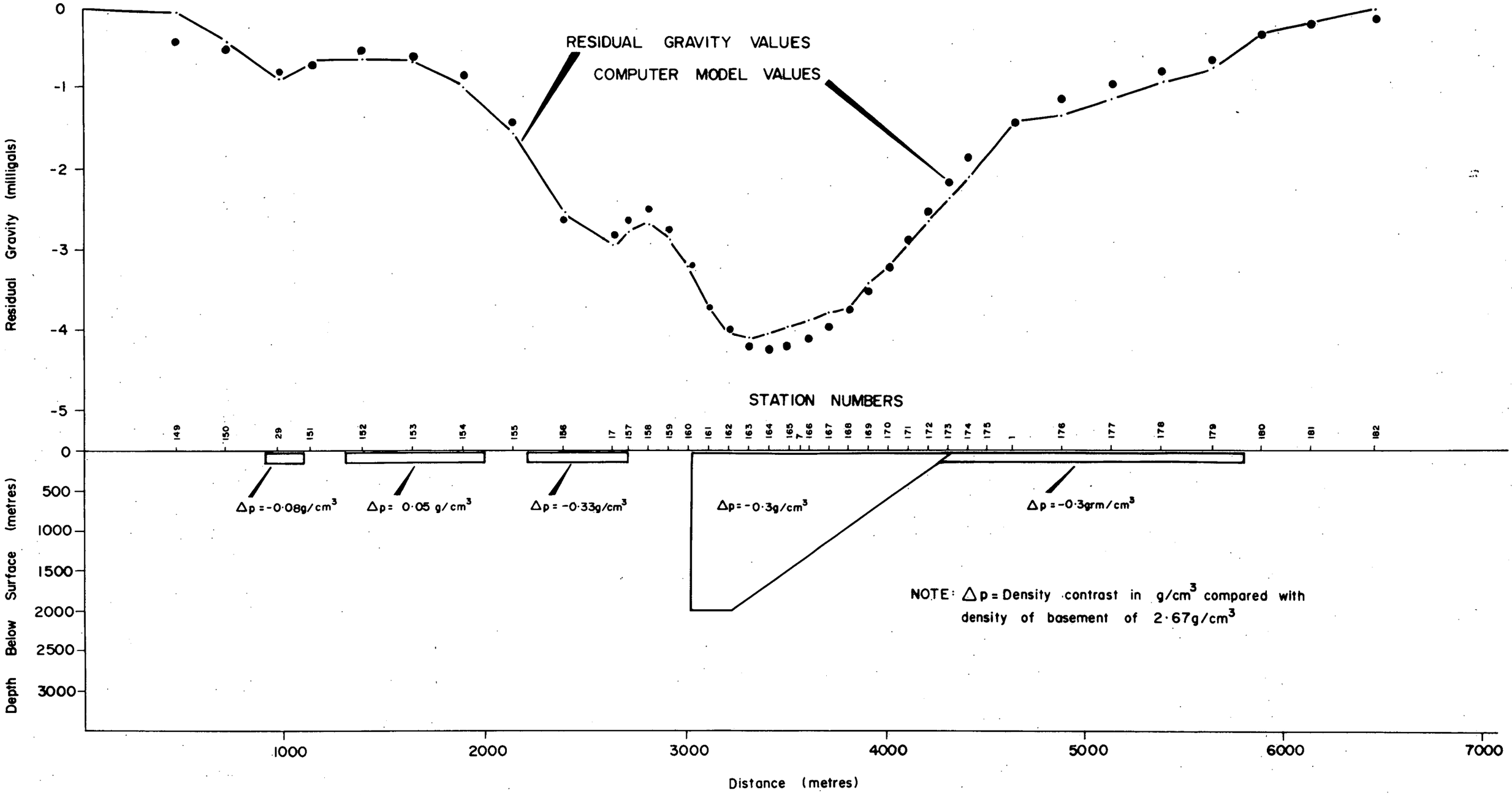
DEPARTMENT OF MINES AND ENERGY SOUTH AUSTRALIA

TEROWIE GRAVITY AND GEOCHEMICAL SURVEY

E-W COMPUTER MODEL GRAVITY TRAVERSE

| | |
|---|---|
| COMPILED B. MORRIS | C.D.O. DATE |
| DRAWN D.S.L. | SCALE |
| DATE Aug 89 | PLAN NUMBER 89-367 |
| CHECKED | |

4876




HORIZONTAL SCALE: 1:20,000

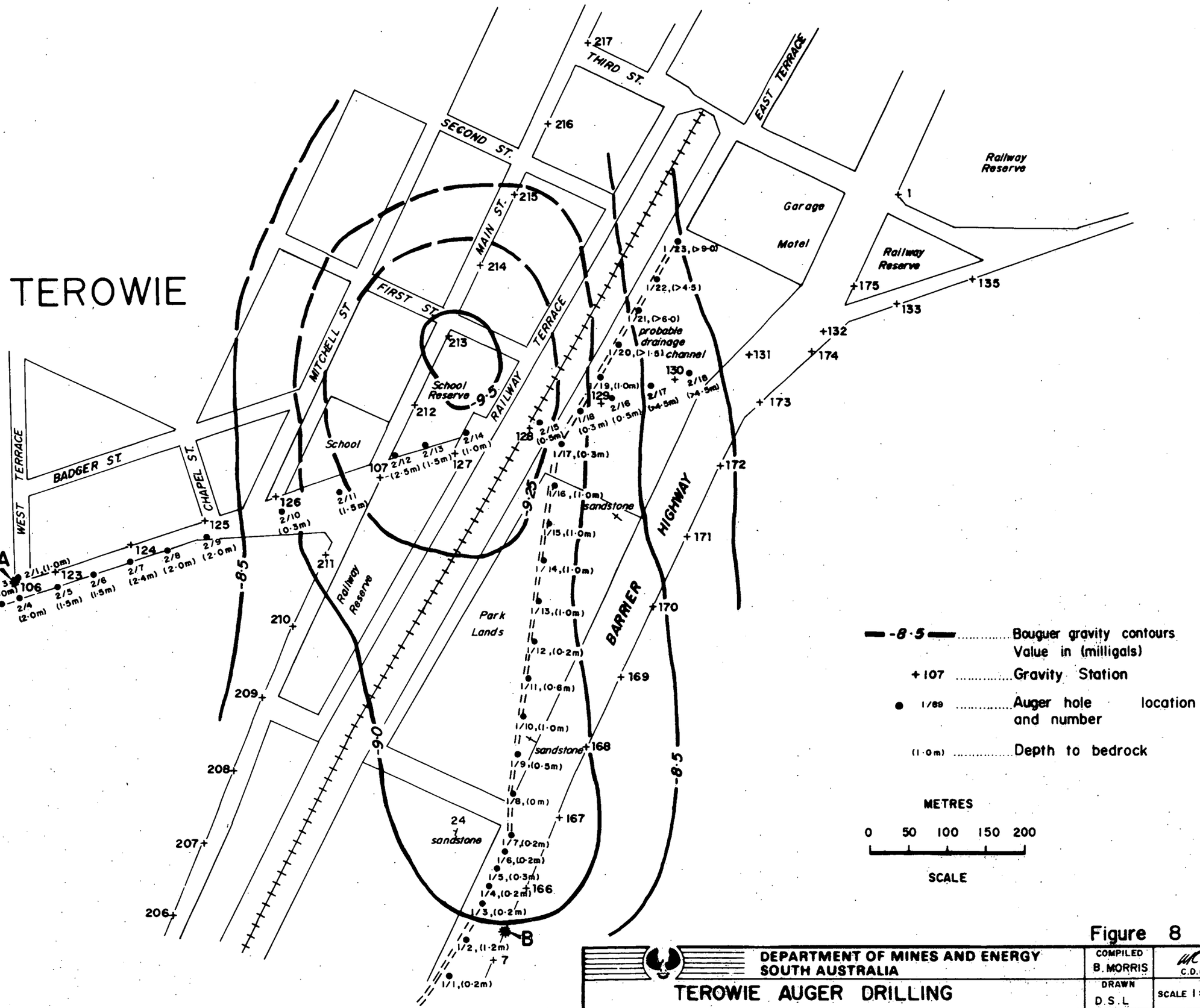
VERTICAL SCALE: 1:50,000

Figure 7

| | | |
|---|---|---|
| DEPARTMENT OF MINES AND ENERGY SOUTH AUSTRALIA | COMPILED B. MORRIS | C.D.O. DATE |
| TEROWIE GRAVITY AND GEOCHEMICAL SURVEY N-S COMPUTER MODEL GRAVITY TRAVERSE | DRAWN D. S. L | SCALE |
| | DATE Aug 89 | PLAN NUMBER 89-368 |
| | CHECKED | |

4876

# TEROWIE




-8·5- ..... Bouguer gravity contours Value in (milligals)

+107 ..... Gravity Station

● 1/89 ..... Auger hole location and number

(1·0m) ..... Depth to bedrock

METRES

0 50 100 150 200

SCALE

Figure 8

| | | |
|---|---|---|
| DEPARTMENT OF MINES AND ENERGY SOUTH AUSTRALIA | COMPILED B. MORRIS | C.D.O. 3.10.89 DATE |
| TEROWIE AUGER DRILLING | DRAWN D.S.L | SCALE 1:5000 |
| DRILL HOLE LOCATION PLAN | DATE Aug 1989 | PLAN NUMBER 89-369 |
| | CHECKED | |

4876