DEPARTMENT OF MINES AND ENERGY

SOUTH AUSTRALIA

REPORT BOOK 95/40

OTWAY BASIN AEROMAGNETIC/ RADIOMETRIC TEST SURVEY

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SEPTEMBER 1995

SR 27/4/749

F07495.RAF

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EXECUTIVE SUMMARY

In 1991, the Australian Petroleum Industries Research Association Limited (APIRA) a division of the Australian Mineral Industries Research Associations Limited (AMIRA) approached MESA to support a proposal to fly, process and interpret aerial spectrometer and aeromagnetic data. The project was put forward by RECON Exploration and the area to be tested was the onshore Otway Basin in South Australia. The aim was to use possible signature responses over the three proven fields, Katnook, Labroke Grove and Caroline, to identify further accumulations. It was hoped that all licencees in the area would contribute to the cost of the project.

It was decided that a test of close-spaced high sensitivity aeromagnetic data (rather than radiometric) would be more useful in helping petroleum exploration. APIRA then attempted to get agreement with the licensees to cover all of the onshore Otway Basin with an aeromagnetic/radiometric survey. This was unsuccessful and a test strip adjacent to the Victorian border, but wide enough to cover the three known fields and the recent Sawpit-1 well which had recovered oil was then proposed. APIRA withdrew from the project when it failed to get the three licence joint ventures to agree to participate. MESA contracted World Geoscience Corporation to fly the survey and the area was designated P1, part of the South Australian Exploration Initiative with contributions from the licensees in the test area (Appendix 2).

The P1 area survey (Fig. 1) was flown in August-September 1993 with a total of 11,834 line km recorded at 400 metre spacing and 80 metre flight height. The P1 area covers the northern margin of the Basin, the Penola Trough, the Kalangadoo High and the eastern margin of the Tantanoola Trough. The southern area covers the Tartwaup Hinge Zone where Tertiary and Upper Cretaceous sediments thicken rapidly to the south (Fig. 2).

MESA mapped the onshore Basin using company seismic data as a National Geological Mapping Accord (NGMA) project. A consistent set of structure maps at Base Tertiary, Top Eumeralla (Fig. 23), Top Crayfish (Fig. 22) and Top Basement (Fig. 21) were available to compare to the aeromagnetic data (stratigraphic column Fig. 5).

MESA carried out a study to determine the magnetic susceptibility of the sediments and basement which had been cored in previous petroleum exploration wells. To avoid contamination of cuttings by steel fragments from casing or drill pipe, cores from six wells (Fig. 6) were measured for magnetic susceptibility (Fig. 7 & Appendix 3). A 1992 B.Sc (Hons) thesis by Chatfield which was sponsored by MESA provided magnetic susceptibility data for outcrops of Holocene volcanic material at Mount Gambier and Mount Schank (Fig. 8 & Appendix 4). The magnetic susceptibility data obtained from cores was uniformly low (Figs 7 & 9). The only significant values were obtained from the volcanic outcrops and these are thought to be typical of a magma chamber under the Mount Gambier/Mount Schank area.

A composite north–south regional seismic line was constructed and major formation tops were depth-picked. The combination of the seismic depths and formation thicknesses were combined with the corrected

magnetic susceptibility data for each formation to model magnetic anomalies and compare to the aeromagnetic survey results (Fig. 4). There was no correlation between the magnetic response computed for the sedimentary section and the observed aeromagnetic anomalies. The sediment responses were computed to be less than one percent of the amplitude of the observed aeromagnetic anomaly dynamic range in this area. It is inferred that the major magnetic response comes from igneous/metamorphic basement beneath the sediments (Figs 11, 15).

In the vicinity of the 3-D seismic survey (Fig. 3) computed depths to the sources of the Sawpit/Penola magnetic anomaly lie in the range 2450–2670 m. This depth range is consistent with the well data from Tilbooroo-1 and Sawpit No-1 where schists, metabasalts and quartzites were intersected at similar depths. It is inferred that the sources of the anomalies are metamorphosed igneous bodies, coinciding with a seismically mapped basement high on which the wells Penola-1, Sawpit-1 and Tilbooroo-1 have been drilled (Appendix 5 Anomaly H).

The Total Magnetic Intensity data supplied by World Geoscience Corporation showed a large circular 400 nT magnetic high area centred on Mount Gambier (Fig. 16) which is interpreted as a magma chamber associated with the volcanoes in the area (Fig. 10). Overall the model extends 40 km in the north northeast direction and 15 km in the east-southeast direction. The depth to the top of this body lies in the range 6300–12700 m. From Mount Schank southwards a magnetic low developed and extended offshore. Modelling of Mount Gambier and Mount Schank anomalies indicates shallow, near surface magnetic bodies (Figs 16, 17).

A north–south magnetic high is located along the western boundary of the P1 block with an estimated source depth of 2500 m, and to the east of the Hungerford 1 well has what appears to be a small, blind associated basaltic plug at a depth of 200 m (Fig. 18). North of the Mount Gambier magnetic high, a magnetic low area is developed over the central and northern Penola Trough. Northwest to southeast lineaments are present in the trough and a second-order magnetic high is located over the Sawpit/Penola structural feature (Figs 12, 20). In the extreme northeast corner of P1, the Kanawinka Fault marks the edge of the Otway Basin and is visible on the aeromagnetic data.

The northwest to southeast magnetic lineaments located southeast of Penola (Fig. 30) are close to the fault planes of tilted fault blocks. The magnetic effects are interpreted to be from the deposition of magnetic minerals on or near the fault planes within the Eumeralla Formation. It is doubtful that these anomalies are caused by volcanics in the fault planes, as good quality seismic indicates clean breaks in the reflection with no evidence of intrusive fill causing a thickening of the fault plane image. Depths to the top of the magnetic bodies are in the range 200–400 m (Appendix 5). The Sawpit/Penola magnetic high has a cross pattern which corresponds to the basement faulting directions (Figs 20, 24B). Apart from the volcanic cones at Mount Gambier and Mount Schank the surface geology (Fig. 14) does not affect the aeromagnetic data.

World Geoscience Corporation has applied a pseudo-depth-slicing (PDS) technique to the aeromagnetic data after removing the effects of surface 'culture' and having reduced the data to the pole. The slicing technique relies on dividing the spectrum of the data into a series of frequency slices with the highest frequency shortest wavelength dominating the shallowest slice and the longest wavelength data representing deep basement. Four PDS coloured images and contour maps of the sedimentary section (from the shallowest PDS-1 to PDS-4) and a fifth deepest image of the basement were generated.

The most useful magnetic images in relation to the sedimentary section were PSD-2 (Fig. 25) to PDS-4. Faulted structures within the Penola Trough especially east of Penola within the 3D seismic area (Figs 24A, 24B) are visible, the faulted basement high east of Penola is clearly defined and an area of deep northwest–southeast faults south of Mount Gambier is visible. Volcanic extrusive and intrusive occurrences are also clearly defined. The PDS images could be further improved by removing additional high frequency effects due to surface 'culture'. An overlay of the location of powerlines and railway lines (Fig. 27) in the area and an airborne sidescan radar image (Fig. 19, Appendix 6) showed that a number of magnetic events present in PDS-1 to PDS-3 are due to powerlines and towns.

The radiometric data acquired as part of the P1 area survey is closely controlled by the surface geology (Fig. 14) and distribution of surface water at the time of acquisition. Uranium, thorium, potassium and total count values (Fig. 13) are displayed in coloured images. South of Mount Gambier the Gambier Limestone (L. Eocene - M. Miocene) is high in all radioactive elements with a northern boundary which corresponds to the limit of the outcrop. The Mount Gambier volcanics have a generally low radiometric response. A series of northwest to southeast stranded coastal ridges of the Bridgewater Formation have moderately high radiometric values in an area east and northeast of Mount Gambier. Younger Padthaway Formation silts and carbonates between the coastal ridges have low radiometric values. In contrast, the Padthaway Formation located in the Penola area and bounded by older north-south trending coastal ridges has quite high radiometric values for all elements. The Penola radiometric anomaly is separated from the Mount Gambier area by a sandy deposit (Molineaux Sand) which cuts across the survey area in a northeast to southwest direction and which has a low radiometric response.

The known gas fields may have had some control on the radiometric results of the P1 survey. In the area of Katnook, Ladbroke Grove and Haselgrove there is a region of relatively low radiometric values which appears to be an east-west embayment into an area of high radiometric values (Figs 13 & 14). The surface geology in the area comprises a relatively smooth northeast to southwest boundary of the Padthaway Formation and the Molineaux Sand. Further west in the area of Laira-1 and Zema-1 the radiometric data have relatively low values in an area which is now thought to have contained a gas accumulation which subsequently leaked following fault re-activation. A possible explanation is that leaking hydrocarbons have caused a reduction in the surface radiometric element content. Alternative explanations are that variation in Padthaway Formation facies is responsible for the low radiometric values around known and past gas accumulations or the distribution of swamps near the gas fields control the radiometric results.

INTRODUCTION

The Australian Petroleum Industries Research Association Limited (APIRA) approached MESA in 1991 to provide support for an aeromagnetic/radiometric survey in the Otway Basin which was proposed by RECON Exploration. MESA agreed to support the project provided that companies exploring in the area contributed. APIRA was unable to get financial support from a number of licencees in the area and withdrew, leaving MESA to manage the project. The emphasis of the project was changed from the original RECON idea of concentrating on the radiometric survey to carrying out an aeromagnetic survey over a relatively small area to test the effectiveness of the method in petroleum exploration. A test area adjacent to the Victorian border was agreed upon and the joint venturers from the three exploration licences agreed to contribute to the survey which was flown in 1993. Sediment thickness from a composite regional seismic line and magnetic susceptibilities from petroleum well-cores and basaltic outcrops were used to model magnetic responses. The volcanic vents at Mount Gambier and Mount Schank were modelled as well as a blind plug to the north near the Hungerford-1 well. The Total Magnetic Intensity was pseudo-depth sliced using frequency increments into four slices in the sedimentary section and a fifth basement slice. Pseudo-depth slices were compared to MESA seismic depth structure mapping from top Cretaceous to top Basement (fault patterns were compared to magnetic lineaments).

A sidescan radar image was used to identify surface `culture' (railway lines, sheds, towns etc) that cause high frequency anomalies in the Total Magnetic Intensity data (Appendix 6). A map of the powerline grid in the area was obtained from the Electricity Trust of South Australia (ETSA) (Fig. 27). The grid was digitised and displayed at the same scale as the aeromagnetic data to identify powerline cultural anomalies.

CHARACTERISTICS OF MAGNETIC DATA

In this area of the Otway Basin the background field strength of total magnetic intensity is approximately 60897 nT, the inclination is -69.5 degrees, and the azimuth is 9.5 degrees east. The dynamic range of the residuals of total magnetic intensity is 545 nT.

The characteristics of the total magnetic intensity field in the survey area are portrayed in the contour map in Figure 10, in the contour map in Figure 28 and in a stacked profile map in Figure 29. The contour map and profile map includes cultural sourced anomalies which can be seen as prominent short wavelength anomalies on a generally smooth background.

Identifying letters have been added to various anomalies to assist with the description of the magnetic field. These letters include A to H, and S and are indicated in Figure 10.

The characteristics of the field can be described in terms of the common wavelength of anomalies seen in Figures 10 and 28, or in terms of the width at half amplitude (commonly referred to as 'Half-width'), which has an approximate relationship to the depth of source below the detector (e.g. width at half amplitude is approximately 2x depth below the sensor).

This report adopts a hybrid of the two terms 'wavelength' and 'Half-width' to describe the observed anomalies.

Long wavelength anomalies (Half-width 15–20 kilometres)

The long wavelength anomalies are indicated by the broad total intensity low and high regions. These anomalies have amplitude from high to low of approximately 400nT and a wavelength of approximately 50–70 kms. With the exception of Anomaly A most of these anomalies extend outside the survey area and are more completely defined in the regional aeromagnetic data portrayed in the 1:2 000 000 scale maps of South Australia.

In the south of the survey area a broad high (A) extends as a distinct low to the south and slopes off to the north, east and west of the survey area.

The source of this dipolar anomaly is typical of anomalies caused by a deep igneous/metamorphic basement source and is interpreted to lie at a depth of approximately 6–10 kms below surface.

Anomalies with Half-width 3–5 kilometres

Anomalies with Half-width 3–5 kms occur in the north of the area near Penola (Anomaly H - Sawpit high), and in the centre of the area north of Mount Gambier (Anomaly G). These anomalies have amplitude in the range 10–25 nT.

The sources of these anomalies are likely to be igneous bodies within igneous metamorphic basements.

Anomalies with Half-width 0.5–1.5 kilometres

Anomalies with Half-width 0.5–1.5 kms occur in the northeast of the area, particularly near Penola. These anomalies are narrow curvilinear have amplitude 1–3 nT and extend up to 10 km with best examples striking northwest–southeast. Circular-elliptical anomalies with this half width range are rare and are recognised as Anomaly E (Mount Schank) and Anomaly F (Hungerford).

Anomalies with Half-width 0.2–0.5 kilometres (Culture)

Power distribution lines shown in Figure 27 are a major disturbing influence on the total magnetic intensity data in this area.

Surface culture in the form of towns, railway lines, power lines, large sheds, fences and well-heads produce high frequency magnetic anomalies in the aeromagnetic data. World Geoscience have produced images of the magnetic data with the culture suppressed. However, the two shallowest pseudo depth slices contain culture from the towns in the survey area as well as an extensive network of culture from the powerline grid. The large interstate interconnection powerline produced a north-south anomaly area near Tarpeena and Nangwarry with a curved feature extending from south of Tarpeena south-east to the Victoria border.

A grid of powerlines north of Penola caused a break-up of northwest–southeast images of fault trends along the northern margin of the Penola Trough. In the Mount Gambier area north–south and east–west lineaments are caused by powerlines with the same orientations and near the coast, more random lineaments coincide with the electricity grid.

The dynamic range of cultural sourced anomalies is assessed as typically 5–100 nT with exceptions up to 200 nT and amplitude and probably ranging down to the noise envelope (0.01 nT).

CHARACTERISTICS OF THE RADIOMETRIC DATA

Introduction - equipment

Gamma spectrometric data were recorded simultaneously with the aeromagnetic data. Equipment included 33 litres of sodium ioide crystal detectors and 256 channel spectrometer recording in the range 0.3 to 3.0 MeV. The data was windowed using Bureau of Mineral Resources (now AGSO) energy ranges. Counts per second were corrected by best practice techniques and converted to equivalent potassium (percent), uranium (ppm) and thorium (ppm).

Total Count

The total count rates recorded in the area lie predominantly in the range 500 to 1500 counts per second. Approximately one third of count rates lie in the range 1500 to 3000 counts per second.

Radiometric data were inspected on 1:100 000 contour presentations and on 1:250 000 processed colour images (Appendix 8). The 1:100 000 data were compared to 1:100 000 topographic maps and 1:250 000 geology maps. The radiometric total count image has an area of high values (2500-3000 cps) in the south of the survey area. Coastal sand and swamp areas have low values but from adjacent to the coast northwards towards Mount Gambier, the values in the area of the Gambier Limestone are high. The northern margin of the anomalously high area is a northwest–southeast trending stranded coastal ridge which extends across the full width of the survey area along the northern margin of the Gambier Limestone outcrop. Northwest–southeast trends are visible in the southern anomaly area where small non-mineralised dunes trend northwest–southeast.

The area centred on Mount Gambier has an intermediate total count value with weak northwest–southeast trends visible. The immediate area around the Mount Gambier city has a relatively low total count and appears to represent a region of volcanic ash deposition around the cones. Further south-southwest, the Mount Schank eruption area shows a very diffuse low total count area.

North of Mount Gambier, the total count image shows an area of low values cut by a number of northwest–southeast trending coastal ridges of the Bridgewater Formation which have relatively high total count values. From Kalangadoo on the western edge of the survey to the north, the trend of radiometric anomaly changes to a northeast–southwest direction with an area of high readings corresponding to an area of Padthaway Formation sediments and swamps. The area of the Katnook, Ladbroke Grove and Haselgrove fields forms a radiometric low embayment into the northeast trending high. Near Penola, the radiometric high anomaly trends north–south and appears to coincide with a low swampy area.

Potassium

Estimated equivalent potassium values lie in the range zero to 0.8 percent, with approximately half between zero and 0.2 percent and half between 0.2 and 0.8 percent (Appendix 8).

The area from the coast northwards towards Mount Gambier is a region of relatively high potassium values. The northwest–southeast coastal ridge south of Mount Gambier is an area of low values but does not produce a strong cut-off zone as occurs in the total count image.

The area around Mount Gambier is deficient in potassium but the Mount Schank area has a small potassium high area. North of Mount Gambier is a generally low potassium region with minor palaeo-dune controlled northwest–southeast linear high potassium features.

From Kalangadoo to the north, a northeast–southwest high potassium trend is dominant with a low count area around the Katnook area gas fields. From Penola north there is a broad north–south area of high potassium extending to the northern edge of the survey area. The northern area retains a weak northwest–southeast pattern similar in direction to the southern survey area. The highest potassium values are from Penola northwards in the area of the Padthaway Formation outcrop.

Thorium

Estimated equivalent thorium values typically lie in the range zero to 6 ppm, with rarer highs up to 8 ppm. Thorium maps appear to give sharper definition of geological character (Appendix 8).

An area of high thorium values occurs in the Gambier Limestone from south of Mount Gambier to the coast. The northern limit of the high values is a definite boundary formed by a long northwest–southeast Bridgewater Formation feature which has a low thorium count along the northern margin of the Gambier Limestone outrcop. The area immediately surrounding Mount Gambier has a low thorium anomaly coinciding to an area of possible volcanic ash deposition. Mount Schank volcanic area has a very poorly defined area of low thorium values. An area northwest of Mount Gambier has high thorium values and to the north of Mount Gambier the northwest–southeast trend is shown by a number of palaeo-dunes which have relatively high thorium content. From Kalangadoo northwards, an area of high thorium content extends northeast–southwest until near Penola where a broad band of high thorium values extend north–south past the northern boundary of the survey area. The area of the Katnook, Ladbroke Grove and Haselgrove gas fields contains low levels of thorium.

Uranium

Estimated equivalent uranium values typically lie in the range zero to 4 ppm, with rare highs to 5 ppm (Appendix 8).

The uranium pattern is similar to the other radiometric elements with an area of higher uranium content from the coast northwards to the northwest–southeast trending palaeo-dune south of Mount Gambier. A number of sub-parallel ridges within the high uranium area produce northwest–southeast areas of low uranium content. Both Mount Gambier and Mount Schank have weak areas of slightly lower uranium content around the volcanic cones.

Several northwest–southeast Bridgewater Formation dunes north of Mount Gambier have slightly elevated uranium content. From Kalangadoo north, trends are northeast–southwest with a large area of Padthaway Formation in the centre-north of relatively high uranium content. The uranium image has more poorly defined areas of high and low values in the northern area of the survey than the other elements. The area of the gas fields around Katnook has a low uranium content.

Ratios of the three estimated radio element concentrates were made using the absolute values of equivalent potassium percent, uranium ppm and thorium ppm. The radiometric maps have low values in the centre and eastern areas (Molineaux Sand and Padthaway Formation), but there is a corresponding high value for all of the ratios (U/K, Th/K, U/Th) in the same areas.

In the northern area of the survey, each element had anomalously high response through the Penola area. In each of the ratio images the corresponding area is low.

In the southern extremity near the coast where the Gambier Limestone outcrops each of the radio elements have a high response with a northwest-southeast margin. In contrast the U/Th has a low value, but the other ratios (U/K and Th/K) show a corresponding high.

SURFACE GEOLOGY

The surface geology in the area of the aeromagnetic/radiometric survey is a major controlling factor on the radiometric data together with distribution of surface water. With the exception of the Mount Gambier and Mount Schank volcanic cones the magnetic response is unaffected by the surface geology.

The oldest outcropping rock unit in the survey area is the Heytesbury Group Gambier Limestone of Late Eocene to Middle Miocene age. This unit consists of a basal limestone and marl member, middle bryozoal limestone that is found to the southeast, south and northwest of Mount Gambier and an upper chert-rich limestone that outcrops along the south coast (figure 14).

In the Middle Miocene a cooler climate resulted in a lower sea level and together with mild uplift produced a break in sedimentation. Latest Miocene and Early Pliocene marine incurious did not affect the survey area.

A major marine transgression in the Early Pleistocene extended as far as the Kanawinka Fault. The Coomandook Formation was deposited and now underlies most of the coastal plains.

The Coomandook Formation is overlain by the Bridgewater Formation a series of stranded coastal ridges composed of calcarenite. The coastal ridges were formed during interglacial periods of high sea level and are the dominant geomorphological features of the area. The oldest ridges are the furtherest from the coast and are designated Lower Bridgewater Formation. Lower Bridgewater ridges occur northeast and west of Penola and to the east and northeast of Mount Gambier. The remainder of the calcarenite ridges, are younger, occur nearer the coast and are known as the Upper Bridgewater Formation (age dating gives ages of the ridges from 870,000 to 100,000 years). West of Penola, the younger ridges converge towards the Mount Burr volcanic complex.

Padthaway Formation sediments were laid down between the Bridgewater Formation ridges. The Pleistocene Padthaway Formation sediments are fine grained and include lacustrine and lagoonal carbonates. The Holocene St Kilda Formation was deposited as lagoonal shelly mud and lacustrine sediments. This unit, together with Holocene peat deposits is found near the coast in the Pt MacDonnell area.

The Molineaux Sand occurs as a sand sheet from north of Mount Gambier extending north-northeast to the south of Penola. The unit ranges in age from late Pleistocene to Holocene and comprises re-worked Bridgewater Formation sandstones.

The younger Holocene volcanics occur at Mount Gambier and Mount Schank. Mount Gambier is a series of explosion craters (maas) formed when molten rock came into contact with groundwater. Lava flows, scoria cones and dykes were also formed. Mount Schank is similar. The eruptions occurred between 5000 and 4000 years ago.

MAGNETIC SUSCEPTIBILITY

Magnetic susceptibility readings in petroleum wells were only obtained from core material (Appendix 3, Fig. 7). A previous study using cuttings and sidewall cores found that steel contamination of cuttings made readings unreliable. Sidewall core data had magnetic susceptibility readings carried out on CSIRO equipment. The problem with these samples was that the material had to be crushed and the correction factor to give a reading equivalent to a solid slab of rock was poorly defined.

Magnetic susceptibility from core material

Magnetic susceptibility measurements were taken from cored intervals in six wells within or adjacent to the area of the P1 aeromagnetic survey. The core material was removed from the MESA core store to reduce possible magnetic background sources and readings were taken using a hand-held magnetic susceptibility meter. The readings were expressed in SI units x 10^{-5}. Wells measured were: Katnook-2, Katnook-3, Penola-1, Caroline-1, Kalangadoo-1, and Mount Salt-1.

The cores measured ranged in age from the Tertiary Gambier Limestone to Pre-Cretaceous meta-sedimentary basement.

All readings obtained from the core data were low, including the `basement' cores of meta-sediments in Kalangadoo-1. Readings were usually taken at 1–2 foot intervals along the core. Values of magnetic $^{-5}$ SI units.

Magnetic susceptibility from outcrop

Chatfield 1992 took a series of ground magnetic susceptibility readings in the Quarternary-Recent basic volcanic province in the south-east of the State (Appendix 4). The area of magnetic susceptibility readings extended from Mount Graham near Millicent to Mount Schank, south of Mount Gambier. The readings which are relevant to the P1 aeromagnetic survey are at Mount Gambier and Mount Schank.

In the Mount Gambier volcanic cone area, 5 sites were investigated (Chatfield, 1992) and values for a number of igneous rock types at each site were measured. Values recorded ranged from 0–8000 x 10^{-5} SI units. Sites 1 and 2 adjacent to the Blue Lake and Valley Lake had the highest readings and highest average readings. Ash, unsorted tephra, massive and vesicular basalt, ropey lava, splatter, tuff and scoria all had high magnetic susceptibility values.

At Mount Schank, three sites were measured for magnetic susceptibility. The sites were all in area of volcanic ash away from the basalt lava flows. Magnetic susceptibility values varied form 150–4,500 x 10^{-5} SI units. The highest values were found to the west and north-west of the main crater. Rock types reported were scoria, fresh and weathered, finely laminated tuff and tephra. For the location of readings see Figure 6 and Figure 8 for values.

MAGNETO-STRATIGRAPHY

Formations

Magnetic susceptibility reading for various formations are summarised in histogram form in Figure 7. There is no information on magnetic remanence.

Basement of pre-Early Cretaceous age was intersected in two wells in the survey area, Kalangadoo-1 and Sawpit-1. Magnetic susceptibility readings were obtained from a number of cores in Kalangadoo-1. Values ranged from 11–26 x 10^{-5} SI units.

The Early Cretaceous Pretty Hill Formation was cored in the Katnook-2 and -3 gas wells. Magnetic susceptibility values range from 7–20 x 10^{-5} SI units.

Stratigraphically above the Pretty Hill Formation are the Laira Formation and the Katnook Sandstone. Measurements were taken on 3 cores of the Laira Formation in Kalangadoo-1 and Penola-1. Values range from 8–30 x 10^{-5} SI units.

The Eumeralla Formation, one of the most uniform mineralogical units in the Otway Basin, is the uppermost unit of the Early Cretaceous. Core measurements were recorded in Katnook-2, Penola-1, Caroline-1 and Kalangadoo-1. Values of magnetic susceptibility have the greatest range and highest maximum value for any formation measured from drill-core. Magnetic susceptibility is in range 8–90 x 10^{-5} SI units.

The Late Cretaceous Sherbrook Group contains a number of units, one of which, the Timboon Sandstone may extend from top Early Cretaceous to base Tertiary where the Sherbrook is condensed. Magnetic susceptibility measurements were taken on core from the Timboon Sandstone in Caroline-1 and Mount Salt-1. Values ranged from 5–18 x 10^{-5} SI units.

The Paaratte Formation also of Late Cretaceous age was measured in Caroline-1 and Mount Salt-1. Values range from 4–19 x 10^{-5} SI units.

The Dilwyn Formation from the Paleocene-Eocene in Mount Salt-1 had magnetic susceptibility measured. Values ranged from 4–11 x 10^{-5} SI units. Another Early Tertiary unit, the Pember Mudstone was measured in Caroline-1 and had values in the range 7–18 x 10^{-5} SI units.

The youngest unit measured was the Oligocene-Miocene Gambier Limestone in Caroline-1. Values were very low, in the range 1–6 x 10^{-5} SI units.

The discussion above uses raw uncorrected magnetic susceptibility readings. In order to correct for the influence of limited core size and bring readings to an effective infinite surface, all should be multiplied by approximately 1.7.

Rock types

Basaltic Volcanics

Outcrop material of Holocene age at Mount Gambier and Mount Schank contain rocks with the highest magnetic susceptibility measured in the survey area. The range of values is greatest at Mount Gambier, where ash, tephra basalt in various forms, tuffs and scoria have magnetic susceptibility values in the range 0–8,000 x 10^{-5} SI units. The results of ground magnetic susceptibility measurements are shown in Figure 8.

Mount Gambier

Lithology	Range	Mean	SD	Number of Samples
Ash	900–8,000 x 10^{-5} SI units.	2480	1605	5
Tephra	1,000–8,000 x 10^{-5} SI units.	432	514	198
Basalt	5–3,000 x 10^{-5} SI units.	1125	758	159
Tuff	4–3,000 x 10^{-5} SI units.	4867	2393	33
Scoria	500–4,000 x 10^{-5} SI units.	1333	1319	6

Mount Schank

At Mount Schank, the total range of values is from 150–4500 x 10^{-5} SI units.

Lithology	Range	Mean	SD	Number of Samples
Tephra	300–2,500 x 10^{-5} SI units.	1373	617	12
Scoria	200–4,500 x 10^{-5} SI units.	946	826	36
Tuff	150–1,000 x 10^{-5} SI units.	446	286	13

Sandstones

Magnetic susceptibility readings were obtained for sandstones from the pre-Cretaceous (turbidite) basement to the Tertiary Pember Mudstone. All sandstone readings were low. Basement readings were 11-26 and the Eumeralla readings were 8–45 x 10^{-5} SI units. The sandstone values for these two units were the highest of all formations. The Late Cretaceous Timboon Formation sands contained some exotic minerals such as glauconite, pyrite limestone and hermatite, but the magnetic susceptibility values remained low in the 5–18 x 10^{-5} SI units range. The range for all sandstones was 4–45 x 10^{-5} SI units.

Shale, claystone, mudstone

The three rock-types have been added together because the group collectively refer to very fine grained rocks with an indefinite mixture of clay, silt and mudstone particles. Shales, mudstones and claystones are often interbedded with siltstones and in some formations, the shales tend to be carbonaceous. Magnetic susceptibilities for the argillaceous group of rock types is 3–30 x 10^{-5} SI units.

Siltstones

Siltstones were cored in a limited number of formations. Values ranged from 8–90 x 10^{-5} SI units. The maximum value of 90 x 10^{-5} SI units was found in the Eumeralla Formation, where the siltstone was interbedded with sandstone and contained grey/green lithics.

Limestone

Gambier Limestone was measured for magnetic susceptibility only in the Caroline-1 well. Readings were extremely low with a range of 1–6 x 10^{-5} SI units.

COMPUTER MODELLING OF MAGNETIC DATA

Data and Methods

The location of all models and depth estimates are shown in Fig. 26 . Results of the modelling of individual anomalies are presented fully in Appendix 5. Selected examples are shown in the text in Figs 15-18. All models are summarised in Table 1 of Appendix 5.

The modelling package 'Potent' licensed to Preview Resources Pty Ltd by PC Potentials Ltd of PO Box 167, Kippax, ACT 2615 was used to model the aeromagnetic data. This software uses 2-D, 21/2D and 3-D body shapes and adopted susceptibilities which can be readily modified in a forward modelling mode to obtain a visual fit to total magnetic intensity data and in an inversion mode to fit mathematical criteria. This software allows use of the induced magnetic field combined with magnetic susceptibility to calculate responses, or use of remanent magnetisation in any chosen direction, or if required both influences acting together.

Theoretical responses were calculated to simulate the 60 metre above ground level observation altitude used by the airborne survey, or other altitudes as appropriate. From two kms north of the coast to the southern edge of the survey over water, the clearance was 120 m above ground level and sea level respectively.

The data used for modelling was the levelled location data for Total Magnetic Intensity. Lines were subsampled to 0.5 seconds from the original 0.1 second samples, giving an along the ground sampling of approximately 30 m between observations.

Models from shallow sourced anomalies associated with culture

Numerous distinctive anomalies with short wavelength were found to overlie high tension power lines, buildings and some fence lines (possibly electric fences) and in our interpretation of this area these features were avoided.

However, some models were run to assist in characterising these features, and to help in distinguishing them from geology.

One model was almost typical of other interpreted geological sources, with depth of 230 m and more than 2000 m of strike extent (Anomaly S3N, Appendix 5). Another indicated unusually shallow sources, at 25 m depth, more consistent with the above ground geometry of buildings or power lines (Anomaly S6, Appendix 5).

Both models are included here to illustrate the distinctive characteristics of power line anomalies on the one hand and the ambiguity with geology on the other.

It is concluded that the removal of cultural features from the aeromagnetic data, on the basis of short wavelength is likely to be ambiguous.

Models from shallow sourced anomalies which are narrow curvilinear (S1–S13)

Models were run for narrow curvilinear anomalies S1, S2, S3, S4, S12 and S14 to S13. These anomalies have amplitude in the range 0.5 nT. 3-D prisms were used, mostly with vertical dip (Appendix 5).

The prisms were given characteristics as follows:

dip:	vertical
width across top:	mostly 60–200 m
depth to top:	20–700 m
susceptibility:	0.001–0.003 SI
remanence:	0.02–0.37 Amps/m
depth extent:	mostly 200–1000 m

The narrower of these models have the appearance of thin steeply dipping fault planes although it must be pointed out that the ambiguities in potential field models do not exclude the magnetised relict dunes as a source of some of the anomalies.

Models from shallow sourced anomalies associated with faults (Group of Anomalies S4)

A suite of models using thin rectangular prisms, were run to generate anomalies which would simulate the fault planes as a magnetic source in the area some six kms east of Wynn No 1. The fault planes in the area east of Penola were modelled where there is prominent narrow curvilinear aeromagnetic response (Appendix 5). Faults identified in Hartogen Energy's north–south seismic line 90–414 (approximately 495000 mE), were used and the results are shown in Appendix 5. The model results are plotted on the seismic section in Figure 30.
Most of the faults mapped in the seismic line 90–414 reach the surface, others just penetrate above the Top Eumeralla. The seismic interpretation indicates most of the faults dip southwards, and a few northwards.

The fault prisms were given characteristics as follows:

- dip to lie in the fault plane (apparent dip is mapped as approx 50 degrees, actual 60–80 degrees) thickness of 50 m
- depth to top found by trial and error (lie in the range 200–400m below surface)- Sherbrook/Eumeralla
- susceptibility or remancence to suit each anomaly
- depth extent (down dip) limited to lie within Eumeralla (200–1000 m).

The results of the modelling show a good fit of the calculated to the observed data, with some faults requiring susceptibility and others requiring remanence. It is concluded that the 1–2 nT narrow curvilinear anomalies are caused by magnetic material in faults. It is inferred that there is magnetic material in the fault planes; this may be pyrrhotite, magnetite or hematite, with variable properties. We note that all faults are not magnetised to the same extent. We speculate that the variable properties may indicate different movement and chemical history, locking in the earths field direction, and introducing magnetic minerals at different times.

Models for sedimentary layers

A model was constructed which used seismic interpretation from several lines which with a number of bends and extended from the northeast corner of the survey to the southwest (Fig. 4). The profile was projected onto a single straight north–south line for the purpose of testing the response of the section. Note that the seismic mapping of the deeper layers is incomplete and for the purpose of this study were simply assumed to stop at a vertical fault where the mapping ended in the south (Fig. 11).

Three horizons were digitised to represent top Basement, top Crayfish and top Eumeralla (Figs 21, 22, 23). Some typically low susceptibilities for sediments were adopted for the layers.

This allowed for a simple magnetic model of intervals as follows:

INTERVAL	ADOPTED SUSCEPTIBILITY
Surface to top Eumeralla Formation	0.00006 SI
Top Eumeralla to top Crayfish Formation	0.0005 SI
Top Crayfish to igneous/metamorphic basement	0.0003 SI
Igneous/metamorphic basement to 15km (arbitrary limit)	nil

The resultant amplitude of total magnetic intensity response for the sediments was less than 5 nT. It is concluded from the models that the sediments do not contribute significantly to the anomalies in this area as shown by the low magnetic susceptibility found in drillcores of sediments. Moreover, in the absence of magnetic volcanics in the drillholes in this area, it appears unlikely from the magnetic survey results that there are any surprises within the sedimentary section.

Models for a uniformly magnetised basement

A model was then constructed which was essentially the same as the sediment layer model above, but now had a uniformly magnetised basement with an adopted high, but not unreasonable susceptibility as indicated below (Fig. 11). Magnetic susceptibility of the sediments assumed to be nil.

INTERVAL	ADOPTED SUSCEPTIBILITY
Surface to top Eumeralla Formation	0.00 SI nil
Top Eumeralla to top Crayfish Formation	0.00 SI nil
Top Crayfish to igneous/metamorphic basement	0.00 SI nil
Igneous/metamorphic basement to 15km (arbitrary limit)	0.001SI

This model assumes that the base of sediments mapped by the seismic method is coincident with igneous and metamorphic basement. This is based on limited well data.

The resultant amplitude of total magnetic intensity response for the variations in depth of the uniformly magnetised basement was approximately 12 nT near AMG 5840 000 N. Further south the basement is too deep to be recognised in seismic mapping and there is consequently no valid magnetic model possible.

This 12 nT amplitude is significantly less than at the 400 nT amplitude long wavelength anomaly indicated in the aeromagnetic data. We conclude that this large anomaly is not attributable to undulations in the basement but rather is caused by intrabasement magnetic rocks.

Models for non uniformly magnetised basement

Long wavelength anomaly near Mount Gambier (Anomaly A)

This circular/elliptical shaped anomaly is the dominant feature of the aeromagnetic survey, with amplitude of 420 nT and half width of 15 kms (Fig. 10). Models tested here included a simple ellipsoid (poor fit), an assembly of rectangular prisms (poor fit), an elliptical shaped cylinder (poor fit) and a 3-D polygonal prism (good fit - Appendix 5 and Fig. 15).

The most successful shape is the 3-D polygonal prism. Initially work was undertaken with the constraint of 0.02SI for magnetic susceptibility, near the upper end of the Mount Gambier basalts values, on the assumption that the anomaly may be indicating a huge chamber from which the Mount Gambier basalts were derived.

It was found that a significantly higher value in the range of 0.05–0.08 was easier to work with, and 0.05SI was finally adopted.

The modelling generated a large body some 15km across which extends 40km north–south, with general depth in the range 5–8 kms, and generally dipping down to the north and south. These depth estimates are likely to be the maximum depth to igneous basement in this part of the Otway Basin.

A couple of thin spikes off either end of the body were required to improve the fit; these may indicate apophyses.

A deep wedge was required to be incised across the body; this may be indicative of one or more basement faults bearing 105–285 degrees, two and six kms south of Mount Gambier.

Long wavelength anomalies near Penola (Anomaly H)

The pair of elliptical shaped anomalies near Penola named the Sawpit/Penola magnetic high were modelled with an assemblage group of rectangular prisms as follows:

Dimensions:	largest	7100 m x 4100 m x 1000 m
	smallest	1800 m x 1500 m x 300 m
Depth below sea level:		2540–2670 m generally (710 m for one small block, possibly an artifact of the modelling procedure, and not a reliable depth.)
Remanence:		0.090–1.32 Amps/m

The resultant fit was classified as poor to OK, largely because of the complexity of modelling this kind of situation of interfering anomalies (Appendix 5).

Long wavelength anomalies near Hungerford (Anomaly F)

This Circular/elliptical to elongate shaped anomaly is the dominant feature in the northwest of the survey area, with amplitude of 60 nT and halfwidth of 5 kms. The eastern side is a near linear northsouth striking gradient, indicative of a fault or contact.

Models tested here include simple rectangular blocks (OK fit) and an assembly of ellipsoidal shaped cylinders (OK fit).

The modelling generated sources with depths in the range 2486–2557m (Appendix 5). A magnetic susceptibility of 0.01 SI was applied. These depth estimates are consistent with the depth to igneous metamorphic basement indicated by drilling in Tilbooroo-1 and Sawpit-1 in this area.

The physical properties for Anomaly F differ from those for the Hungerford Anomaly E which is inferred to be intrusive.

Models for intrusives and extrusives

Mount Gambier (Anomaly B)

A group of rectangular prisms and a cylinder were assembled to account for the magnetic anomaly over Mount Gambier (Appendix 5 and Fig. 16). Their characteristics were:

Dimensions prisms:	largest 300 m x 900 m x 1500 m smallest 300 m x 300 m x 1000 m
Depth below ground level:	60–290 m
Susceptibility:	0.005–0.02 SI
Dimensions cylinder:	300 x 900 m
Depth below ground level:	120 m
Susceptibility:	0.03 SI

The depths below ground level are surprisingly high in view of the fact that the basalts are significantly magnetic at the surface (Fig. 16). This is caused by the fact that the aircraft flew higher than the survey height of 60 m above the Mount Gambier township, as required by regulations.

The magnetic susceptibility required to readily achieve a fit to the observed data was commonly at the upper end of the susceptibilities measured on basalt rock samples in this area (typical range 0.01–0.02SI). This may mean that the basalt is more magnetic at depth, than at the surface.

Mount Schank (Anomaly C)

A group of rectangular prisms were assembled to account for the magnetic anomaly over Mount Schank (Fig. 17). Their characteristics were:

Dimensions:	200–400 m x 200 m x 500 m depth extent
Depth below ground level:	36–42 m - essentially at the surface
Susceptibility:	0.01–0.03 SI

Hungerford (Anomaly E)

A pair of rectangular prisms were assembled to account for the magnetic anomaly near Hungerford (Fig. 18). The characteristics were:

Dimensions:	530 m x 1000 m x 420 m depth extent
Depth below ground level:	260–270 m
Remanence:	0.2–0.35 Amps/m

It is unlikely that the source of this anomaly will be found on the surface. Perhaps this anomaly is caused by a blind basalt plug. Alternatively, because of the confined nature of the anomaly, a carbonatitic or sulphide/magnetite basemetals vein is possible.

DEPTH TO BASEMENT INTERPRETATION

Two methods of depth to basement estimation were applied to the Otway Basin aeromagnetic data, namely forward modelling of specific anomalies and Euler deconvolution over the whole area. Both methods are accurate to ± 10% of true depth for ideally shaped magnetic anomalies.

The forward 3-D modelling was undertaken on profile data by David H Tucker of Preview Resources Pty Ltd, using software POTENT (Appendix 5) while the 3-D Euler deconvolution was undertaken on gridded data by Duncan R Cowan of Cowan Geodata Services, using proprietary software. (Appendix 7).

A summary of the depth to magnetic bodies from forward modelling is given in Figure 26.

Application of Euler Deconvolution was made with a 9 point window and a 16 point window on a 135 metre mesh. Results should be used with some caution. Results are dominated by east–west and west-northwest striking shallow sources commonly in the depth range 0–500 m and 500–1000 m below ground level, being shallower in the north of the area and deeper in the south (Appendix 7).

Results are also indicative of depths to the sources of longer wavelength anomalies. For example, in the vicinity of the Penola magnetic high, maximum depths lie in the range 1500–2000 m (some 500 m less than indicated in Sawpit No 1 where basement meta basalt was reached at 2500 m). In the vicinity of the Hungerford Anomaly, maximum depth estimates of 400–600 m to this inferred igneous plug were obtained. A second set of maximum estimates at this vicinity lie in the range 3000–4000 m. These are considered indicative of the depth to the source of the longer wavelength background to the Hungerford Anomaly.

In the vicinity of the Mount Gambier anomaly, numerous depth estimates lie in the range 1000–3000 m. These are substantially less than the maximum depths indicated by seismic surveys, and are not considered reliable. A lesser number of significantly deeper estimates lie in the range 4000–6000 m, and are at the minimum of the probable depth to this particular body (A).

The forward modelling approach gave depth estimates in the range 20–600 m below surface for various narrow curvilinear type sources, believed to originate within the sedimentary section. We do not infer that the sedimentary section is significantly magnetic, but rather that fault fillings are magnetic. In the vicinity of the Penola high, depth estimates lie in the range 2000–2500 m, comparable with the depth to basement in Sawpit-1.

In the vicinity of the Hungerford Anomaly (F), depth estimates to the plug like source lie in the range 200–400 m.

The Mount Gambier anomaly (A) has depth estimates of 5000–8000 m, considered reliable for this particular body.

PSEUDO-DEPTH-SLICING

Basis of the method

The basis of Pseudo-depth-slicing lies in the application of potential field frequency spectra to estimate depth to source bodies. The use of spectra for this purpose is discussed in the literature and is commonly used by interpreters to gain a regional summary of source depths.

The details of the WGCL's Pseudo-depth-slicing technique are proprietary information and have not been released for this survey.

WGC's procedure of Pseudo-depth-slicing followed is likely to go along the following lines. The aeromagnetic profile data are manually smoothed to remove culture effects. Data are then gridded and reduced to the pole (grid interval one third of line spacing). The power spectrum of the gridded aeromagnetic data is generated. Portions of the spectrum which exhibit linearity (and therefore are likely to have associated source depths) are then used to construct matched filters. These have been described as band pass filters – we will use the term matched filters. Each matched filter is then applied to the data to generate a grid of 'Pseudo-depth-sliced' data. The grids are used to generate contour maps and pixel maps (contour intervals generally are small – typically 0.1 nT).

Selection of the appropriate Pseudo-depth-slices is a trial and error technique which benefits from proprietary experience.

WGCL advise that the sum of the Pseudo-depth-slices closely matches the original reduced to pole total intensity data.

Pseudo-depth-slices generated in P1

A single attempt at Pseudo-depth-slicing was made by World Geoscience and a five slice set was adopted.

Pseudo-depth-slice 1

This image contains prominent parallel narrow curvi-linear anomalies striking at 300^{o} in the northeast of the survey area (near Penola). There is a strong overprint of short east–west elongated anomalies over most of the survey. There is also a north–south trend through the centre of the area, a number of small circular features and a number of slightly curved east–west features between Mount Gambier and Tarpeena. With the exception of the 300^{0} linears the remainder of the anomalies are thought to be caused by surface culture'. (Towns, powerlines, roads, railway lines and buildings – a surface utilities map is included as Figure 27). Offshore, the strong shortwave length overprint is absent, amplitude is significantly reduced and there is a weak east–west and 300^{0} texture (the processed image contains clearer trends than the contour map). Further processing of the offshore data may enhance magnetic trends.

Onshore there is a large, background magnetic high area centred at Mount Gambier with a radius of approximately 10 km. The cones at Mount Gambier and Mount Schank show as poorly defined annular features (5 km and 3 km diameter respectively). A smaller feature (2km diameter) is located near Hungerford.

The near surface expression of the upthrown basement block north of the Kanawinka Fault has high amplitude features and is located in the extreme northeast corner of the survey.

Prominent circular magnetic high features are caused by the Tarpeena Sawmill and the Nangwarry and Penola townships.

Pseudo-depth-slice 2

The 300^o curvi-linear anomalies are prominent in the northeast. In addition, a scattered number are now noticeable from south of Mount Gambier to Penola in the north. There is also a linear direction of 310^o south of Mount Gambier.

The north–south feature through the centre of the survey is still present but is less continuous. The large Mount Gambier magnetic high is better defined and the volcanic plugs at Mount Gambier and Mount Schank are very well defined as is the Hungerford anomaly.

Anomalies over the towns are still present but with less definition. Northeast of Penola, longer wavelength magnetic highs are emerging (Penola high). A regional high along the western edge of the survey, north of Hungerford, is noticeable. The southern area of the Penola High is criss-crossed with linear anomalies with 320^o and 40^o strike directions.

Pseudo-depth-slice 3

Most short wavelengths have disappeared. The Mount Gambier High is very clearly defined and the Mount Gambier cones are represented as a small circular feature on the western flank of the main anomaly. The Mount Schank and Hungerford anomalies are more subdued. A magnetic low south of Mount Gambier and centred on the coast is evident and may be associated with the high.

A short wavelength overprint is present south of Mount Gambier with a strike of 310^o. The curvi-linear features southeast of Penola (300^o strike) are still present but weaker. The Penola High is very clear, dumb-bell shaped with peaks 6km apart. It lies within a large magnetic low that occupies the northern third of the survey area and contains the Penola Trough.

A magnetic high anomaly (approx. 7km long) is located south of Tarpeena with a strike of 300^o. The anomaly coincides with the upthrown block of the Kalangadoo High and marks the southern margin of the Penola Trough.

The magnetic high along the northwest edge of the survey area is now quite prominent and includes the Hungerford blind plug.

Pseudo-depth-slice 4

The contours and processed image are characterised by large smooth anomalies. The Mount Gambier and Mount Schank cone anomalies have disappeared as has the Hungerford plug. The large Mount Gambier High is very well defined. The Penola High is more subdued and the northern magnetic low still has the Tarpeena anomaly along the southern boundary.

Pseudo-depth-slice 5 (Pseudo-Basement Slice)

The image is dominated by the Mount Gambier high and the regional northern low. On the northwest side, the western high is still prominent. All shallow features have disappeared and only a hint of the Penola High remains.

SEISMIC MAPPING

MESA employed a consultant geophysicist to map the South Australia area of the onshore Otway Basin using existing open file company seismic data. The mapping exercise was designed to produce a consistent series of maps of structural horizons which are important in understanding the structural evolution of the basin and which would be useful for future company exploration in the area. Seismic mapping in the various licences by different operators was inconsistent in the horizons mapped and the area of mapping was patchy.

Horizons mapped were the Top Sherbrook Group (Top Cretaceous - Base Tertiary), Top Eumerella Formation (Early Cretaceous - Late Cretaceous unconformity), Top Crayfish Group (intra Early Cretaceous unconformity) and Top Basement.

Two way time values were picked, tied to available wells and digitised. Time values were hand contoured for each horizon. The time map was digitised and data were converted to depth using a regional grid of seismically derived stacking velocities to each mapped horizon. Digital depth data was gridded and recontoured using Petroseis software. Contour images of each of the four horizons were extracted from Petroseis at a scale of 1:100,000.

COMPARISON OF SEISMIC STRUCTURE MAPPING AND PSEUDO-DEPTH SLICED MAGNETICS

Mapped Formation Tops

Structure on Top Sherbrook (Base Tertiary) compared to Depth Slice 2.

Mount Schank lies near a fault system trending west-northwest–east-southeast down thrown to the south. Depth to Top Sherbrook is 1100–1200 m in the area of the faults and aeromagnetic lineaments and the faults are parallel.

North of Mount Gambier faults which are approximately east–west correspond to magnetic lineaments. The Kalangadoo Structural High is a northwest–southeast trending basement high bounded on the north side by a down to the north fault. The bounding fault is sub-parallel to a number of magnetic lineaments. Other magnetic features appear to terminate at the Kalangadoo Fault.

Southwest of the Katnook Field, two northwest–southeast faults correspond to magnetic lineaments. In the Laira-Zema area a number of faults are sub-parallel to the magnetic elements with a secondary cross-cutting magnetic pattern.

At Katnook, there are minor parallel east–west faults and near Penola 1, faults and magnetic lineaments are sub-parallel. In the north of the magnetic survey area, the magnetic trend is east–west.

Structure of Top Eumeralla compared to Depth Slice 2.

South of Mount Gambier faults and magnetic lineaments are sub-parallel. The Tartwaup Fault is mapped in close proximity to a powerline and it is difficult to determine if the magnetic lineaments are due to structure or culture.

In an area close to and north of Mount Gambier west-northwest trending faults have nearby sub-parallel magnetic lineaments. The Kalangadoo Fault (down to the north) is sub-parallel to a number of magnetic lineaments. The Laira-Zema area in the northwest of the survey has more northwest–southeast faults than the shallower horizon and there is an east–west magnetic trend which cross-cuts the fault direction and extends eastwards to Katnook where east–west faults are mapped.

In the Penola area there is a close correspondence between northwest–southeast faults and magnetic lineaments. In the far north of the survey, east–west magnetic lineaments cross-cut the mapped northwest–southeast faults.

Structure of Top Eumeralla compared to Depth Slice 3

South of Mount Gambier the seismic faults are approximately east–west but the magnetic lineaments are cross-cutting in a north-northwest–south-southeast direction.

Immediately north of Mount Gambier there are a small number of magnetic lineaments parallel to seismically defined faults. The Kalangadoo Fault and magnetic trends are parallel in a broad band. There are a few east–west cross-cutting magnetic trends north of the fault.

In the Laira-Zema area there are only a couple of magnetic lineaments parallel to the fault pattern.

Immediately north of Katnook a number of east–west magnetic trends and faults are parallel. To the southwest and east of Katnook there is good agreement between faults and magnetic lineaments. In the eastern area there appears to be an east–west magnetic direction cross-cutting some faults.

Structure of Top Crayfish compared to Depth Slice 3

There has been no mapping south of Mount Gambier because of the poor quality of the deep seismic data. North of Mount Gambier the magnetic response and faults are parallel. The Kalangadoo Fault has mainly sub parallel magnetic lineaments. East and northeast of Katnook northwest–southeast faults parallel linear magnetic anomalies. There is an east–west cross-cutting magnetic trend present as well. In the Penola area cross-cutting faults and magnetic anomalies are present.

Structure on Top Crayfish compared to Depth Slice 4

Magnetic anomaly G is located south of and parallel to the Kalangadoo Fault. The anomaly is associated with the Kalangadoo basement high. Southwest of Katnook are a few parallel magnetic anomalies and faults down thrown to the north, northeast of Katnook are a few cross-cutting faults and magnetic anomalies.

The Penola-Sawpit anomaly is circular and faults that cross the anomaly don't disrupt the shape of the anomaly. The magnetic anomaly is independent of the fault displacement. Anomaly F in the northwest corner has north–south magnetic lineaments cutting across northwest–southeast faults.

Structure of Top of Basement compared to Depth Slice 4

Anomaly G is parallel to the Kalangadoo Fault and immediately south of the fault location. Anomaly I is on the north side of the Kalangadoo Fault and is bounded by minor faults. Southwest of Katnook, faults are subparallel to a few magnetic elements. North of Katnook there are a number of east–west magnetic anomalies which the faults cut across. East of Katnook there are a number of magnetic lineaments parallel to mapped faults with an additional set of cross-cutting east–west lineaments.

The Penola anomaly shows no displacement of mapped cross cutting faults.

Structure on Top of Basement compared with basement magnetics

Anomaly G is parallel to the Kalangadoo Fault. An intrusion on the western end of the Kalanadoo Fault at Hungerford is Anomaly E.

The Penola anomaly has minor magnetic lineaments parallel to mapped basement faults. The north and south ends of the anomaly are bounded by faults.

Penola 3-D seismic survey

Lineaments within the aeromagnetic data were compared with structures in the Penola 3-D Seismic Survey using Pseudo-depth-slice 2 and Top Eumeralla and structure on Top of Basement (Figure 24).

The magnetic data was on grey scaled second vertical derivative of Pseudo-depth-slice 2, especially produced by World Geoscience Corporation to enhance narrow curvilinear and linear cross cutting features. We have ignored possible residual cultural features.

Lineaments mapped include highs, lows and linear cross cutting features. Strike directions are dominantly west-northwest, east-west and north-northeast.

Pseudo-depth slice 2 lineaments east of Penola appear to closely match fault patterns mapped using seismic at the structure on top of basement. As the pseudo-depth slice 2 is presumed to represent shallow features in the sedimentary section, it is concluded that the faults are near vertical (normal horst and graben type) and extend somewhat higher in the section than currently mapped on seismic.

Depth to magnetic source

The Mount Gambier magma chamber has been modelled with a depth estimate of 5000–8000 m. The seismic structure mapping on Top Basement Structure is not known at Mount Gambier.

The Mount Gambier volcanic cone complex has plug depths of between 120 and 220 m. The plug images are best developed on pseudo-depth slices 2 and 3. North of Mount Gambier and 10–15 km southeast of Kalangadoo is a northeast–southwest trending magnetic anomaly which appears to be produced from a depth of 3360 m at its southern extremity and dips to the northeast at 28°. The anomaly is best defined on the basement pseudo-depth slice.

Along the western margin of the survey a large north–south magnetic anomaly is developed with the anomaly's eastern edge modelled at 2500 m depth. A blind plug at the Hungerford well location on top of and associated with the deep north–south anomaly is modelled at 260–270 m and is best seen on pseudo slices 1 and 2 with a poorer image on slice 3. There is no depth estimate from seismic on the plug.

Northwest–southeast linear features between Laira-Zema and Katnook are estimated to be at 250 m and 270 m and are seen on slices 2 and 3.

Small northwest–southeast anomalies in the northwest extremity of the survey are estimated to be at 450 m and are best seen on slices 2 and 3.

The plugs associated with Mount Schank are modelled at 35 m. Along the northeast corner of the survey a series of parallel northwest–southeast anomalies associated with parallel faults with down to the south throws have depth sources of 220, 500 and 760 m from north to south. The anomalies are associated with the fault planes. The depth estimates all lie within the Eumeralla Formation and may be due to mildly magnetic mineralisation possibly associated with Tertiary movement.

Anomaly G north of Mount Gambier has a southern margin defined by the Kalangadoo basement high. The source of the anomaly lies south of the down to the north fault within the basement and dips to the north.

RECOMMENDATIONS

- The remainder of the onshore and offshore SA Otway Basin should be flown and aeromagnetic/radiometric data recorded at 400 metre line spacing. Following the P1 survey a joint AGSO/MESA aeromagnetic survey has covered a small offshore area of the basin adjacent to the Victorian border and MESA have flown a minerals aeromagnetic survey covering the northern basin margin as part of the 1995 South Australian Exploration Initiative. AGSO should be approached to see if they are interested in completing the aeromagnetic coverage of the SA Otway Basin.

- Use the mineral exploration survey data to map the northern boundary of the basin. The seismic coverage in the northern area is quite widely spaced and the aeromagnetic results will help in the mapping of potential stratigraphic traps along the basin margin.

- Attempt to minimise the effects of surface 'culture' by reprocessing the acquired data then undertake further pseudo-depth slicing. If further surveying is undertaken try to minimise the culture effects through the equipment used and additional processing techniques.

- When the remainder of the basin is covered by aeromagnetic surveys attempt to map faulted structures within the sediments of the Penola Trough as per the area southeast of Penola.

- Further evaluate a break in structural continuity which occurs in the aeromagnetic data west of the Sawpit high and west of Tarpeena and follows a line 20° east of north.

- Map basement structures and volcanic occurrences and in particular, define the Hungerford plug. Volcanic bodies may control the distribution of CO_2 in the gas fields.

- Radiometric data require further processing and analysis. Investigate the occurrence of a number of gas fields in an area of low radiometric response.

- The southern area has minimal structure interpretation of basement and lower Cretaceous horizons because of the poor quality of the seismic data. Reprocessing of the available seismic may provide improved definition (Basement from aeromagnetic modelling is thought to be at 6–8 km).

  Offshore magnetic data (no surface culture effects) could be further processed to enhance structural features especially over the three nautical mile strip which contains little seismic data.

CONCLUSIONS

The Residual Total Magnetic Intensity Reduced To the Pole contour display is dominated by an elliptical high feature in the Mount Gambier area with magnetically low areas to the north and south. The Mount Gambier high appears to be a large magma chamber (15 km across) located at a depth of 5–8 kms with the Mount Gambier and Mount Schank cones as small subsidiary anomalies. The Penola Trough north of Mount Gambier is poorly defined along the southern margin where the Kalangadoo high is not as continuous as mapped by seismic. The northern margin of the Trough is defined by the Kanawinka basement fault and the northwest–southeast fault trend within the Trough is evident in the magnetic data.

Structure within the sedimentary section is best observed in pseudo-depth slice images 2, 3 and 4. Of particular interest are northwest–southeast faulted structures within the Penola Trough and a cross faulting pattern over the Sawpit High near Penola. South of Mount Gambier, curvilinear northwest–southeast features similar to those near Penola are seen in pseudo-depth slices 2, 3 and 4. Seismic mapping in the area shows a more east–west orientation of faults which are mappable in the Tertiary and Late Cretaceous. The seismic quality is too poor to map Early Cretaceous and basement which could contain the source of the northwest–southeast curvilinear features.

There is a major problem in the Otway Basin area with surface culture. The magnetic data used in the pseudo-slicing exercise contains magnetic effects from powerlines, railways and towns which has not been adequately removed and which remain visible in slices 2 and 3.

Further processing of the magnetic data is required to give a clearer interpretation of the effects of the geology. Narrow curvilinear magnetic features in the Penola Trough are interpreted to be faults containing magnetic material which is confined to the depth interval of the Eumeralla Formation. Offshore, there is no surface culture and the magnetic response on pseudo-depth-slices 2 and 3 show vague cross cutting northwest–southeast and northeast–southwest features.

Magnetic susceptibility readings in petroleum wells were obtained only from core material to avoid the problem of contamination by drill pipe derived steel fragments. Cores measured ranged in age from Tertiary Gambier Limestone to pre-Cretaceous metasedimentary basement and the values were all too low to be the source of aeromagnetic anomalies. Magnetic susceptibility values obtained from a study by Chatfield (1992) of basaltic material at Mount Gambier and Mount Schank had values which when used in modelling matched the aeromagnetic response over the Mount Gambier magma chamber. The core values especially in the Eumeralla Formation did not match the magnetic susceptibilities required to produce the curvilinear fault derived anomalies near Penola. It has to be assumed that mineralisation along the fault planes with considerable depth extent is responsible for the fault related anomalies.

Variations in radiometric data presented as potassium (K), uranium (U) and thorium (Th) and as total count and ratios of the above three elements closely reflect distribution of surface rock types. The best images of rock type distribution are seen in the Th and Total Count images. The Gambier Limestone outcrops near Mount Gambier and is surprisingly high in all three radioactive elements, particularly Th and U.

The radiometric response of volcanic activity at Mount Gambier is a low anomaly which shows the area of distribution of volcanic material. The Bridgewater Formation calcarenite ridges produce radiometric highs in the central area of the survey. The interdune Padthaway Formation gives contrasting responses in different areas. In the Penola area throughout the Terra Rossa soil unit there are high readings in all three elements. The same rock unit has medium to low readings in areas of outcrop to the east and northeast of Mount Gambier. It is interpreted that the Padthaway Formation contains a number of different facies resulting in different rock types in the two areas with contrasting radiometric response.

The known gas fields in the Katnook area occupy a region of low radiometric values. Further west in the Laira/Zema area, the radiometric values are also low. The low values near Katnook are not related to variations in surface geology and may be caused by leakage of hydrocarbons to the surface, changing the near surface radiometric response. The low readings may also be due to the presence of surface water in swampy areas near the Katnook field. Laira 1 and Zema 1 are on a structure which when tested produced small gas flows and is interpreted to have previously contained a gas accumulation which subsequently leaked following recent fault reactivation. An old soil geochemistry survey carried out after the Katnook-1 discovery, found a number of areas around Katnook, Ladbroke Grove and Hungerford with anomalous soil gas readings, which coincide with the areas of radiometric low values.

The Radiometric Ternary image with each of the elements represented as different colours contains a fine northeast–southwest linear pattern which may be associated with a surface fracture pattern as it is not reflected in the surface geology, or seismic mapping. A few fine linear northwest–southeast features southeast of Penola on the Ternary image appear to have high U readings and may be the surface expression of a number of seismically mapped faults.

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APPENDIX 1

CATALOGUE OF MAPS SUPPLIED

CONTOURS FLIGHT PATH AND PROFILES ON PAPER AND FILM 1:50 000

1:100 000

DME 93-1488	Aeromagnetic Contour Map. Area P1. Residual Total Magnetic Intensity with culture. 400 metre line spaced data. 1 nT contours. SEISMIC Geophysical 1:100 000 Series. Colour paper.		SM
DME 93-1489	Aeromagnetic Contour Map. Area P1. Residual Total Magnetic Intensity Reduced to Pole. 400 metre line spaced data. 1 nT contours. SEISMIC Geophysical 1:100 000 Series. Colour paper.		SM
DME 93-1495	Aeromagnetic Contour Map. Area P1. Residual Total Magnetic Intensity Reduced to Pole. First vertical derivative calculated on the grid. 400 metre line spaced data. 0.2 nT contours. SEISMIC Geophysical 1:100 000 Series. Colour paper.		SM

1:250 000

IMAGE PROCESSED PIXEL MAPS (PHOTOGRAPHIC)
1:50 000
1:100 000
1:250 000

DME 93-1496	Image processed aeromagnetics. Culture suppressed. Montage of 3 images comprising: Colour: TMI. Shading: Northeast illumination Colour: TMI: Shading: Southeast illumination Greyscale: First vertical derivative	A1	SM
DME 93-1497	Image processed radiometrics. Montage of 2 images comprising: Colour: total count Colour: radiometric ternary Red-potassium, green-thorium, blue-uranium.	A1	SM
DME 93-1498	Image processed radiometrics. Montage of 3 images comprising: Colour: Equivalent potassium concentration percent Colour: Equivalent uranium concentration ppm Colour: Equivalent thorium concentration ppm	A1	SM
DME 93-1504	Image processed radiometrics. Montage of 3 images comprising: Colour: ratio of uranium vs potassium Colour: ratio of thorium vs potassium	A1	SM

	Colour: uranium vs thorium		
DME 93-1499	Image processed aeromagnetics. Culture suppressed Reduced to pole. Pseudo-depth-slice 1 Montage of 6 images comprising: Colour: TMI. Shading: Northeast illumination Colour: TMI. Shading: Southeast illumination Colour: TMI. Shading: First vertical derivative Greyscale: Northeast illumination Greyscale: Southeast illumination Greyscale: First vertical derivative	A0	SM
DME 93-1500	Image processed aeromagnetics. Culture suppressed Reduced to pole. Pseudo-depth-slice 2 Montage of 6 images comprising: Colour: TMI. Shading: Northeast illumination Colour: TMI. Shading: Southeast illumination Colour: TMI. Shading: First vertical derivative Greyscale: Northeast illumination Greyscale: Southeast illumination Greyscale: First vertical derivative	A0	SM/DT
DME 93-1501	Image processed aeromagnetics. Culture suppressed Reduced to pole. Pseudo-depth-slice 3 Montage of 6 images comprising: Colour: TMI. Shading: Northeast illumination Colour: TMI. Shading: Southeast illumination Colour: TMI. Shading: First vertical derivative Greyscale: Northeast illumination Greyscale: Southeast illumination Greyscale: First vertical derivative	A0	SM
DME 93-1502	Image processed aeromagnetics. Culture suppressed Reduced to pole. Pseudo-depth-slice 4 Montage of 6 images comprising: Colour: TMI. Shading: Northeast illumination Colour: TMI. Shading: Southeast illumination Colour: TMI. Shading: First vertical derivative Greyscale: Northeast illumination Greyscale: Southeast illumination Greyscale: First vertical derivative	A0	SM
DME 93-1502	Image processed aeromagnetics. Culture suppressed Reduced to pole. Pseudo-depth-slice basement Montage of 6 images comprising: Colour: TMI. Shading: Northeast illumination Colour: TMI. Shading: Southeast illumination Colour: TMI. Shading: First vertical derivative Greyscale: Northeast illumination Greyscale: Southeast illumination Greyscale: First vertical derivative	A0	SM

APPENDIX 2

AEROMAGNETIC/RADIOMETRIC CONTRACT

TENDER SPECIFICATION

QUOTATION FOR AN EXTENSION SURVEY OVER THE AREA REFERRED TO AS P1 UNDER THE CONTRACT

BETWEEN

WORLD GEOSCIENCE CORPORATION LIMITED

AND

THE SOUTH AUSTRALIAN DEPARTMENT OF MINES AND ENERGY

WORLD
GEOSCIENCE
CORPORATION LIMITED

CONTENTS

WORLD GEOSCIENCE
CORPORATION LIMITED
A.C.N. 009 238 395

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Floreat 6014
Postal Address: Locked Bag 6
Wembley 6014 Australia
Telephone (09) 383 7833
Facsimile (09) 383 7166
Telex: 'AERODA' AA96146

11 August 1993

South Australian Department of Mines & Energy
191 Greenhill Road
PARKSIDE SA

Attention: Mr R A Laws

Dear Mr Laws

QUOTATION FOR AN EXTENSION SURVEY OVER THE AREA REFERRED TO AS P1 UNDER THE CONTRACT BETWEEN WORLD GEOSCIENCE CORPORATION LIMITED AND THE SOUTH AUSTRALIAN DEPARTMENT OF MINES AND ENERGY

This document describes airborne survey work to be carried out in the Otway Basin over the area referred to as P1 (see Figure 1). This work is regarded as an "Extension Survey" to South Australian Exploration Initiative surveys within the existing contract between the South Australian Department of Mines and Energy and World Geoscience Corporation Limited. The spirit and substance of the existing contract and its included technical specifications will continue to apply except as altered by this document.

1. MOBILISATION

World Geoscience will mobilise to and demobilise from the survey areas.

2. EQUIPMENT

World Geoscience will supply the following equipment installed in a Cessna C-206 aircraft:

(a) Scintrex V2321 H8 stinger mounted split beam cesium magnetometer sensor.
(b) Picodas PDAS 1000 Acquisition System.
(c) Sperry AA100 Radar Altimeter.
(d) Sensym Barometric Alimeter.
(e) World Geoscience Video Tracking System or Vinten Camera.
(f) RMS Multi-channel analog recorder.
(g) Ashtech GPS satellite navigation and positioning system.
(h) ENMOS - 1000 256 channel.self calibrating spectrometer.
(i) Geometrics DET 1024 NAI X-Tal sensor pack (33 Ltrs).

3. PERSONNEL

World Geoscience will supply experienced survey pilots, experienced operators/ technicians and experienced data personnel as required.

4. SUPPLIES

World Geoscience will supply aviation fuel and all materials and supplies ancillary to the performance of the survey.

5. NAVIGATION AND FLIGHT PATH RECOVERY

Ashtech real time differential GPS navigation system or Syledis radionavigation system.

World Geoscience will provide a GPS satellite positioning system for navigation and flight path recovery. The system will be used in real time differential mode with the aircraft and base station systems synchronised in real time by a radio link. In this configuration the system is accurate to within $\pm$ 10m.

Syledis may be used if it is deemed appropriate by World Geoscience in order to meet the specifications.

6. BASE STATION

World Geoscience will provide a Geometrics G856 memory magnetometer system to monitor the diurnal variations of the Earth's magnetic field. The resolution of the base station will be 0.1 nano Tesla with a noise envelope of $\pm$ 0.25 nano Tesla and cycle rate of 5 seconds. The digital data recorded (time and magnetic reading) will be downloaded each evening onto the hard disk of a PC computer.

Analog records will be clearly annotated with date, flight number, vertical analog scale and start and end time of flight. Should the magnetic field change in a non-linear fashion by more than 5 nano Teslas in 5 minutes, data will be deemed unacceptable within ten minutes of these periods. Affected lines or line segments will be reflown at World Geoscience's expense.

7. SURVEY SPECIFICATIONS

7.1 AREA

World Geoscience will fly the nominated area using the following parameters:
Area Name and Survey Size (approx.)

Penola P1 - 7,000 line kilometres

Flight Line Spacing	-	400m
Flight Line Direction	-	AMG Grid North-South
Tie Line Spacing	-	4,000m
Tie Line Direction	-	AMG Grid East-West
Sensor Height	-	60m
Magnetometer Sample Interval	-	6m approx.
Magnetometer Cycle Rate	-	0.1 second
Magnetometer Resolution	-	0.001nT
Spectrometer Sample Interval	-	60m approx.
Spectrometer Cycle Rate	-	1 second

7.2 NOISE ENVELOPE OF THE MAGNETIC DATA

The noise envelope of the magnetic records will be less than 0.05nT as measured by the fourth difference and seventh order polynomial applied to 19 points and will differ by less than 25% for any of the NS-SN, NE-SW, EW-WE and NW-SE directions.

World Geoscience will attempt to maintain the noise envelope at a minimum, and furthermore World Geoscience accepts that data generally and clearly outside the 0.05nT limit for one kilometre or more is to be rejected and reflown at no charge to the Client.

7.3 NAVIGATION

Reflights will be flown at World Geoscience's expense if flight lines cross or deviate more than 50m from the predetermined flight path over 5km of the flight line length.

All refly lines will cross at least 2 tie lines and be of at least 50% of a line. There will be no more than one join in any line. Reflies will be in the same direction as the original line.

7.4 AIRCRAFT TERRAIN CLEARANCE

Where possible World Geoscience will endeavour to maintain terrain clearance of 60 ± 20 metres. Except where such lines breach air regulations or in the opinion of the pilot put aircraft and crew at risk.

7.5 REFLIGHT CONDITIONS

Reflights and fill-in will be required under conditions specified in the SAEI contract, and as further indicated in 7.2, 7.3 and 7.4.

8. SYSTEM CALIBRATION

8.1 SYSTEM PARALLAX

At the start of the survey, a test flight will be flown over a prominent magnetic feature in opposite directions to determine system parallax.

8.2 MAGNETOMETER COMPENSATION

At the start of the survey a test flight will be flown at high altitude (eg 8000 ft) over a magnetically quiet area for several minutes (3-4 minutes) in each of the 4 survey line directions in turn whilst the aircraft performs roll, pitch and yaw manoeuvres. The output from the Develco 3 axes fluxgate magnetometer and appropriate software will be used to calculate 34 compensation co-efficients per heading.

The compensation box survey data will be provided on a separate tape in a form readable by DME. A tabulation will be provided which indicates to which flight lines the compensation flight applies.

8.3 RADIOMETRIC CALIBRATION

ENMOS-1000 Self Calibrating Spectrometer

It is proposed to use the ENMOS-1000 self calibrating spectrometer for the radiometric data acquisition.

With this system each individual sodium iodide crystal 4.15 litres is calibrated by having its temperature vs gain profile program on its own transputer. In software the system contains a spectral transfer function too match the sensor characteristics and maintain calibration. Linearity over the whole spectrum is maintained once the system either locks on to the thorium peak or in the case where this peak is insufficient by reverting to the temperature coefficients.

Window channels are no longer necessary for potassium, uranium and thorium. These are recovered in post processing with three channels for thorium, two for uranium and one each for potassium, and cosmic suggested as ideal.

Test Range and Pad Calibrations

For this project World Geoscience propose to subject the spectrometer system to all calibration and tests used by World Geoscience for the SADME South Australian Exploration Initiative Surveys 1992-1993.

9. DATA ACQUISITION

9.1 ANALOG RECORDING

World Geoscience will use a RMS multi channel chart recorder. Altimeter, a fine and coarse channel of magnetic data, fiducial marks, 4th digital difference and four channels of radiometrics will be recorded. Suitable scales will be selected by the operator or the Client's representative. Analog scales are software controlled allowing a wide range of scales to be selected.

9.2 DIGITAL RECORDING

For each reading interval the following will be recorded on magnetic tape:

Real Time and/or local ltime and/or WGS time
Radar Altitude (metres)
Barometric Altitude (metres)
AMG Easting (from navigation system)
AMG Northing (from navigation system)
Magnetic Reading (uncompensated).
Magnetometer Reading (compensated)
3 axes Develco Fluxgate output voltages
Full 256 channel radiometric spectrum

Manually inserted information such as flight number, line number, start and end fiducial, start and end time of line will be recorded in the header record for each line.

10. DATA PROCESSING

10.1 FLIGHT PATH RECOVERY

World Geoscience will provide the necessary computing facilities at the field base to enable daily plotting of the aircraft flight path data.

10.2 ANALOG PRESENTATION

Analog charts will be annotated, folded and catalogued in the field. The analog chart recorder will record two channels of magnetics, 4 channels of corrected radiometric data, one of altimeter, fiducial events and the 4th digital difference.

10.3 DATA REDUCTION

i) World Geoscience will remove the IGRF and level the magnetic data using both diurnal and tie line information and this data will then be microlevelled.

ii) World Geoscience will correct the radiometric data for compton scatter, height attenuation and system parallax.

11. DIGITAL DATA

11.1 LOCATED DATA TAPE

World Geoscience will provide the client with five (5) copies of located data containing the following information:

Line Number
Flight Number
Date
Time (local hh mm SS.SS)
Fiducial Number
AMG Easting
AMG Northing
Total Magnetic Intensity (uncompensated)
Total Magnetic Intensity Value (compensated)
Total Magnetic Intensity Value (corrected and levelled)
Magnetic Diurnal Value
Radar Altimeter Reading (metres)
Barometric Altimeter reading (metres)
Final radiometric windows to be decided

The located data will be organised such that lines are in increasing numerical order.

Data format will be compatible SAEI standards.

11.2 GRIDDED DATA

Digital data containing grids of corrected total magnetic intensity and all final radiometric windows will be supplied in ER mapper format.

12. DATA PRODUCTS - MAPS

Five full sets of all products will be provided;

1:50,000 Scale

i) Stacked profiles of total magnetic intensity.
ii) Contours of total magnetic intensity (colour).
iii) Contours of reduced to pole total magnetic intensity (colour).
iv) Flight path
v) Contours of 4 selected channels of radiometric data (colour).

1:100,000 Scale

i) Stacked profiles of total magnetic intensity.

ii) Contours of total magnetic intensity (colour).

iii) Contours of reduced to pole total magnetic intensity (colour).

iv) Flight path

v) Contours of 4 selected channels of radiometric data (colour).

1:250,000 Scale - SAEI Products

Image processed pixel maps at 1:250,000 scale will be produced for Area P1, as listed below, as standard SAEI products.

i) Total Magnetic Intensity (TMI) colour with relief shading from 045°.

ii) Total Magnetic Intensity (TMI) colour with relief shading from 315° and highlights.

iii) Total Magnetic Intensity (TMI) grids - first vertical gradient calculated from the grid.

iv) Gamma total count.

v) Gamma RGB three colour composite.

vi) Equivalent potassium concentration percent.

vii) Equivalent uranium concentration ppm.

viii) Equivalent thorium concentration ppm.

Image processed pixel maps for SAEI have full title blocks, as in normal DME published maps. Suitable title blocks will be provided to WGC by DME. DME prefers that the pixel maps are produced on a Canon A1 Bubblejet. Once proofs are agreed, WGC will be required to produce the required five sets of pixel maps. It will be necessary to provide DME with the necessary streamer tape to be able to make further copies on the Canon A1 Bubblejet at Rainbow Colour Copy Centre, 149 Hutt Street, Adelaide (phone: (08) 232-3636).

Enhanced Processing for Interpretation

i) Full set of 35mm slides of enhanced images of magnetics and radiometrics

ii) Six (6) images of enhanced magnetic and radiometric data at 1:250,000.

   1. Reduced to Pole Total Magnetic Intensity shaded relief from 045° and highlights.
   2. Reduced to Pole Total Magnetic Intensity shaded relief from 315° and highlights.
   3. Th = Th - U (regression Th/U)
   4. U = U - Th (regression U/Th)
   5. K = K - Th (regression K/Th) - U (regression K/U)
   6. One to be chosen.

iii) Depth sliced processed magnetics to include 4 hardcopy images at 1:250,000

1. Optimised 50 - 200m depth.
2. Optimised 1,000 - 2,000m depth.
3. Optimised 2,000 - 3,000m depth
4. Optimised 3,000 + depth,

or, as is indicated appropriate by the data.

iv) Stacked profiles of band pass filtered Total Magnetic Intensity (TMI) at 1:100,000 scale:

0-1 Hz
1-2 Hz
2-3 Hz
3-4 Hz
4-5 Hz

v) Full access to WGC imaging bureau during the life of the project.

vi) Single copy of final tapes for the located data and grids of enhanced magnetics. DME will make additional copies as required.

OPTIONAL
Interpretation Products

Depth to magnetic basement using 3D Euler deconvolution and 2D/3D modelling supported with 2D Euler and Werner deconvolution as required (provided by Cowan Geodata Services). Interpretation will be carried out in the offices of SADME using image processing and data integration, concentrating on the interpretation of sedimentary residual magnetic, micromagnetic and radiometric data.

Integrated interpretation of magnetics, radiometrics, seismic and geology by Dr Mike Etheridge and geophysicists from World Geoscience Corporation Limited, defining structural and tectronic framework and exploration targets.

13. STANDBY

Standby charges will apply for any production days lost due to unsuitable flying conditions created by bad weather, magnetic storms, bushfires or other causes beyond the control of World Geoscience. These causes will not include aircraft or equipment breakdown.

14. DELIVERY SCHEDULE

Preliminary plots	-	4 weeks after completion of flying.
Final maps and located data	-	Will be delivered approximately 2-3 weeks after acceptance of preliminary data.
Optional imaging and interpretation	-	6-8 weeks after delivery of final maps.

15. CLIENT SUPERVISION

The Client may have a representative in the field area during the survey, and that person shall have the authority to:

(a) Agree to changes in the survey specifications, if necessary.

(b) Check the flight path recovery as plotted in the field.

(c) Agree to the reflying required and location of boundaries of the area.

16. SALES TAX

To claim exemption under Item 1 - Mining Activities of the Sales Tax Assessment Act 1992, it is necessary for the Client to complete the attached "Quotation of Sales Tax Number" form and return with the signed contract.

17. CHARGES

Based on approximately 7,000 line kilometres World Geoscience's charges for the above services will be as follows:

(a)	For mobilisation/demobilisation (aircraft and crew)	No Charge.
(b)	For magnetic data acquisition at the rate of $10.00/km flown and recovered	$ 70,000
(c)	For ENMOS radiometric data acquisition at the rate of $2.00/km	$ 14,000
(d)	For ENMOS radiometric data processing, maps and digital data at the rate of $1.50/km	$ 10,500
(e)	For magnetic data processing, maps, and digital data at the rate of $1.50/km	$ 10,500
(f)	For enhanced processing for interpretation at the rate of $4.00/km	$ 28.000
Total Estimated Charge		$133,000

Optional Charges:

Interpretation and products at the rate of $4.30/km

18. SCHEDULE

Given current commitments World Geoscience could commence this survey in August 1993. The flying would take approximately 10 days, with preliminary maps available 4 weeks from completion of flying.

Payment Schedule

(a) 20% of total charge fulls due on mobilisation.

(b) 50% of the estimated total charge falls due on completion of flying as specified in this Agreement.

(c) 20% of the estimated total charge falls due on delivery of preliminary data as specified in this Agreement.

(d) Balance will be due upon delivery of all final data and maps as specified in this Agreement.

World Geoscience offers to perform the above services at the stated charges.

Signed on behalf of **WORLD GEOSCIENCE CORPORATION LIMITED** by:

R B CREAGH
GENERAL MANAGER

11/8/93.
DATE

South Australian Department of Mines and Energy accepts the above offer.

Signed on behalf of **SOUTH AUSTRALIAN DEPARTMENT OF MINES AND ENERGY** by:

NAME

POSITION

DATE

QUOTATION OF SALES TAX NUMBER

I hereby quote Sales tax Registration Number: ______________________

Name of person authorised to quote ______________________

Signature of person authorised to quote ______________________

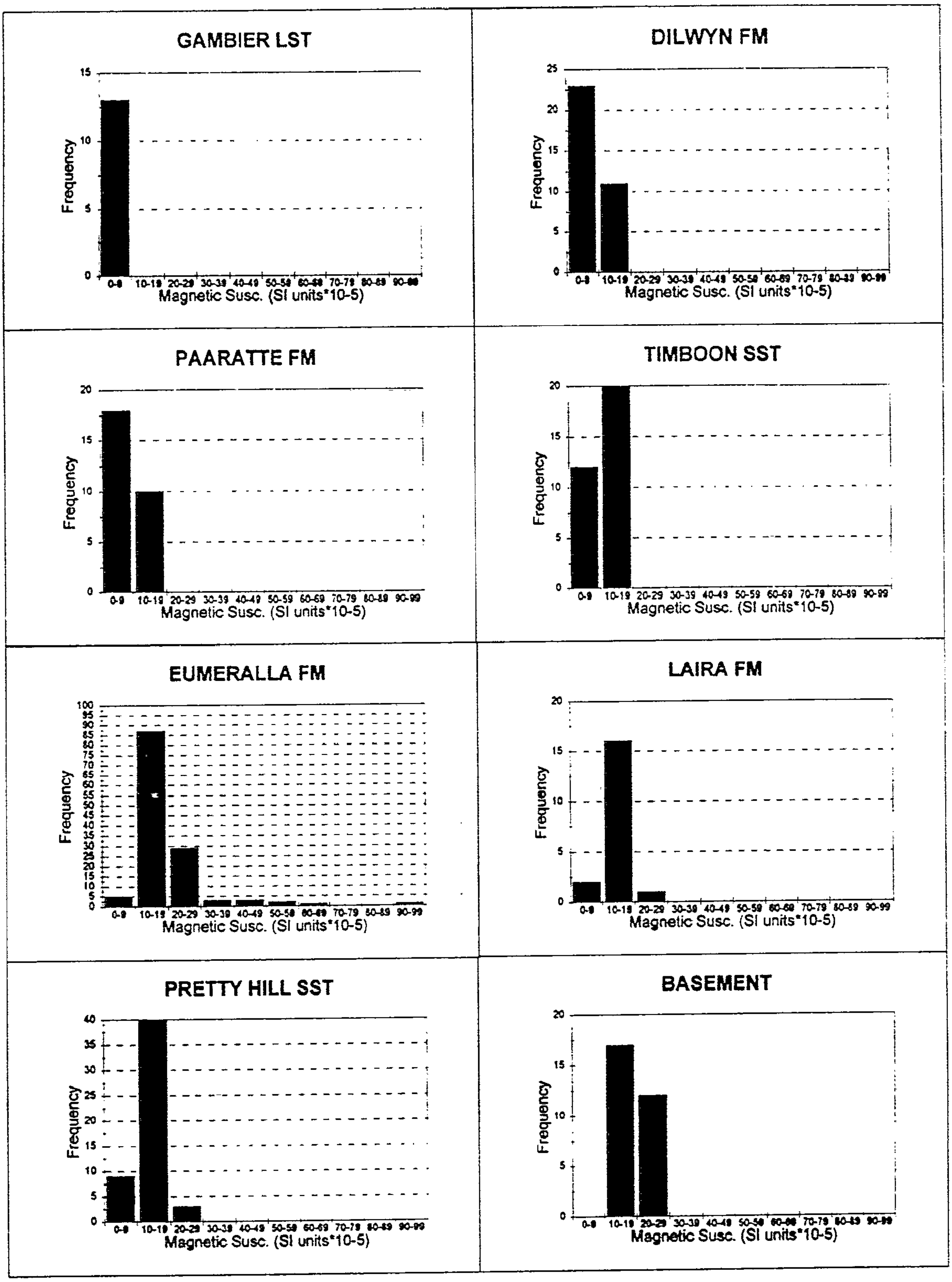
Date: ______________________

APPENDIX 3

CORE MAGNETIC SUSCEPTIBILITY DATA

Magnetic susceptibility readings were taken from cored rocks in six petroleum wells. A hand held Geoinstrument JH-8 meter was used and the readings recorded in SI units x 10^{-5}. The wells and the formations from which the cores were obtained are listed below:-

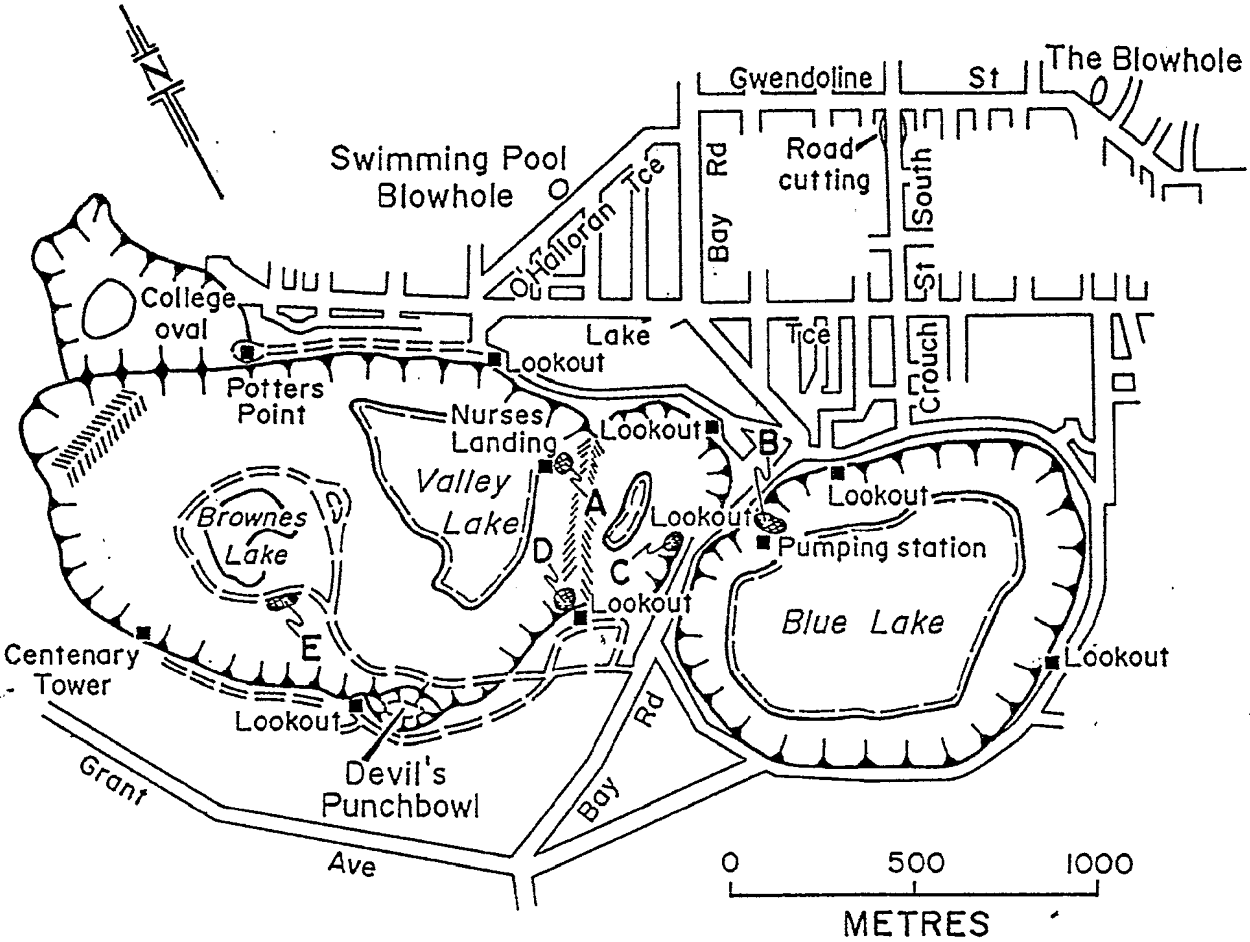
Well	Formations
Katnook-2	Eumeralla Pretty Hill
Katnook-3	Pretty Hill
Penola-1	Eumeralla Laira
Caroline-1	Gambier Limestone Pember Mudstone Timboon Paaratte Eumeralla
Kalangadoo-1	Sherbrook Eumeralla Laira Basement (undifferentiated meta sediments)
Mount Salt-1	Dilwyn Timboon Paaratte


GAMBIER LST
DILWYN FM
PAARATTE FM
TIMBOON SST
EUMERALLA FM
LAIRA FM
PRETTY HILL SST
BASEMENT
Frequency
0-9 10-19 20-29 30-39 40-49 50-59 60-69 70-79 80-89 90-99
Magnetic Susc. (SI units*10-5)

APPENDIX 4

GROUND MAGNETIC SUSCEPTIBILITY DATA

(FROM CHATFIELD, 1992)



A

A, WA . . .	1000 - 8000
Ba, Ma, V	600 - 2500
Ba, RLS . .	400 - 3000
T, M	150 - 400
T, B	40 - 400

Site 2

B

T	1000 - 3000
S, W	700 - 900
S, R	500 - 4000
A, Be	900 - 5000
Ba, W . . .	5 - 900

Site 1

C

T, M	50 - 250
T, B	4 - 1000

Site 3

D

T, M	50 - 700
T, B	10 - 450

Site 4

E

RLS, M . .	15 - 700
RLS, B . . .	0 - 350

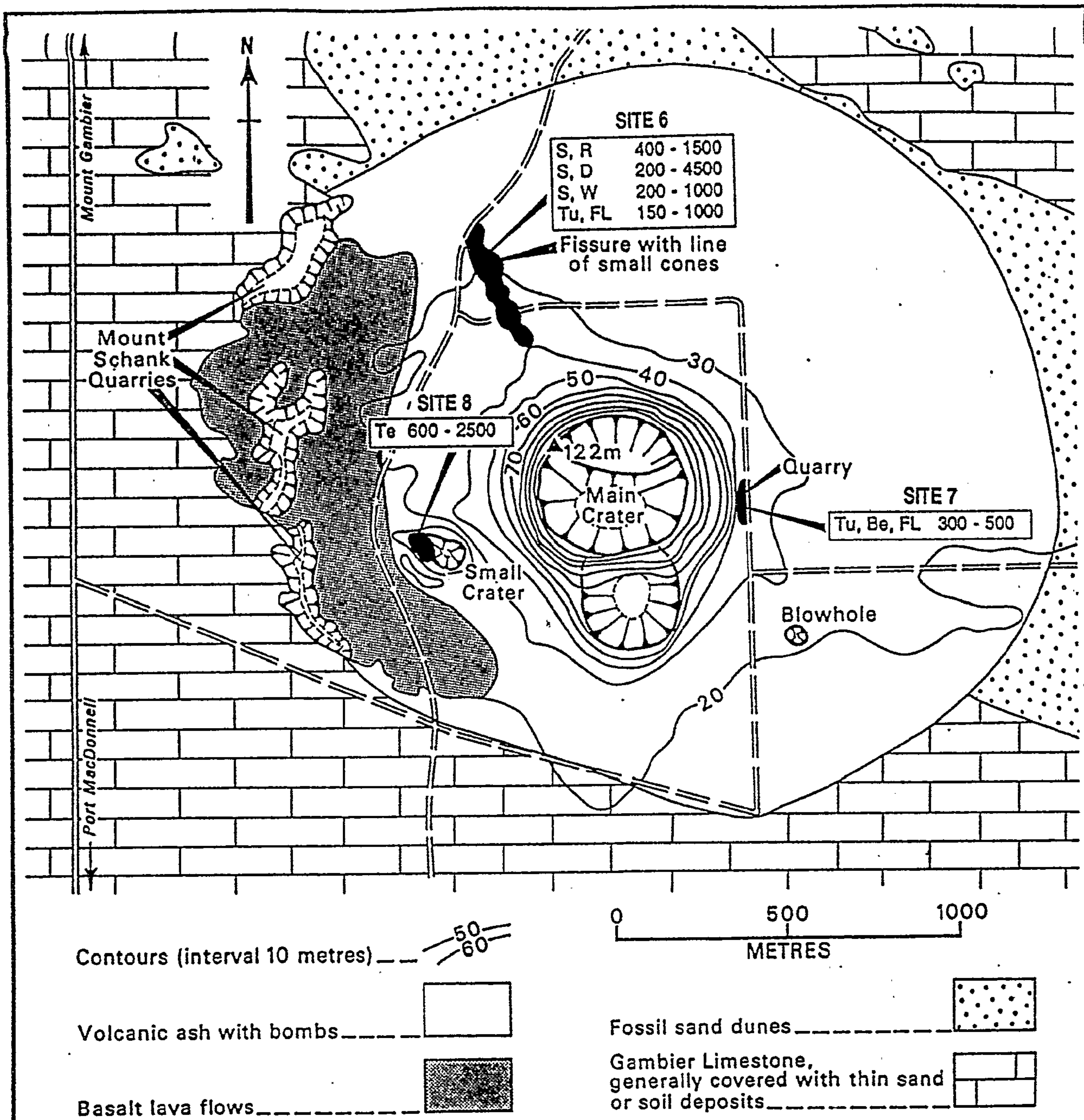
Site 5

KEY

A . . . Ash
WA . Unsorted tephra
Ba . . Basalt
Ma . . Massive
V . . . Vesicular
RLS . Ropey Lava Spatter
T . . . Tuff
M . . . Matrix
B . . . Bomb
S . . . Scoria
W . . Weathered
R . . . Red
Be . . Bedded

MOUNT GAMBIER VOLCANIC COMPLEX
GROUND MAGNETIC SUSCEPTIBILITY RANGES
(SI units x 10^{-5})

5680 **SADME 92-1326** *(map from Sheard, 1980)* **Figure 15**

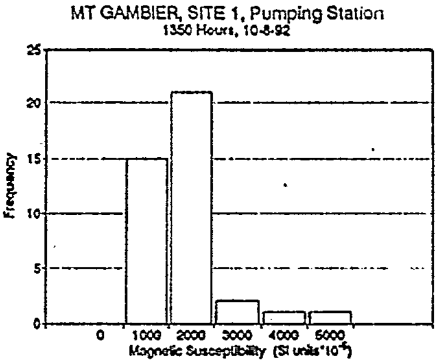


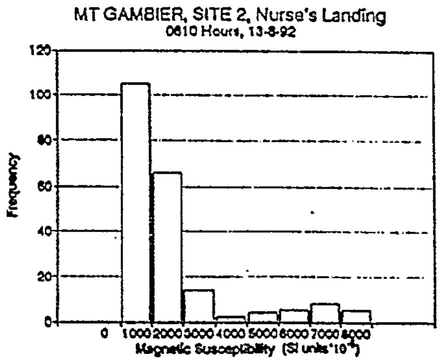
KEY

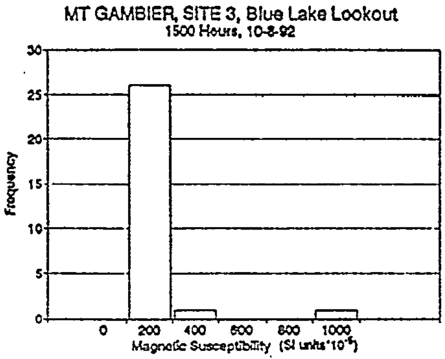
S	scoria	Tu	tuff
R	red	FL	finely laminated
D	dark	Be	bedded
W	weathered	Te	tephra

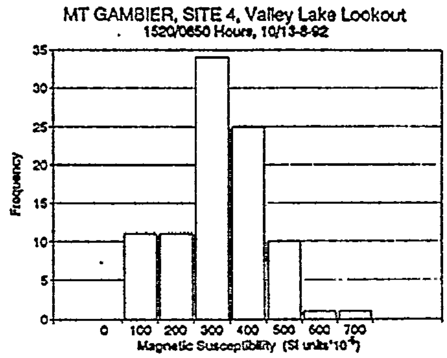
BASE MAP
THE MOUNT SCHANK VOLCANIC COMPLEX
GROUND MAGNETIC SUSCEPTIBILITY RANGES
(SI units x 10^{-5})

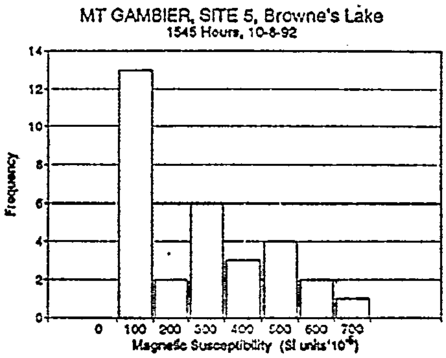
(map from Sheard 1980)

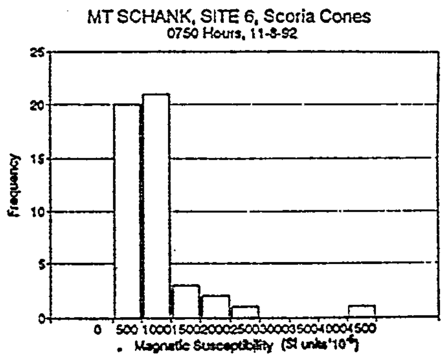

MT GAMBIER, SITE 1, Pumping Station
1350 Hours, 10-8-92
Frequency
Magnetic Susceptibility (SI units*10-6)

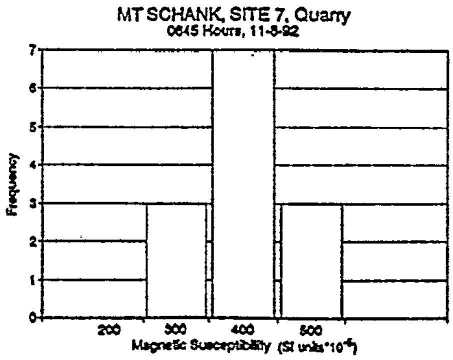

MT GAMBIER, SITE 2, Nurse's Landing
0610 Hours, 13-8-92
Frequency
Magnetic Susceptibility (SI units*10-6)

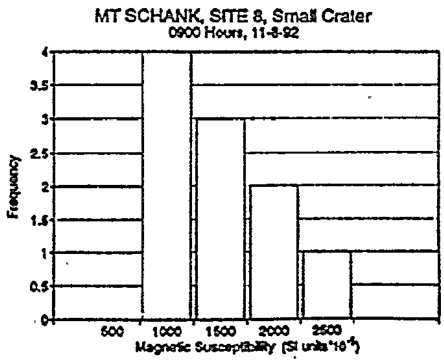

MT GAMBIER, SITE 3, Blue Lake Lookout
1500 Hours, 10-8-92
Frequency
Magnetic Susceptibility (SI units*10-6)


MT GAMBIER, SITE 4, Valley Lake Lookout
1520/0650 Hours, 10/13-8-92
Frequency
Magnetic Susceptibility (SI units*10-6)


MT GAMBIER, SITE 5, Browne's Lake
1545 Hours, 10-8-92
Frequency
Magnetic Susceptibility (SI units*10-6)


MT SCHANK, SITE 6, Scoria Cones
0750 Hours, 11-8-92
Frequency
Magnetic Susceptibility (SI units*10-6)


MT SCHANK, SITE 7, Quarry
0645 Hours, 11-8-92
Frequency
Magnetic Susceptibility (SI units*10-6)


MT SCHANK, SITE 8, Small Crater
0900 Hours, 11-8-92
Frequency
Magnetic Susceptibility (SI units*10-6)

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	MOUNT GAMBIER		(*10-5)			MOUNT SHANK		(*10-5)
	ASH	TEPHRA	BASALT	TUFF	SCORIA	TEPHRA	SCORIA	TUFF
NO. OF SAMPLES	5	198	159	33	6	12	36	13
MEAN	2480	432	1125	4867	1333	1373	946	446
STANDARD DEVIATION	1605	514	758	2393	1319	617	826	286

APPENDIX 5

COMPUTER MODELLING OF MAGNETIC DATA

POTENT v3.04 Model Summary Report created at 16:31 31/01/1995 for Preview Resources Pty. Limited

Inducing fi | Intensity = 60896
Azimuth = 10
Inclination -69

Body type abbreviations and the shape parameters have the following significance:

Cylndr - A, B are axes lengths; C = thickness; D = slope
Ellpsd - A, B, C are axes lengths
Rect - A = width, B = length, C = height
Poly3 - (A,C) pairs represent vertex coordinates relative to vertex #1, B = length

Model title: AREA P1 summary map of all bodies

No.	Type	X	Y	Depth	Strike	Dip	Plunge	Susc.	Rem f	Rem az	Rem inc	A	B	C	D	Anomaly
		m	m	m	deg	deg	deg	SI	Amp/m	deg	deg					name
1	Poly3	485353	5808394	5476	-75	90	0	0.06	0	0	0	0	15000	0		seismic b
2	Poly3	485111	5874157	7	90	90	0	0.00006	0	0	0	0	32000	0		seismic b
3	Poly3	489111	5874046	115	90	90	0	0.0005	0	0	0	0	32000	0		seismic b
4	Poly3	493111	5874083	662	90	90	0	0.0003	0	0	0	0	32000	0		seismic b
5	Poly3	493111	5874013	1081	90	90	0	0.001	0	0	0	0	32000	0		seismic b
6	Poly3	484312	5805108	6321	-75	90	0	0.08	0	0	0	0	15000	0		A
7	Poly3	479963	5830856	3357	-54	90	0	0.015	0	0	0	0	10000	0		G
8	Rect	476411	5801121	36	0	90	0	0.03	0	0	0	400	200	500		C
9	Rect	476782	5800695	43	0	90	0	0.017	0	0	0	300	300	500		C
10	Rect	475992	5800647	36	0	90	0	0.03	0	0	0	200	200	500		C
11	Rect	475972	5800297	36	0	90	0	0.015	0	0	0	200	200	500		C
12	Rect	476411	5800153	36	0	90	0	0.01	0	0	0	200	200	500		C
13	Ellpsd	465741	5855214	2486	30	90	0	0.0125	0	0	0	5200	8600	3000		F
14	Rect	467929	5860400	2557	26	90	0	0.01	0	0	0	3000	2000	2000		F
15	Rect	466588	5859200	2557	26	90	0	0.01	0	0	0	3000	1200	500		F
16	Rect	467370	5853726	267	-62	90	0	0	0.35	0	-47	532	1002	418		E
17	Rect	467718	5854584	257	-62	90	0	0	-0.2	0	-47	532	1002	418		E
18	Poly3	479964	5830857	3357	-54	90	0	0.015	0	0	0	0	10000	0		G
19	Poly3	481400	5793990	15749	95	90	0	0.057511	0	0	0	0	45000	0		A
20	Cylndr	487057	5812078	12714	10			0.05	0	0	0	5000	13000	7000	90	A
21	Cylndr	487059	5812000	9714	10			0.05	0	0	0	13000	33000	3000	90	A
22	Cylndr	466471	5851824	8623	-90			0.05	0	0	0	10000	10000	4000	90	F
23	Rect	491805	5866318	2571	31	90	0	0	0.55	0	-75	1600	1400	1000		G
24	Rect	489532	5864341	2543	31	90	0	0	0.62	0	-90	7100	4093	1000		G
25	Rect	490201	5866977	2600	31	90	0	0	0.5	0	-75	1400	1100	1000		G
26	Rect	492161	5868908	2672	0	90	0	0	1.32	0	-75	4000	2400	1000		G
27	Rect	490999	5865948	714	31	90	0	0	0.09	0	-75	1800	1500	300		G
28	Rect	487258	5861708	2457	31	90	0	0	0.36273	0	-90	2996	1900	1000		G
29	Rect	474876	5872325	446	103	90	0	0.00028	0	0	0	200	1000	500		S1
30	Rect	489835	5844190	871	290	90	0	0	0.18	0	-120	190	2000	500		S2
31	Rect	476047	5851635	911	120	90	0	0	0.18	0	-127	100	4000	200		S3
32	Rect	476018	5854745	1643	120	90	0	0	2.8	0	-120	100	4000	200		S3
33	Rect	476018	5854780	232	120	90	0	0	0.015	0	-127	100	4000	200		S3
34	Rect	476018	5851655	268	120	90	0	0	0.04	0	-127	100	4000	200		S3
35	Rect	495000	5862259	207	33	90	45	-0.0001	0	0	0	2000	50	1000		S4
36	Rect	495000	5861687	214	33	90	42	0.0006	0	0	0	2000	100	1000		S4
37	Rect	495000	5859496	285	33	90	45	0	0.105	10	-135	2000	50	1000		S4
38	Rect	495000	5858871	400	33	90	45	-0.002	0	0	0	2000	50	1000		S4
39	Rect	495000	5857554	197	33	90	45	-0.00035	0	0	0	2000	50	200		S4
40	Rect	495000	5858109	400	33	90	-45	0	0.125	10	-98	2000	50	500		S4
41	Rect	495000	5856602	230	33	90	45	0	0.052	10	-30	2000	50	1000		S4
42	Rect	495000	5856188	300	33	90	45	0.0001	0	0	0	2000	50	1000		S4
43	Rect	480709	5810672	222	-40	100	0	0.022	0	0	0	300	300	1000		B
44	Cylndr	478592	5812324	120	110			0.03	0	0	0	300	900	1500	45	B
45	Poly3	478378	5810829	62	113	90	0	0.01	0	0	0	0	300	0		B
46	Poly3	479905	5811542	215	-66	90	0	0.02	0	0	0	0	600	0		B
47	Rect	478804	5813411	113	17	100	0	0.005	0	0	0	300	100	1000		B
48	Rect	480880	5813016	288	17	100	0	0.005	0	0	0	1600	100	1000		B
49	Rect	478804	5810439	157	-68	95	0	0.011	0	0	0	300	300	1000		B
50	Rect	479581	5812151	157	-68	95	0	0.011	0	0	0	300	300	1000		B
51	Rect	485167	5790857	33	90	90	0	0.005	0	0	0	50	300	200		S6
52	Rect	484772	5791226	12	90	70	0	0.004	0	0	0	20	300	50		S6
53	Rect	484377	5791545	23	90	90	0	0.004	0	0	0	20	300	50		S6
54	Rect	485986	5790558	40	90	90	0	0.009	0	0	0	20	300	100		S6
55	Rect	486441	5859053	577	19	90	0	0	0.34	0	-114	400	100	300		S10
56	Rect	487394	5858670	986	19	90	0	0	0.37	0	-114	700	250	300		S10
57	Rect	487686	5793186	21	-60	90	0	0	0.015	0	-82	50	1000	500		S12
58	Rect	491088	5792546	36	113	90	0	0	0.02	0	-132	60	1250	100		S12
59	Rect	484614	5823246	21	88	90	0	0	0.025	0	-149	80	1000	200		S14

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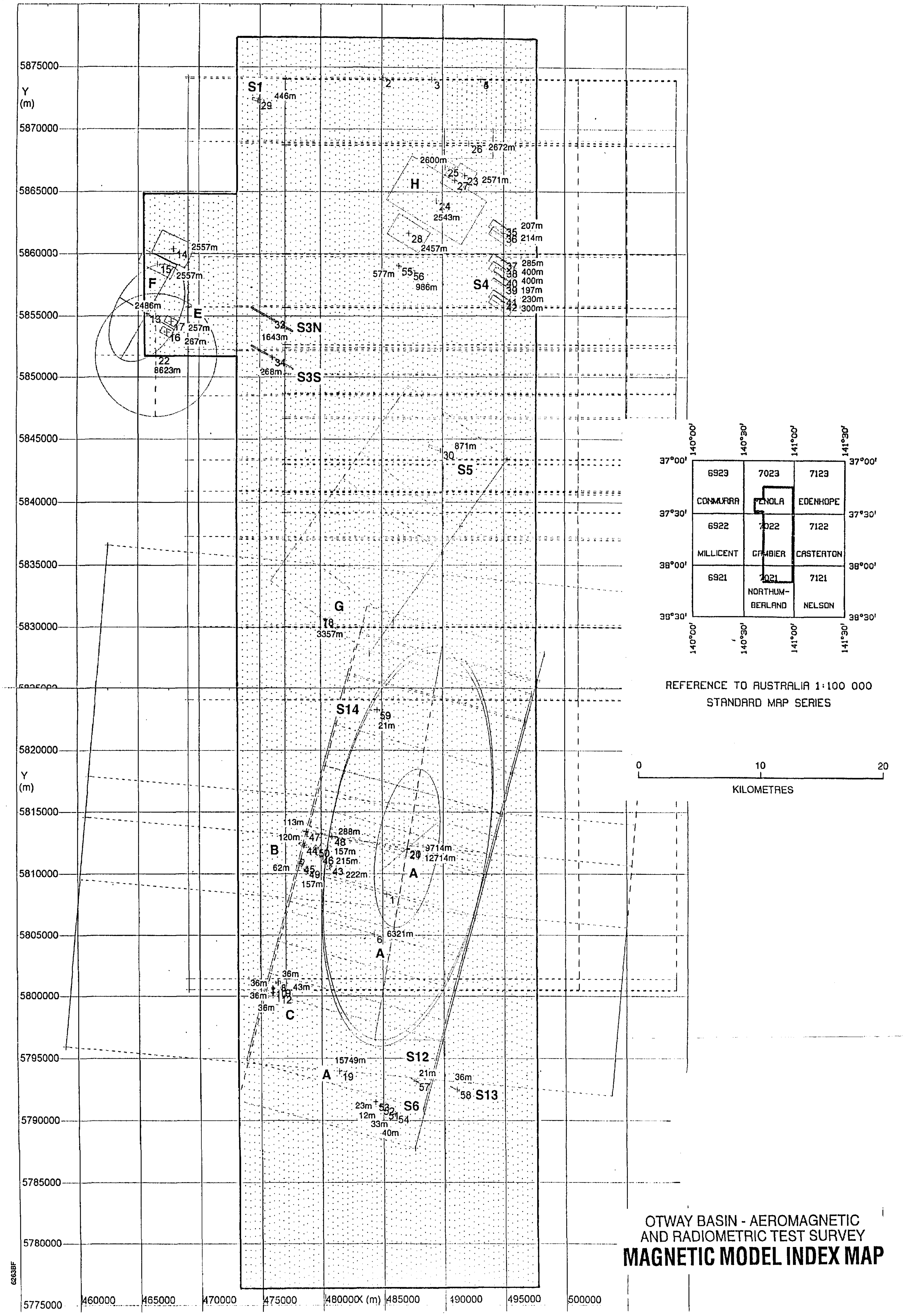
APPENDIX 5 MODELS FOR SELECTED MAGNETIC ANOMALIES

Model index map

Model title and description		Quality of correlation of prognosed model to survey data
Seismic beds 1	3-D polygons, with susceptibility applied to sediments where mapped, basement susceptibility zero	Nil fit
Seismic beds 2	3-D polygons with susceptibility applied to basement only 0.001 SI. Sediments assumed to have nil susceptibility	Nil fit
Seismic beds 3	3-D polygons with susceptibility applied to sediments and to basement and including 3-D polygons for Anomalies A and G	Poor fit
Anomaly A	3-D polygon at 5475 metres depth	OK fit
Anomaly B	3-D polygons, prisms and cylinder 113 to 288 metres depth	Poor fit
Anomaly C	prisms 35 metres to 43 metres depth	Poor fit
Anomaly E	418 metre thick prisms 257 to 266 metres depth	OK fit
Anomaly F	ellipsoid and prisms 2485 to 2556 metres depth	OK fit
Anomaly G	3-D polygon 3357 metres depth	Poor fit
Anomaly H	prisms 300 to 1000 metres depth	OK fit
Anomaly S1	500 metre thick prism 446 metres depth	Poor fit
Anomaly S2	500 metre thick prism 871 metres depth	Poor fit
Anomaly S3N	200 metre thick stacked prisms 232 to 1642 metres depth possible culture	OK fit
Anomaly S3S	200 metre thick stacked prisms 267 to 910 metres depth	OK fit
Anomaly S4	seismic line 90-414 fault plane prisms 207 to 214 metres depth	OK fit
Anomaly S4	seismic line 90-414 fault plane prisms 197 to 400 metres depth	OK fit
Anomaly S4	seismic line 90-414 fault plane prisms 230 to 300 metres depth	OK fit
Anomaly S5	500 metre thick prism 757 metres depth	Poor fit
Anomaly S6	prisms 11 to 40 metres depth culture	Poor fit
Anomaly S10	prisms 579 to 986 metres depth	OK fit
Anomaly S12	500 metre thick prism 21 metres depth	OK fit
Anomaly S13	100 metre thick prism 36 metres depth	Poor fit
Anomaly S14	200 metre thick prism 22 metres depth	Poor fit

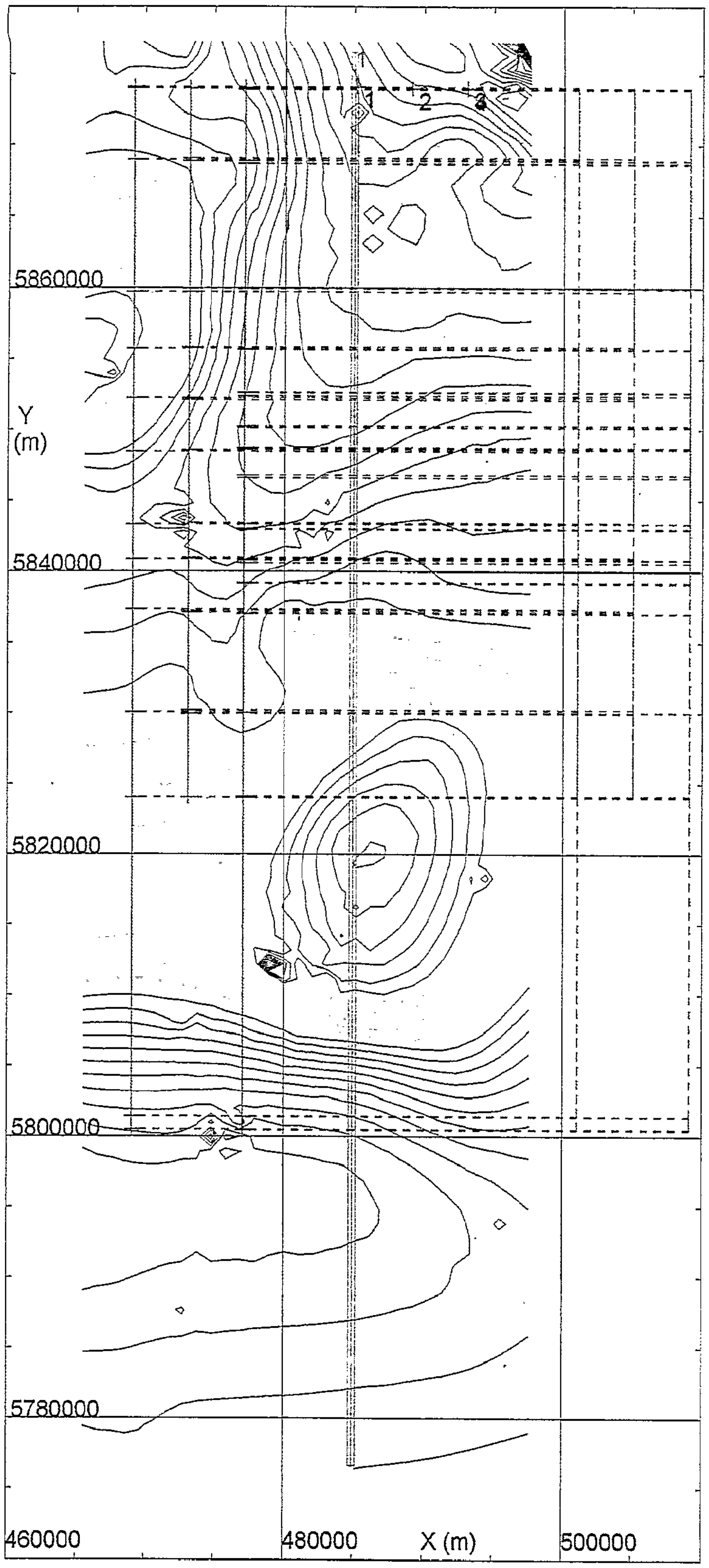
Four classifications were used to grade the quality of the model response to the observed anomaly data. Note that this is a judgement of the mathematical qualities of the model. It is not a judgment of the geological qualities of the model.

GRADING PROFILES TO FIT	ESTIMATED ERROR RANGE FOR MODEL	COMMENTS
Excellent	+/- 10%	Exact at all critical points
OK	+/- 20%	Exact at 2/3 of critical points
Poor	+/- 40%	Inexact fit at all critical points, but general forms of profiles are similar
Nil	not relevant	No similarity at all



OTWAY BASIN - AEROMAGNETIC AND RADIOMETRIC TEST SURVEY

MAGNETIC MODEL INDEX MAP



Observations:	
Model:	P1SESMBA.MOD Seismic beds uniformly magn
Contours of:	Observed field; Contour intervals: 20.0000,
POTENT v3.04	Plan drawn at 09:29 06/02/1995 for Preview R

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Seismic beds I 3-D polygons, with susceptibility applied to sediments where mapped, basement susceptibility zero Nil fit

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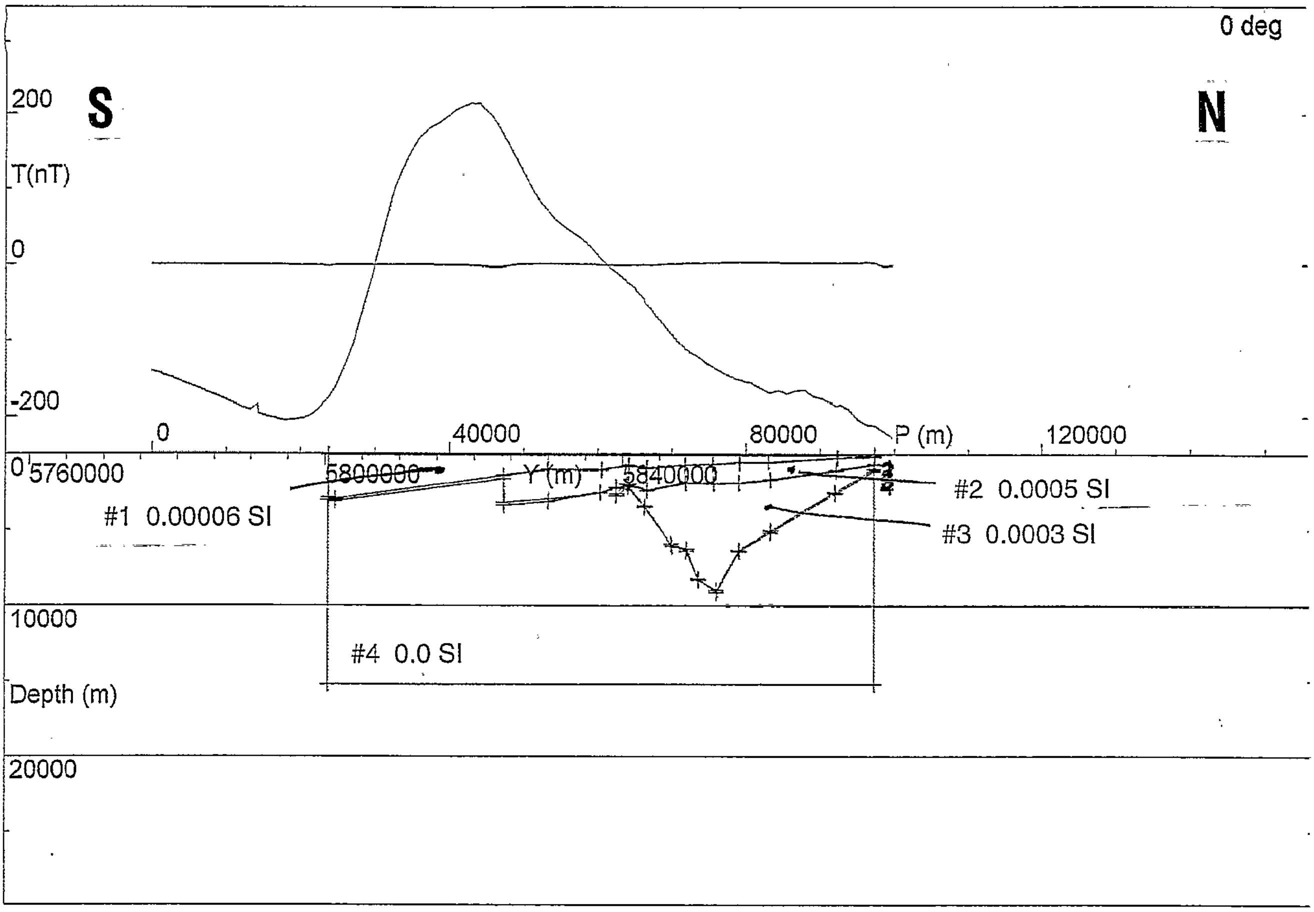
POTENT v3.04 Model Summary Report created at 09:24 06/02/1995 for Preview Resources Pty. Limited												
Inducing fi	Intensity =	60896										
	Azimuth =	10										
	Inclination	-69										
Body type abbreviations and the shape parameters have the following significance:												
Poly3 -		(A,C) pairs represent vertex coordinates relative to vertex #1. B = length										
Model title: P1SESMBA.MOD Seismic beds uniformly magnetised beds												
No.	Type	X	Y	Depth	Strike	Dip	Plunge	Susc.	A	B	C	D
		m	m	m	deg	deg	deg	SI				
1	Poly3	485111	5874157	7	90	90	0	0.00006	0	32000	0	
2	Poly3	489111	5874046	115	90	90	0	0.0005	0	32000	0	
3	Poly3	493111	5874083	662	90	90	0	0.0003	0	32000	0	
4	Poly3	493111	5874013	1081	90	90	0	0	0	32000	0	

Appendix 5
95-996A MESA

Seismic beds 1 3-D polygons, with susceptibility applied to sediments where mapped, basement susceptibility zero

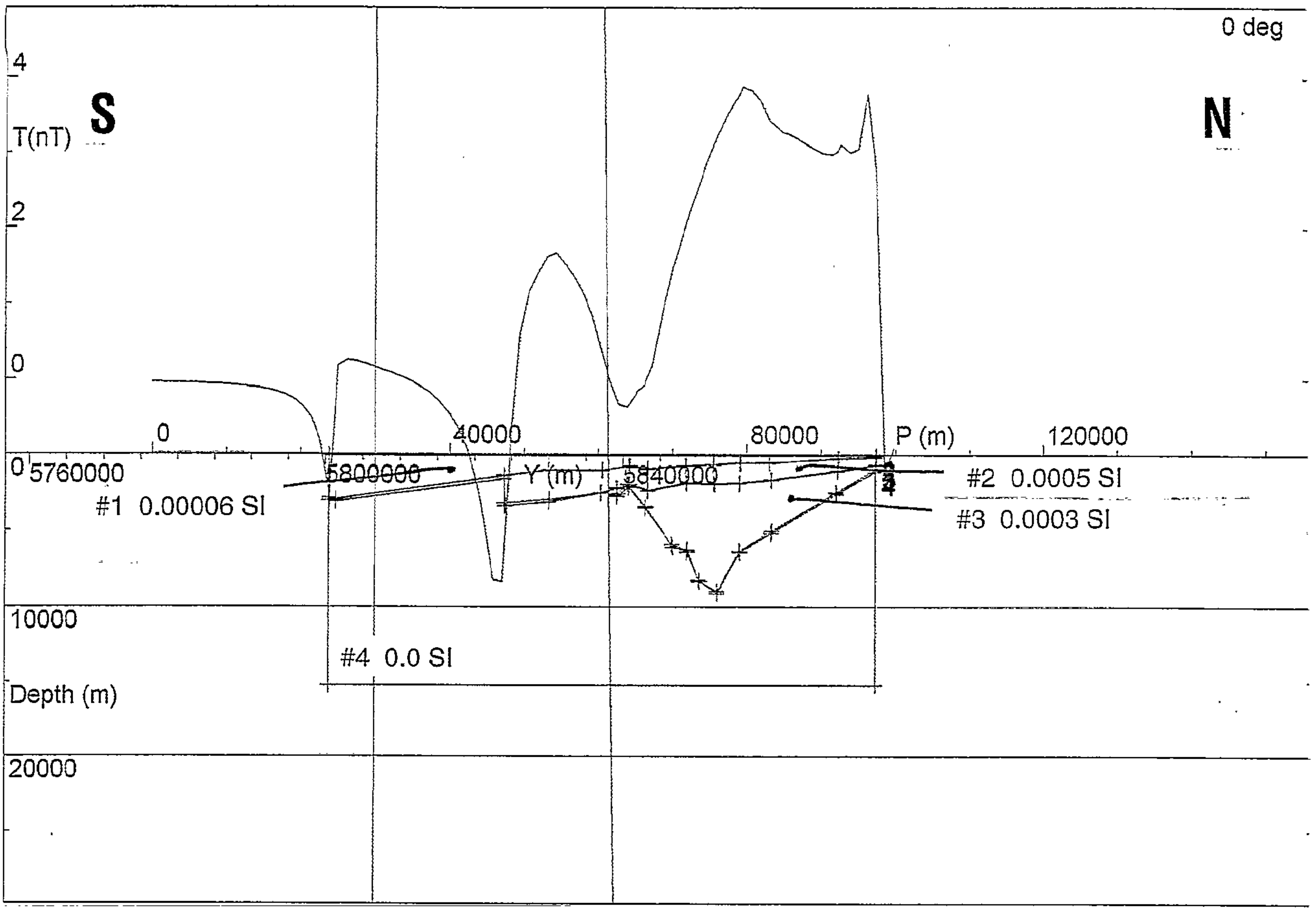
Nil fit



Observations:

Profile #1;	485000		
Model:	P1SESMBA.MOD Seismic beds uniformly magnetised beds		
Calculation mode:	Total Magnetic Intensity		
Observed:	————	Calculated:	————
Residual:	————	Individual body:	————
POTENT v3.04	Profile drawn at 09:20 06/02/1995 for Preview Resources Pty. Limited		

Seismic beds 1	3-D polygons, with susceptibility applied to sediments where mapped, basement susceptibility zero	Nil fit



Observations:			
Profile #1;	485000		
Model:	P1SESMBA.MOD Seismic beds uniformly magnetised beds		
Calculation mode:	Total Magnetic Intensity		
Observed:	————————	Calculated:	————————
Residual:	————————	Individual body:	————————
POTENT v3.04	Profile drawn at 09:22 06/02/1995 for Preview Resources Pty. Limited		

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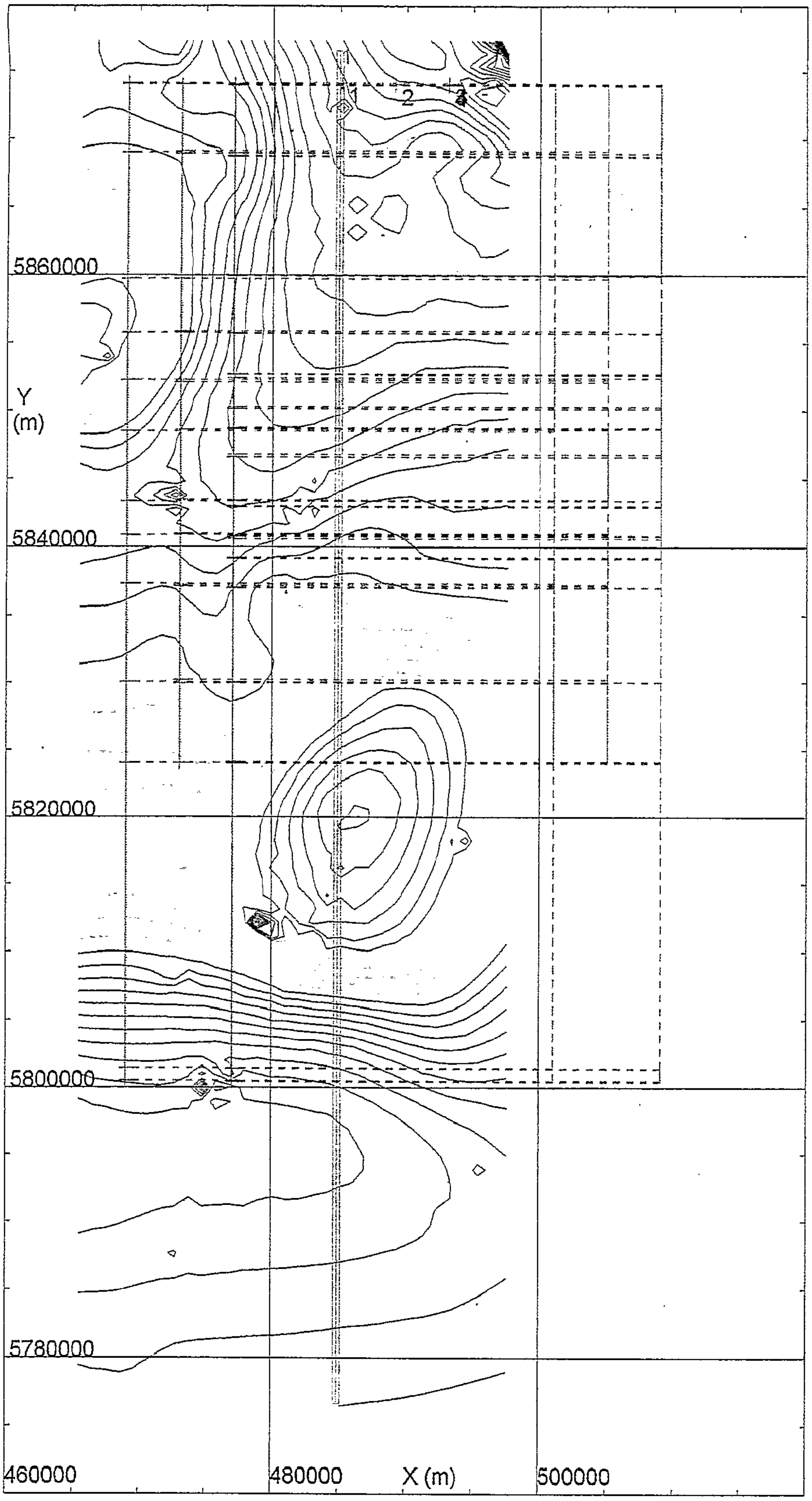
Seismic beds 1 3-D polygons, with susceptibility applied to sediments where mapped, basement susceptibility zero Nil fit



Observations:	
Model:	P1SESMBB.MOD Seismic bed SI=0.001
Contours of:	Observed field; Contour intervals: 20.0000, 100.0000 nT
POTENT v3.04	Plan drawn at 10:46 07/02/1995 for Preview Resources Pty

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Seismic beds 2	3-D polygons with susceptibility applied to basement only 0.001 SI, Sediments assumed to have nil susceptibility	Nil fit

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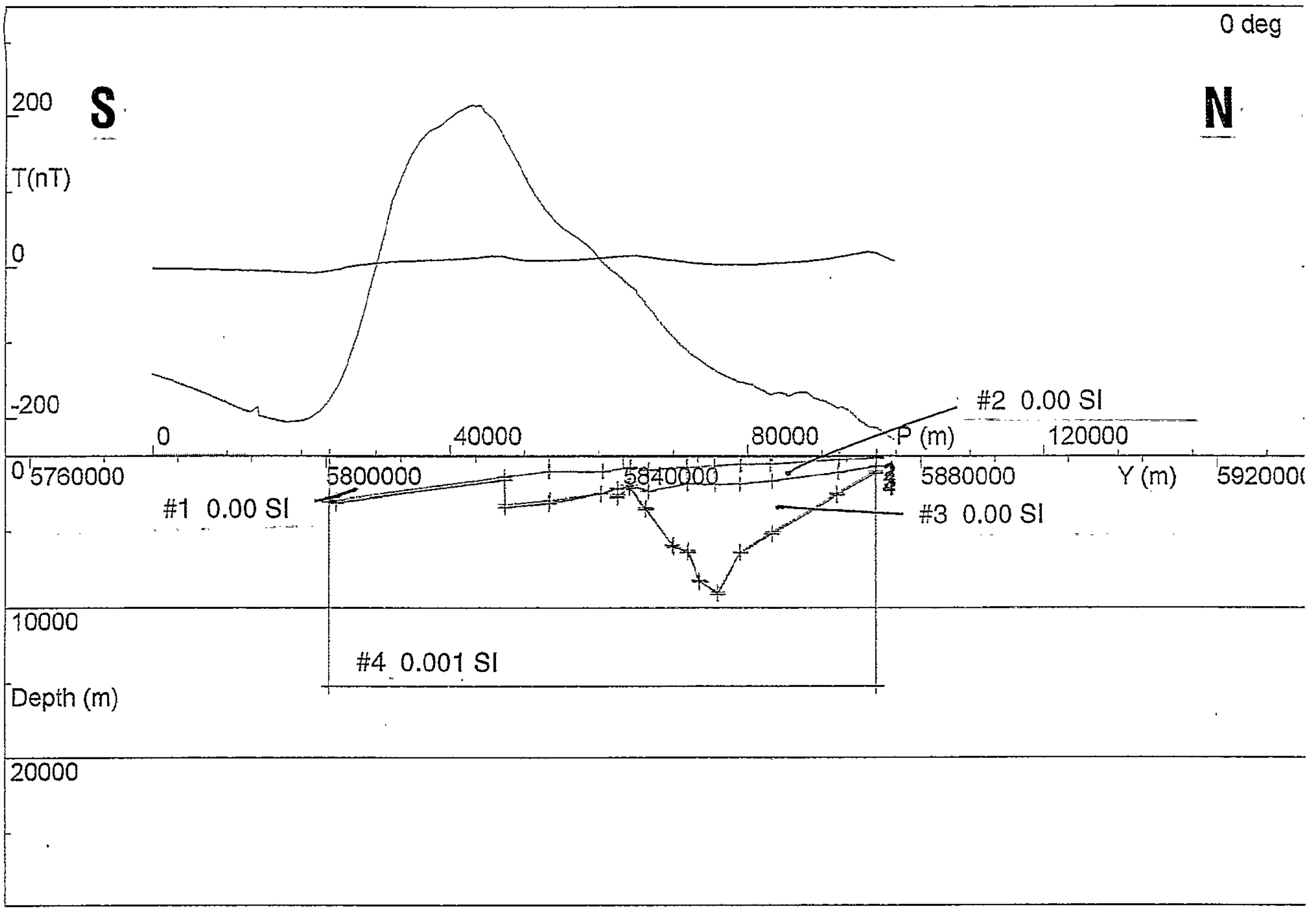
POTENT v3.04 Model Summary Report created at 10:48 07/02/1995 for Preview Resources Pty. Limited												
Inducing fi	Intensity =	60896										
	Azimuth =	10										
	Inclination	-69										
Body type abbreviations and the shape parameters have the following significance:												
Poly3 -		(A,C) pairs represent vertex coordinates relative to vertex #1, B = length										
Model title: P1SESMBB.MOD Seismic bed SI=0.001												
No.	Type	X	Y	Depth	Strike	Dip	Plunge	Susc.	A	B	C	D
		m	m	m	deg	deg	deg	SI				
4	Poly3	493111	5874013	1081	90	90	0	0.001	0	32000	0	

Seismic beds 2 3-D polygons with susceptibility applied to basement only 0.001 SI. Sediments assumed to have nil susceptibility Nil fit



Observations:			
Profile #1;	485000		
Model:	P1SESMBB.MOD Seismic bed SI=0.001		
Calculation mode:	Total Magnetic Intensity		
Observed:	————	Calculated:	————
Residual:	————	Individual body:	————
POTENT v3.04	Profile drawn at 10:34 07/02/1995 for Preview Resources Pty. Limited		

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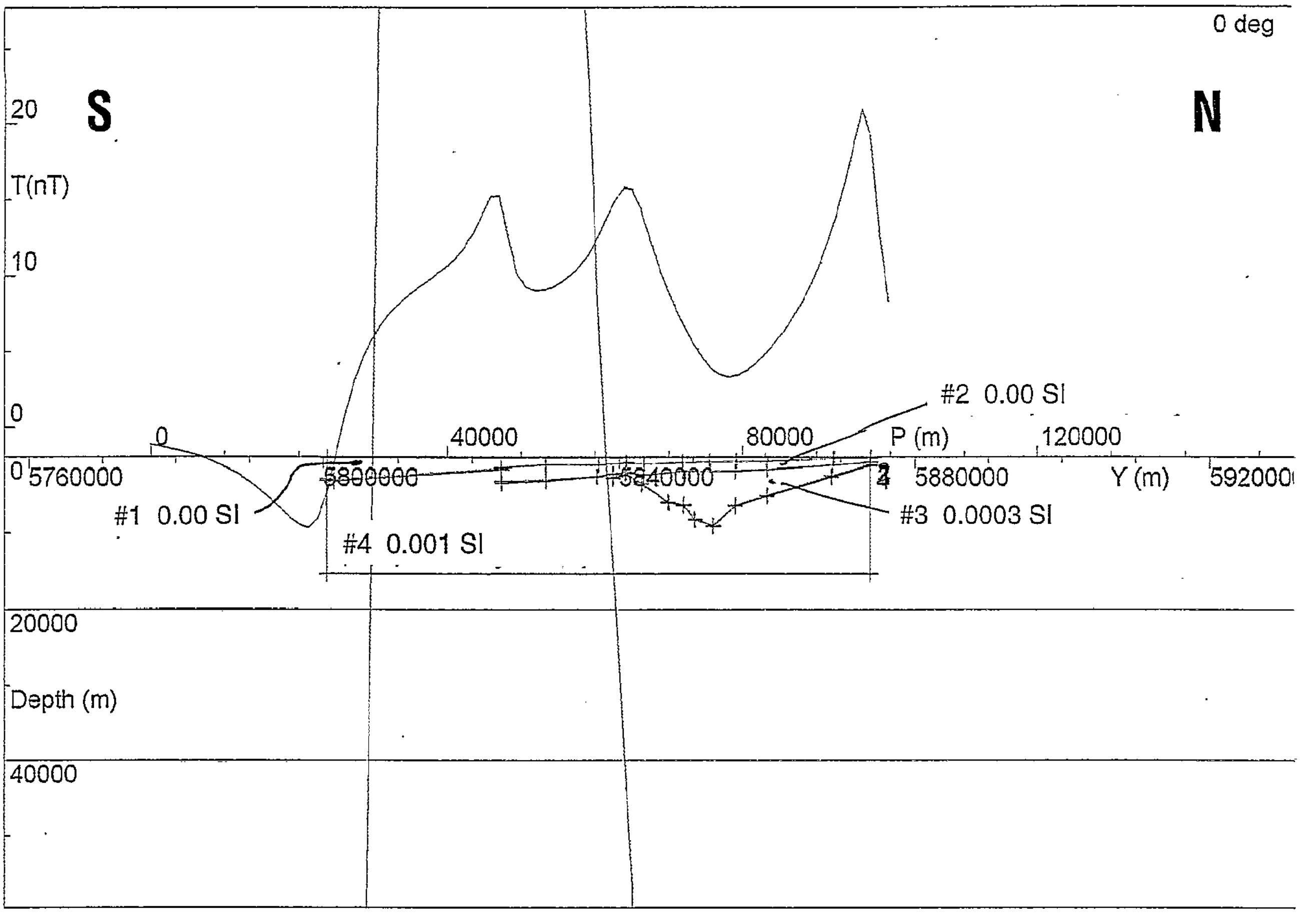
Seismic beds 2	3-D polygons with susceptibility applied to basement only 0.001 SI. Sediments assumed to have nil susceptibility	Nil fit



Observations:	
Profile #1;	485000
Model:	P1SESMBB.MOD Seismic bed SI=0.001
Calculation mode:	Total Magnetic Intensity
Observed: ________	Calculated: ________
Residual: ________	Individual body: ________
POTENT v3.04	Profile drawn at 10:32 07/02/1995 for Preview Resources Pty. Limited

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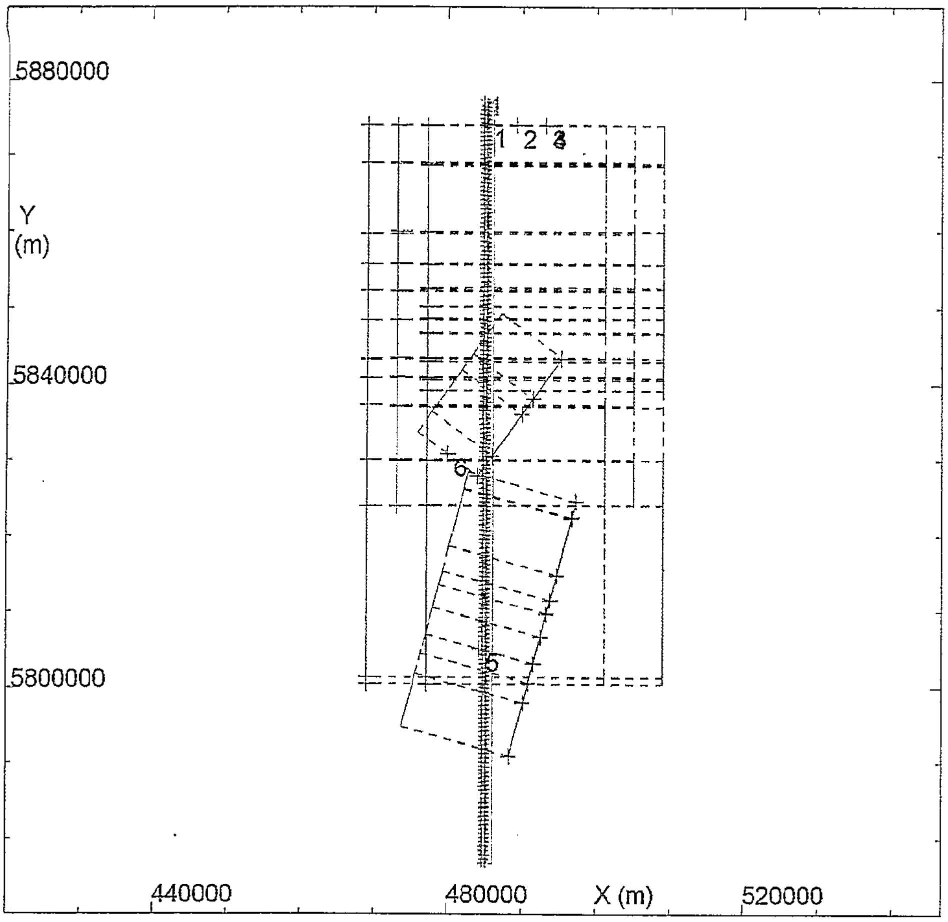
Seismic beds 2	3-D polygons with susceptibility applied to basement only 0.001 SI. Sediments assumed to have nil susceptibility	Nil fit



Observations:	485000
Model:	ANOMALY A&G SEISMIC BEDS P1SES2B.MOD
POTENT v3.04	Plan drawn at 16:32 23/11/1994 for Preview Resources Pty. Lim

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Seismic beds 3	3-D polygons with susceptibility applied to sediments and to basement and including 3-D polygons for anomalies A and G	Poor fit

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POTENT v3.04 Model Summary Report created at 16:38 23/11/1994 for Preview Resources Pty. Limited

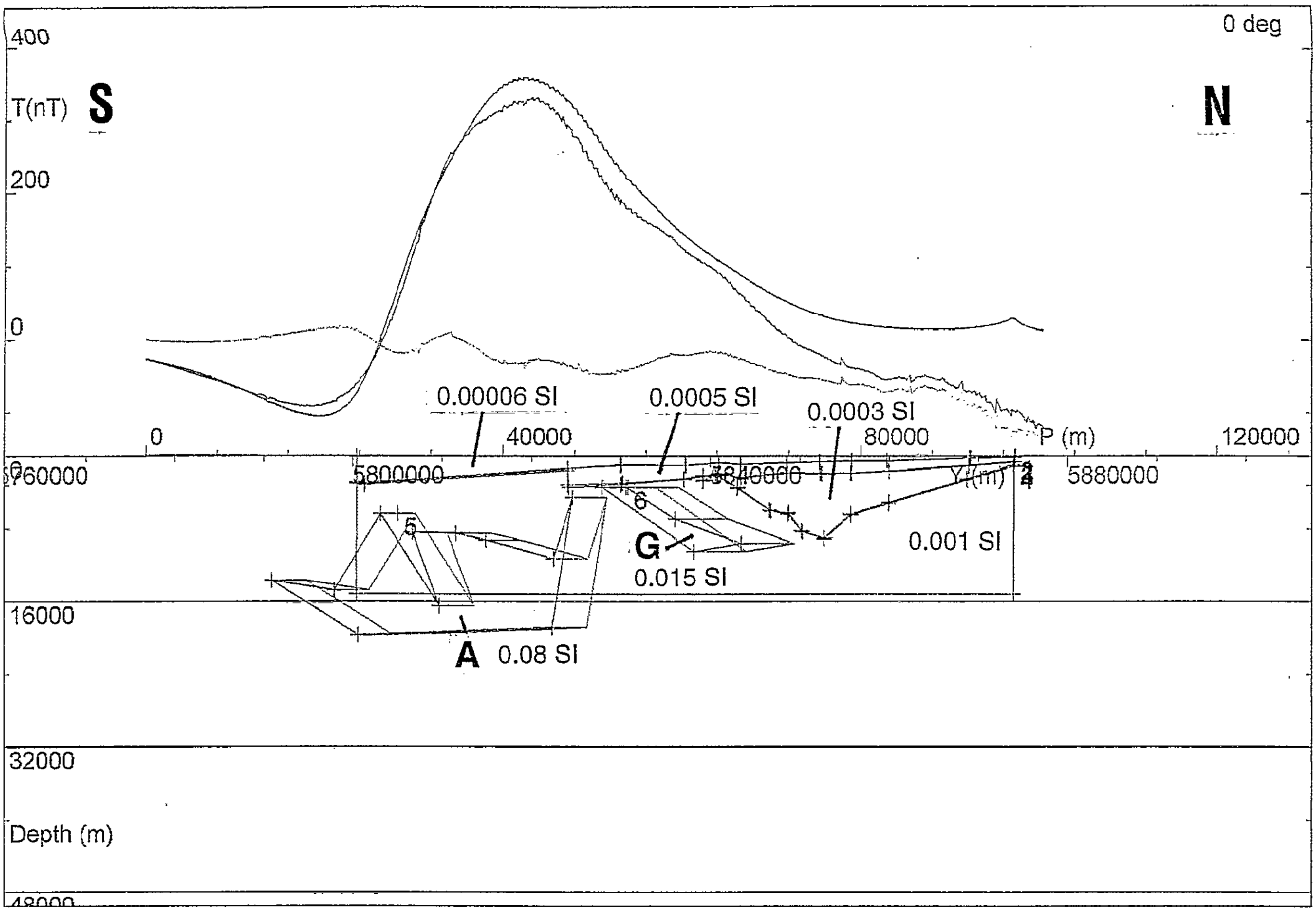
Inducing field - Intensity = 60896
Azimuth = 10
Inclination = -69

Body type abbreviations and the shape parameters have the following significance:
Poly3 - 3-D POLYGONAL PRISM - (A,C) pairs represent vertex coordinates relative to vertex #1, B = length

Model title: ANOMALY A&G SEISMIC BEDS P1SES2B.MOD

	No.	Type	X	Y	Depth	Strike	Dip	Plunge	Susc.	A	B	C	D
			m	m	m	deg	deg	deg	SI				
	1	Poly3	485111	5874157	7	90	90	0	0.00006	0	32000	0	
	2	Poly3	489111	5874046	115	90	90	0	0.00050	0	32000	0	
	3	Poly3	493111	5874083	662	90	90	0	0.00030	0	32000	0	
	4	Poly3	493111	5874013	1081	90	90	0	0.00100	0	32000	0	
A	5	Poly3	484312	5805108	6321	-75	90	0	0.08000	0	15000	0	
G	6	Poly3	479963	5830856	3357	-54	90	0	0.01500	0	10000	0	

Seismic beds 3 — 3-D polygons with susceptibility applied to sediments and to basement and including 3-D polygons for anomalies A and G — Poor fit



Observations:	485000
Profile #1;	485000E
Model:	ANOMALY A&G SEISMIC BEDS P1SES2B.MOD
Calculation mode:	Total Magnetic Intensity

Observed: ———— Calculated: ————
Residual: ———— Individual body: ————

POTENT v3.04 Profile drawn at 16:18 23/11/1994 for Preview Resources Pty. Limited

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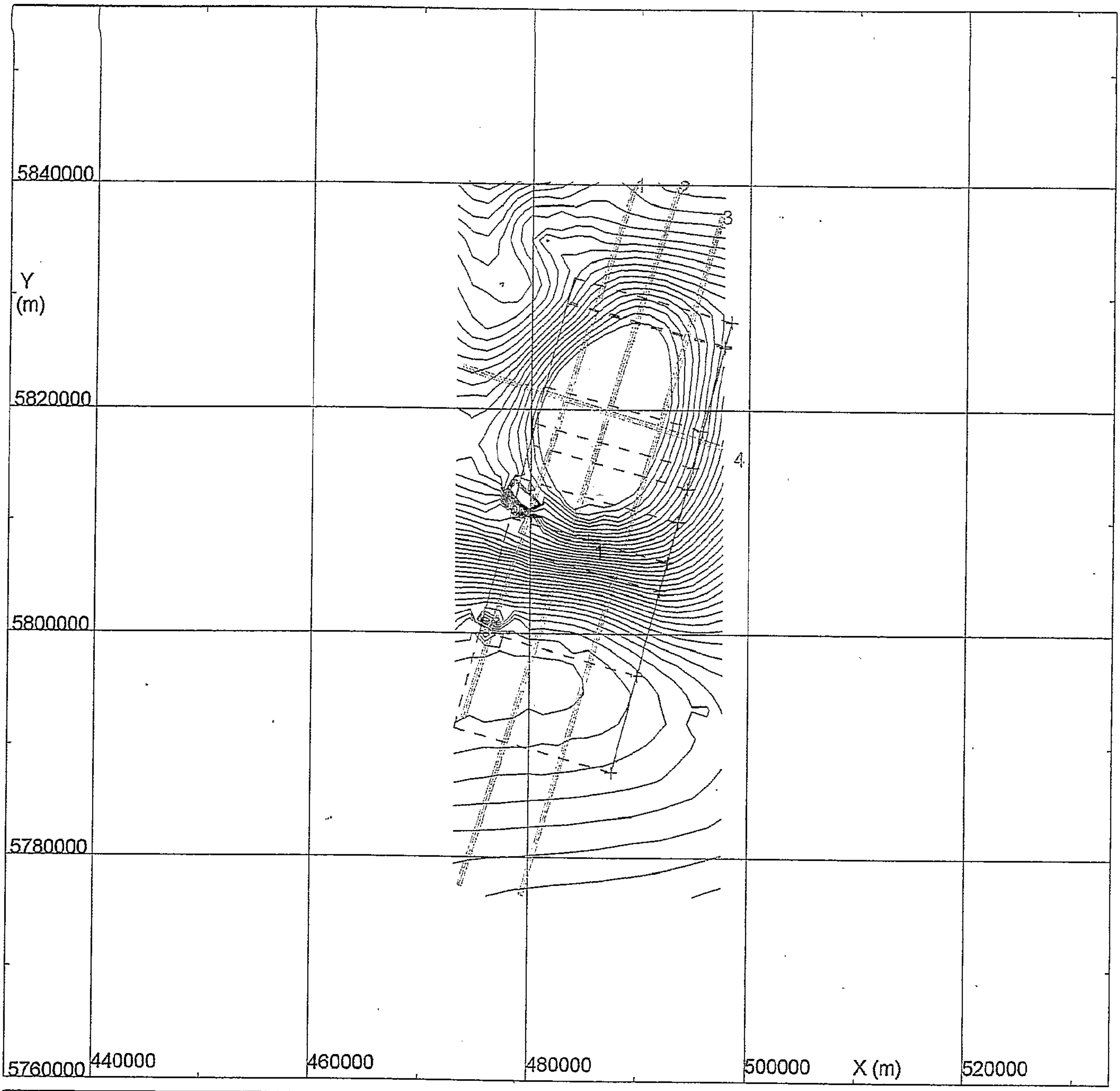
Seismic beds 3	3-D polygons with susceptibility applied to sediments and to basement and including 3-D polygons for anomalies A and G	Poor fit



Observations: P1 subset for a1, b1
Model: anomaly a, 3d polygonal prism 0.08 SI P1 P1A1d.mod
Contours of: Observed field; Contour intervals: 10.0000, 100.0000 nT
POTENT v3.04 Plan drawn at 22:33 25/01/1980 for Preview Resources Pty. Limited

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Anomaly A 3-D polygon at 5475 metres depth OK fit

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POTENT v3.04 Model Summary Report created at 15:19 09/12/1994 for Preview Resources Pty. Limited

Inducing field - Intensity = 59000
Azimuth = 5
Inclination = -63

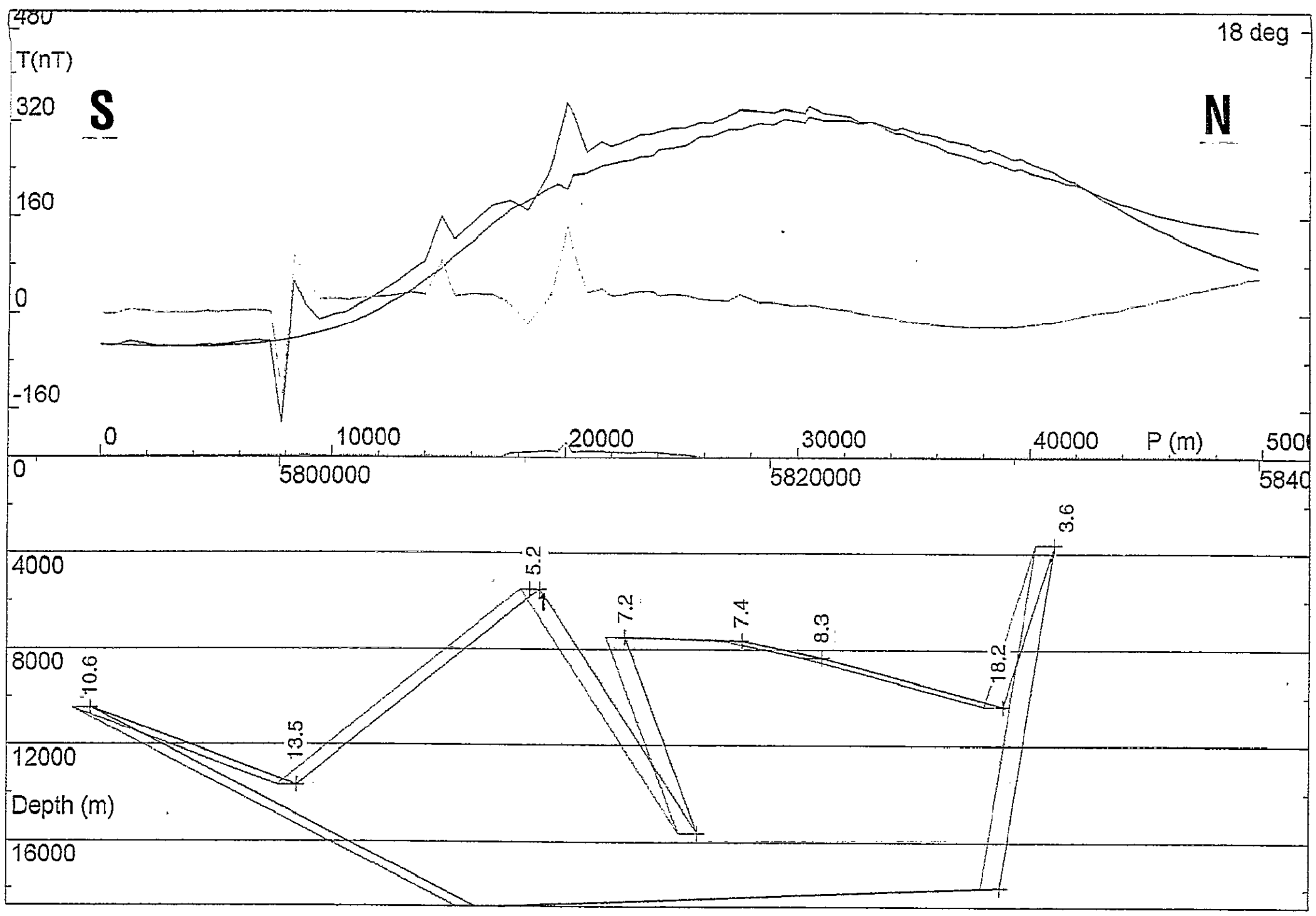
Body type abbreviations and the shape parameters have the following significance:
Poly3 - 3-D POLYGONAL PRISM - (A,C) pairs represent vertex coordinates relative to vertex #1, B = length

Model title: anomaly a, 3d polygonal prism 0.08 SI P1 P1A1d.mod

No.	Type	X	Y	Depth	Strike	Dip	Plunge	Susc.	A	B	C	D
		m	m	m	deg	deg	deg	SI				
1	Poly3	485353	5808394	5475	-75	90	0	0.060	0	15000	0	
									6811.3	10142.9		
									3665.2	2000.0		
									8715.0	2143.0		
									12147.0	2857.0		
									19968.0	4857.0		
									22165.0	-1857.0		
									19825.0	12429.0		
									-2626.9	13285.7		
									-19341.2	4964.8		
									-10424.7	8177.3		

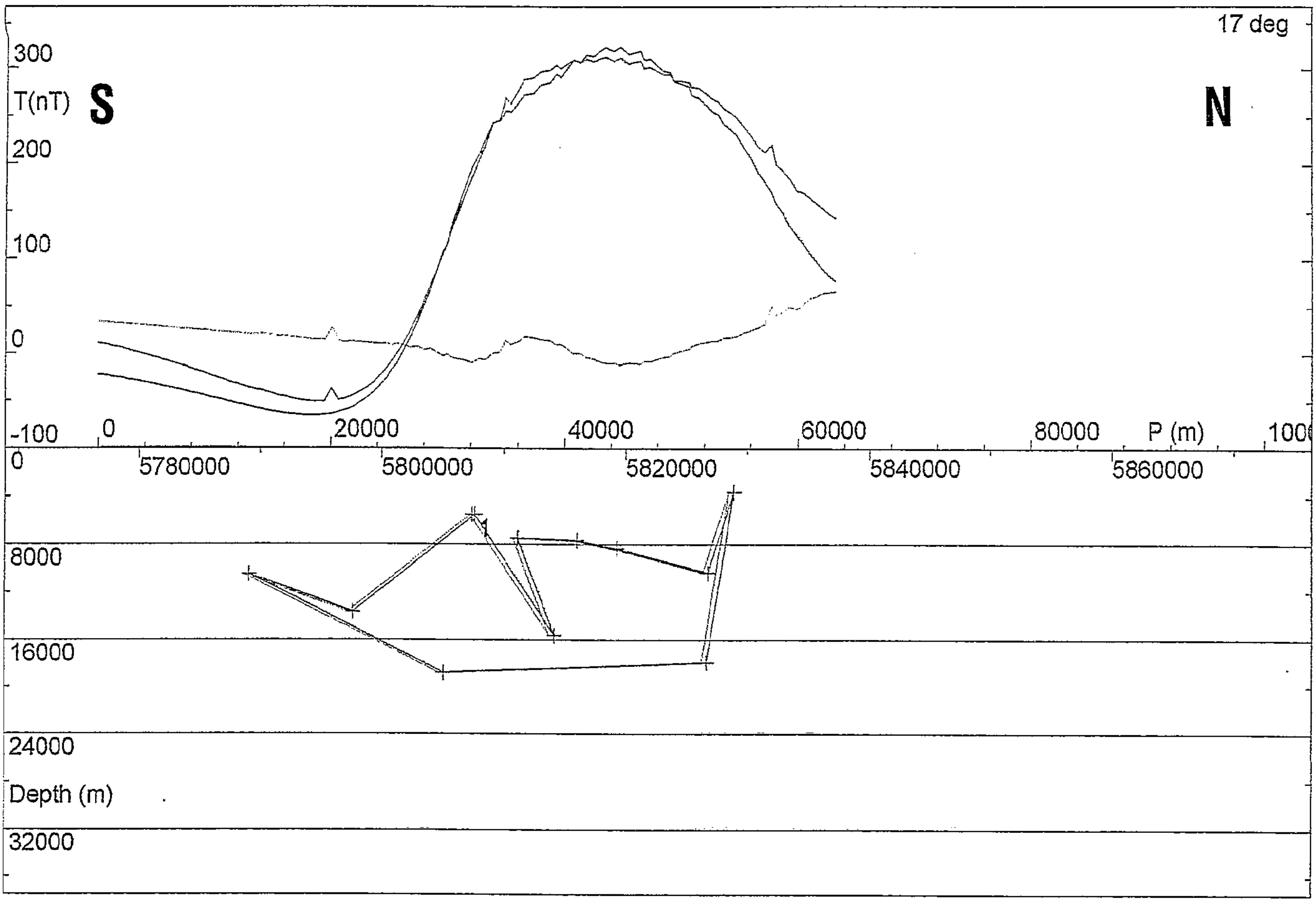
Appendix 5
95-996D MESA

Anomaly A 3-D polygon at 5475 metres depth OK fit



Observations:	P1 subset for a1, b1		
Profile #1;	NNE/400/10		
Model:	anomaly a, 3d polygonal prism 0.08 SI P1 P1A1d.mod		
Calculation mode:	Total Magnetic Intensity		
Observed:	————	Calculated:	————
Residual:	————	Individual body:	————
POTENT v3.04	Profile drawn at 22:45 25/01/1980 for Preview Resources Pty. Limited		

Anomaly A 3-D polygon at 5475 metres depth OK fit



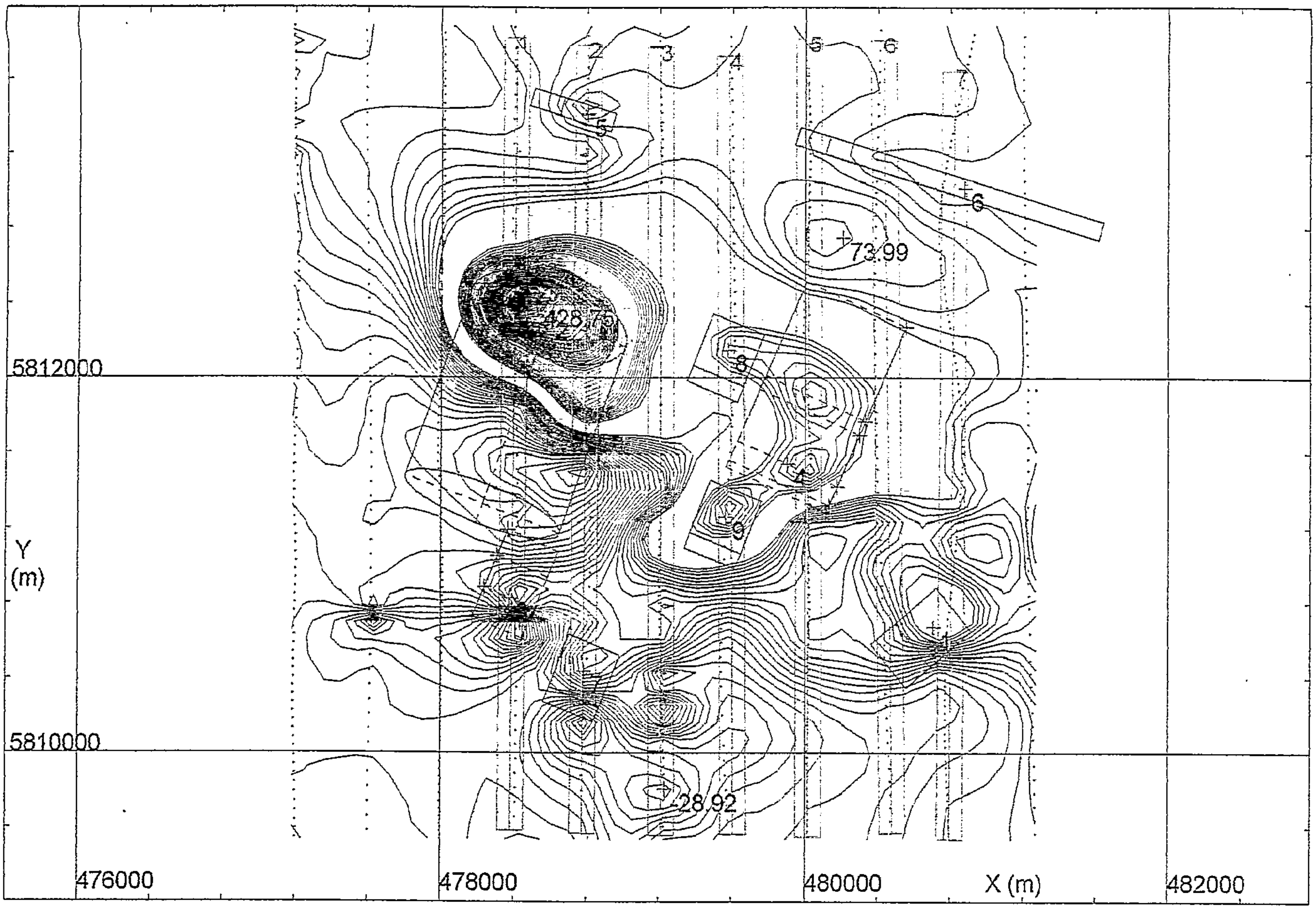
Observations: P1 subset for a1, b1
Profile #3; 3NNE/400/10
Model: anomaly a, 3d polygonal prism 0.08 SI P1 P1A1d.mod
Calculation mode: Total Magnetic Intensity

Observed: ———— Calculated: ————
Residual: ———— Individual body: ————

POTENT v3.04 Profile drawn at 22:43 25/01/1980 for Preview Resources Pty. Limited

6263BF

Anomaly A 3-D polygon at 5475 metres depth OK fit



Observations:	
Model:	Anom `B' P1B1B.MOD Mt Gambier composite of near vertical plugs. Mag susc only 0.005-0.030 SI
Contours of:	Observed field; Contour intervals: 5.0000, 50.0000 nT
POTENT v3.04	Plan drawn at 20:59 27/01/1980 for Preview Resources Pty. Limited

6263BF

Anomaly B	3-D polygons, prisms and cylinder 113 metres to 288 metres depth	Poor fit

6263BF

POTENT v3.04 Model Summary Report created at 21:13 27/01/1980 for Preview Resources Pty. Limited

Inducing field - Intensity =60100
Azimuth =6
Inclination = -63

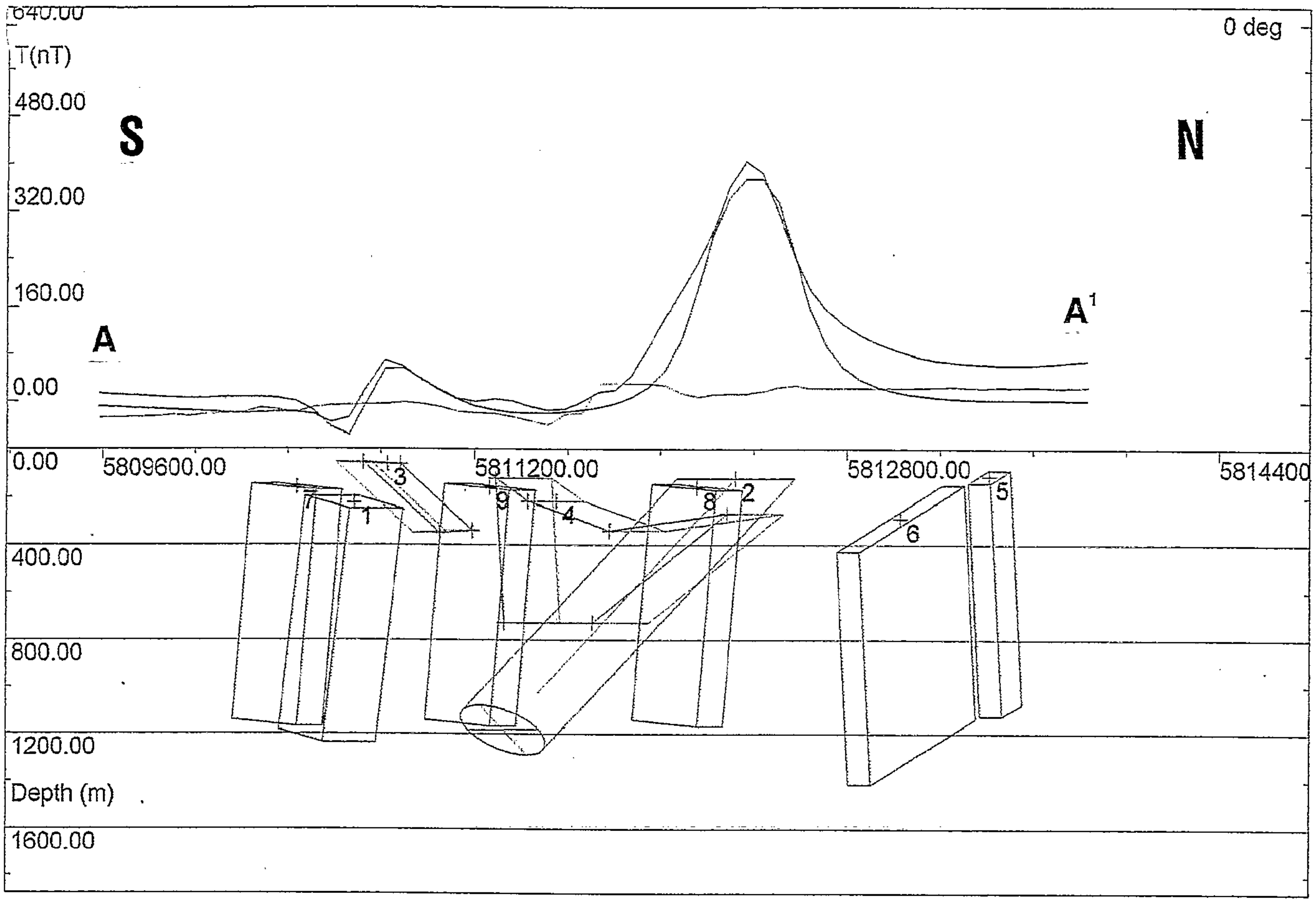
Body type abbreviations and the shape parameters have the following significance:
Cylndr - CYLINDER - A, B are axes lengths; C = thickness; D = slope
Rect - RECTANGULAR PRISM - A = width, B = length, C = height
Poly3 - 3-D POLYGONAL PRISM - (A,C) pairs represent vertex coordinates relative to vertex #1, B = length

Model title: Anom 'B' P1B1B.MOD Mt Gambier composite of near vertical plugs. Mag susc only 0.005-0.030 SI

No.	Type	X	Y	Depth	Strike	Dip	Plunge	Susc.	A	B	C	D
		m	m	m	deg	deg	deg	SI				
1	Rect	480709.7	5810672.9	222.7	-40	100	0	0.022000	300.0	300.0	1000.0	
2	Cylndr	478592.4	5812324.4	120.5	110			0.030000	300.0	900.0	1500.0	45.0
3	Poly3	478378.7	5810829.0	62.1	113	90	0	0.010000	0.0	300.0	0.0	
									174.0		-7.3	
									-182.7		284.7	
									-333.0		277.4	
4	Poly3	479905.3	5811542.7	215.4	-66	90	0	0.020000	0.0	600.0	0.0	
									383.6		124.1	
									935.1		51.1	
									303.7		511.1	
									-111.9		511.1	
									-151.9		-94.9	
5	Rect	478804.2	5813410.9	113.2	17	100	0	0.005000	300.0	100.0	1000.0	
6	Rect	480880.2	5813016.9	288.4	17	130	0	0.005000	1600.0	100.0	1000.0	
7	Rect	478790.7	5810439.4	157.0	-68	95	0	0.011000	300.0	300.0	1000.0	
8	Rect	479581.2	5812150.6	157.0	-68	95	0	0.011000	300.0	300.0	1000.0	
9	Rect	479567.1	5811261.2	157.0	-68	95	0	0.011000	300.0	300.0	1000.0	

Appendix 5
95-996E MESA

Anomaly B	3-D polygons, prisms and cylinder 113 metres to 288 metres depth	Poor fit



Observations:

Profile #1; 478400e/140/1

Model: Anom `B' P1B1B.MOD Mt Gambier composite of near vertical plugs. Mag susc only 0.005-0.030 SI

Calculation mode: Total Magnetic Intensity

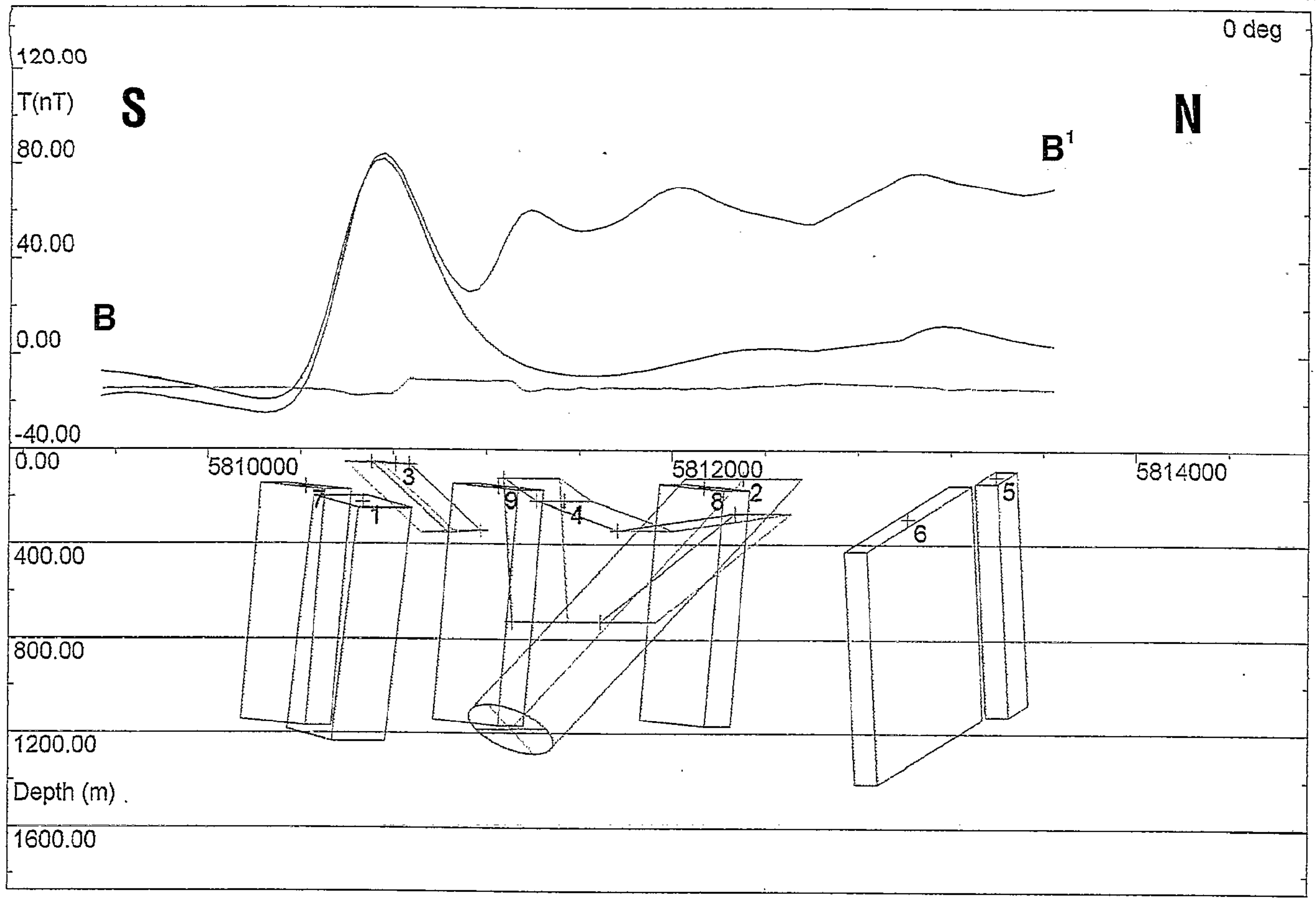
Observed: ———— Calculated: ————

Residual: ———— Individual body: ————

POTENT v3.04 Profile drawn at 20:52 27/01/1980 for Preview Resources Pty. Limited

6263BF

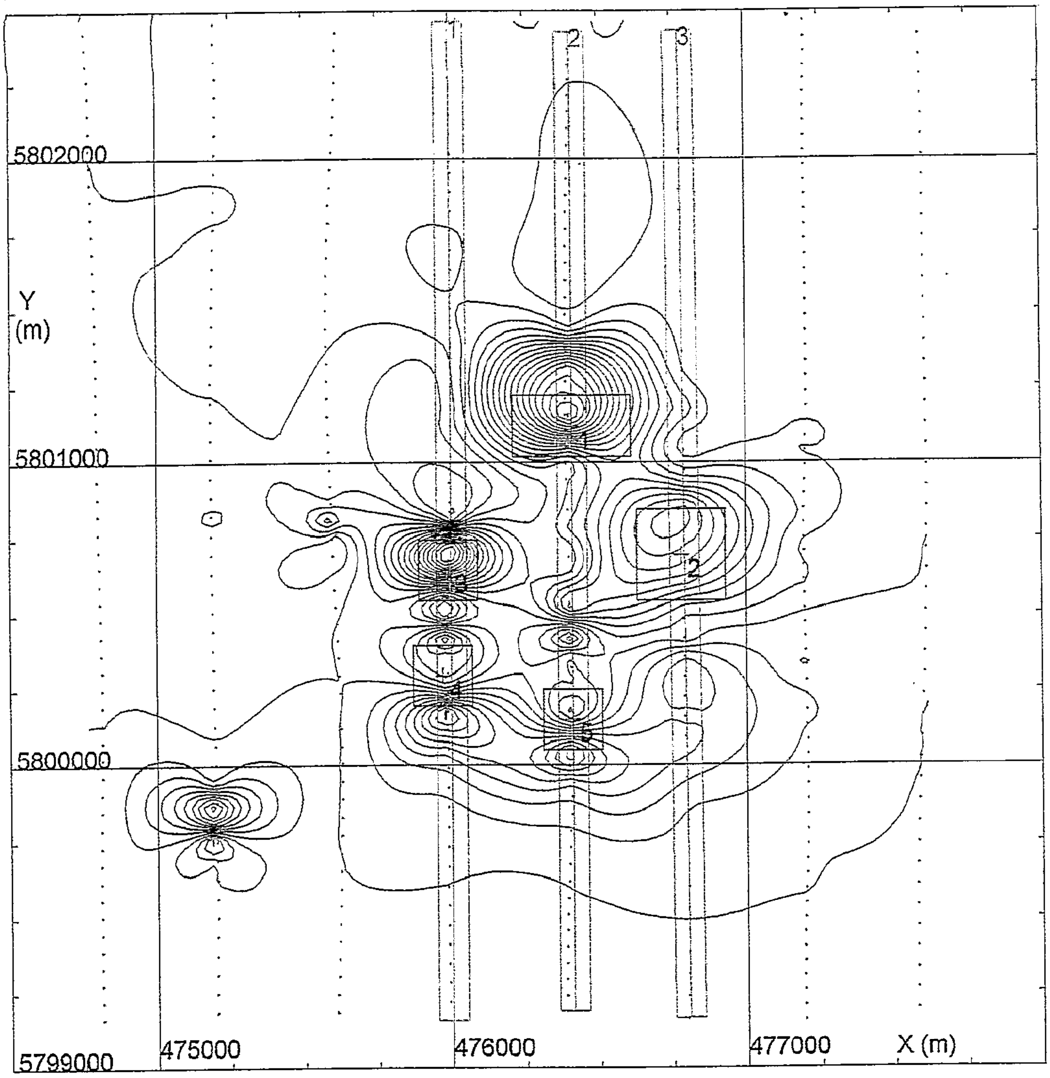
Anomaly B	3-D polygons, prisms and cylinder 113 metres to 288 metres depth	Poor fit



Observations:			
Profile #7;	480800e/140/1		
Model:	Anom `B' P1B1B.MOD Mt Gambier composite of near vertical plugs. Mag susc only 0.005-0.030 SI		
Calculation mode:	Total Magnetic Intensity		
Observed:	____________	Calculated:	____________
Residual:	____________	Individual body:	____________
POTENT v3.04	Profile drawn at 21:10 27/01/1980 for Preview Resources Pty. Limited		

6263BF

Anomaly B	3-D polygons, prisms and cylinder 113 metres to 288 metres depth	Poor fit



Observations:
Model: P1 C AATP1C.MOD SI 0.03-0.01
Contours of: Observed field; Contour intervals: 20.0000, 100.0000 nT
POTENT v3.04 Plan drawn at 09:25 28/11/1994 for Preview Resources Pty. Limited

6263BF

Anomaly C prisms 35 metres to 43 metres depth Poor fit

6263BF

POTENT v3.04 Model Summary Report created at 09:34 28/11/1994 for Preview Resources Pty. Limited

Inducing field - Intensity = 60896
Azimuth = 10
Inclination = -69

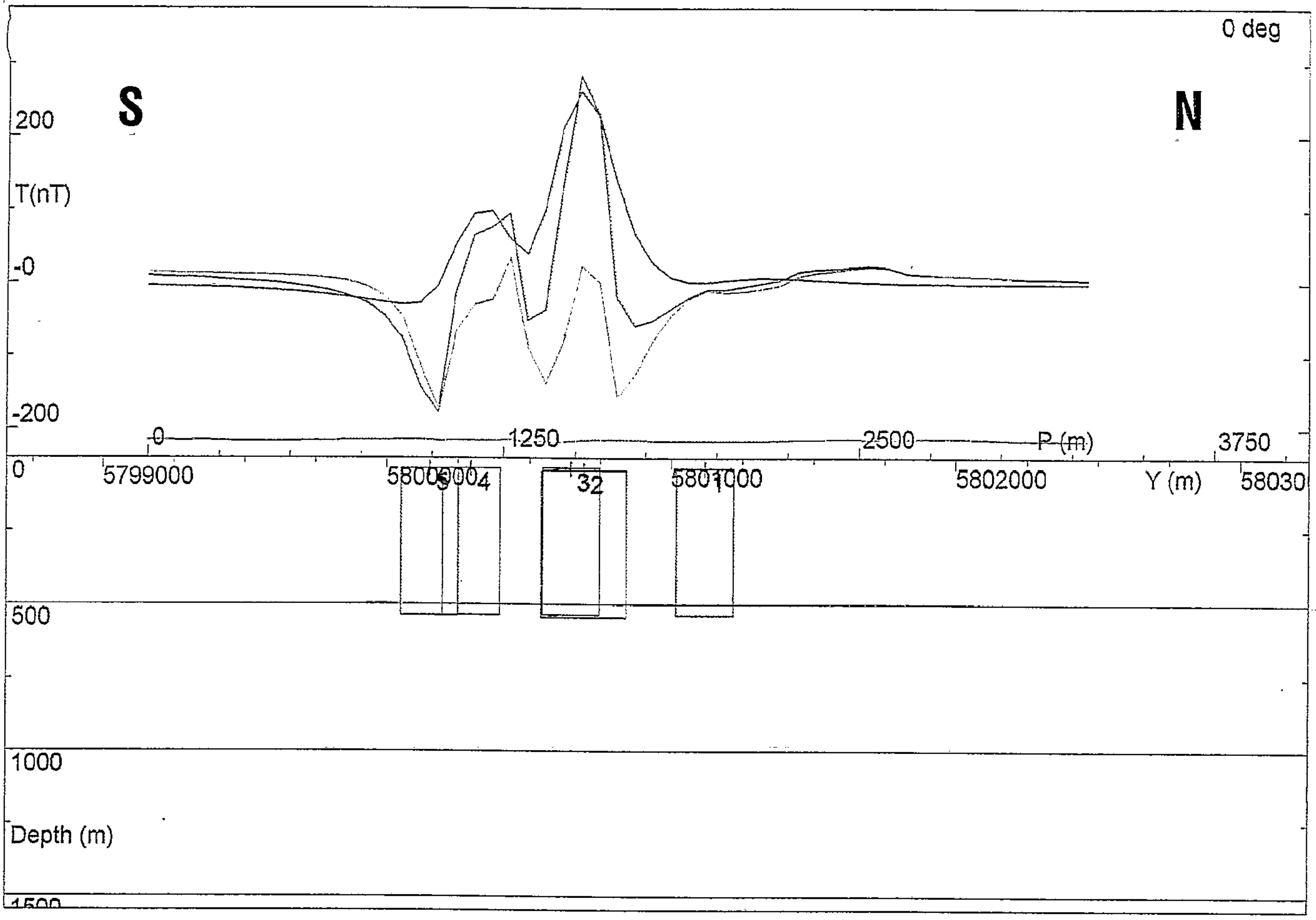
Body type abbreviations and the shape parameters have the following significance:
Rect - RECTANGULAR PRISM - A = width, B = length, C = height

Model title: P1 C AATP1C.MOD SI 0.03-0.01

No.	Type	X	Y	Depth	Strike	Dip	Plunge	Susc.	A	B	C	D
		m	m	m	deg	deg	deg	SI				
1	Rect	476410	5801120	35.71	0	90	0	0.0300	400.00	200.00	500.00	
2	Rect	476781	5800695	42.86	0	90	0	0.0170	300.00	300.00	500.00	
3	Rect	475991	5800647	35.71	0	90	0	0.0300	200.00	200.00	500.00	
4	Rect	475972	5800297	35.71	0	90	0	0.0150	200.00	200.00	500.00	
5	Rect	476410	5800152	35.71	0	90	0	0.0100	200.00	200.00	500.00	

Appendix 5
95-996F MESA

Anomaly C   prisms 35 metres to 43 metres depth   Poor fit



Observations:

Profile #1; 476000

Model: P1 C AATP1C.MOD SI 0.03-0.01

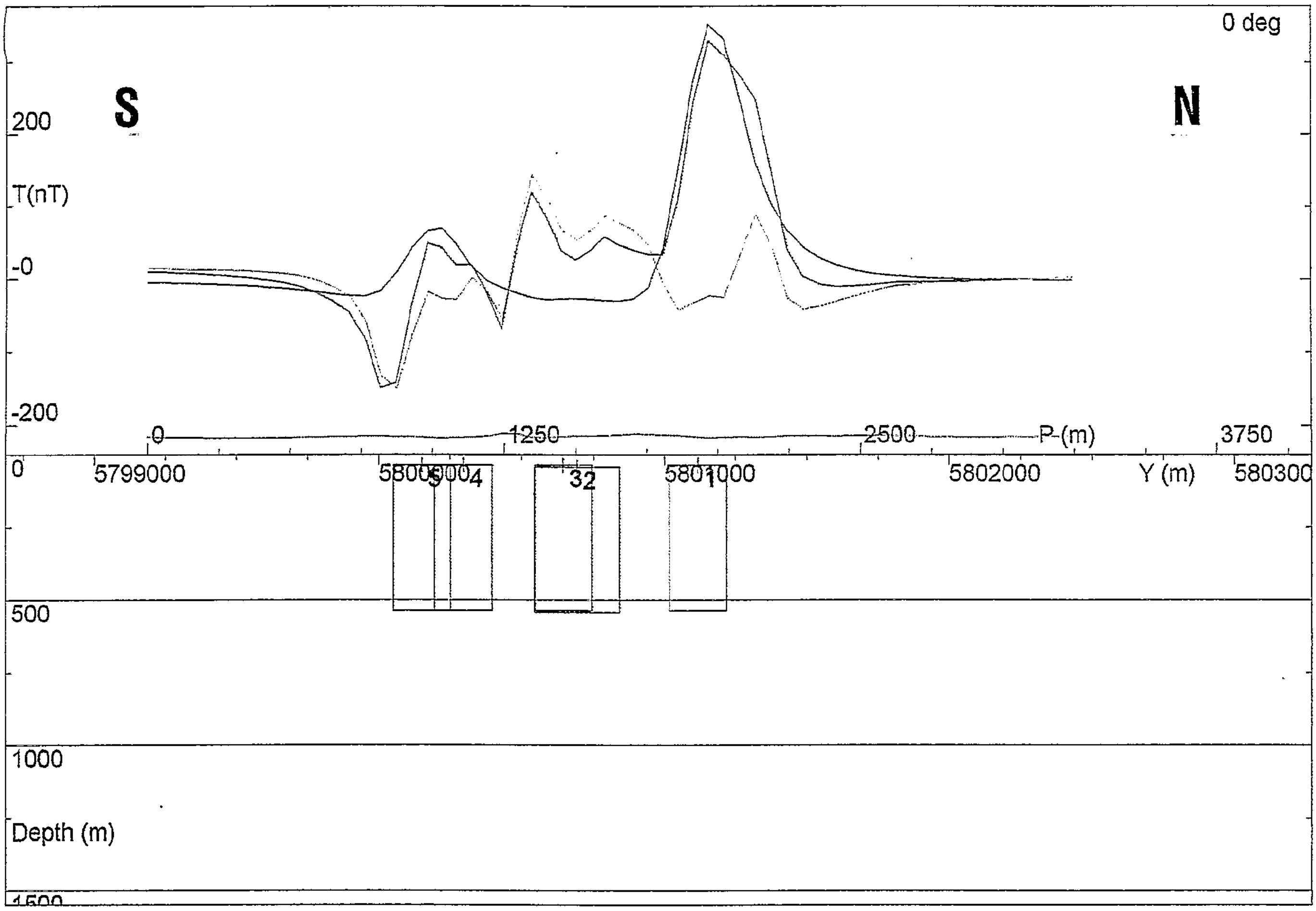
Calculation mode: Total Magnetic Intensity

Observed: ______ Calculated: ______

Residual: ______ Individual body: ______

POTENT v3.04 Profile drawn at 09:28 28/11/1994 for Preview Resources Pty. Limited

Anomaly C prisms 35 metres to 43 metres depth Poor fit



Observations:

Profile #2; 476400

Model: P1 C AATP1C.MOD SI 0.03-0.01

Calculation mode: Total Magnetic Intensity

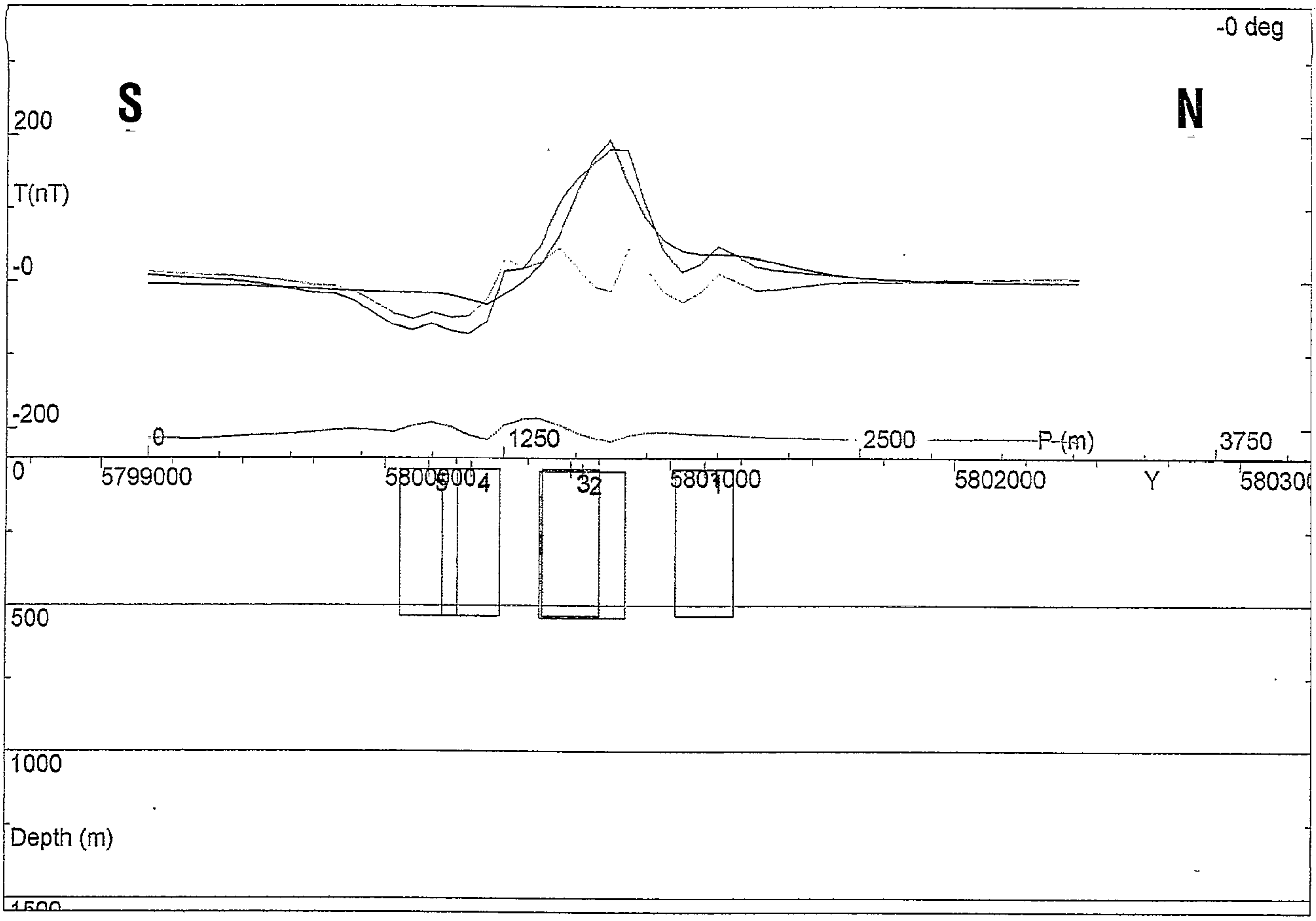
Observed: ———— Calculated: ————

Residual: ———— Individual body: ————

POTENT v3.04 Profile drawn at 09:29 28/11/1994 for Preview Resources Pty. Limited

6263BF

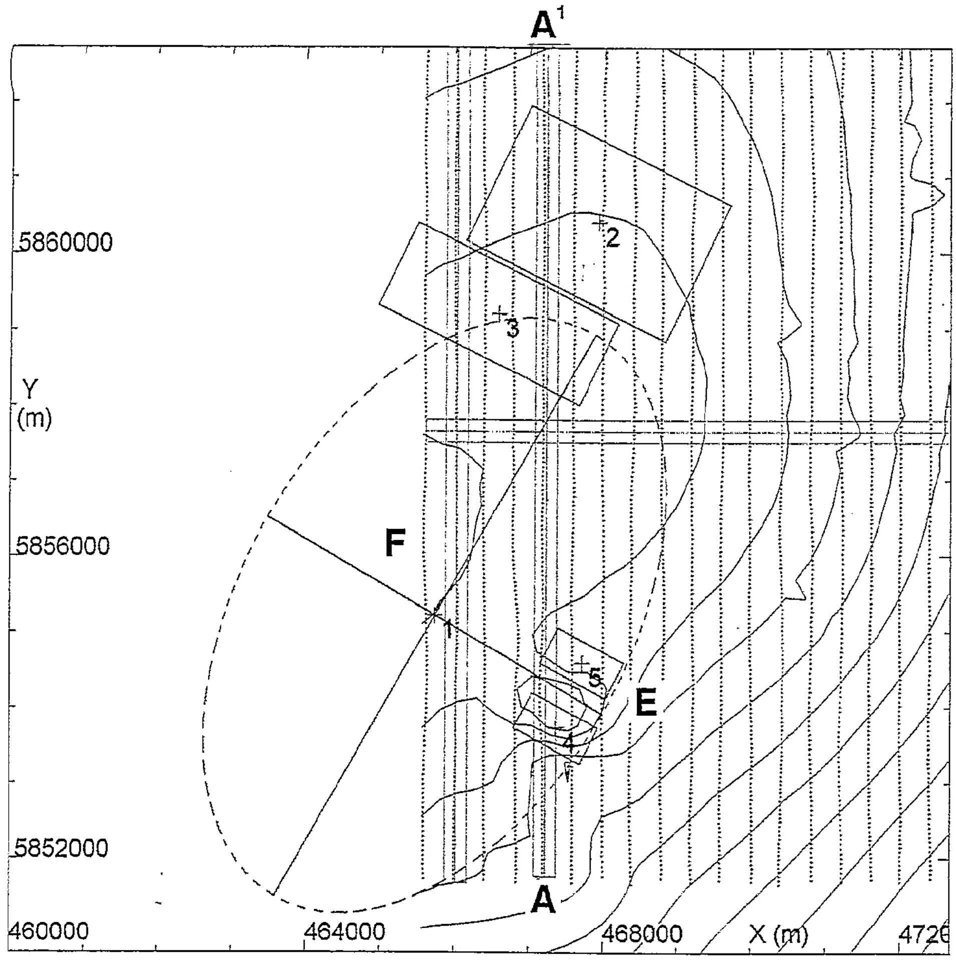
Anomaly C prisms 35 metres to 43 metres depth Poor fit



Observations:	
Profile #3;	476800
Model:	P1 C AATP1C.MOD SI 0.03-0.01
Calculation mode:	Total Magnetic Intensity
Observed: ————	Calculated: ————
Residual: ————	Individual body: ————
POTENT v3.04	Profile drawn at 09:32 28/11/1994 for Preview Resources Pty. Limited

6263BF

Anomaly C prisms 35 metres to 43 metres depth Poor fit



Observations:		
Model:	ANOMALIES F&E ABVP1F.MOD	
Contours of:	Observed field;	Contour intervals: 20.0000, 100.0000 nT
POTENT v3.04	Plan drawn at 21:18 07/12/1994 for Preview Resources Pty. Lim	

6263BF

Anomaly E	418 metre thick prisms 257 to 266 metres depth	OK fit
Anomaly F	ellipsoid and prisms 2485 to 2556 metres depth	OK fit

6263BF

POTENT v3.04 Model Summary Report created at 21:30 07/12/1994 for Preview Resources Pty. Limited

Inducing field - Intensity = 60896
Azimuth = 10
Inclination = -69

Body type abbreviations and the shape parameters have the following significance:
Ellpsd - ELLIPSOID - A, B, C are axes lengths
Rect - RECTANGULAR PRISM - A = width, B = length, C = height

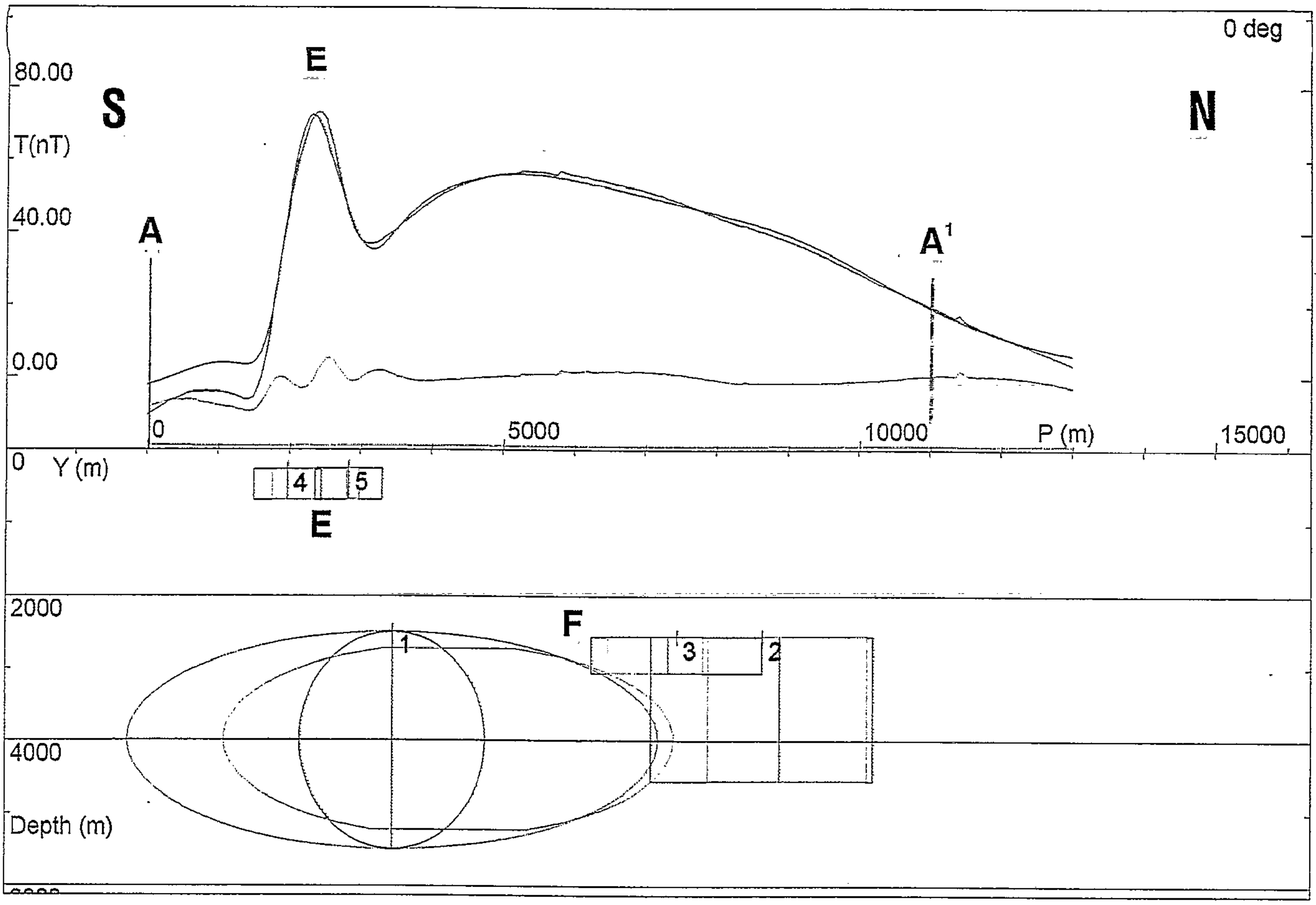
Model title: ANOMALIES F&E ABVP1F.MOD

No.	Type	X	Y	Depth	Strike	Dip	Plunge	Susc.	Rem f	Rem az	Rem inc	A	B	C	D
		m	m	m	deg	deg	deg	SI	Amp/m	deg	deg				
1	Ellpsd	465741	5855214	2485	30	90	0	0.0125	0.000	0	0	5200.0	8600.0	3000.0	
2	Rect	467929	5860400	2556	26	90	0	0.0100	0.000	0	0	3000.0	2000.0	2000.0	
3	Rect	466588	5859200	2556	26	90	0	0.0100	0.000	0	0	3000.0	1200.0	500.0	
4	Rect	467370	5853720	266	-62	90	0	0.0000	0.350	0	-47	531.8	1001.5	418.0	
5	Rect	467717	5854583	257	-62	90	0	0.0000	-0.200	0	-47	531.8	1001.5	418.0	

Appendix 5
95-996G MESA

Anomaly E 418 metre thick prisms 257 to 266 metres depth *OK fit*

Anomaly F ellipsoid and prisms 2485 to 2556 metres depth OK fit



Observations:

Profile #2; 467200

Model: ANOMALIES F&E ABVP1F.MOD

Calculation mode: Total Magnetic Intensity

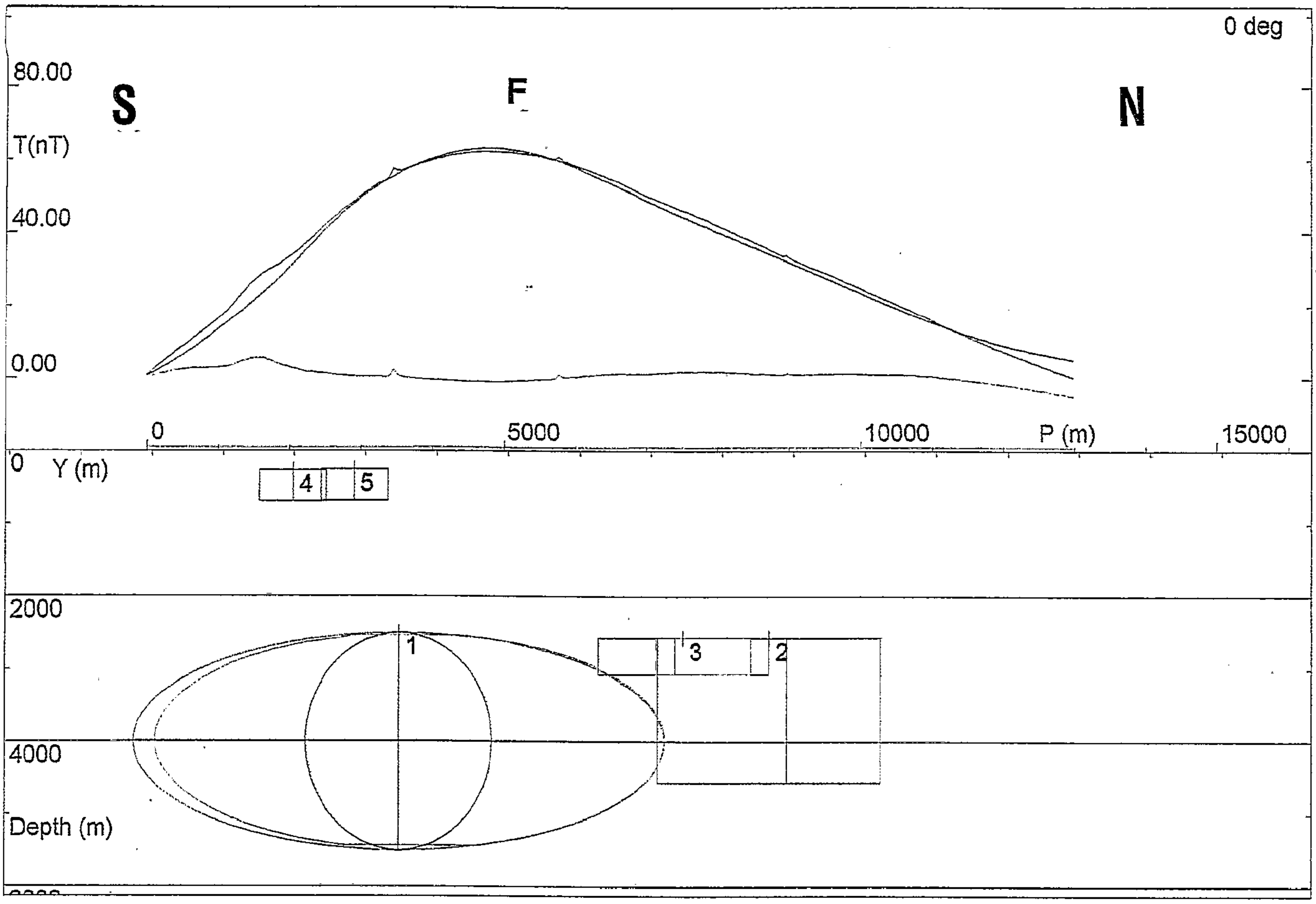
Observed: ______ Calculated: ______

Residual: ______ Individual body: ______

POTENT v3.04 Profile drawn at 21:24 07/12/1994 for Preview Resources Pty. Limited

6263BF

Anomaly E	418 metre thick prisms 257 to 266 metres depth	OK fit
Anomaly F	ellipsoid and prisms 2485 to 2556 metres depth	OK fit



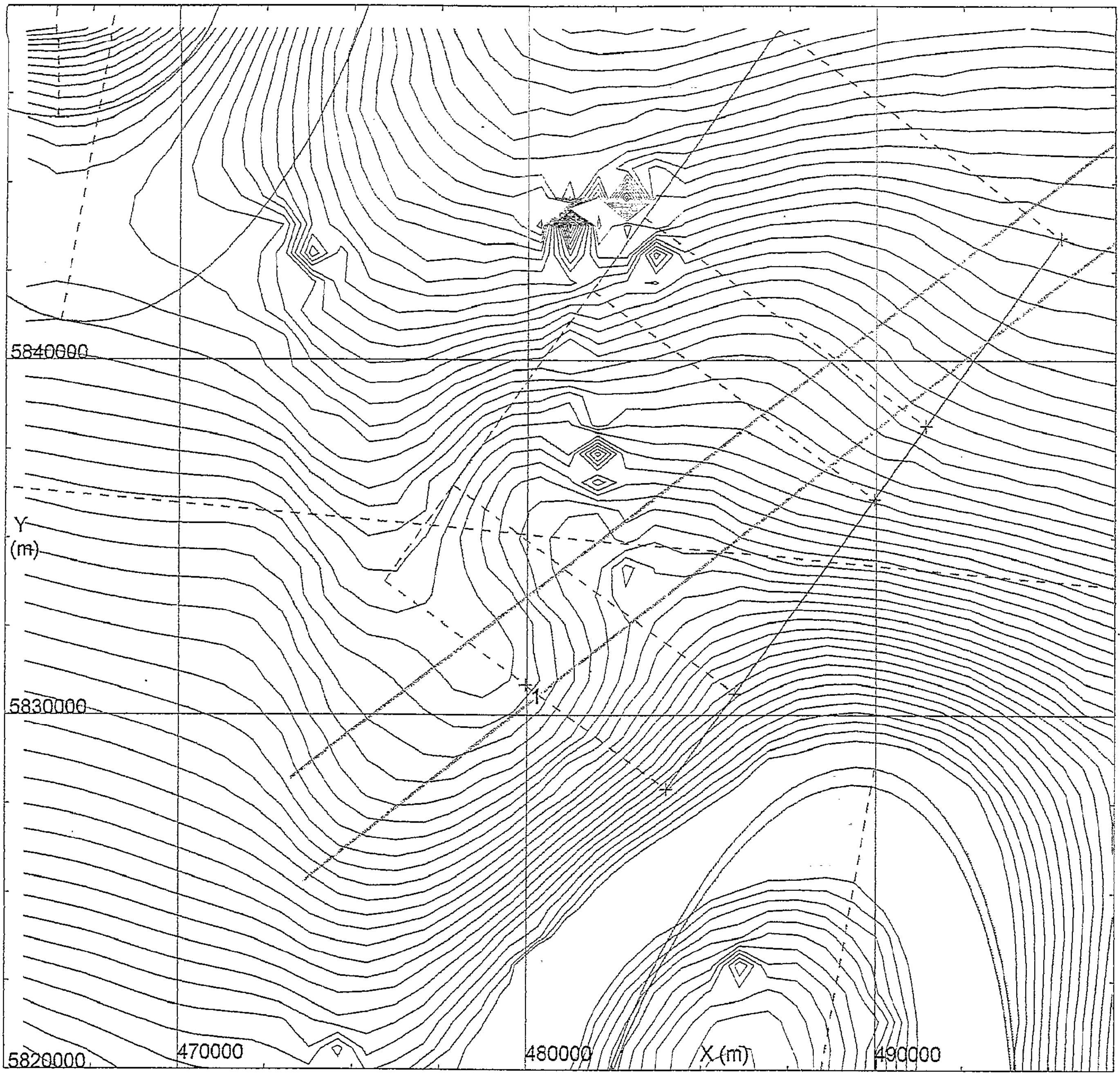
Observations:
Profile #1; 466000
Model: ANOMALIES F&E ABVP1F.MOD
Calculation mode: Total Magnetic Intensity

Observed: ———— Calculated: ————
Residual: ———— Individual body: ————

POTENT v3.04 Profile drawn at 21:28 07/12/1994 for Preview Resources Pty. Limited

6263BF

Anomaly E	418 metre thick prisms 257 to 266 metres depth	OK fit
Anomaly F	ellipsoid and prisms 2485 to 2556 metres depth	OK fit



Observations:
Model: a,g,e: p1a3b.mod composite (data p1a.obs)
Contours of: Observed field; Contour intervals: 5.0000, 50.0000 nT
POTENT v3.04 Plan drawn at 20:43 29/01/1980 for Preview Resources Pty. Limited

6263BF

Anomaly G 3-D polygon 3357 metres depth Poor fit

6263BF

POTENT v3.04 Model Summary Report created at 20:51 29/01/1980 for Preview Resources Pty. Limited

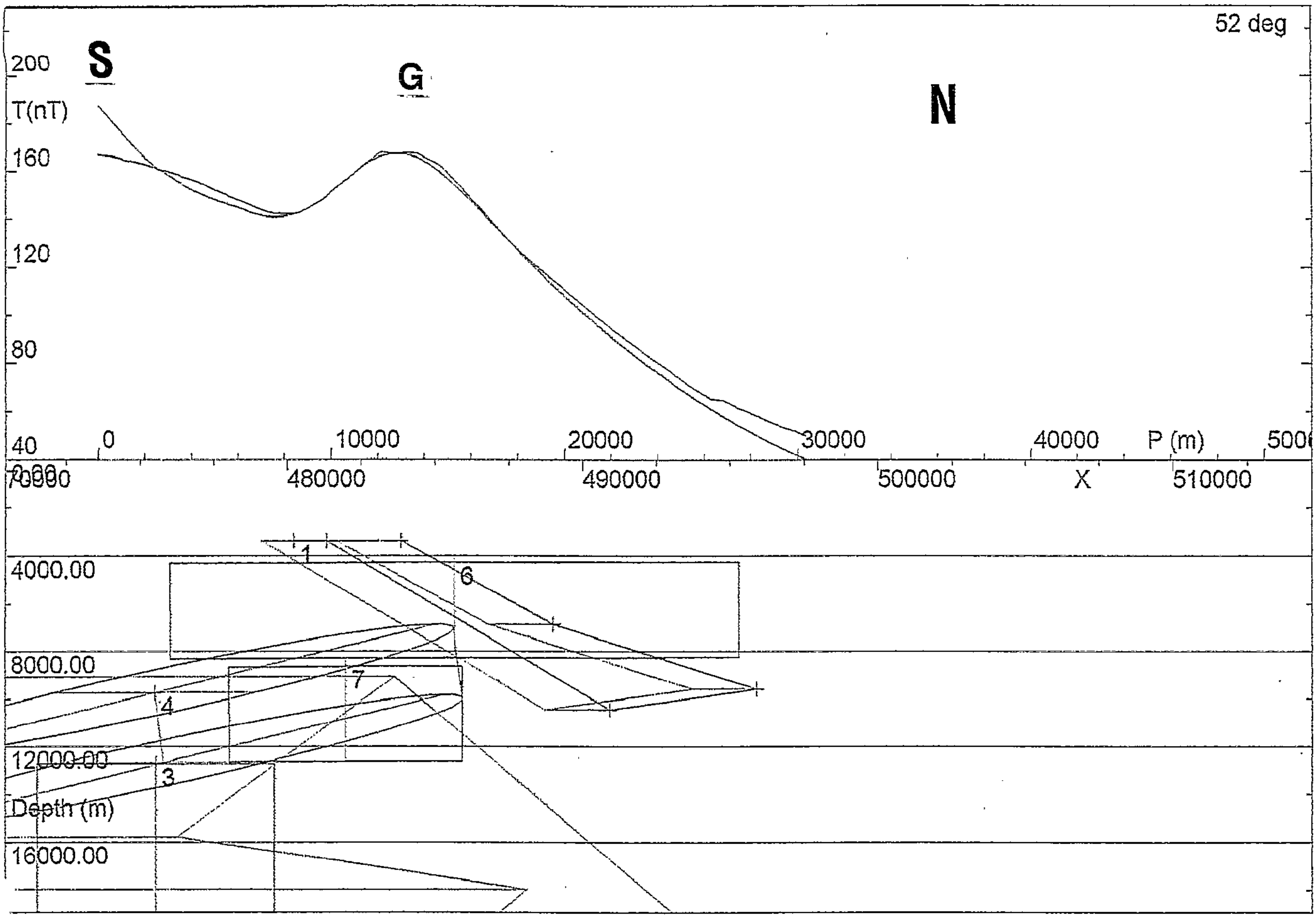
Inducing field - Intensity = 61000
Azimuth = 5
Inclination = -61

Body type abbreviations and the shape parameters have the following significance:
Cylndr - CYLINDER - A, B are axes lengths; C = thickness; D = slope
Poly3 - 3-D POLYGONAL PRISM - (A,C) pairs represent vertex coordinates relative to vertex #1, B = length

Model title: a,g,e: p1a3b.mod composite (data p1a.obs)

	No.	Type	X	Y	Depth	Strike	Dip	Plunge	Susc.	A	B	C	D
			m	m	m	deg	deg	deg	SI				
G	1	Poly3	479963.6	5830856.8	3357.1	-54	90	0	0.015000	0.0	10000.0	0.0	
										3328.0		0.0	
										10116.7		3500.0	
										19218.3		6214.3	
										12652.1		7071.4	
A	2	Poly3	481400.0	5793990.0	15749.0	95	90	0	0.057511	0.0	45000.0	0.0	
										-22041.0		2211.0	
										-18739.0		4033.0	
										-40842.0		8594.0	
										-13684.0		-6700.0	
	3	Cylndr	487057.1	5812078.0	12714.3	10			0.050000	5000.0	13000.0	7000.0	90.0
	4	Cylndr	487059.0	5812000.0	9714.0	10			0.050000	13000.0	33000.0	3000.0	90.0
	6	Cylndr	469211.4	5855898.9	4260.9	-80			0.025000	30000.0	15000.0	4000.0	90.0
	7	Cylndr	466470.6	5851823.5	8623.2	-90			0.050000	10000.0	10000.0	4000.0	90.0

Anomaly G 3-D polygon 3357 metres depth Poor fit



Observations:

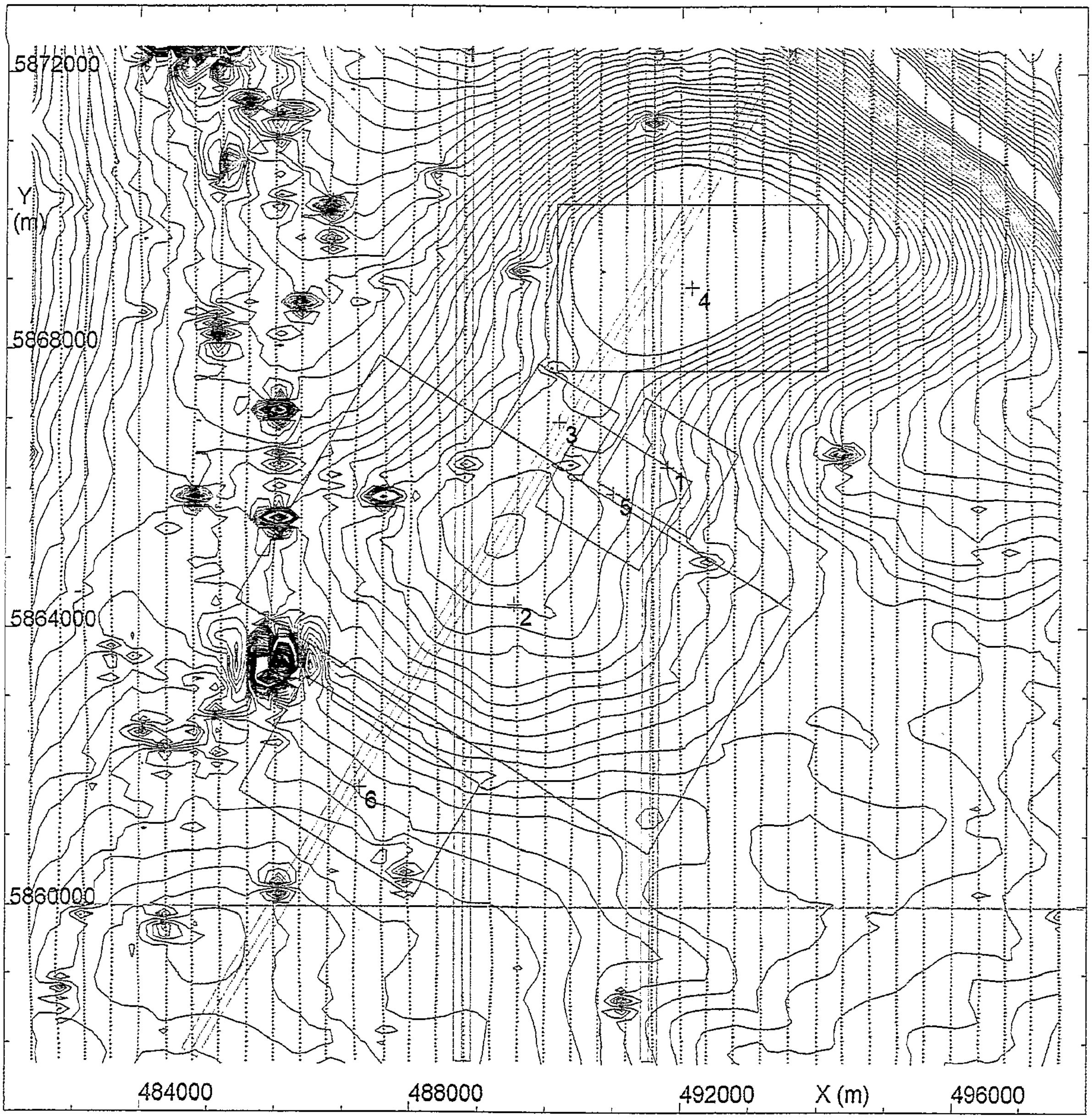
Profile #3; p1a.obs across g:
Model: a,g,e: p1a3b.mod composite (data p1a.obs)
Calculation mode: Total Magnetic Intensity

Observed: ———— Calculated: ————
Residual: ———— Individual body: ————

POTENT v3.04 Profile drawn at 20:48 29/01/1980 for Preview Resources Pty. Limited

6263BF

Anomaly G 3-D polygon 3357 metres depth Poor fit



Observations:	
Model:	ANOMALY H REM ACFP1H.MOD
Contours of:	Observed field; Contour intervals: 2.0000, 10.0000 nT
POTENT v3.04	Plan drawn at 15:09 09/12/1994 for Preview Resources Pty. Limited

6263BF

Anomaly H prisms 300 to 1000 metres depth OK fit

6263BF

POTENT v3.04 Model Summary Report created at 15:11 09/12/1994 for Preview Resources Pty. Limited

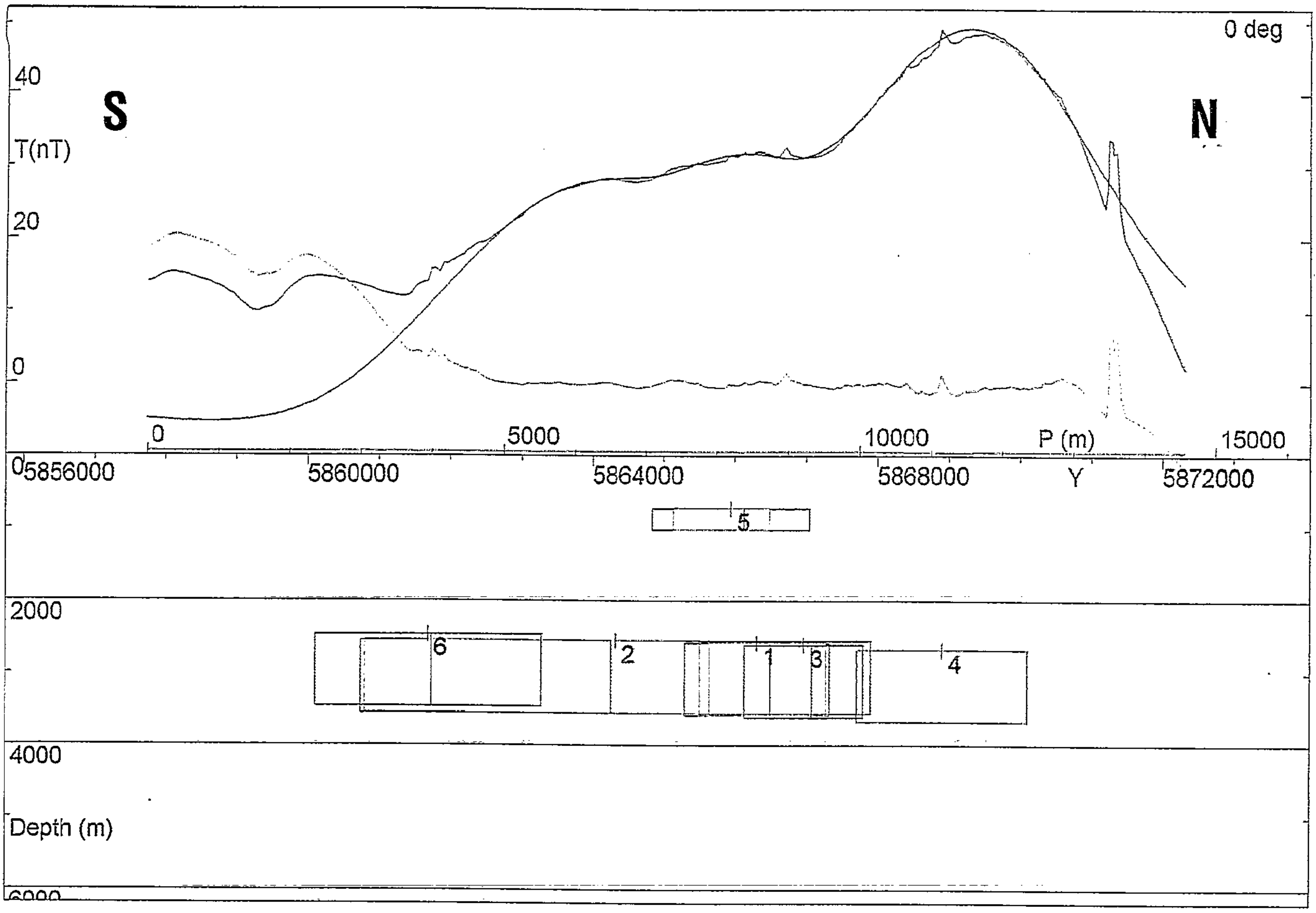
Inducing field - Intensity = 60896
Azimuth = 10
Inclination = -69

Body type abbreviations and the shape parameters have the following significance:
Rect - RECTANGULAR PRISM - A = width, B = length, C = height

Model title: ANOMALY H REM ACFP1H.MOD

No.	Type	X	Y	Depth	Strike	Dip	Plunge	Susc.	Rem f	Rem az	Rem inc	A	B	C	D
		m	m	m	deg	deg	deg	SI	Amp/m	deg	deg				
1	Rect	491805	5866317	2571	31	90	0	0.000	0.550	0	-75	1600.0	1400.0	1000.0	
2	Rect	489532	5864341	2542	31	90	0	0.000	0.620	0	-90	7100.0	4093.3	1000.0	
3	Rect	490200	5866976	2600	31	90	0	0.000	0.500	0	-75	1400.0	1100.0	1000.0	
4	Rect	492160	5868907	2672	0	90	0	0.000	1.320	0	-75	4000.0	2400.0	1000.0	
5	Rect	490999	5865948	714	31	90	0	0.000	0.090	0	-75	1800.0	1500.0	300.0	
6	Rect	487257	5861707	2457	31	90	0	0.000	0.363	0	-90	2996.0	1900.0	1000.0	

Anomaly H prisms 300 to 1000 metres depth OK fit



Observations:	
Profile #2;	491600
Model:	ANOMALY H REM ACFP1H.MOD
Calculation mode:	Total Magnetic Intensity

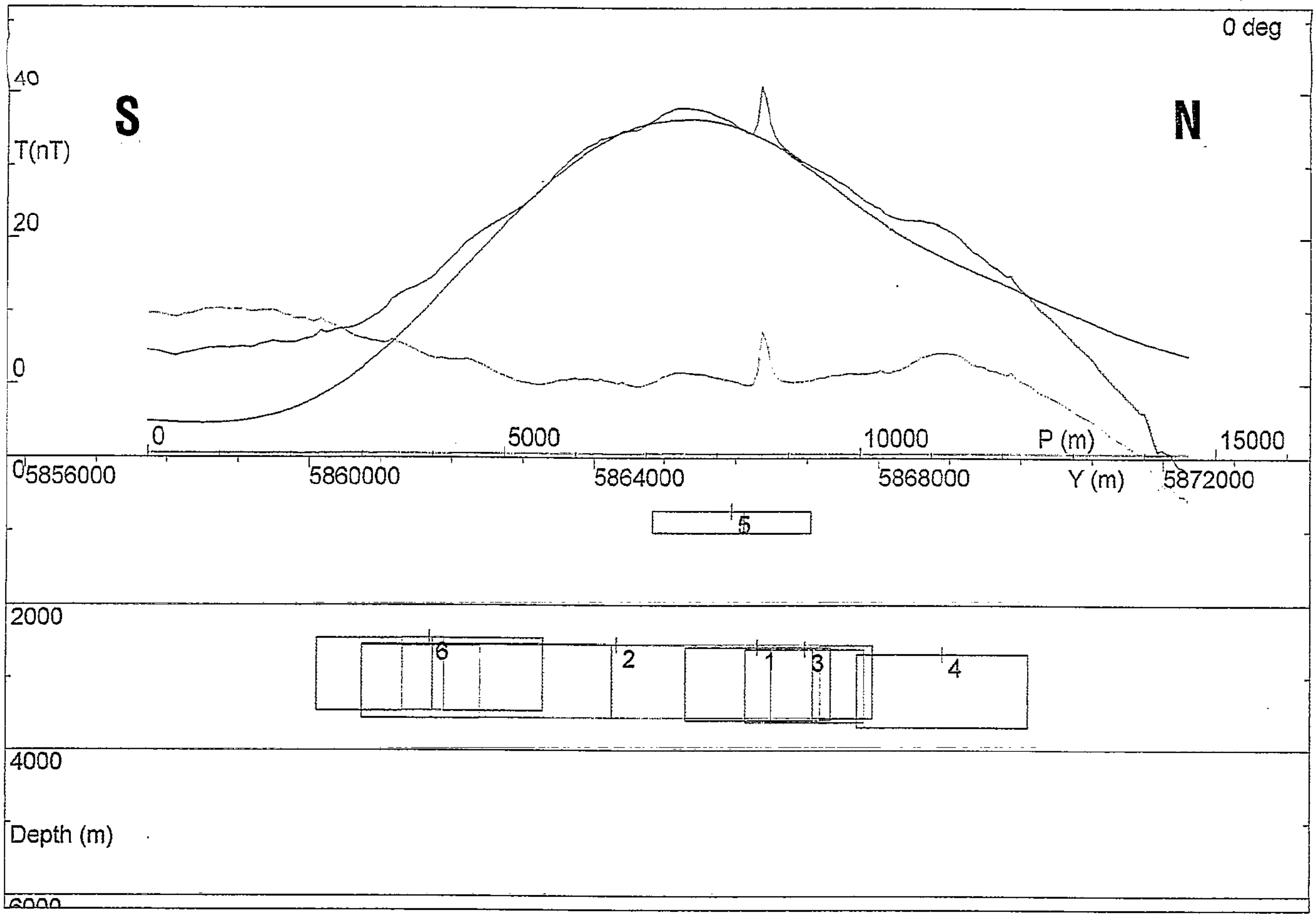
Observed: ―――――― Calculated: ――――――

Residual: ―――――― Individual body: ――――――

POTENT v3.04 Profile drawn at 15:06 09/12/1994 for Preview Resources Pty. Limited

6263BF

Anomaly H prisms 300 to 1000 metres depth OK fit



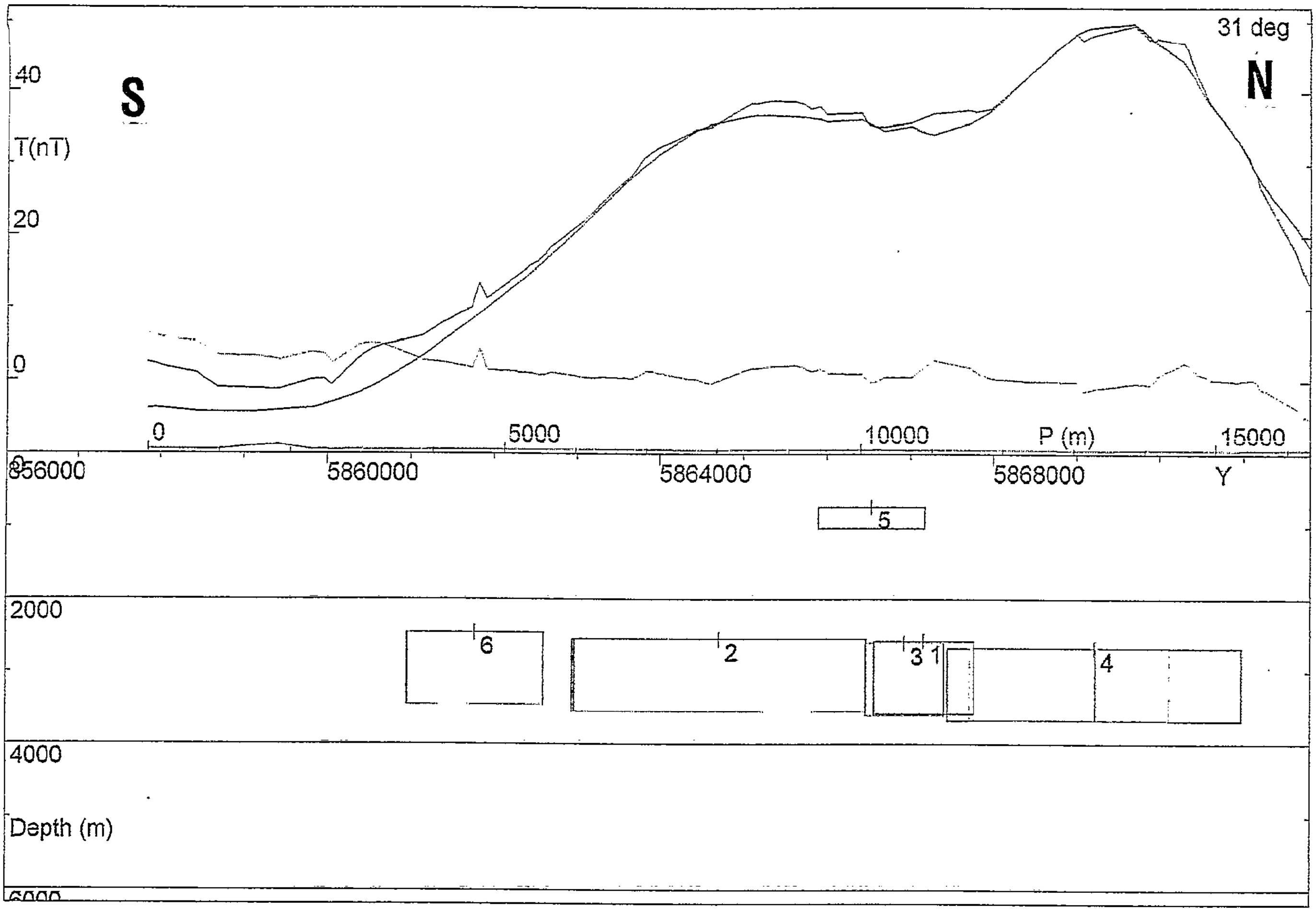
Observations:
Profile #1; 488800
Model: ANOMALY H REM ACFP1H.MOD
Calculation mode: Total Magnetic Intensity

Observed: ———— Calculated: ————
Residual: ———— Individual body: ————

POTENT v3.04 Profile drawn at 15:02 09/12/1994 for Preview Resources Pty. Limited

6263BF

Anomaly H prisms 300 to 1000 metres depth OK fit



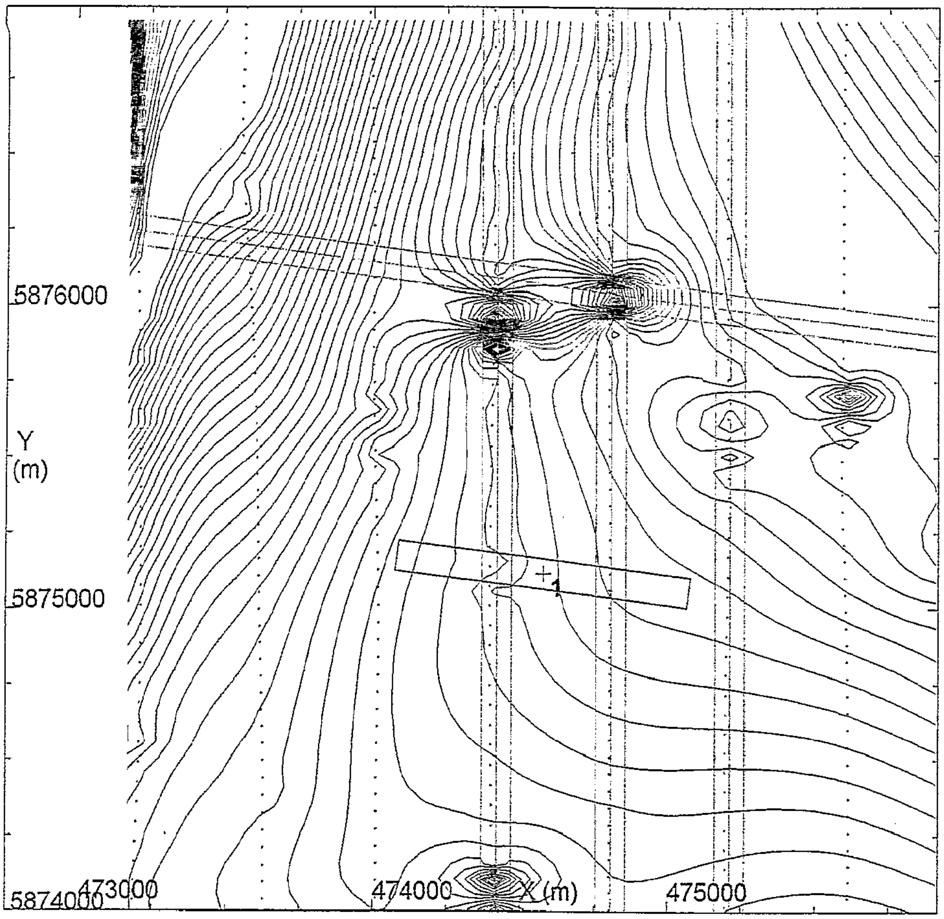
Observations:
Profile #4;
Model: ANOMALY H REM ACFP1H.MOD
Calculation mode: Total Magnetic Intensity

Observed: ______________ Calculated: ______________
Residual: ______________ Individual body: ______________

POTENT v3.04 Profile drawn at 15:07 09/12/1994 for Preview Resources Pty. Limited

6263BF

Anomaly H prisms 300 to 1000 metres depth OK fit



Observations:		
Model:		
Contours of:	Observed field;	Contour intervals: 1.0000, 5.0000 nT
POTENT v3.04	Plan drawn at 17:41 26/11/1994	for Preview Resources Pty. Lim

6263BF

Anomaly S1 500 metre thick prism 446 metres depth Poor fit

6263BF

POTENT v3.04 Model Summary Report created at 10:36 27/11/1994 for Preview Resources Pty. Limited

Inducing field - Intensity = 60896
Azimuth = 10
Inclination = -69

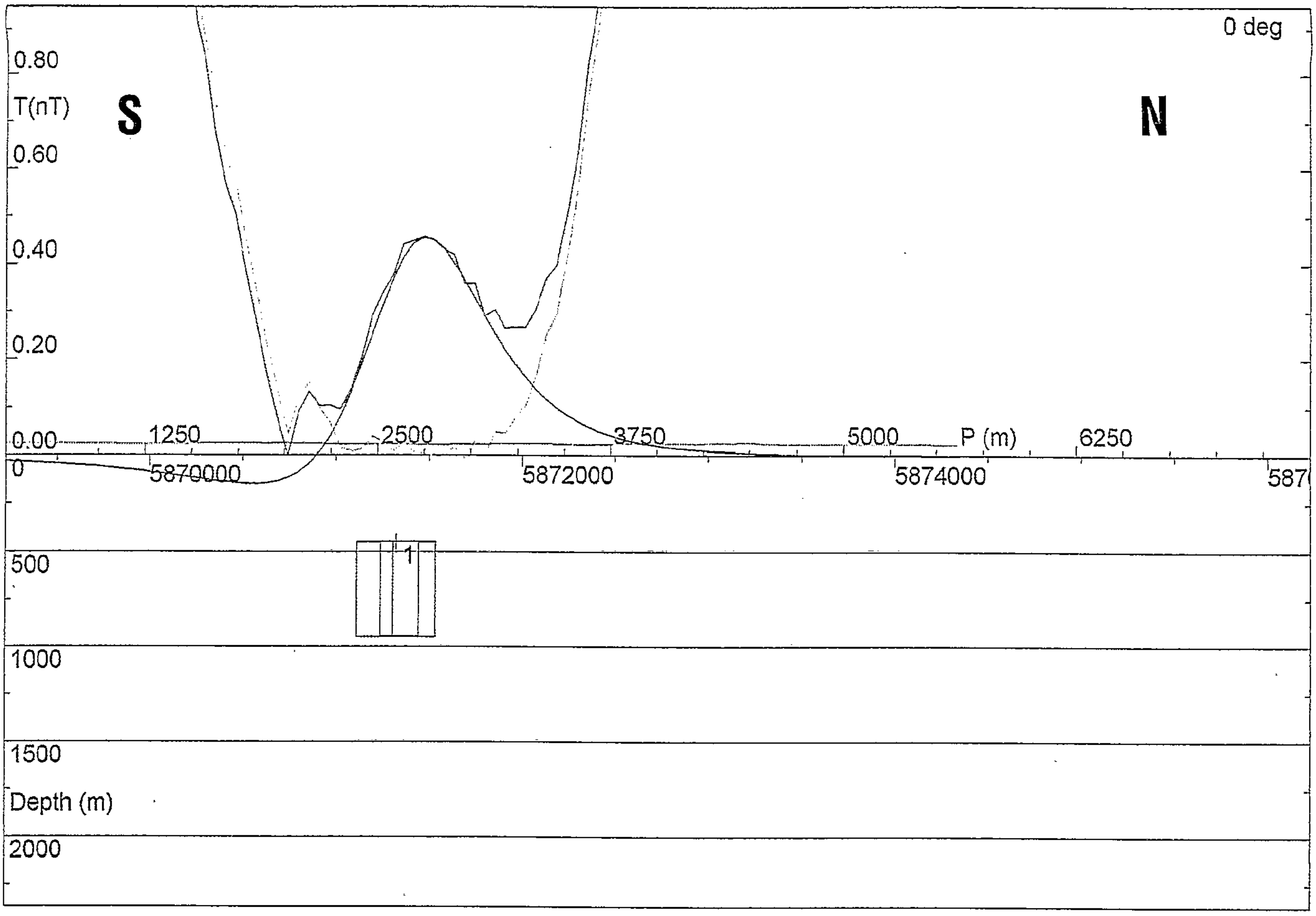
Body type abbreviations and the shape parameters have the following significance;
Rect - RECTANGULAR PRISM - A = width, B = length, C = height

Model title: S1 Rect Prism body SI=0.00028 induction aalp1s1.mod

No.	Type	X	Y	Depth	Strike	Dip	Plunge	Susc.	A	B	C	D
		m	m	m	deg	deg	deg	SI				
1	Rect	474876	5872325	446	103	90	0	0.00028	200.0	1000.0	500.0	

Appendix 5
95-996J MESA

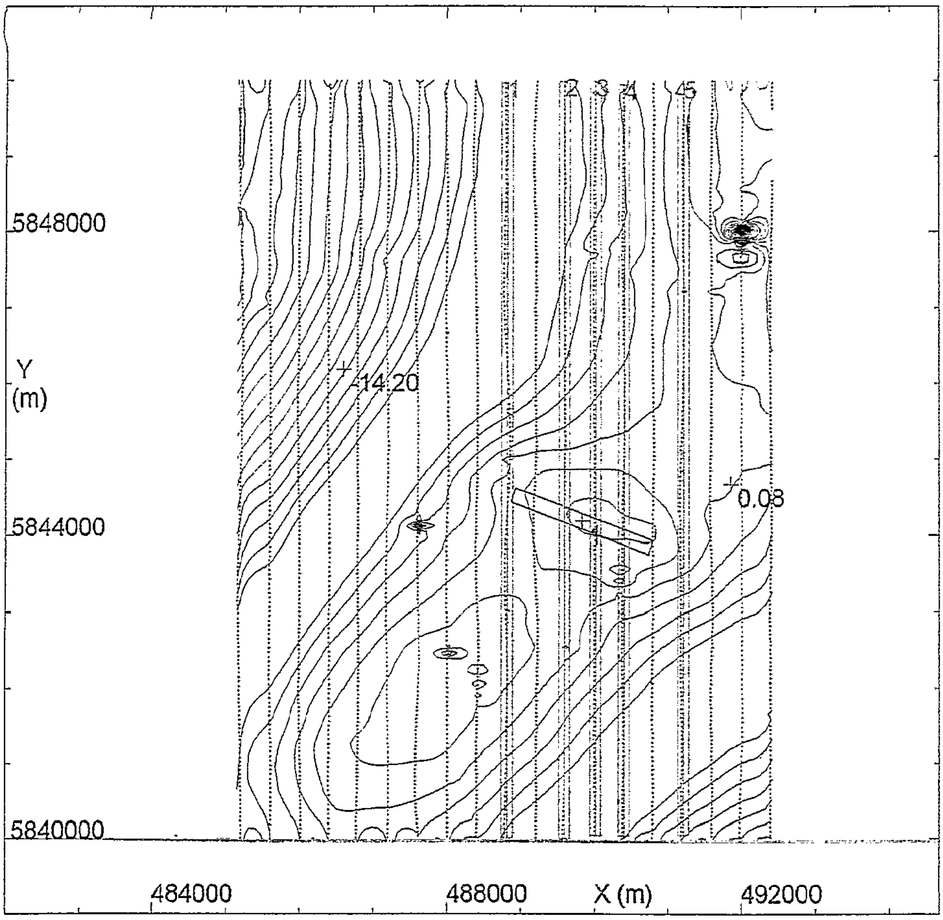
Anomaly S1 500 metre thick prism 446 metres depth Poor fit



Observations:	
Profile #1;	474800
Model:	S1 Rect Prism body SI=0.00028 induction aalp1s1.mod
Calculation mode:	Total Magnetic Intensity
Observed: ————	Calculated: ————
Residual: ————	Individual body: ————
POTENT v3.04	Profile drawn at 19:03 26/11/1994 for Preview Resources Pty. Limited

6263BF

Anomaly S1 500 metre thick prism 446 metres depth Poor fit



Observations:	
Model:	ANOMALY S2 AAIP1S2.MOD
Contours of:	Observed field; Contour intervals: 1.0000, 5.0000 nT
POTENT v3.04	Plan drawn at 15:15 26/11/1994 for Preview Resources Pty. Lim

6263BF

Anomaly S2 500 metre thick prism 871 metres depth Poor fit

6263BF

POTENT v3.04 Model Summary Report created at 15:20 26/11/1994 for Preview Resources Pty. Limited

Inducing field - Intensity = 61000
Azimuth = 2
Inclination = -55

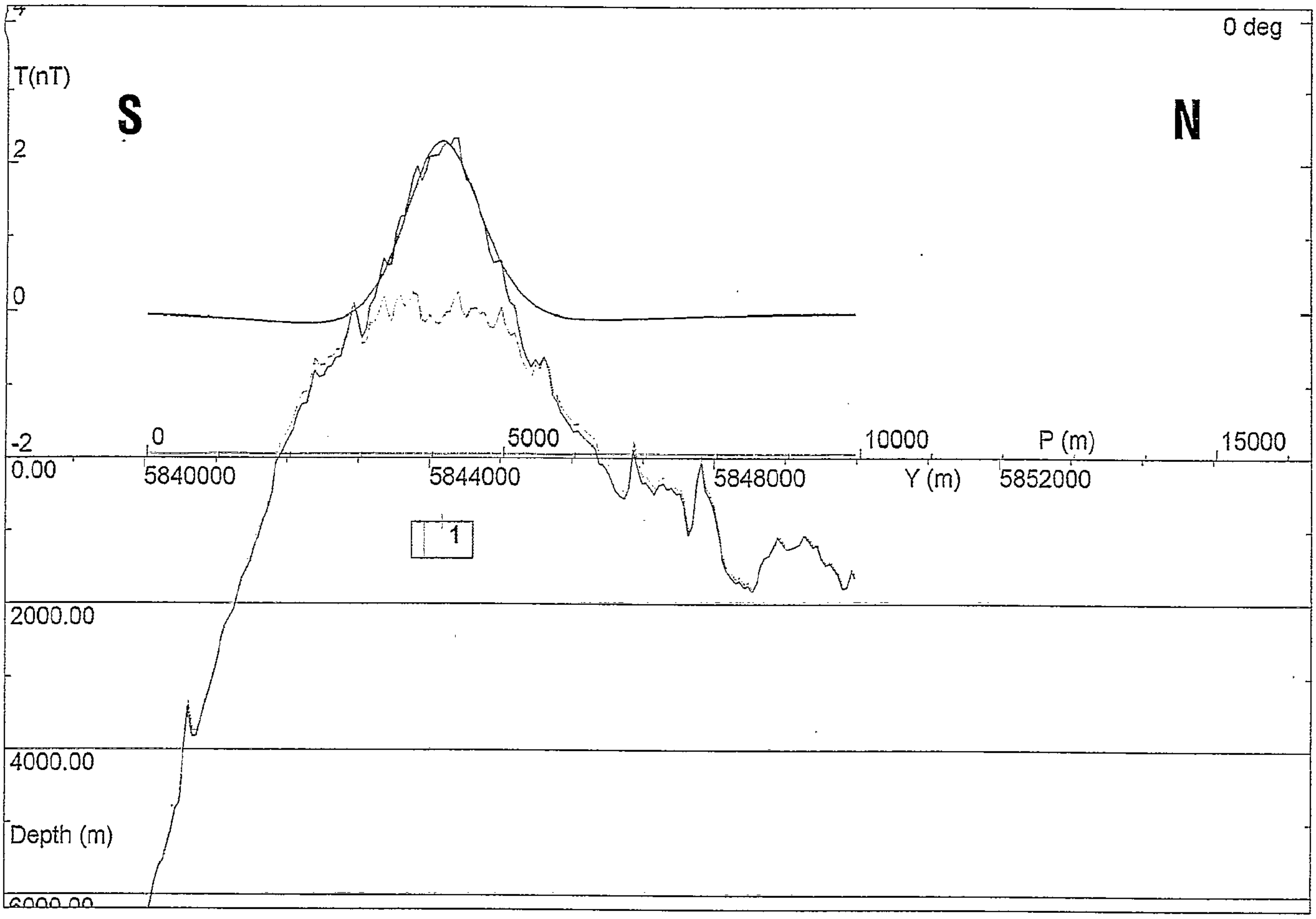
Body type abbreviations and the shape parameters have the following significance:
Rect - RECTANGULAR PRISM - A = width, B = length, C = height

Model title: ANOMALY S2 AAIP1S2.MOD

No.	Type	X	Y	Depth	Strike	Dip	Plunge	Susc.	Rem f	Rem az	Rem inc	A	B	C	D
		m	m	m	deg	deg	deg	SI	Amp/m	deg	deg				
1	Rect	489835	5844189	871	290	90	0	0.000	0.180	0	-120	190.0	2000.0	500.0	

Appendix 5
95-996K MESA

Anomaly S2 500 metre thick prism 871 metres depth Poor fit

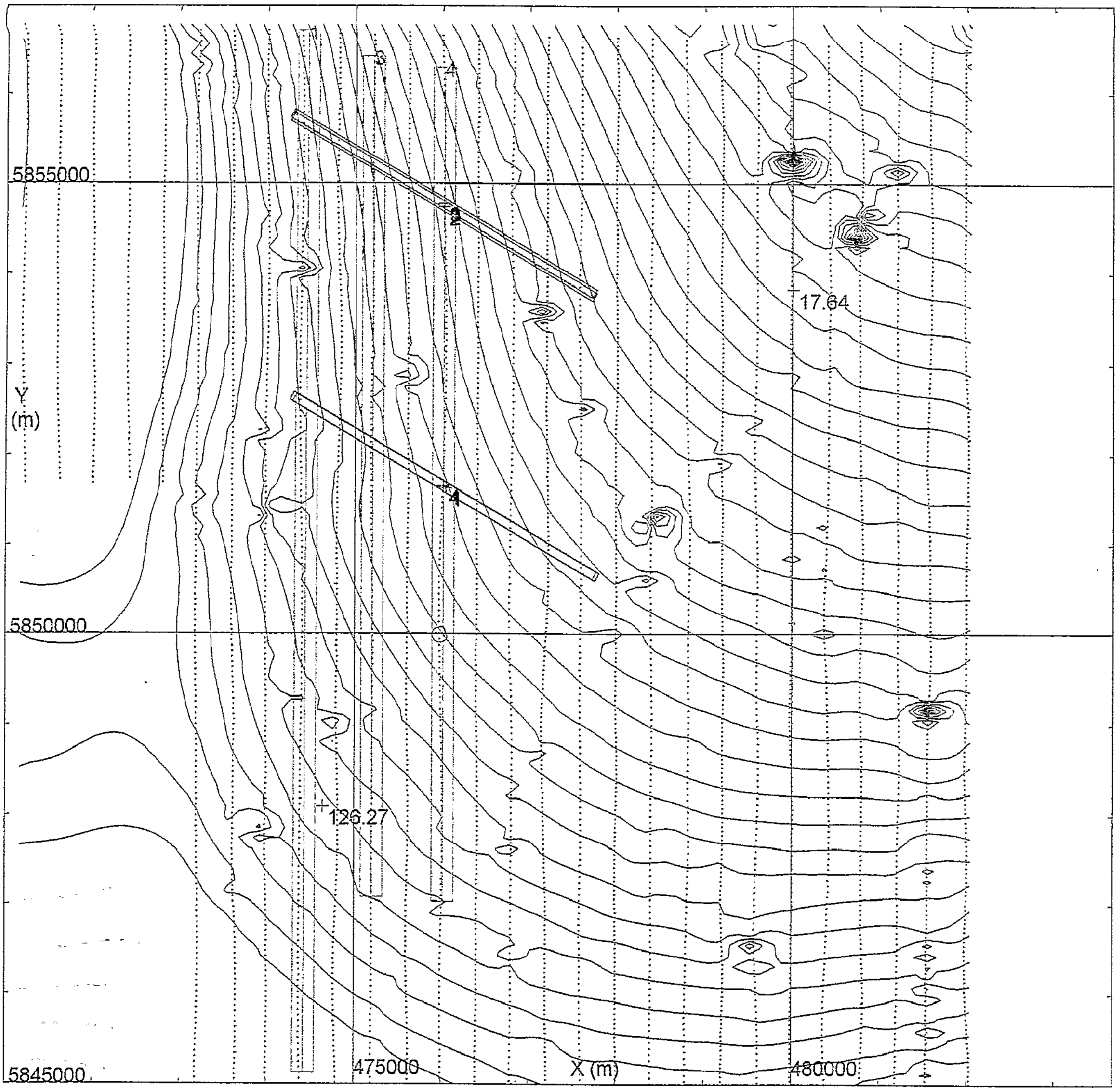


Observations:
Profile #3; 490000
Model: ANOMALY S2 AAIP1S2.MOD
Calculation mode: Total Magnetic Intensity

Observed: ———— Calculated: ————
Residual: ———— Individual body: ————

POTENT v3.04 Profile drawn at 15:11 26/11/1994 for Preview Resources Pty. Limited

Anomaly S2 500 metre thick prism 871 metres depth Poor fit



Observations:	P1 0.5 second located data
Model:	ANOMALY S3 AAHP1S3.MOD 100m thick multilevel ribbons. Fault fill Rem. 0.03 to 3.0A/m -127 deg 476
Contours of:	Observed field; Contour intervals: 5.0000, 50.0000 nT
POTENT v3.04	Plan drawn at 22:39 25/11/1994 for Preview Resources Pty. Limited

6263BF

Anomaly S3N	200 metre thick stacked prisms 232 to 1642 metres depth possible culture	OK fit
Anomaly S3S	200 metre thick stacked prisms 267 to 910 metres depth	OK fit

6263BF

POTENT v3.04 Model Summary Report created at 22:58 25/11/1994 for Preview Resources Pty. Limited

Inducing field - Intensity = 55000
Azimuth = 2
Inclination = -55

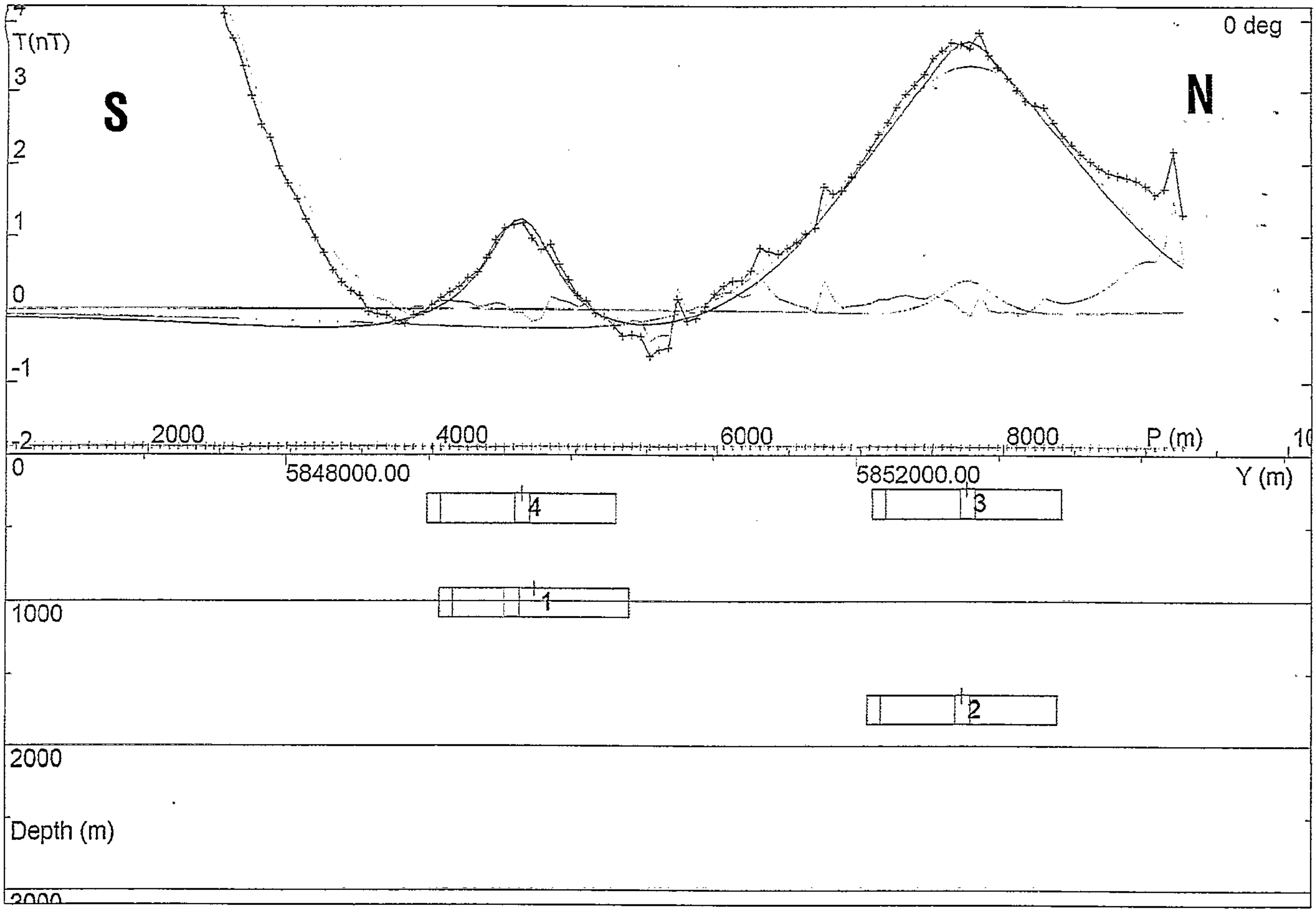
Body type abbreviations and the shape parameters have the following significance:
Rect - RECTANGULAR PRISM - A = width, B = length, C = height

Model title: ANOMALY S3 AAHP1S3.MOD 100m thick multilevel ribbons. Fault fill Rem. 0.03 to 3.0A/m -127 deg 476000

No.	Type	X	Y	Depth	Strike	Dip	Plunge	Susc.	Rem f	Rem az	Rem inc	A	B	C	D
		m	m	m	deg	deg	deg	SI	Amp/m	deg	deg				
1	Rect	476047.1	5851635.3	910.7	120	90	0	0.000000	0.180000	0	-127	100.0	4000.0	200.0	
2	Rect	476017.6	5854744.7	1642.9	120	90	0	0.000000	2.800000	0	-120	100.0	4000.0	200.0	
3	Rect	476017.6	5854780.4	232.1	120	90	0	0.000000	0.015000	0	-127	100.0	4000.0	200.0	
4	Rect	476017.6	5851655.4	267.9	120	90	0	0.000000	0.040000	0	-127	100.0	4000.0	200.0	

Appendix 5
95-996L MESA

Anomaly S3N	200 metre thick stacked prisms 232 to 1642 metres depth possible culture	OK fit
Anomaly S3S	200 *metre thick* stacked prisms 267 to 910 metres depth	OK fit



Observations:

Profile #4;	476000
Model:	ANOMALY S3 AAHP1S3.MOD 100m thick multilevel ribbons. Fault fill Rem. 0.03 to 3.0A/m -127 deg 476
Calculation mode:	Total Magnetic Intensity

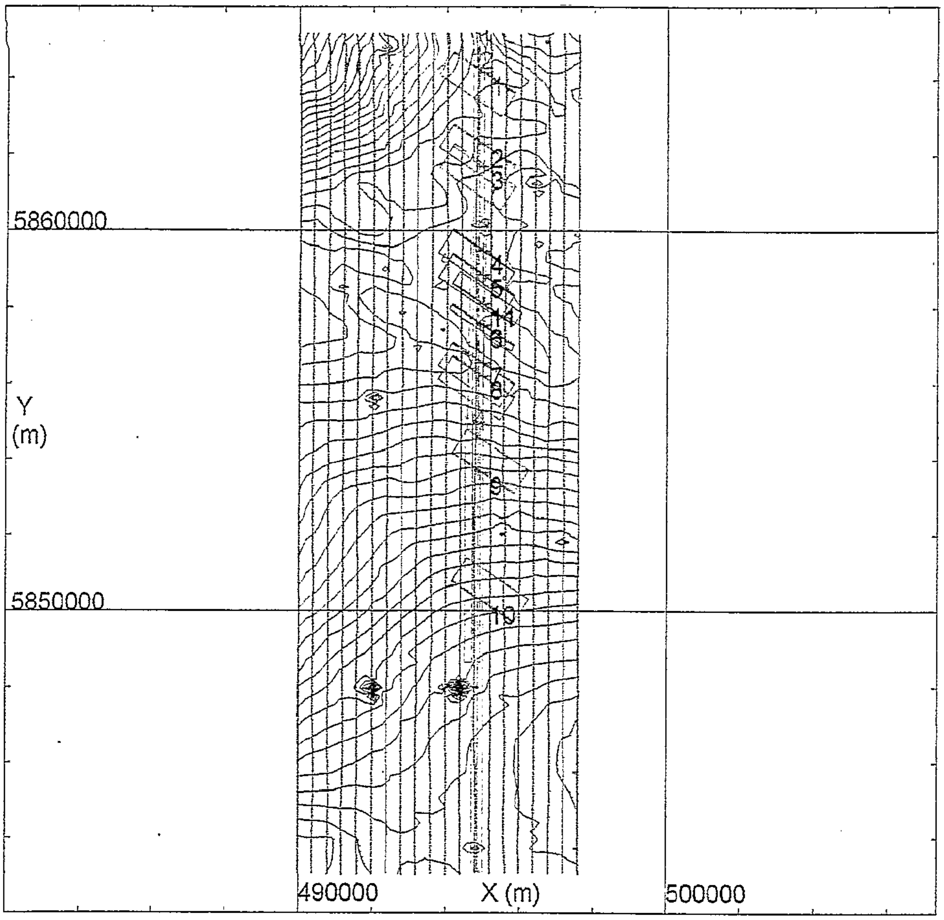
Observed: ―――――― Calculated: ――――――

Residual: ―――――― Individual body: ――――――

POTENT v3.04 Profile drawn at 22:19 25/11/1994 for Preview Resources Pty. Limited

6263BF

Anomaly S3N	200 metre thick stacked prisms 232 to 1642 metres depth possible culture	OK fit
Anomaly S3S	200 metre thick stacked prisms 267 to 910 metres depth	OK fit



Observations:
Model: p1deaan.mod Remanent & induced faults between 5857500 & 585
Contours of: Observed field; Contour intervals: 2.0000, 10.0000 nT
POTENT v3.04 Plan drawn at 11:37 29/01/1995 for Preview Resources Pty. Lim

Anomaly S4 seismic line 90-414 fault plane prisms 197 to 400 metres depth OK fit

Sheet1

6263BF

POTENT v3.04 Model Summary Report created at 22:43 28/01/1995 for Preview Resources Pty. Limited

Inducing fi	Intensity =	60896
	Azimuth =	10
	Inclination	-69

Body type abbreviations and the shape parameters have the following significance:

Rect - A = width, B = length, C = height

Model title: p1deaag.mod faults 5861600 & 5862250

No.	Type	X	Y	Depth	Strike	Dip	Plunge	Susc.	A	B	C	D
		m	m	m	deg	deg	deg	SI				
2	Rect	495000	5862259	207.1	33	90	45	-0.0001	2000	50	1000	
3	Rect	495000	5861687	214.3	34	90	42	0.0006	2000	100	1000	

POTENT v3.04 Model Summary Report created at 13:31 29/01/1995 for Preview Resources Pty. Limited

Inducing fi	Intensity =	60896
	Azimuth =	10
	Inclination	-69

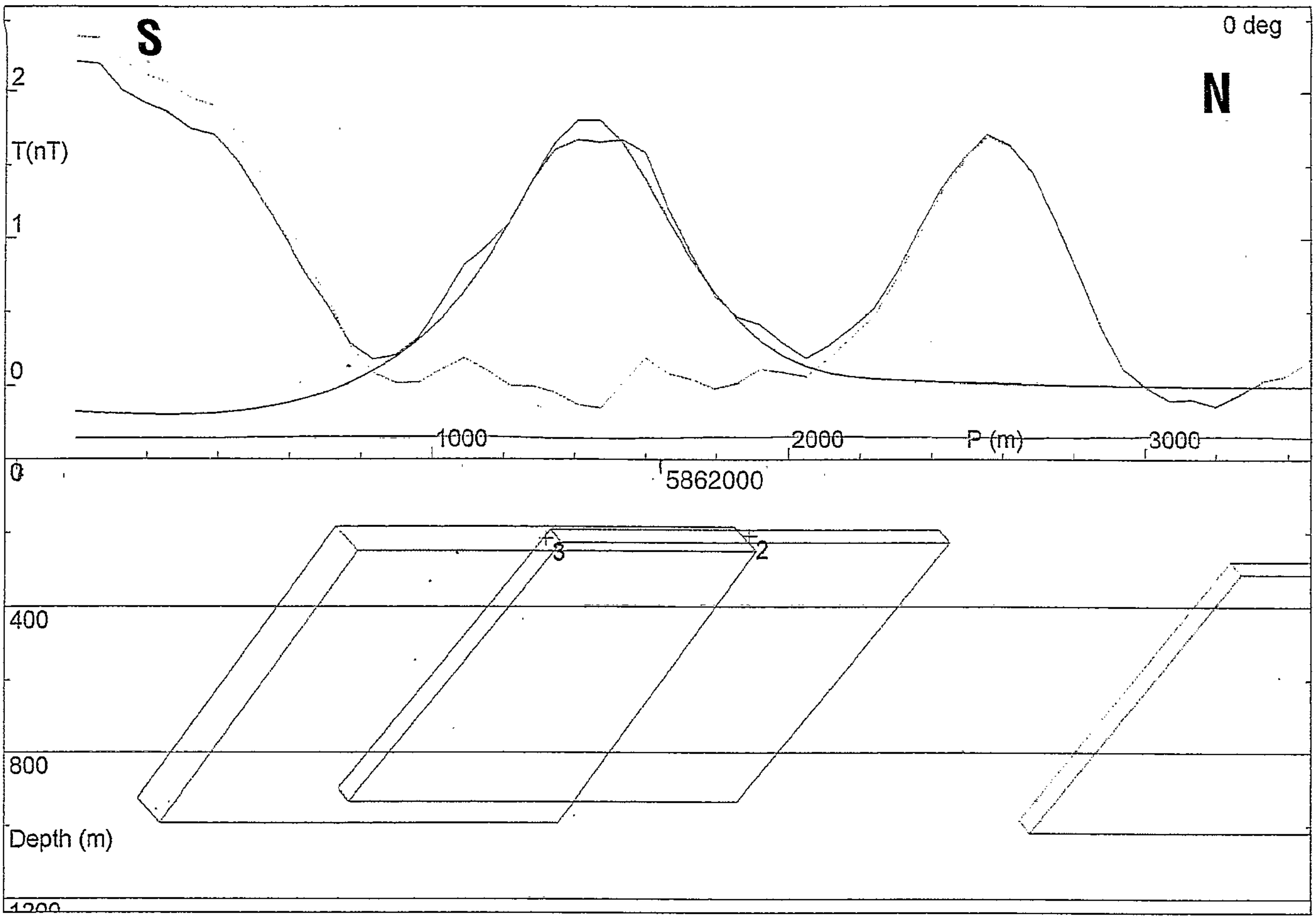
Body type abbreviations and the shape parameters have the following significance:

Rect - RECTANG A = width, B = length, C = height

Model title: p1deaao.mod Remanent & induced faults between 5856500 & 5856000

No.	Type	X	Y	Depth	Strike	Dip	Plunge	Susc.	Rem f	Rem az	Rem inc	A	B	C	D
		m	m	m	deg	deg	deg	SI	Amp/m	deg	deg				
4	Rect	494999.9	5859496	284.7	33	90	45	0	0.105	10	-135	2000	50	1000	
5	Rect	495000	5858871	400	33	90	45	-0.002	0	0	0	2000	50	1000	
6	Rect	494996.7	5857554	197.1	33	90	45	-0.00035	0	0	0	2000	50	200	
7	Rect	494999.6	5856602	230	33	90	45	0	0.052	10	-30	2000	50	1000	
8	Rect	495000	5856188	300	33	90	45	0.0001	0	0	0	2000	50	1000	
11	Rect	494998.2	5858109	401.6	33	90	-45	0	0.125	10	-98	2000	50	500	

Anomaly S4 seismic line 90-414 fault plane prisms 197 to 400 metres depth OK fit



Observations:

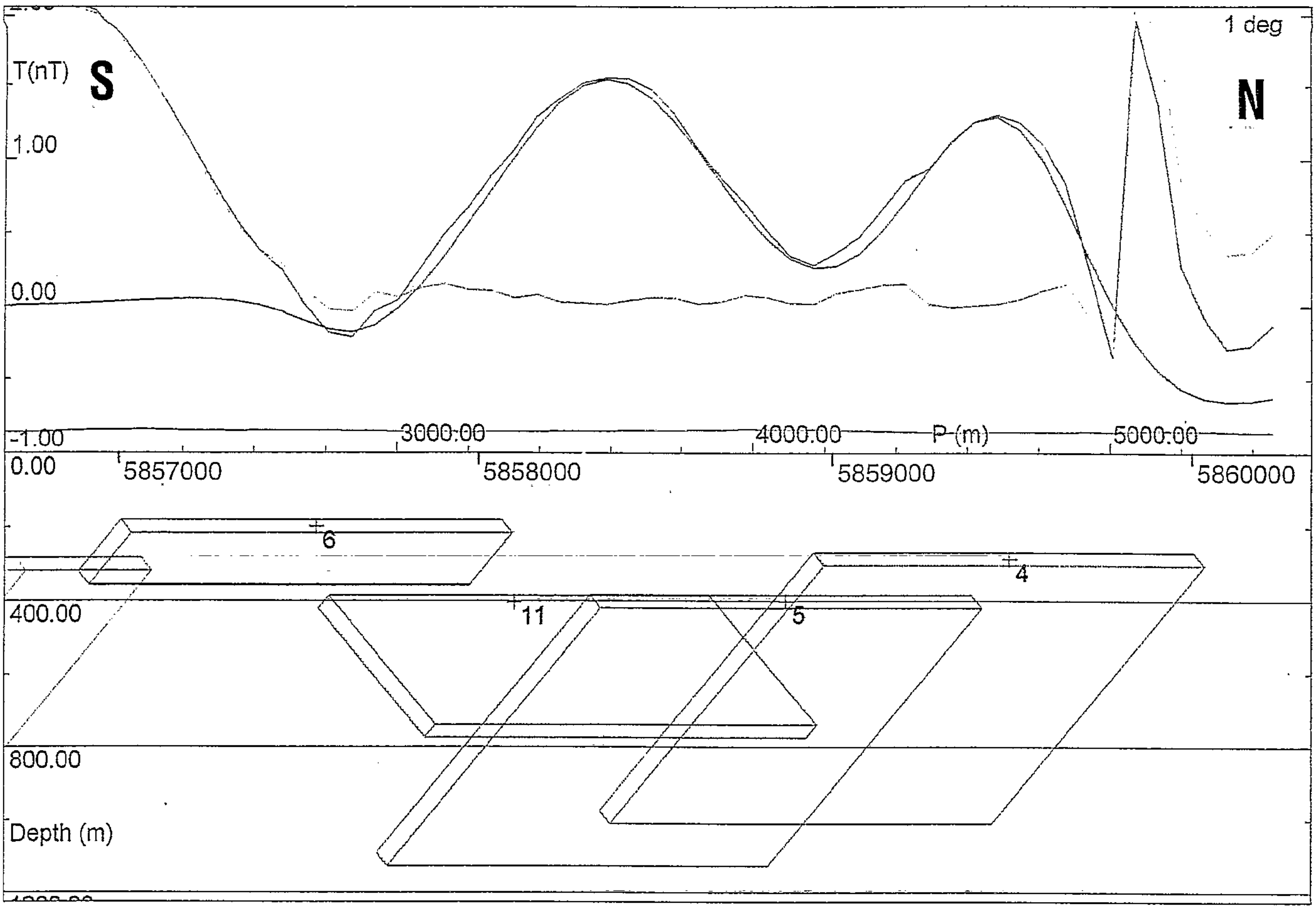
Profile #2;	495000 subset faults at 5861600 & 5862250
Model:	p1deaag.mod faults 5861600 & 5862250
Calculation mode:	Total Magnetic Intensity

Observed: ———— Calculated: ————
Residual: ———— Individual body: ————

POTENT v3.04 Profile drawn at 22:41 28/01/1995 for Preview Resources Pty. Limited

6263BF

Anomaly S4 seismic line 90-414 fault plane prisms 197 to 400 metres depth OK fit



Observations:

Profile #3;	495000 subset faults between 5857500 & 5859500
Model:	p1deaan.mod Remanent & induced faults between 5857500 & 5859500
Calculation mode:	Total Magnetic Intensity

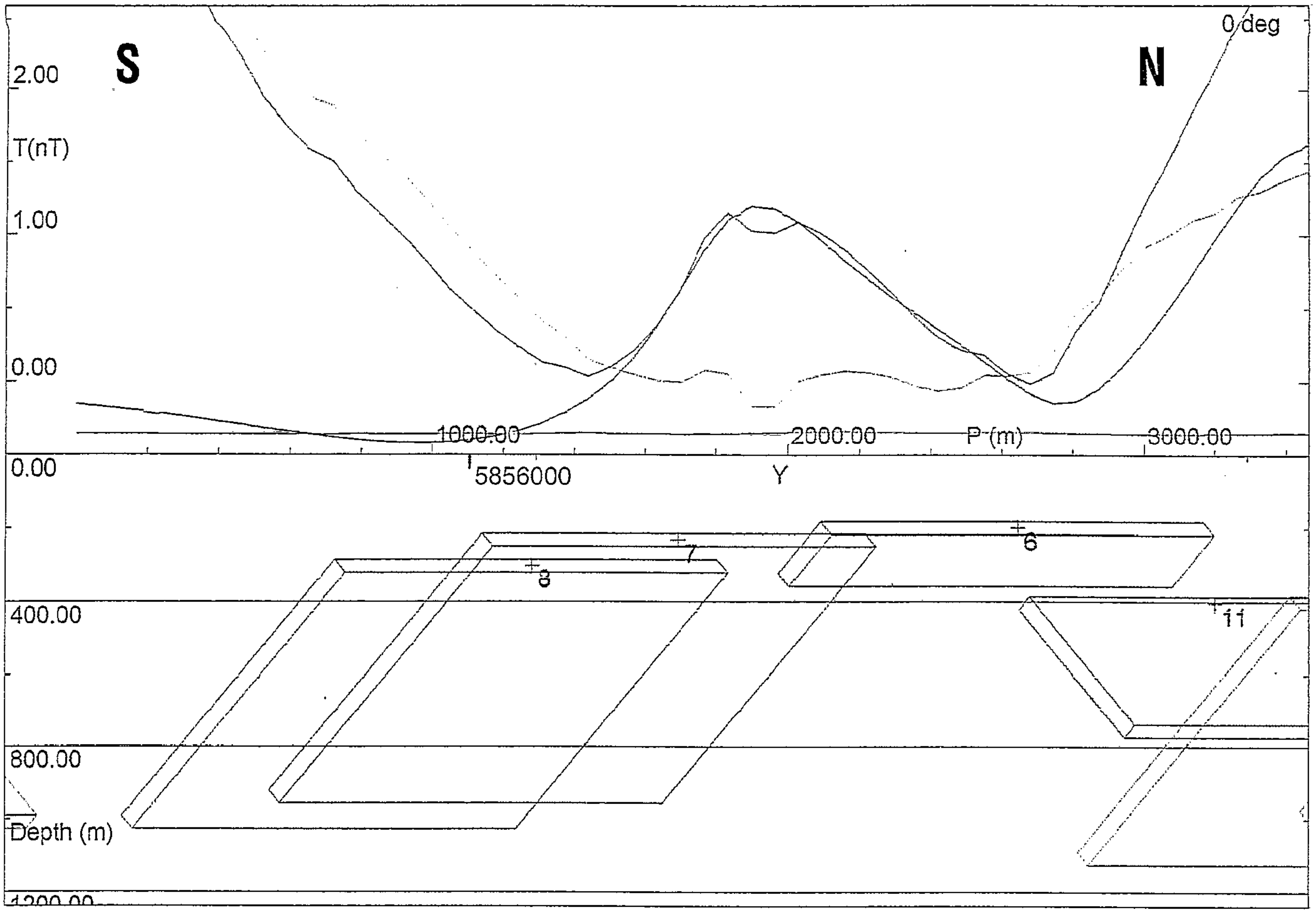
Observed: · ——— Calculated: ———

Residual: ——— Individual body: ———

POTENT v3.04 Profile drawn at 11:35 29/01/1995 for Preview Resources Pty. Limited

6263BF

Anomaly S4 seismic line 90-414 fault plane prisms 197 to 400 metres depth OK fit

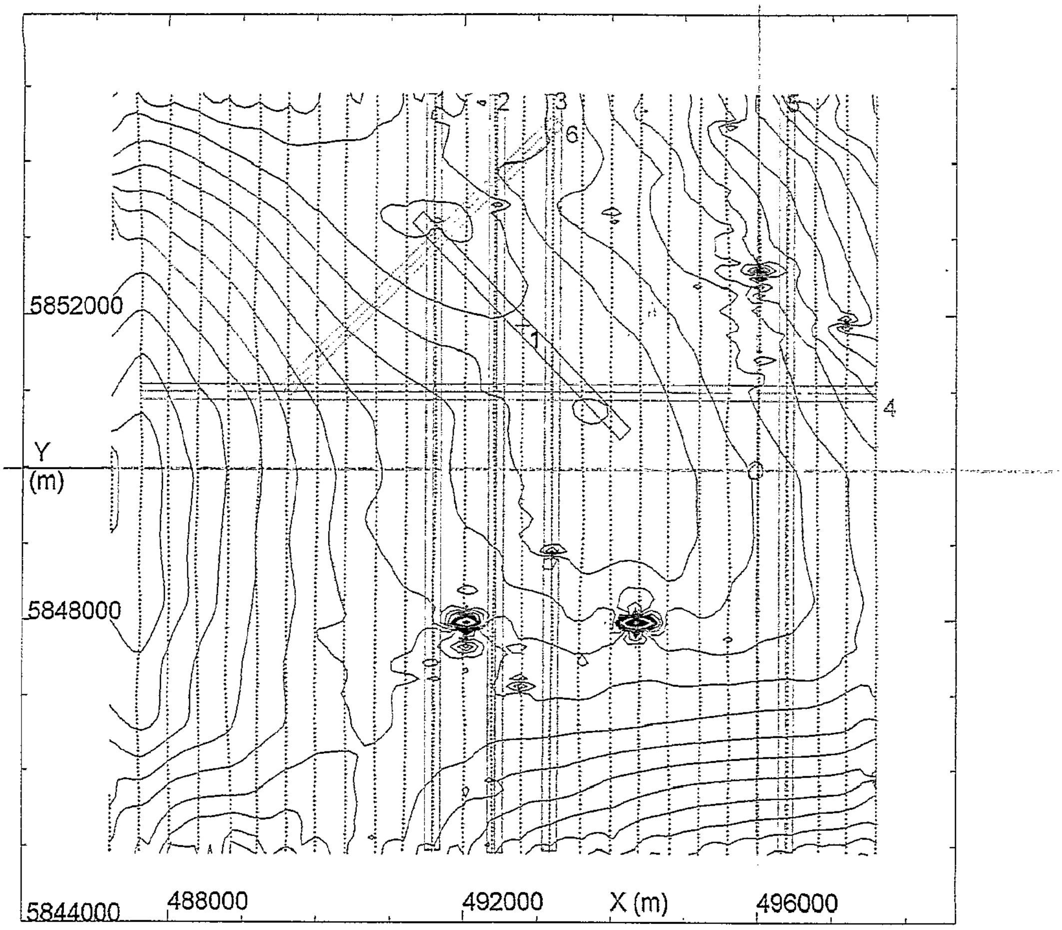


Observations:
Profile #4; 495000 subset fault between 5856500 & 5856000
Model: p1deaao.mod Remanent & induced faults between 5856500 & 5856000
Calculation mode: Total Magnetic Intensity

Observed: ——————— Calculated: ———————
Residual: ——————— Individual body: ———————

POTENT v3.04 Profile drawn at 13:36 29/01/1995 for Preview Resources Pty. Limited

Anomaly S4 seismic line 90-414 fault plane prisms 197 to 400 metres depth OK fit



Observations:		
Model:		
Contours of:	Observed field;	Contour intervals: 1.0000, 5.0000 nT
POTENT v3.04	Plan drawn at 15:43 27/11/1994	for Preview Resources Pty. Lim

6263BF

Anomaly S5 500 metre thick prism 757 metres depth Poor fit

6263BF

POTENT v3.04 Model Summary Report created at 15:44 27/11/1994 for Preview Resources Pty. Limited

Inducing field - Intensity = 60896
Azimuth = 10
Inclination = -69

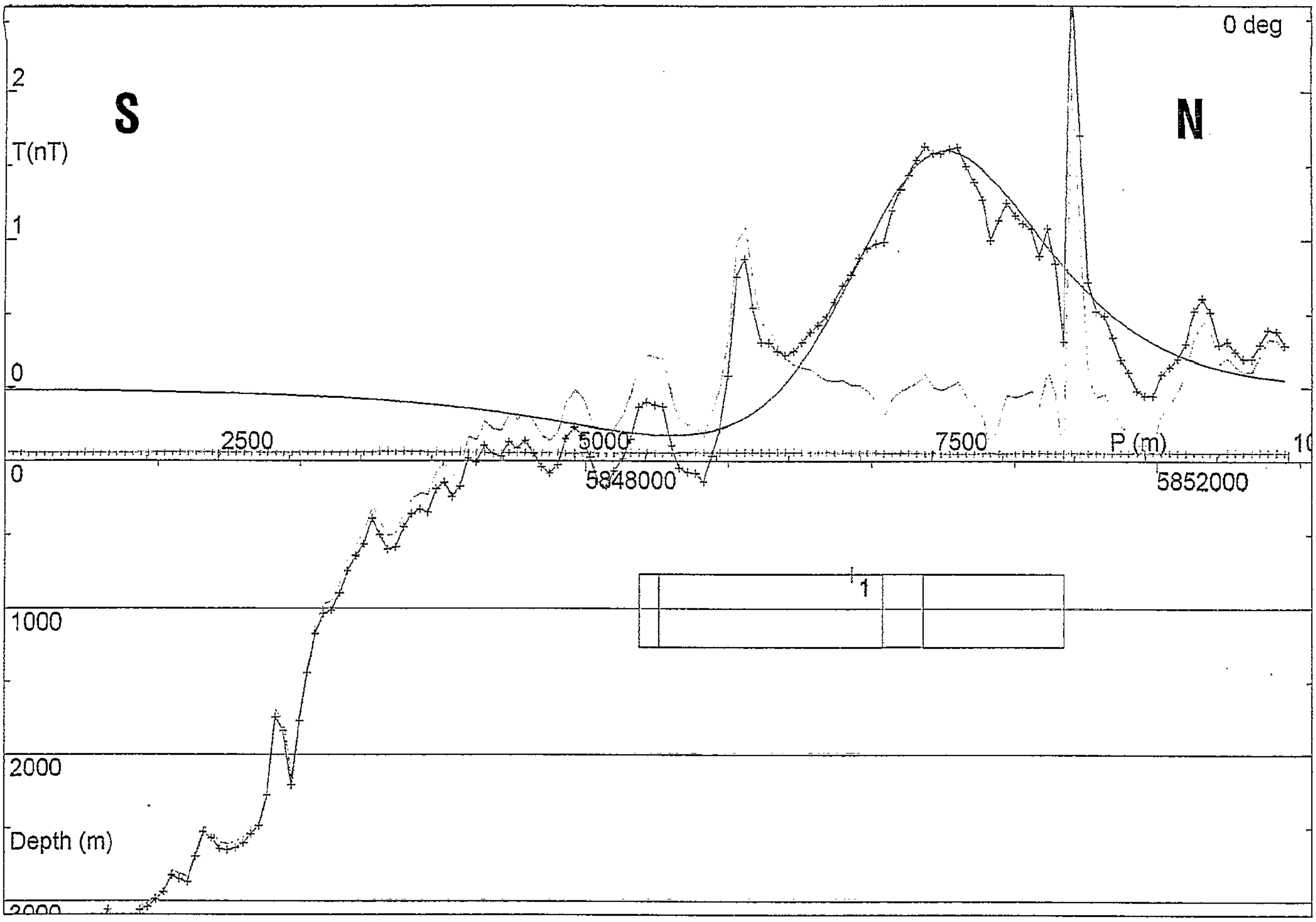
Body type abbreviations and the shape parameters have the following significance:
Rect - RECTANGULAR PRISM - A = width, B = length, C = height

Model title:

No.	Type	X	Y	Depth	Strike	Dip	Plunge	Susc.	A	B	C	D
		m	m	m	deg	deg	deg	SI				
1	Rect	492776	5851863	757	-45	90	0	0.0018	200.0	4000.0	500.0	

Appendix 5
95-996N MESA

Anomaly S5 500 metre thick prism 757 metres depth Poor fit



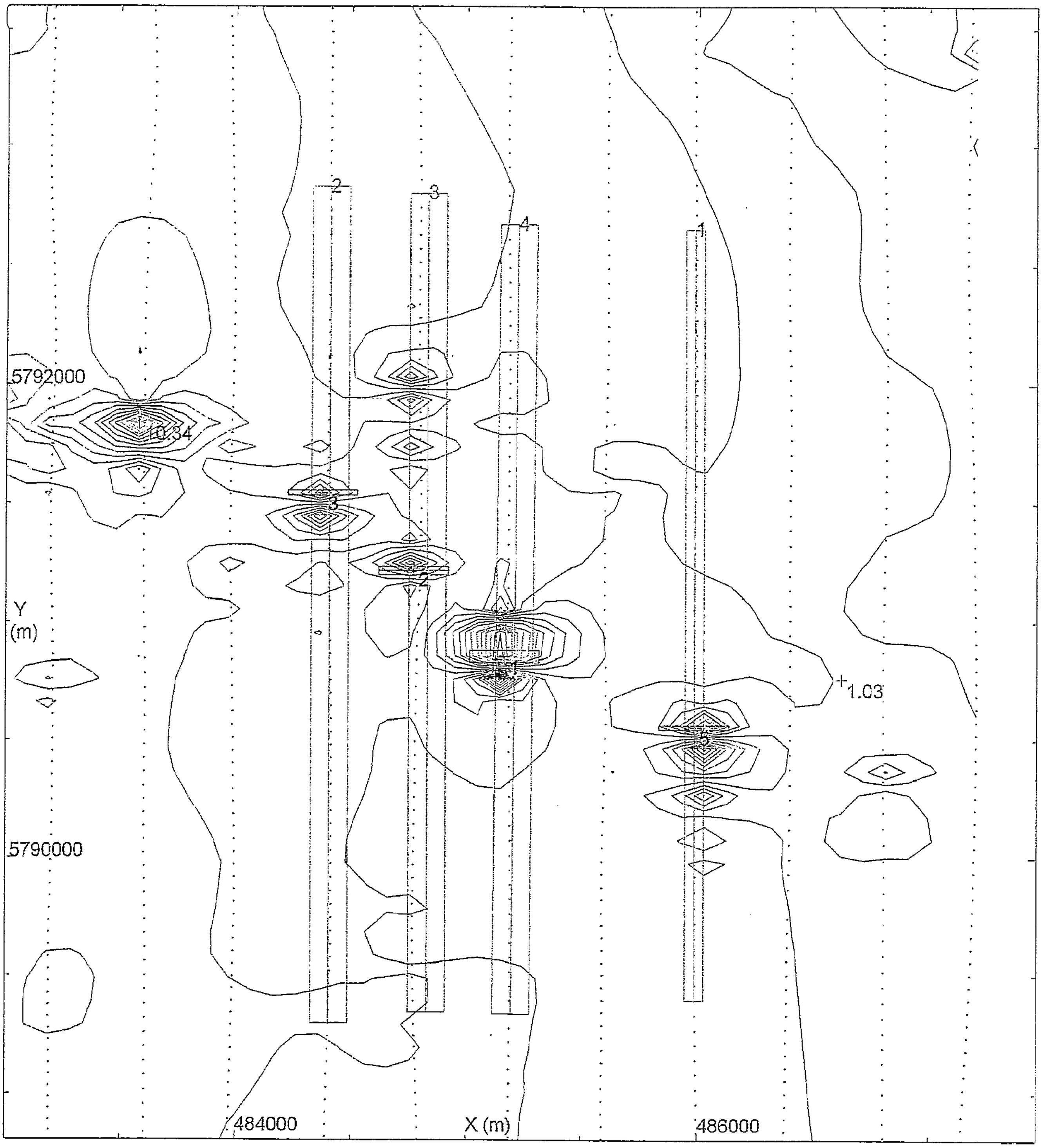
Observations:
Profile #2; 492400
Model:
Calculation mode: Total Magnetic Intensity

Observed: ———— Calculated: ————
Residual: ———— Individual body: ————

6263BF

POTENT v3.04 Profile drawn at 15:41 27/11/1994 for Preview Resources Pty. Limited

Anomaly S5 500 metre thick prism 757 metres depth Poor fit



Observations:
Model: ANOMALY S6 AABP1S6.MOD
Contours of: Observed field; Contour intervals: 1.0000, 5.0000 nT
POTENT v3.04 Plan drawn at 10:13 25/11/1994 for Preview Resources Pty. Limited

Anomaly S6 prisms 11 to 40 metres depth culture Poor fit

6263BF

POTENT v3.04 Model Summary Report created at 10:07 25/11/1994 for Preview Resources Pty. Limited

Inducing field - Intensity = 55000
Azimuth = 2
Inclination = -55

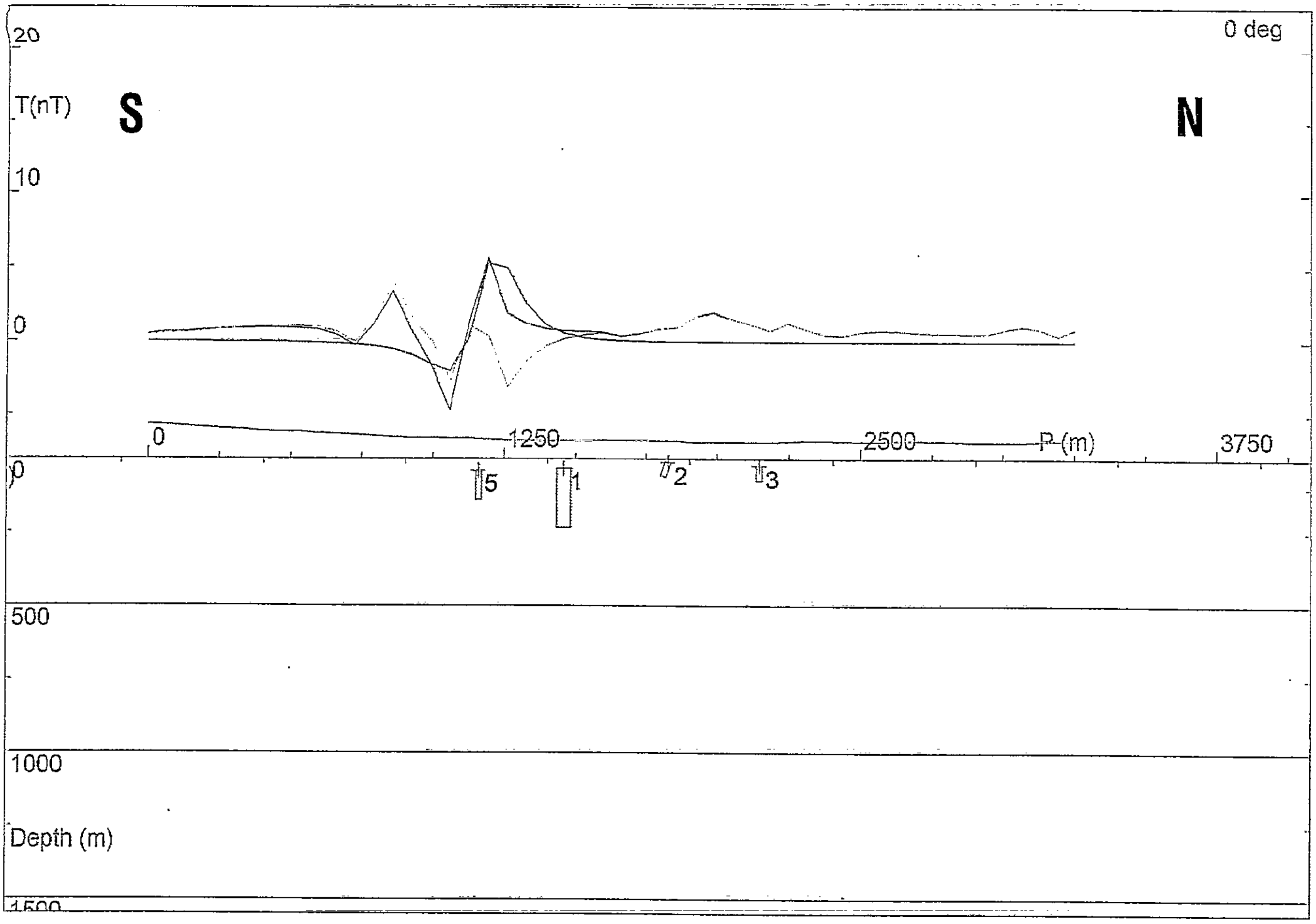
Body type abbreviations and the shape parameters have the following significance:
Rect - RECTANGULAR PRISM - A = width, B = length, C = height

Model title: ANOMALY S6 AABP1S6.MOD

No.	Type	X	Y	Depth	Strike	Dip	Plunge	Susc.	A	B	C	D
		m	m	m	deg	deg	deg	SI				
1	Rect	485167	5790857	32.9	90	90	0	0.005	50.0	300.0	200.0	
2	Rect	484771	5791225	11.9	90	70	0	0.004	20.0	300.0	50.0	
3	Rect	484376	5791544	22.8	90	90	0	0.004	20.0	300.0	50.0	
5	Rect	485985	5790558	40.2	90	90	0	0.009	20.0	300.0	100.0	

Appendix 5
95-996O MESA

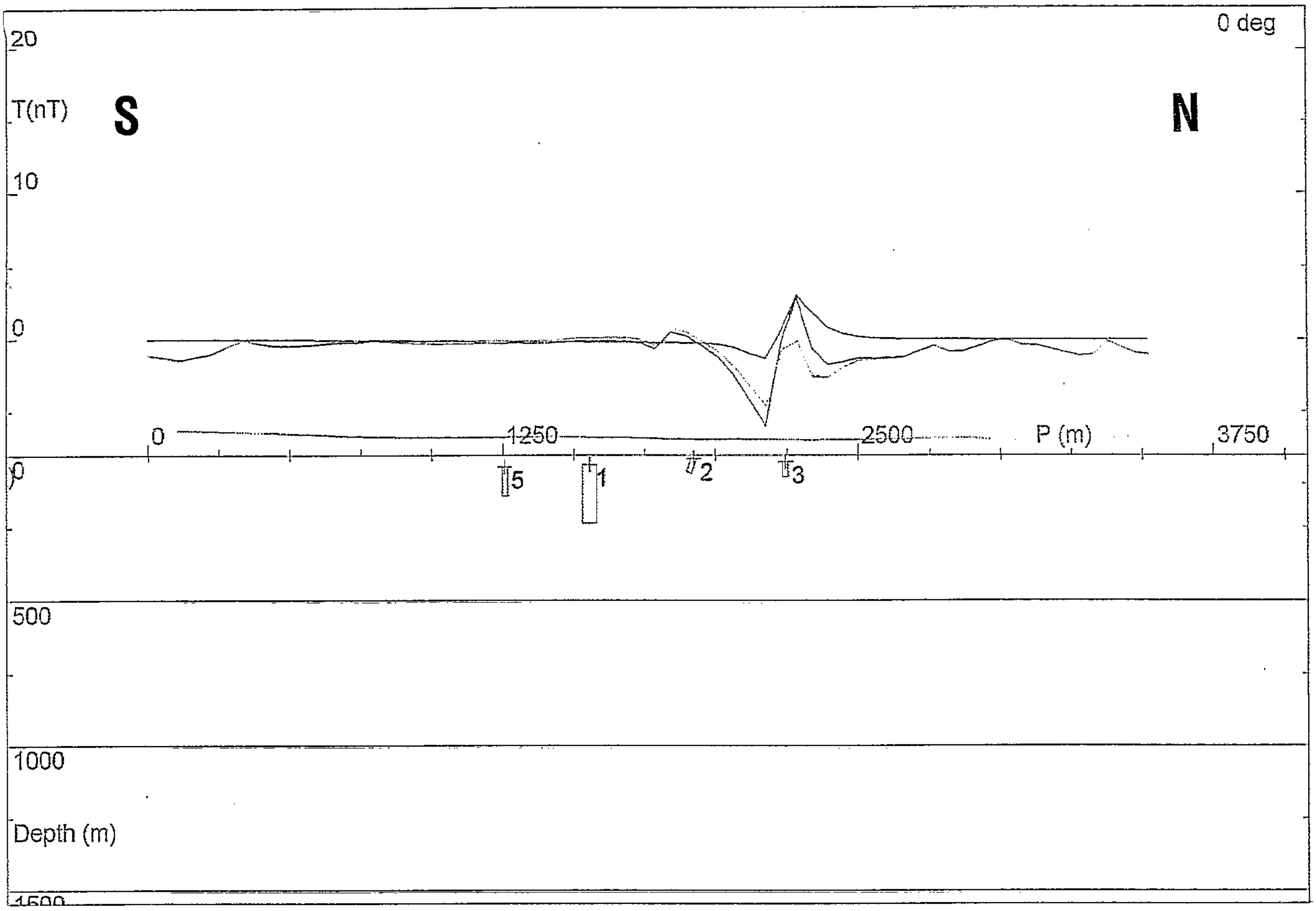
Anomaly S6 prisms 11 to 40 metres depth culture Poor fit



Observations:			
Profile #1;	486000		
Model:	ANOMALY S6 AABP1S6.MOD		
Calculation mode:	Total Magnetic Intensity		
Observed:	————	Calculated:	————
Residual:	————	Individual body:	————
POTENT v3.04	Profile drawn at 10:01 25/11/1994 for Preview Resources Pty. Limited		

6263BF

Anomaly S6 prisms 11 to 40 metres depth culture Poor fit



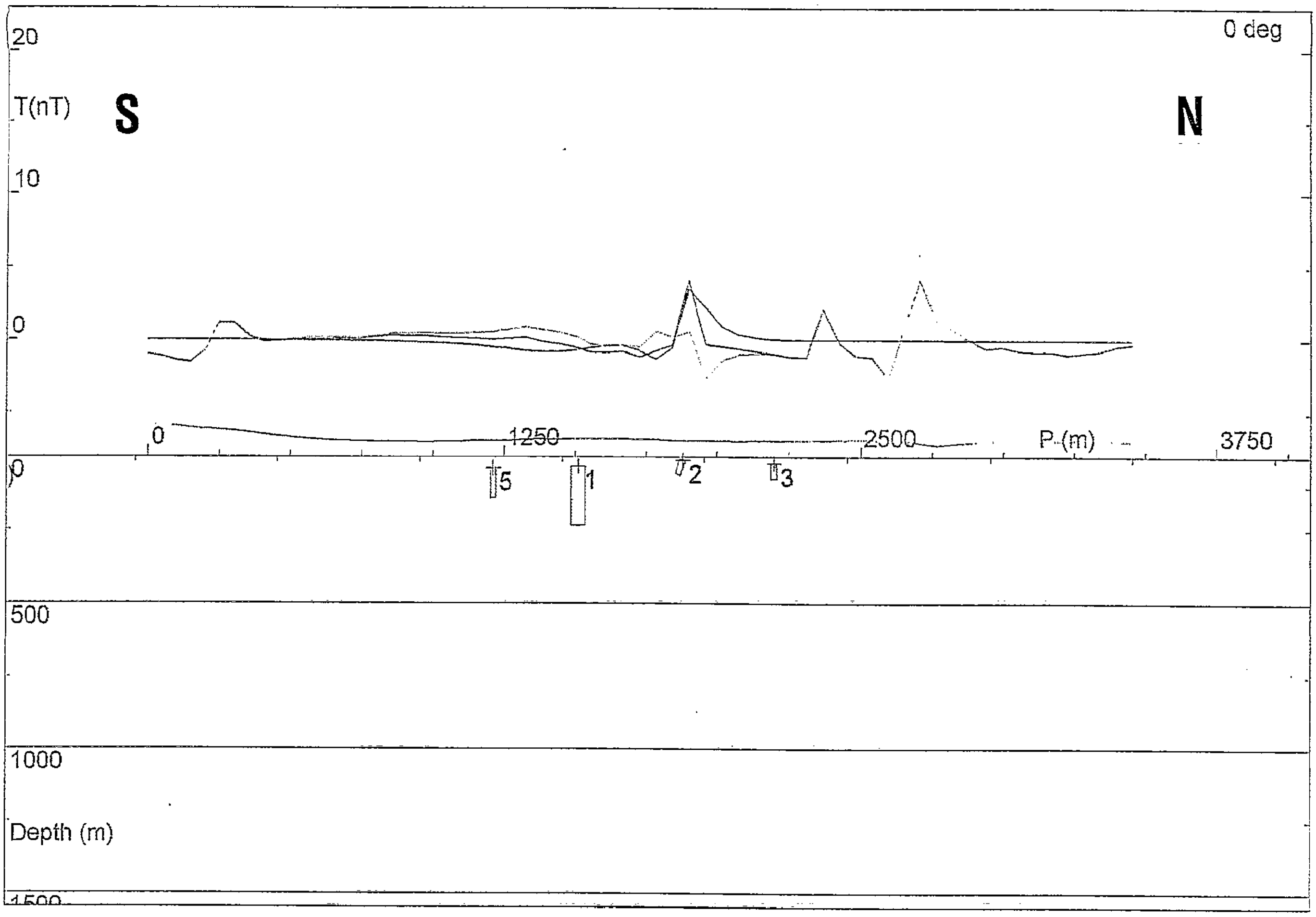
Observations:
Profile #2; 484400
Model: ANOMALY S6 AABP1S6.MOD
Calculation mode: Total Magnetic Intensity

Observed: ———— Calculated: ————
Residual: ———— Individual body: ————

POTENT v3.04 Profile drawn at 09:55 25/11/1994 for Preview Resources Pty. Limited

6263BF

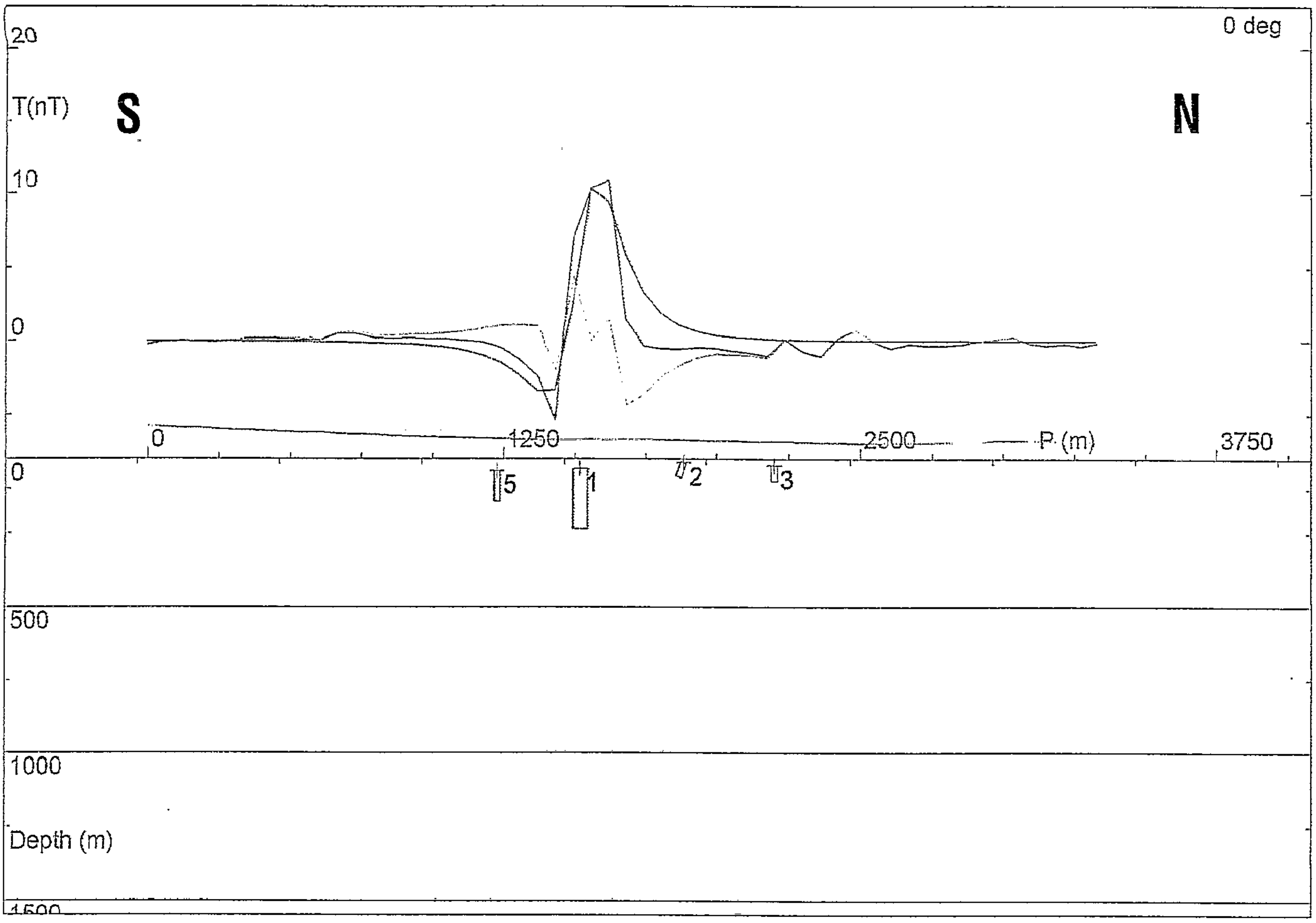
Anomaly S6 prisms 11 to 40 metres depth culture Poor fit



Observations:			
Profile #3;	484800		
Model:	ANOMALY S6 AABP1S6.MOD		
Calculation mode:	Total Magnetic Intensity		
Observed:	————	Calculated:	————
Residual:	————	Individual body:	————
POTENT v3.04	Profile drawn at 09:58 25/11/1994 for Preview Resources Pty. Limited		

6263BF

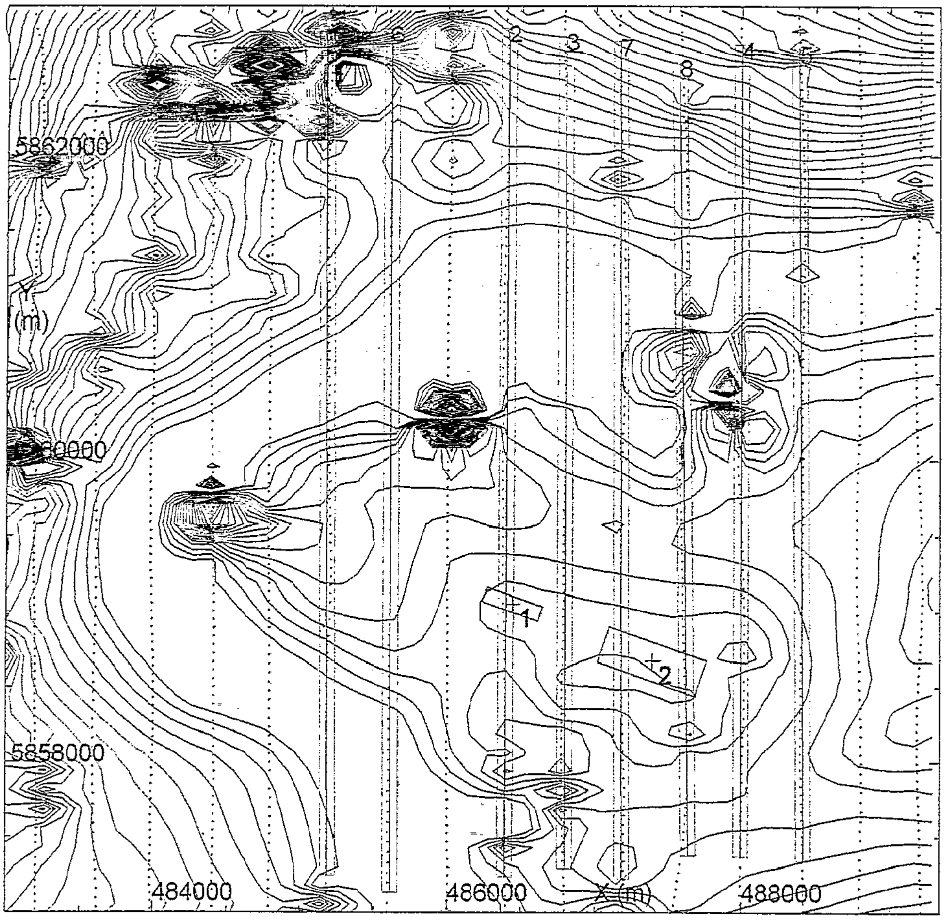
Anomaly S6 prisms 11 to 40 metres depth culture Poor fit



Observations:			
Profile #4;	485200		
Model:	ANOMALY S6 AABP1S6.MOD		
Calculation mode:	Total Magnetic Intensity		
Observed:	————	Calculated:	————
Residual:	————	Individual body:	————
POTENT v3.04	Profile drawn at 09:52 25/11/1994 for Preview Resources Pty. Limited		

6263BF

Anomaly S6 prisms 11 to 40 metres depth culture Poor fit



Observations:	
Model:	ANOMALY S10 2 BODIES 576m 986m ABHP1S10.MOD
Contours of:	Observed field; Contour intervals: 0.5000, 2.5000 nT
POTENT v3.04	Plan drawn at 11:40 29/11/1994 for Preview Resources Pty. Lim

Anomaly S10 prisms 579 to 986 metres depth OK fit

6263BF

POTENT v3.04 Model Summary Report created at 11:45 29/11/1994 for Preview Resources Pty. Limited

Inducing field - Intensity = 60896
Azimuth = 10
Inclination = -69

Body type abbreviations and the shape parameters have the following significance:
Rect - RECTANGULAR PRISM - A = width, B = length, C = height

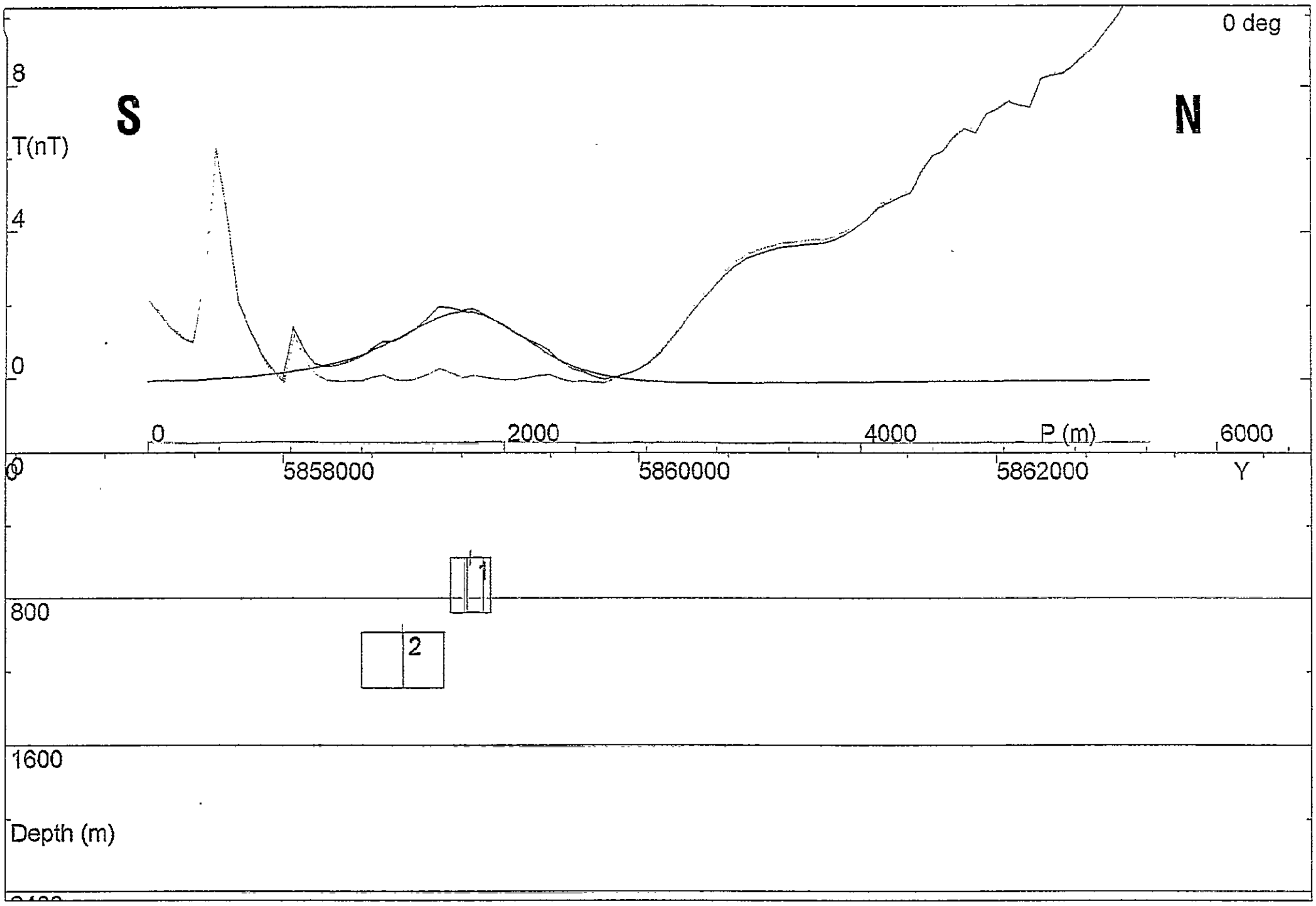
Model title: ANOMALY S10 2 BODIES 576m 986m ABHP1S10.MOD

No.	Type	X	Y	Depth	Strike	Dip	Plunge	Susc.	Rem f	Rem az	Rem inc	A	B	C	D
		m	m	m	deg	deg	deg	SI	Amp/m	deg	deg				
1	Rect	486441	5859053	576.8	19	90	0	0.000	0.340	0	-114	400.0	100.0	300.0	
2	Rect	487394	5858670	985.7	19	90	0	0.000	0.370	0	-114	700.0	250.0	300.0	

Appendix 5
95-996P MESA

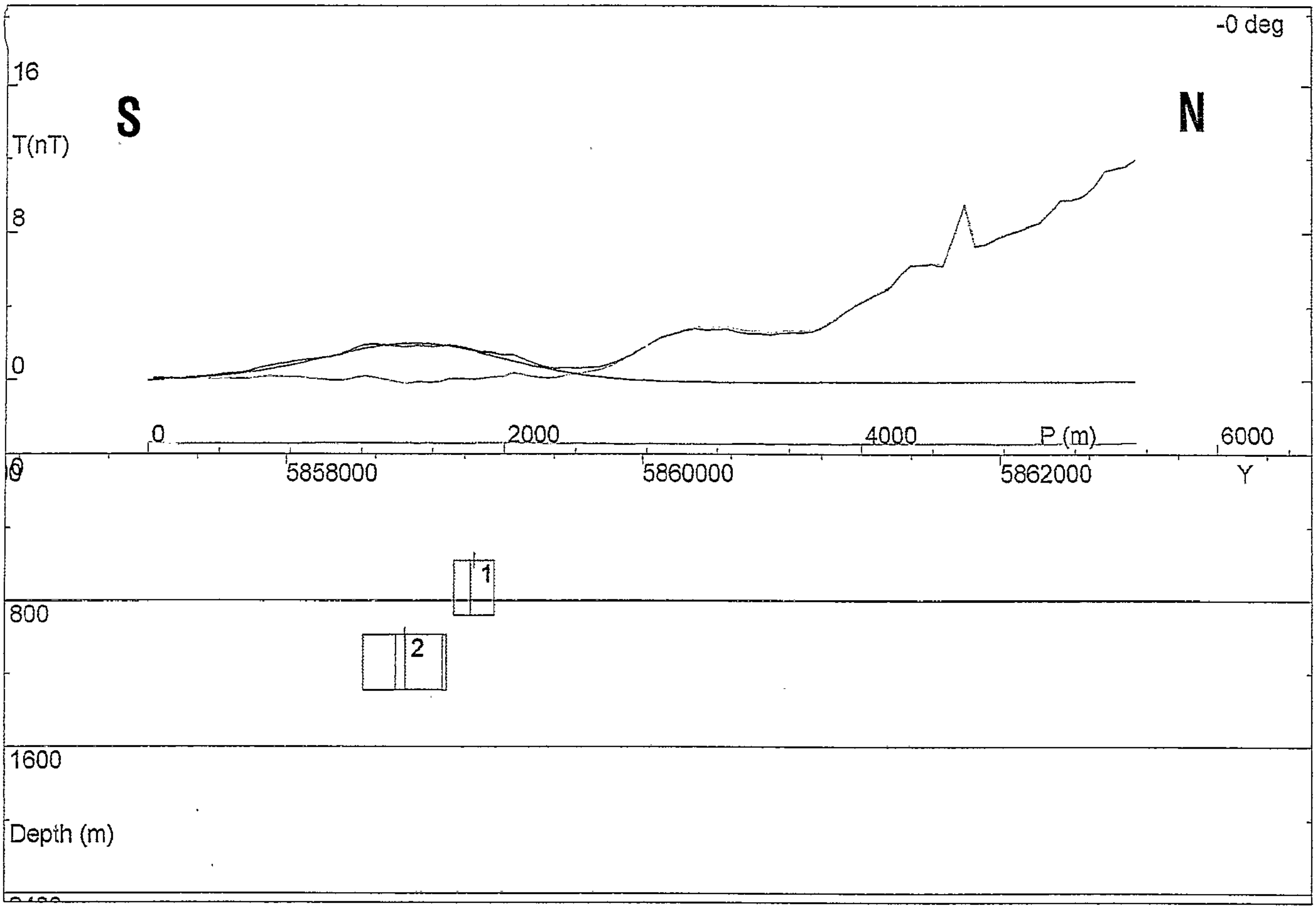
Anomaly S10 prisms 579 to 986 metres depth

OK fit



Observations:			
Profile #2;	486400		
Model:	ANOMALY S10 2 BODIES 576m 986m ABHP1S10.MOD		
Calculation mode:	Total Magnetic Intensity		
Observed:	————————	Calculated:	————————
Residual:	————————	Individual body:	————————
POTENT v3.04	Profile drawn at 11:42 29/11/1994 for Preview Resources Pty. Limited		

Anomaly S10 prisms 579 to 986 metres depth OK fit



Observations:

Profile #7; 487200

Model: ANOMALY S10 2 BODIES 576m 986m ABHP1S10.MOD

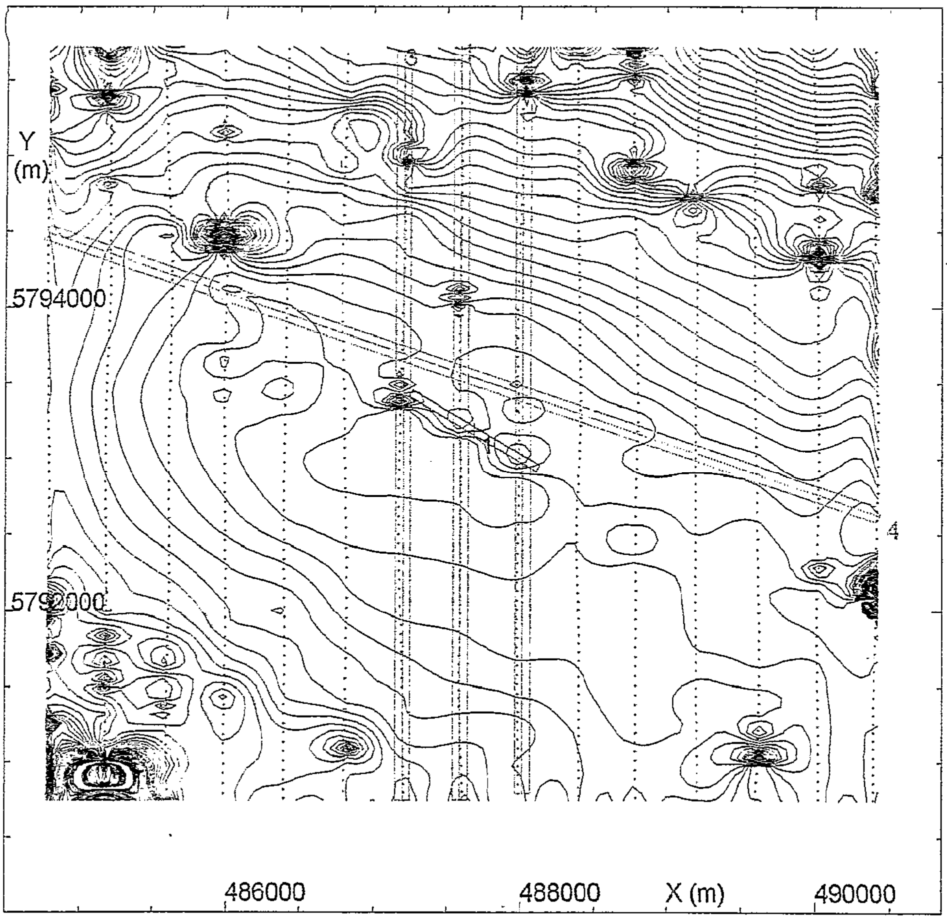
Calculation mode: Total Magnetic Intensity

Observed: ———— Calculated: ————

Residual: ———— Individual body: ————

POTENT v3.04 Profile drawn at 11:43 29/11/1994 for Preview Resources Pty. Limited

Anomaly S10 prisms 579 to 986 metres depth OK fit



Observations:	
Model:	P1 S12 HIGH IN REGIONAL LOW ABJP112.MOD
Contours of:	Observed field; Contour intervals: 0.2500, 1.5000 nT
POTENT v3.04	Plan drawn at 16:43 02/12/1994 for Preview Resources Pty. Lim

6263BF

Anomaly S12 500 metre thick prism 21 metres depth OK fit

6263BF

POTENT v3.04 Model Summary Report created at 16:47 02/12/1994 for Preview Resources Pty. Limited

Inducing field - Intensity = 60896
Azimuth = 10
Inclination = -69

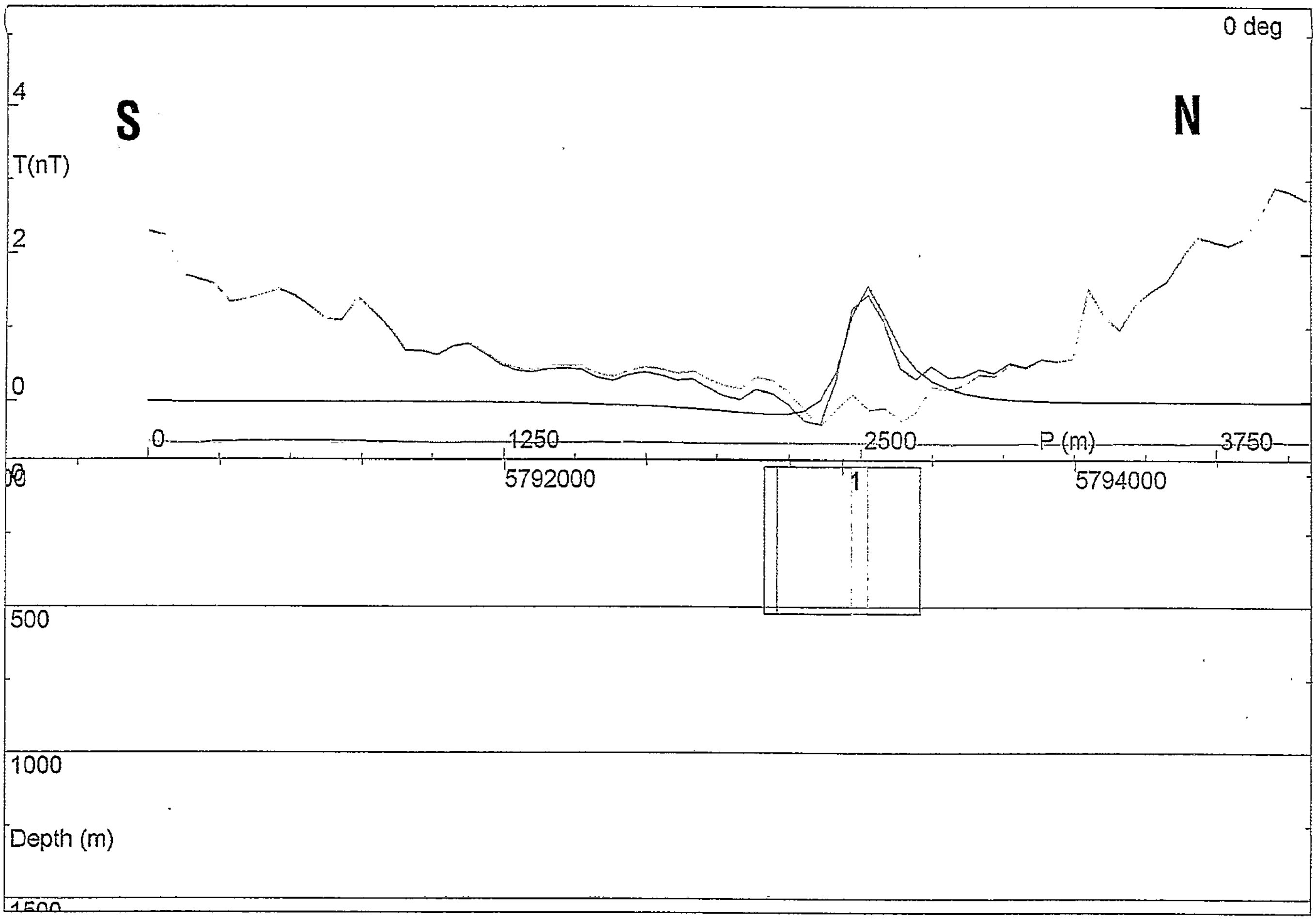
Body type abbreviations and the shape parameters have the following significance:
Rect - RECTANGULAR PRISM - A = width, B = length, C = height

Model title: P1 S12 HIGH IN REGIONAL LOW ABJP112.MOD

No.	Type	X	Y	Depth	Strike	Dip	Plunge	Susc.	Rem f	Rem az	Rem inc	A	B	C	D
		m	m	m	deg	deg	deg	SI	Amp/m	deg	deg				
1	Rect	487685	5793185	21.4	-60	90	0	0.000	0.0150	0	-82	50,0	1000,0	500.0	

Appendix 5
95-996Q MESA

Anomaly S12 500 metre thick prism 21 metres depth OK fit

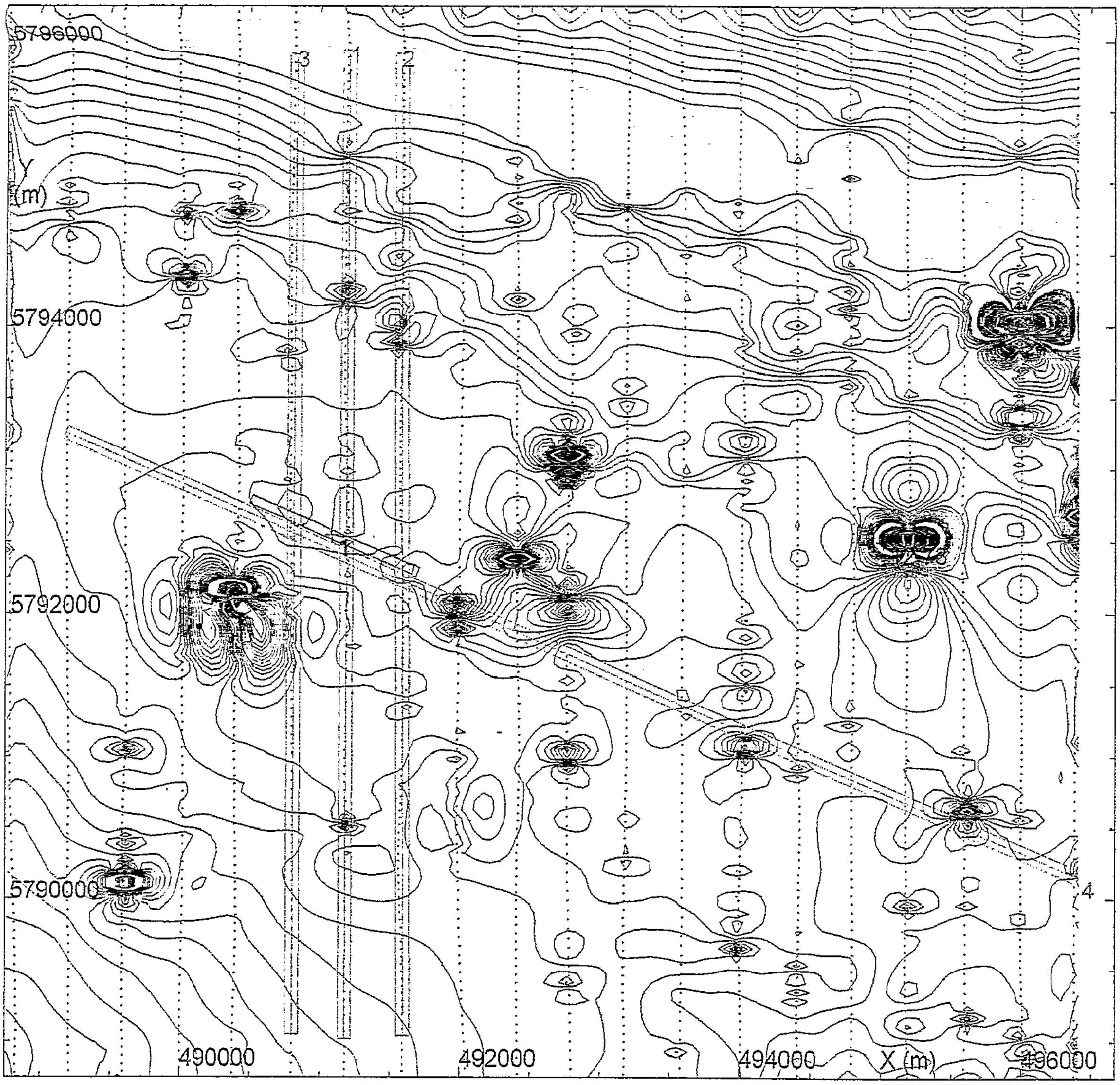


Observations:
Profile #1; 487600
Model: P1 S12 HIGH IN REGIONAL LOW ABJP112.MOD
Calculation mode: Total Magnetic Intensity

Observed: ——————— Calculated: ———————
Residual: ——————— Individual body: ———————

POTENT v3.04 Profile drawn at 16:32 02/12/1994 for Preview Resources Pty. Limited

Anomaly S12 500 metre thick prism 21 metres depth OK fit



Observations:	
Model:	ANOMALY S13 HIGH WITHIN REGIONAL LOW ABKP1S13.MOD
Contours of:	Observed field; Contour intervals: 0.5000, 2.5000 nT
POTENT v3.04	Plan drawn at 09:19 05/12/1994 for Preview Resources Pty. Limited

6263BF

Anomaly S13 100 metre thick prism 36 metres depth Poor fit

6263BF

POTENT v3.04 Model Summary Report created at 09:23 05/12/1994 for Preview Resources Pty. Limited

Inducing field - Intensity = 60896
Azimuth = 10
Inclination = -69

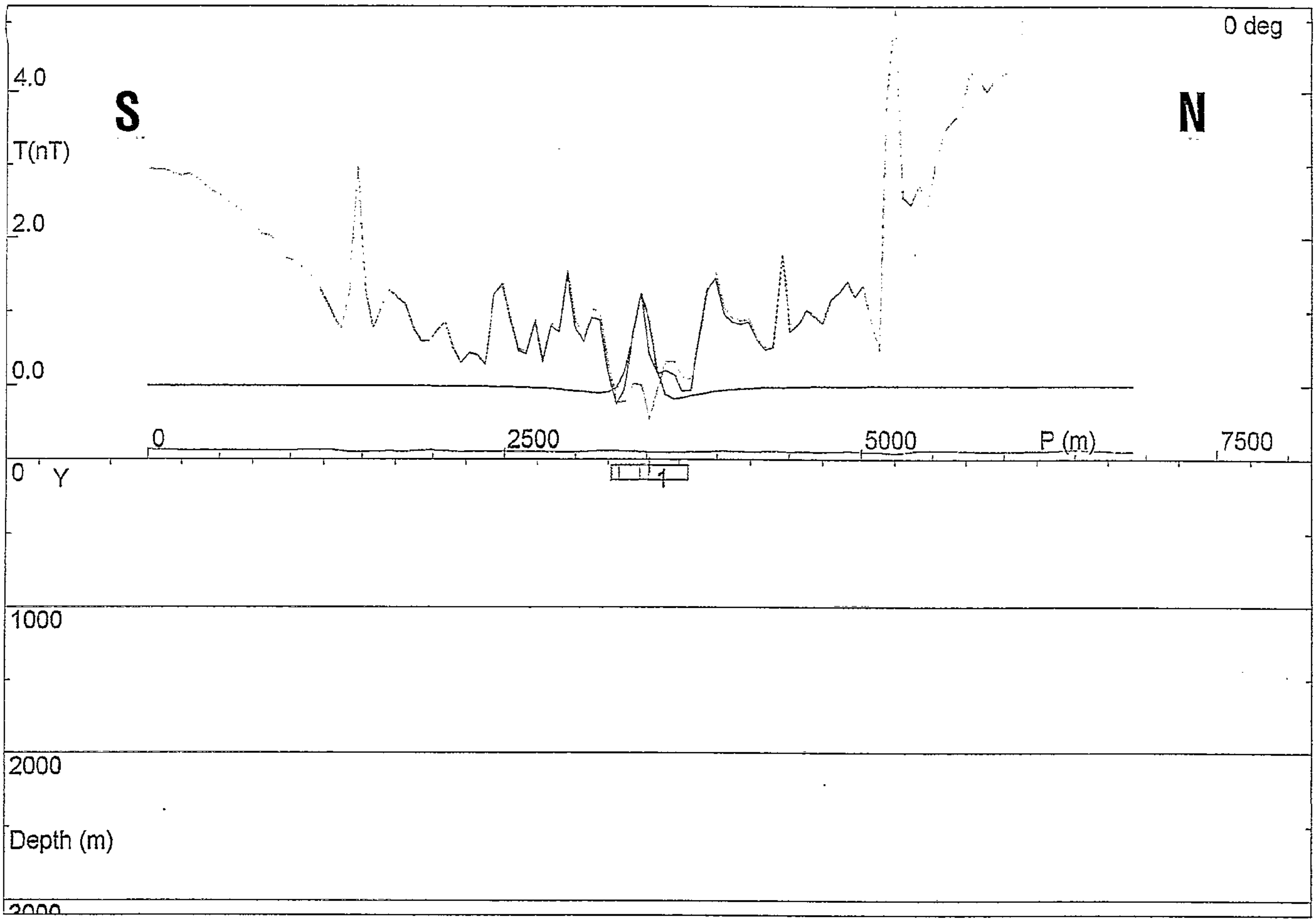
Body type abbreviations and the shape parameters have the following significance:
Rect - RECTANGULAR PRISM - A = width, B = length, C = height

Model title: ANOMALY S13 HIGH WITHIN REGIONAL LOW ABKP1S13.MOD

No.	Type	X	Y	Depth	Strike	Dip	Plunge	Susc.	Rem f	Rem az	Rem inc	A	B	C	D
		m	m	m	deg	deg	deg	SI	Amp/m	deg	deg				
1	Rect	491087	5792545	35.7	113	90	0	0.000	0.020	0	-132	60.0	1250.0	100.0	

Anomaly S13 100 metre thick prism 36 metres depth

Poor fit



Observations:

Profile #1; 491200

Model: ANOMALY S13 HIGH WITHIN REGIONAL LOW ABKP1S13.MOD

Calculation mode: Total Magnetic Intensity

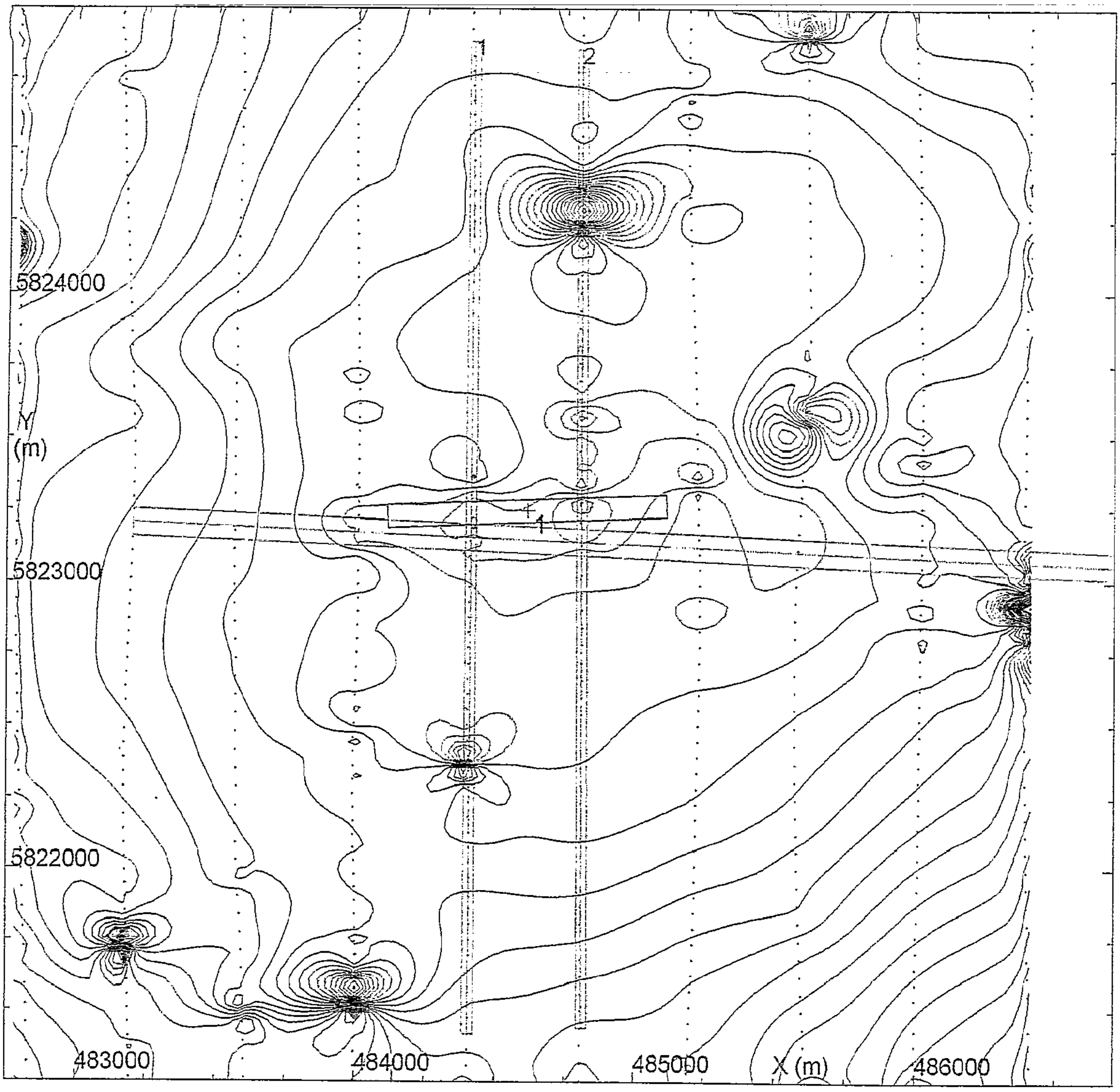
Observed: ———— Calculated: ————

Residual: ———— Individual body: ————

POTENT v3.04 Profile drawn at 09:16 05/12/1994 for Preview Resources Pty. Limited

6263BF

Anomaly S13 100 metre thick prism 36 metres depth Poor fit



Observations:	
Model:	ANOMALY S14 HIGH ON STH REGIONAL HIGH ABLP1S14.MOD
Contours of:	Observed field; Contour intervals: 1.0000, 5.0000 nT
POTENT v3.04	Plan drawn at 11:56 05/12/1994 for Preview Resources Pty. Limited

6263BF

Anomaly S14 200 metre thick prism 22 metres depth Poor fit

6263BF

POTENT v3.04 Model Summary Report created at 12:13 05/12/1994 for Preview Resources Pty. Limited

Inducing field - Intensity = 60896
Azimuth = 10
Inclination = -69

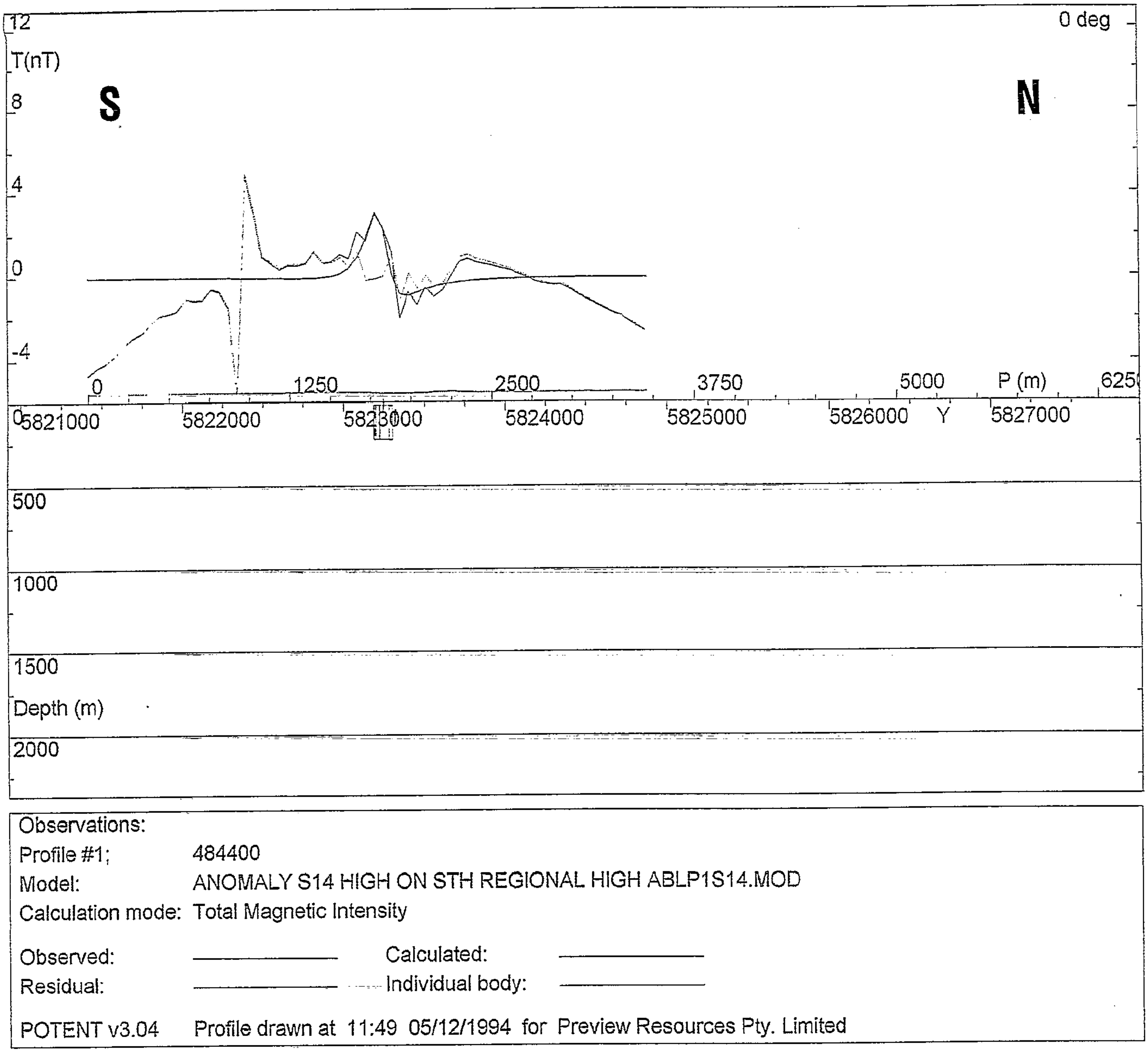
Body type abbreviations and the shape parameters have the following significance:
Rect - RECTANGULAR PRISM - A = width, B = length, C = height

Model title: ANOMALY S14 HIGH ON STH REGIONAL HIGH ABLP1S14.MOD

No.	Type	X m	Y m	Depth m	Strike deg	Dip deg	Plunge deg	Susc. SI	Rem f Amp/m	Rem az deg	Rem inc deg	A	B	C	D
1	Rect	484613	5823245	21.43	88	90	0	0.000	0.0250	0	-149	80.00	1000.00		200.00

Appendix 5
95-996S MESA

Anomaly S14 200 metre thick prism 22 metres depth Poor fit



6263BF

Anomaly S14 200 metre thick prism 22 metres depth Poor fit

APPENDIX 6

SIDESCAN RADAR DATA

ERS-1 is a satellite launched by the European Space Agency (ESA) on 17 July 1991. Among its instrument suite this satellite carries a synthetic aperture radar which is an active sensor using the 5.3 Ghz (C-band) frequency. "In image mode the on-board SAR instrument obtains strips of high resolution imagery 100 km wide, with a spatial resolution of 26 m in range (across track) and between 6 m and 30 m in azimuth (along track)". "A narrow beam is directed sideways and downwards onto the Earth's surface with an incident angle of 23 degrees (mid swath). The radar beam illuminates the ground and an image is built up from the return signals of individual targets". (ACRES user Manual, 1991, p80).

An ERS-1 SAR image over south-eastern SA extending from Mount Gambier in the south to Penola in the north was purchased from ACRES in conjunction with an aeromagnetic survey of the region conducted by World Geoscience (see figure 19). The justification for the purchase was twofold:

1. C-Band radar imagery penetrates cloud hence the imagery have a greater chance of having been acquired close to the time of the aeromagnetic survey. The south-east is notorious for its cloud cover, making timely acquisition of Landsat imagery highly unlikely.

2. The active radar signal responds to the electrical properties of the materials with which it interacts. For example radar imagery highlights railways and power lines compared to Landsat imagery which highlights roads. It was felt that radar might assist in the identification of those surface features causing spurious high frequency responses in the aeromagnetics.

The results were not as encouraging as anticipated. The imagery did highlight linear metallic features such as the railway and the power lines. However the orientation of the object relative to the orbit of the satellite determined the strength of the return signal and certain objects that should have responded to the radar signal were not detected. The resolution of the imagery was disappointing at 30 m x 30 m ground pixel size. There did not appear to be any features visible in the ERS-1 image that could not have been found on the relevant topographic map and there were features of interest on the map which were not present in the imagery at all.

APPENDIX 7

REPORT ON LINEAR ANALYSIS OF

AEROMAGNETIC DATA INCLUDING

EULER DEPTH TO BASEMENT INTERPRETATION

FAX Transmission

From:	Duncan R. Cowan	Cowan Geodata Services
Questions?	Call 386-1603	12 Edna Road
To:	Paul Cartwright	Dalkeith, W.A 6009 Australia
Company:	Aerodata/WGC	Tel/Fax (09) 386-1603
Address:	Floreat	International +619-386-1603
Date:	February 6, 1995	
Time:	9:11 AM	

Message: **PENOLA, OTTWAY BASIN**

Dear Paul,

I have checked out the 3D Euler results for Penola.

I ran the Euler with a 16 point window for structural index 0.5 and have zipped the X,Y,Z data to floppy disk for you. Please let me know if you want to send a courier or just want us to mail it.

I can't see any evidence for very deep basement. Around anomalies A,B,C,D on the enclosed A4 plot, we see maximum depths in the 3-4 km range. The absolute maximum for the Euler run was 5 kms. We are getting good clusters of Euler solutions over these anomalies so the indicated depth range looks good.

I can't really justify re-sampling to say 500m as the grid is only 32 kms wide. It is too narrow a window for this type of exercise.

There are magnetic sources at a least 3 different levels. The shallow, presumably intra-sedimentary anomalies occur right along the strip of data. The intermediate depths occur mainly in the north but isolated anomalies occur elsewhere. Presumably all this came out of the depth slicing and qualitative interpretation ?

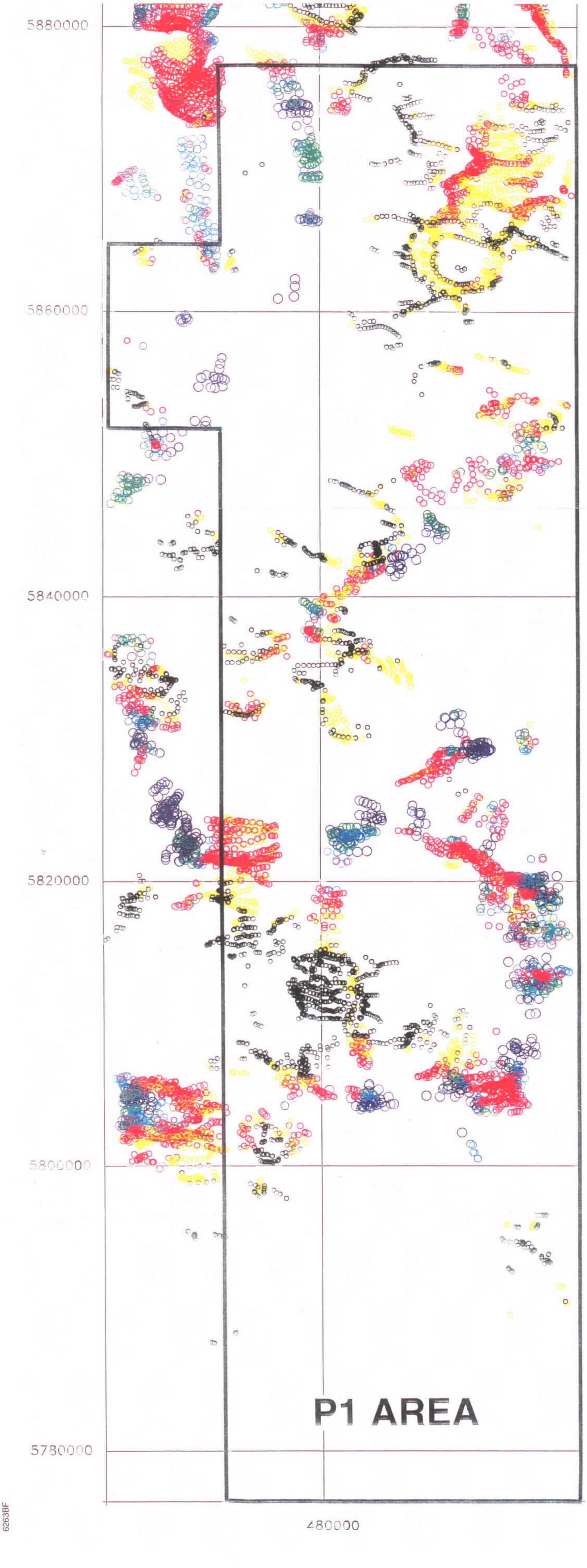
Best regards,

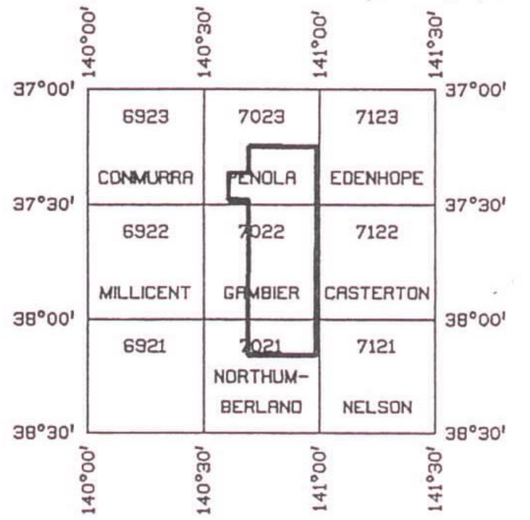
Duncan

NOTE: Anomaly letters A,B,C & D referenced in this Appendix correspond with Figure 10 letters as follows:

Appendix 8	Figure 10
A	A
B	G
C & D	F

Non-Linear Geophysics Pty. Ltd.
A.C.N. 058 106 540





REFERENCE TO AUSTRALIA 1:100 000
STANDARD MAP SERIES

0 10 20
KILOMETRES

STRUCTURAL INDEX .5
16 POINT WINDOW
135m GRID MESH
DEPTH KEY

- >= 3000m
- >= 2500m
- >= 2000m
- >= 1500m
- >= 1000m
- >= 500m
- >= 0m

COWAN GEODATA SERVICES
WORLD GEOSCIENCE CORPORATION

OTWAY BASIN - AEROMAGNETIC
AND RADIOMETRIC TEST SURVEY

LINEAR ANALYSIS OF AEROMAGNETIC DATA INCLUDING EULER DEPTH TO BASEMENT INTERPRETATION

Appendix 7
95-1122 MESA

APPENDIX 8

IMAGE PROCESSED AEROMAGNETIC AND RADIOMETRIC DATA

SOUTH AUSTRALIAN EXPLORATION INITIATIVE

1992-1993 AIRBORNE GEOPHYSICAL SURVEYS

IMAGE PROCESSED AEROMAGNETICS

AREA P1

WORLD GEOSCIENCE
CORPORATION LIMITED

AREA - P1 - South Australia

(Part Penola and SJ54-10 1:250,000)

SURVEY DETAILS

TRAVERSE SPACING	-	400m
TIE LINE SPACING	-	4000m
TRAVERSE DIRECTION	-	180 - 360 deg
TIE LINE DIRECTION	-	090 - 270 deg
SENSOR HEIGHT	-	60m mtc

PROCESSING DETAILS

GRID CELL SIZE	-	135m
CULTURE SUPPRESSED		
MICROLEVELLED		

IMAGING DETAILS

PIXEL SIZE	-	70m
IMAGE PROCESSED DATE	-	June, 1994

IMAGE PROCESSED AEROMAGNETIC and RADIOMETRIC

IMAGE NO.	FILTER TYPE
DME93 1496	TMI Colour + NE Illumination of Magnetics
	TMI Colour + SE Illumination of Magnetics
	Greyscale First Vertical Derivative of Magnetics
DME93 1497	Radiometric Total Count (cps)
	Radiometric Ternary - Red: Potassium, Green: Thorium, Blue: Uranium
DME93 1498	Equivalent Potassium Concentration (percent)
	Equivalent Thorium Concentration (ppm)
	Equivalent Uranium Concentration (ppm)
DME93 1499	Pseudo Depth Slice 1 - RTP
	TMI Colour + NE Illumination of Magnetics
	Greyscale NE Illumination of Magnetics
	TMI Colour + SE Illumination of Magnetics
	Greyscale SE Illumination of Magnetics
	TMI Colour + First Vertical Derivative of Magnetics
	Greyscale First Vertical Derivative of Magnetics
DME93 1500	Pseudo Depth Slice 2 - RTP
	TMI Colour + NE Illumination of Magnetics
	Greyscale NE Illumination of Magnetics
	TMI Colour + SE Illumination of Magnetics
	Greyscale SE Illumination of Magnetics
	TMI Colour + First Vertical Derivative of Magnetics
	Greyscale First Vertical Derivative of Magnetics

IMAGE PROCESSED AEROMAGNETIC and RADIOMETRIC

IMAGE NO.	FILTER TYPE
DME93 1501	Pseudo Depth Slice 3 - RTP
	TMI Colour + NE Illumination of Magnetics
	Greyscale NE Illumination of Magnetics
	TMI Colour + SE Illumination of Magnetics
	Greyscale SE Illumination of Magnetics
	TMI Colour + First Vertical Derivative of Magnetics
	Greyscale First Vertical Derivative of Magnetics
DME93 1502	Pseudo Depth Slice 4 - RTP
	TMI Colour + NE Illumination of Magnetics
	Greyscale NE Illumination of Magnetics
	TMI Colour + SE Illumination of Magnetics
	Greyscale SE Illumination of Magnetics
	TMI Colour + First Vertical Derivative of Magnetics
	Greyscale First Vertical Derivative of Magnetics
DME93 1503	Pseudo Basement Slice - RTP
	TMI Colour + NE Illumination of Magnetics
	Greyscale NE Illumination of Magnetics
	TMI Colour + SE Illumination of Magnetics
	Greyscale SE Illumination of Magnetics
	TMI Colour + First Vertical Derivative of Magnetics
	Greyscale First Vertical Derivative of Magnetics
DME93 1504	Radiometric Ratio Uranium:Potassium
	Radiometric Ratio Thorium:Potassium
	Radiometric Ratio Uranium:Thorium

IMAGE FILTER DESCRIPTION

RAW DATA IMAGES

Raw data images are produced by grey scaling or colouring the gridded data set according to the relative data values of each grid point. In the greyscale case there are 255 shades of grey used, ranging from black (low data values) through to white (high data values). Coloured images are produced by assigning a "look up table" consisting of a maximum of 500 colours to the data values. The colour scheme can be designed to suit individual preferences, but in general a rainbow colour spectrum is used with purple depicting low data values through to red/white representing high data values.

SUN ANGLE OR ILLUMINATION IMAGES

A simulated light source is used to Illuminate the data set from a selected elevation and azimuth. The data set onto which the "sun" is illuminating will give maximum reflectance when the normal vector * of the surface (data) is parrallel to the direction of the illumination. In a greyscale these areas are shaded white. When the normal vector of the surface is perpendicular to the direction of illumination the reflectance is at a minimum and these areas are assigned dark shades. The effect of this type of process is analogous to shading topographic relief maps. The sunangle image will highlight subtle features striking perpendicular to the direction of application. A colour sun angle image can be formed by merging the colour raw data image with the greyscale sun angle image. In this type of display the colour represents the relative intensities of the data and the shading or relief is the sunangle image of the data set.

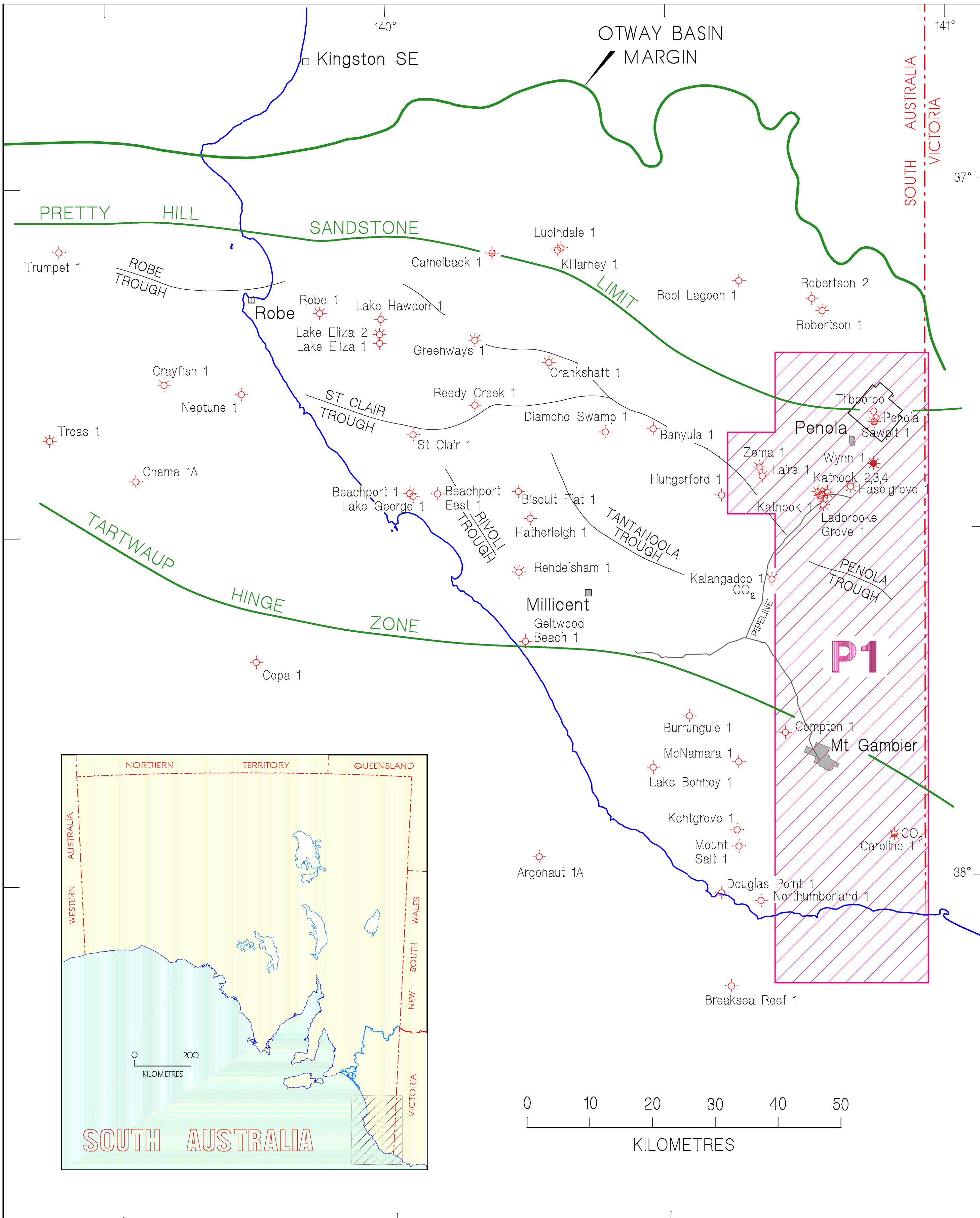
AGC ENHANCEMENT

The AGC Enhancement is essentially an Automatic Gain Control (AGC) filter in that it amplifies low amplitudes and supresses high amplitudes. The scale factor indicates the sensitivity of the AGC filter applied. A scale factor of one is maximum sensitivity, whereas a Scale Factor of 0.5 retains some amplitude information at the expense of very subtle texture. The AGC Enhancement enables the detection of extremely subtle features in the data set. Unlike sunangle operators the AGC Enhancement has no directional bias (ie highlights all directions equally). It does, however perform poorly in steep gradients where it has poor resolving power of subtle anomalies. In these areas the filter may also introduce "ringing" #.

Ringing - Noise introduced by the filtering operation.

VERTICAL DERIVATIVES

The vertical derivative of the magnetic field provides higher resoloution of the edges of magnetic bodies. Vertical derivatives enhance subtle features, are non directional and are more indicative of the location of the source. These enhancements are generated in the space domain (vs. Frequency Domain) using a kernel. Since it acts over a local area, the overall sense of magnitude is suppressed within the image.



Dry well

Dry well, gas show

Gas well

Dry well, oil show

Oil well

Figure 1

OTWAY BASIN - AEROMAGNETIC AND RADIOMETRIC TEST SURVEY

LOCATION OF AEROMAGNETIC and RADIOMETRIC SURVEY AREA

MESA 95–131

MINES and ENERGY RESOURCES SOUTH AUSTRALIA

QD-TOJO 6263DT.DTA

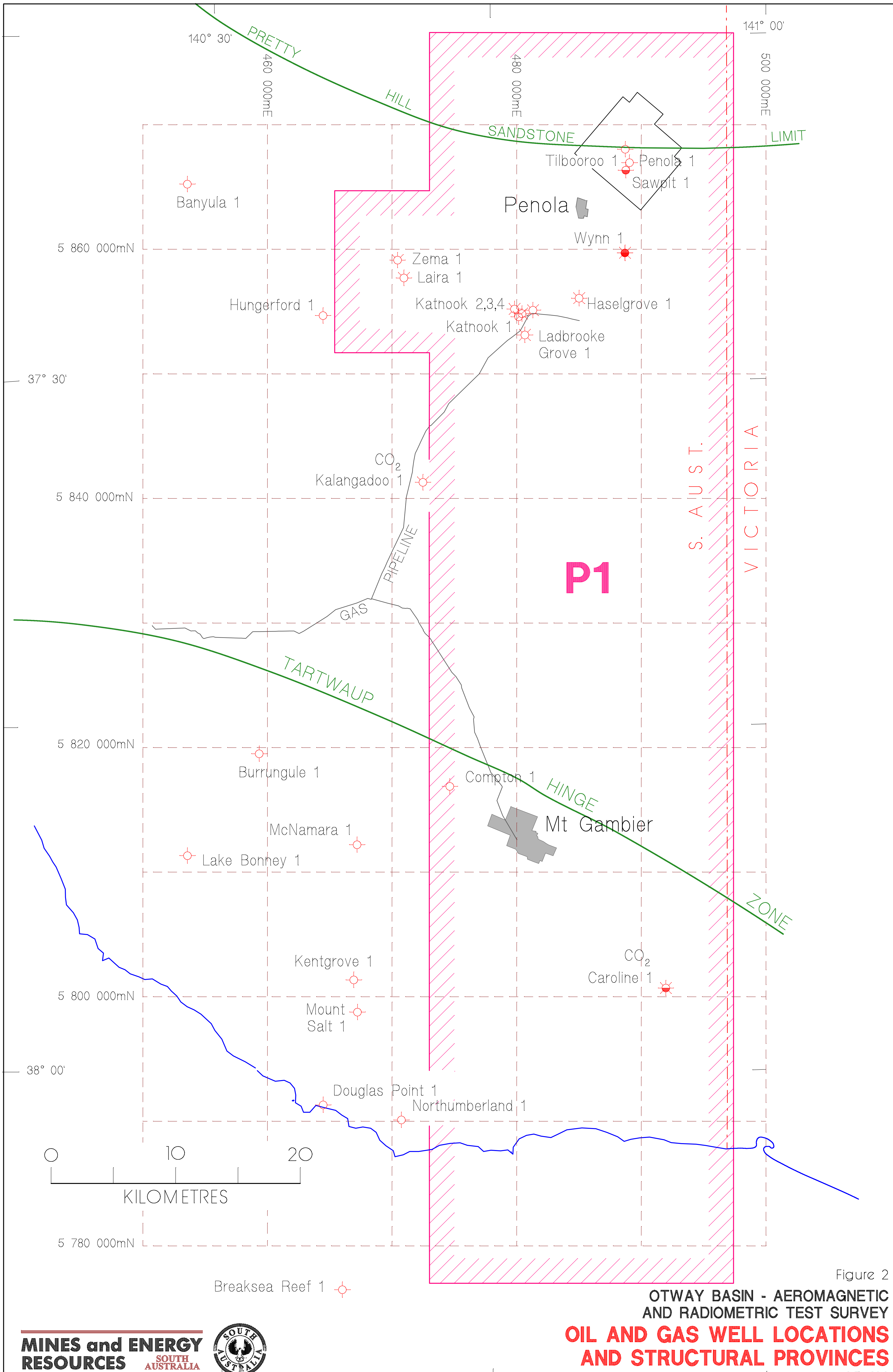
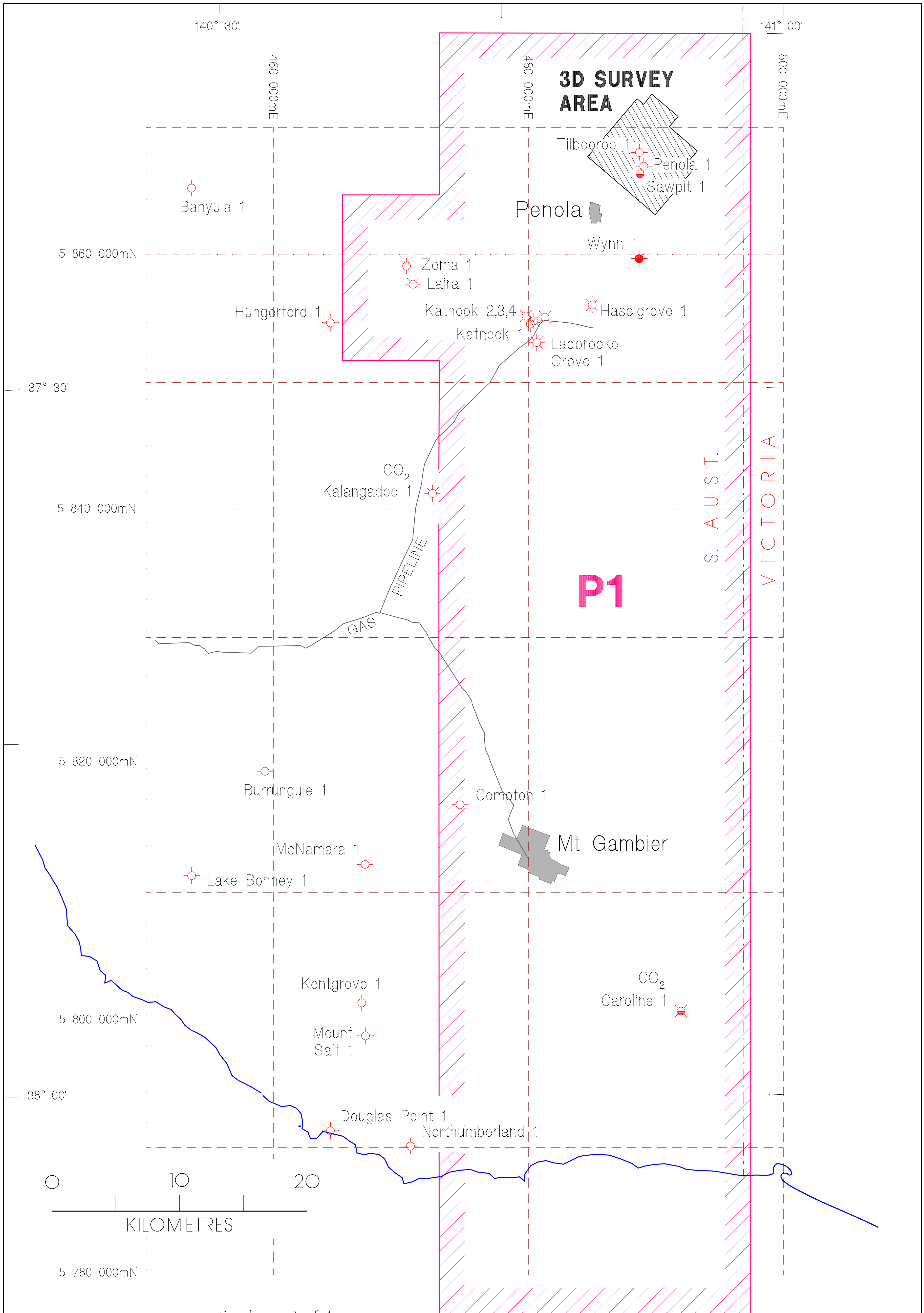


Figure 2
OTWAY BASIN - AEROMAGNETIC AND RADIOMETRIC TEST SURVEY
OIL AND GAS WELL LOCATIONS AND STRUCTURAL PROVINCES
95-132



QD-TOJO 6263DT.DTA

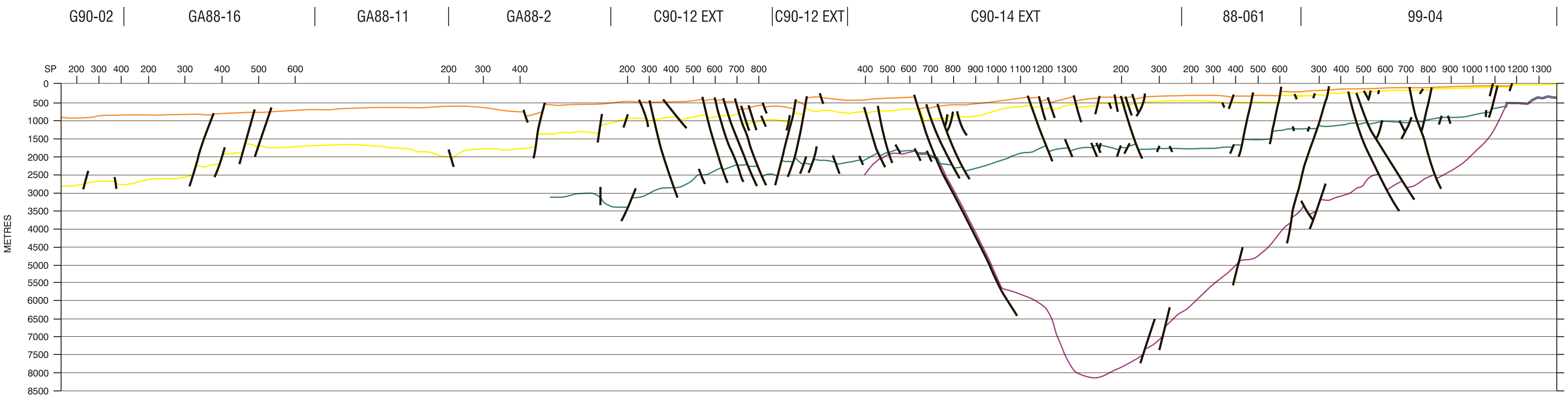
MINES and ENERGY RESOURCES SOUTH AUSTRALIA

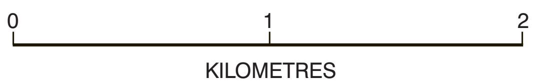
Figure 3

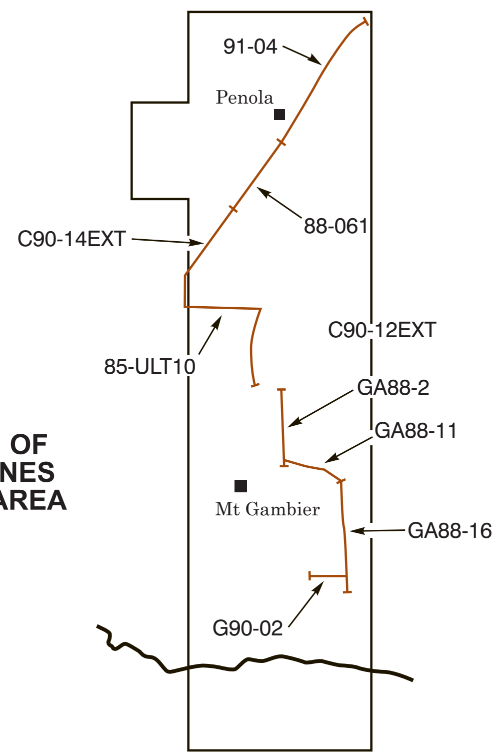
OTWAY BASIN - AEROMAGNETIC AND RADIOMETRIC TEST SURVEY

AREA OF PENOLA 3D SEISMIC SURVEY

95-133







LOCATION OF SEISMIC LINES WITHIN P1 AREA

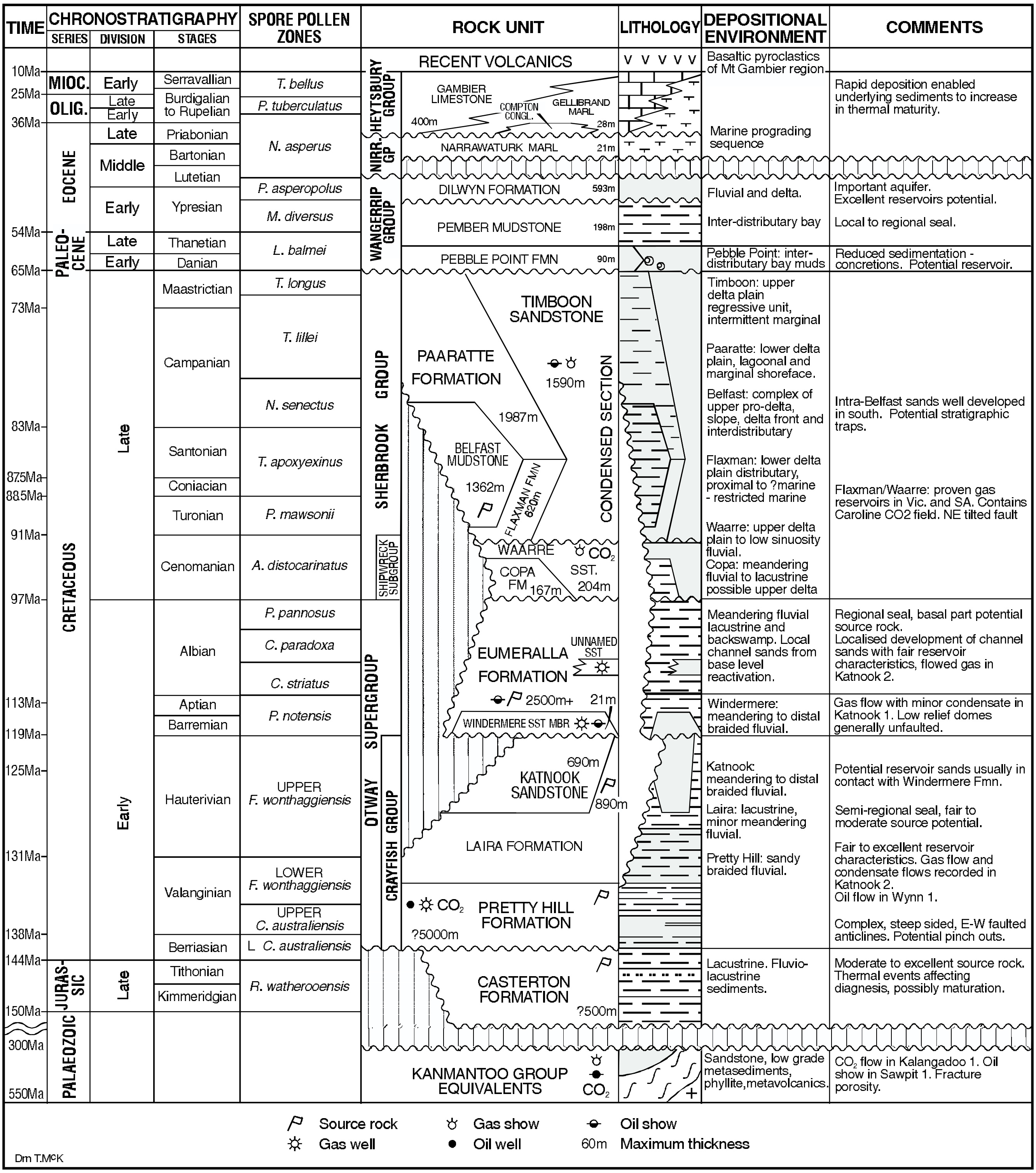
Top of Sherbrook Group
Top of Eumeralla Group
Top of Crayfish Group
Top of Basement

OTWAY BASIN AEROMAGNETIC - RADIOMETRIC TEST SURVEY

REGIONAL SEISMIC LINES USED IN MAGNETIC MODELLING

Figure 4
95-969 MESA

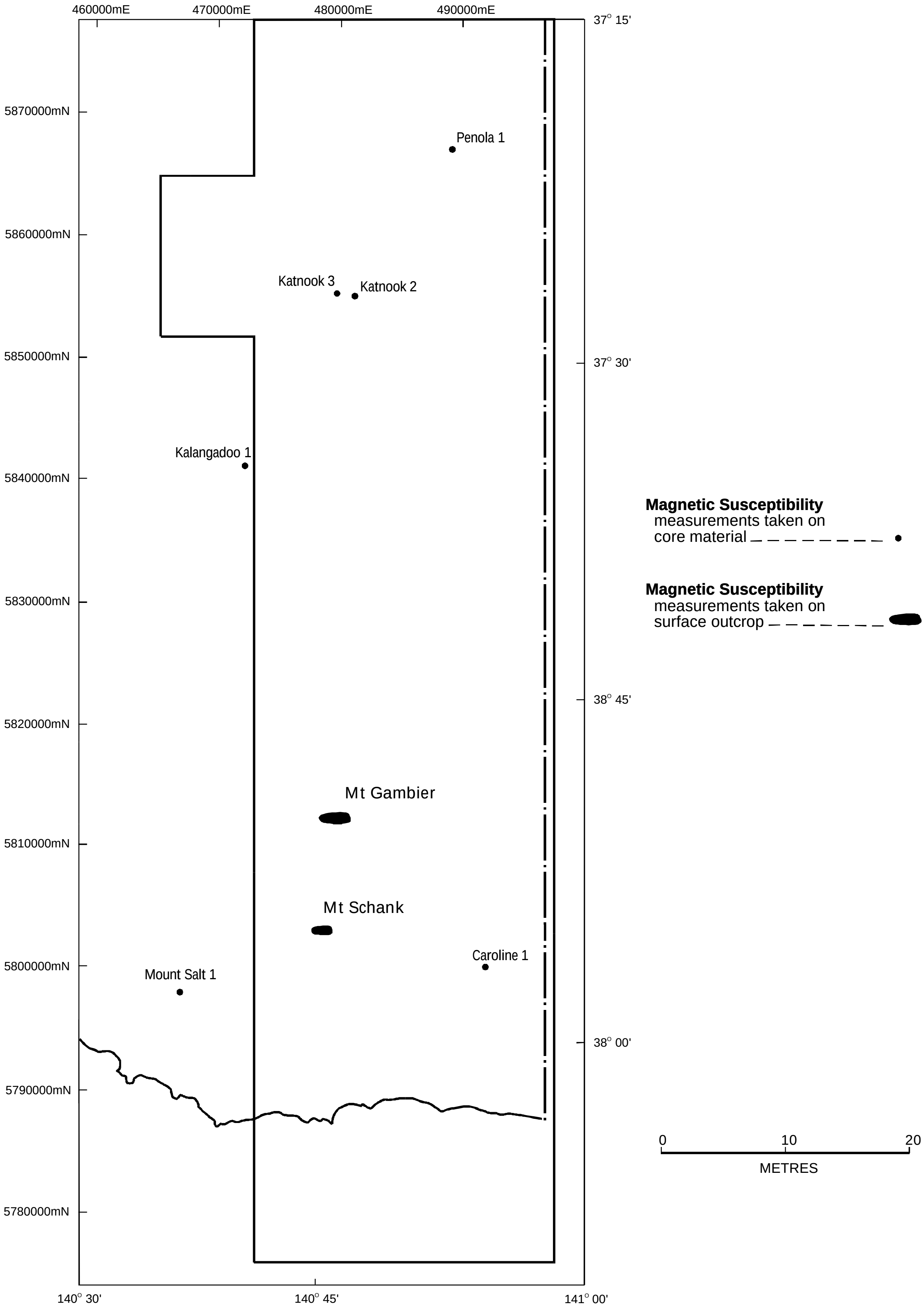
6263bf.cdr



Western Otway Basin
STRATIGRAPHIC GEOLOGICAL SUMMARY

MINES AND ENERGY SOUTH AUSTRALIA

95-105 MESA

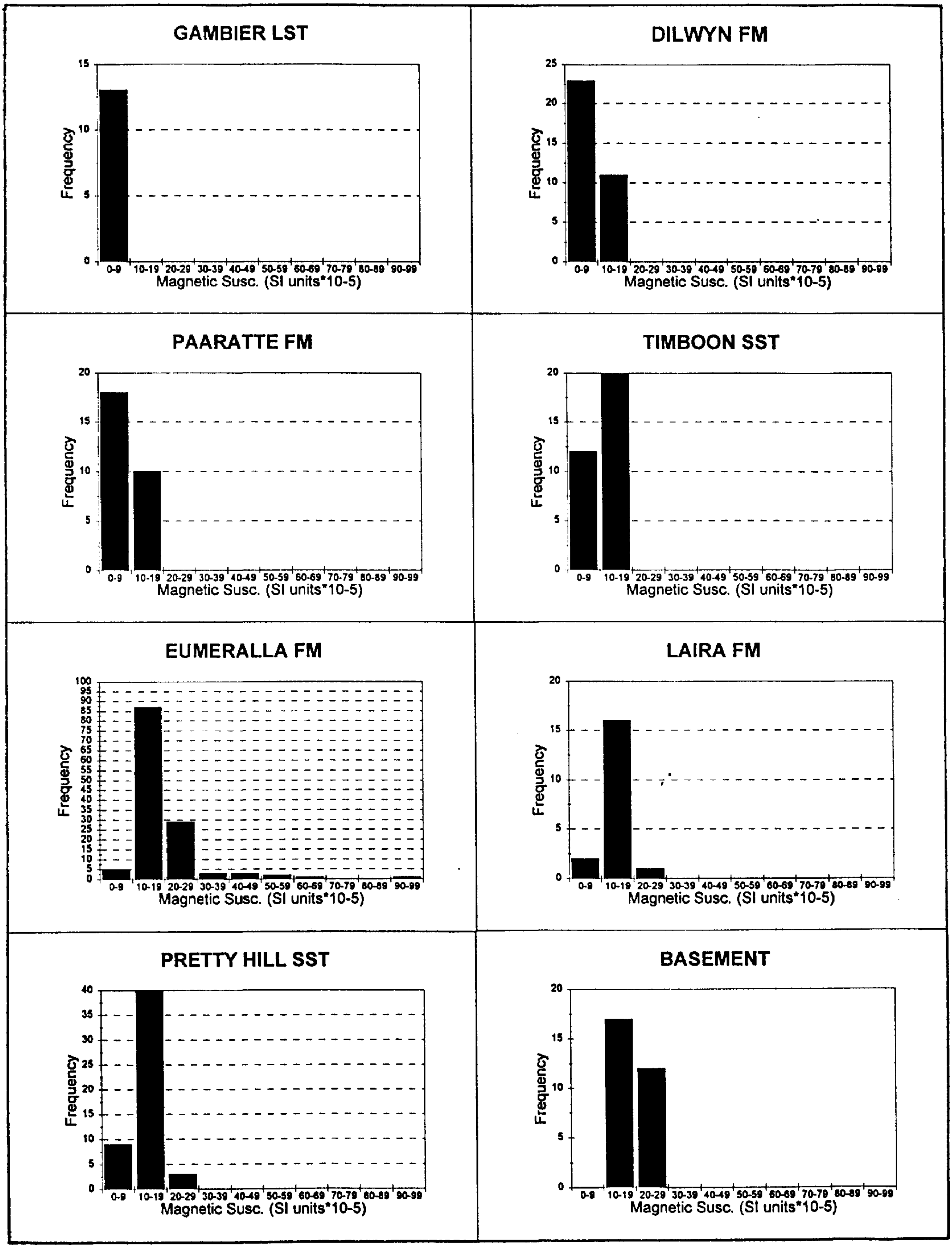


OTWAY BASIN AEROMAGNETIC - RADIOMETRIC TEST SURVEY

LOCATION MAP OF SUSCEPTIBILITY READINGS

Figure 6
95-997 MESA

6263bf.cdr

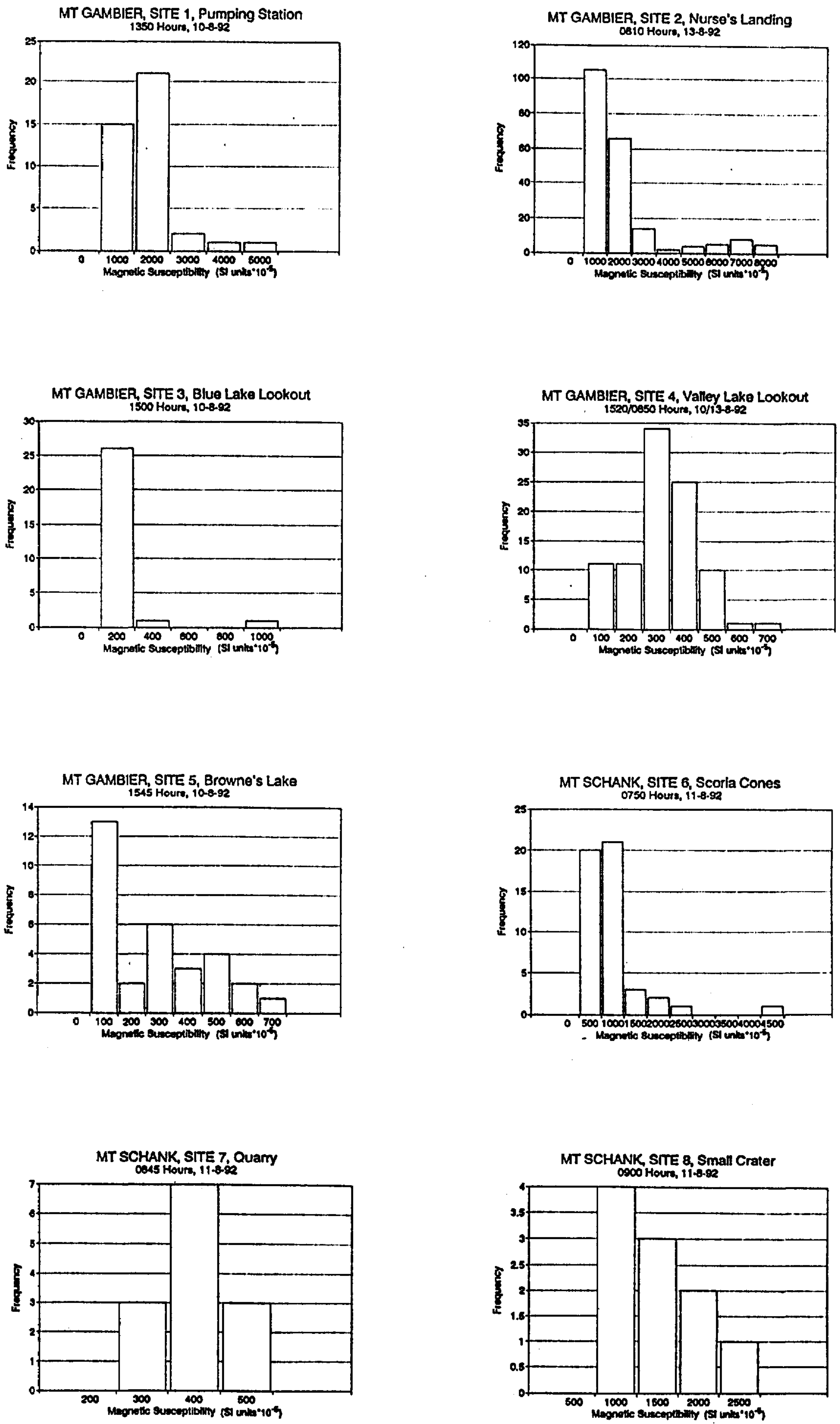


OTWAY BASIN - AEROMAGNETIC AND RADIOMETRIC TEST SURVEY

RESULTS OF CORE MAGNETIC SUSCEPTIBILITY MEASUREMENTS (UNCORRECTED)

Figure 7

95-883 MESA

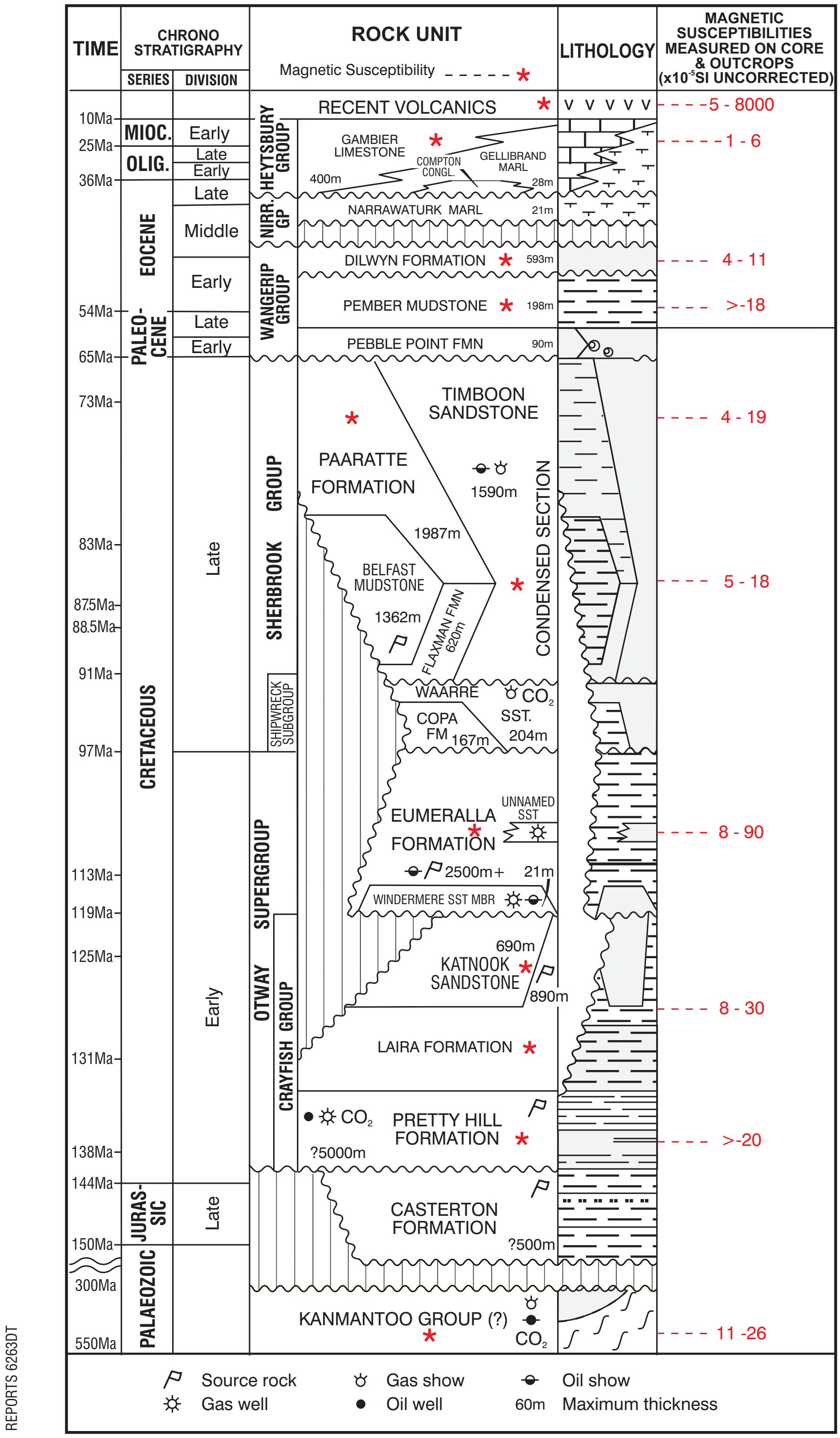


OTWAY BASIN - AEROMAGNETIC AND RADIOMETRIC TEST SURVEY

RESULTS OF GROUND MAGNETIC SUSCEPTIBILITY MEASUREMENTS
(UNCORRECTED)

Figure 8 95-884 MESA

6263BF

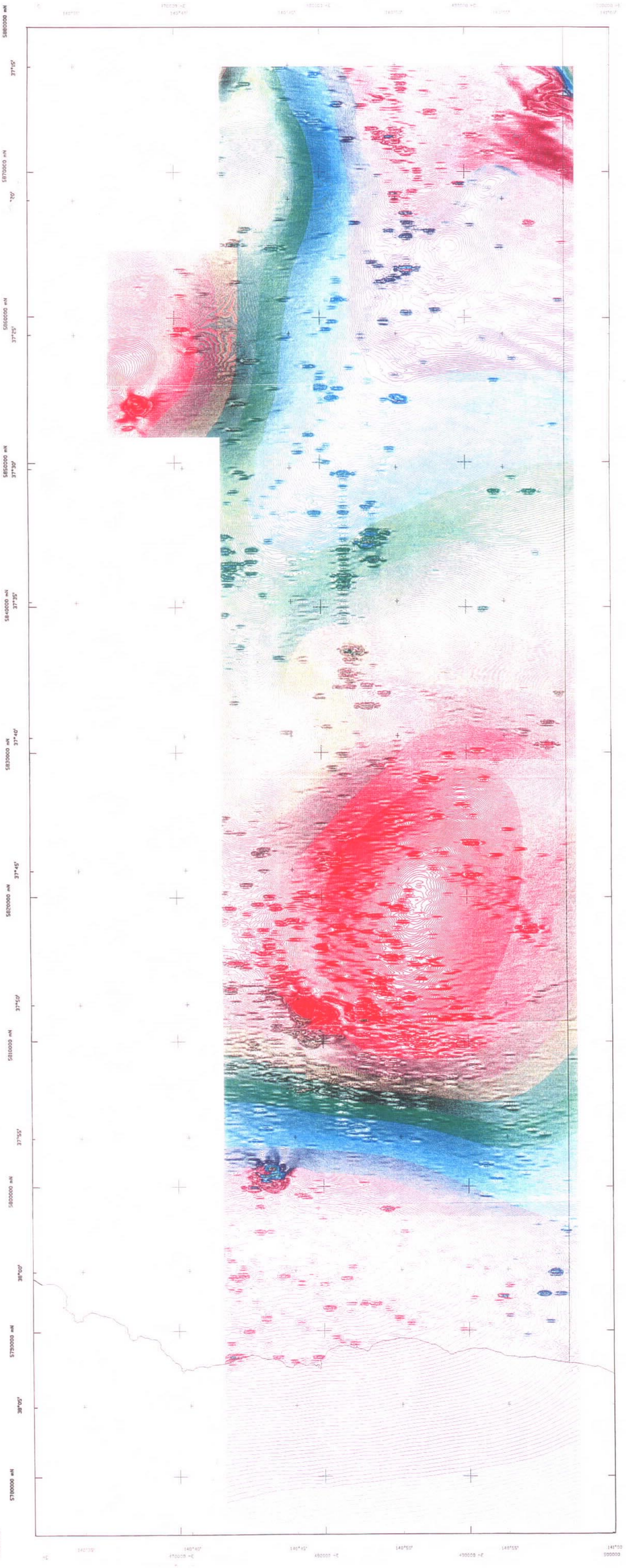


Otway Basin Aeromagnetic and Radiometric Test Survey

SUMMARY OF SUSCEPTIBILITY AND MAGNETIC LITHOSTRATIGRAPHY

MINES AND ENERGY
SOUTH AUSTRALIA

Figure 9
95-999

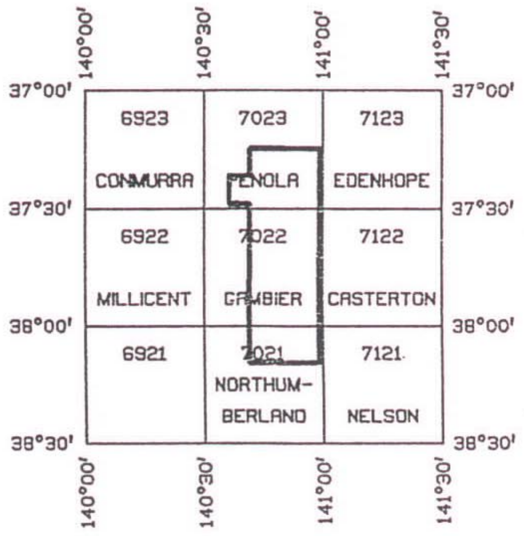


SOUTH AUSTRALIAN EXPLORATION INITIATIVE

1992-93 Airborne Geophysical Surveys

AREA P1

(part PENOLA and SJ54-10 1:250 000)



REFERENCE TO AUSTRALIA 1:100 000
STANDARD MAP SERIES

0 10 20
KILOMETRES

SOUTH AUSTRALIA
DEPARTMENT OF MINES AND ENERGY

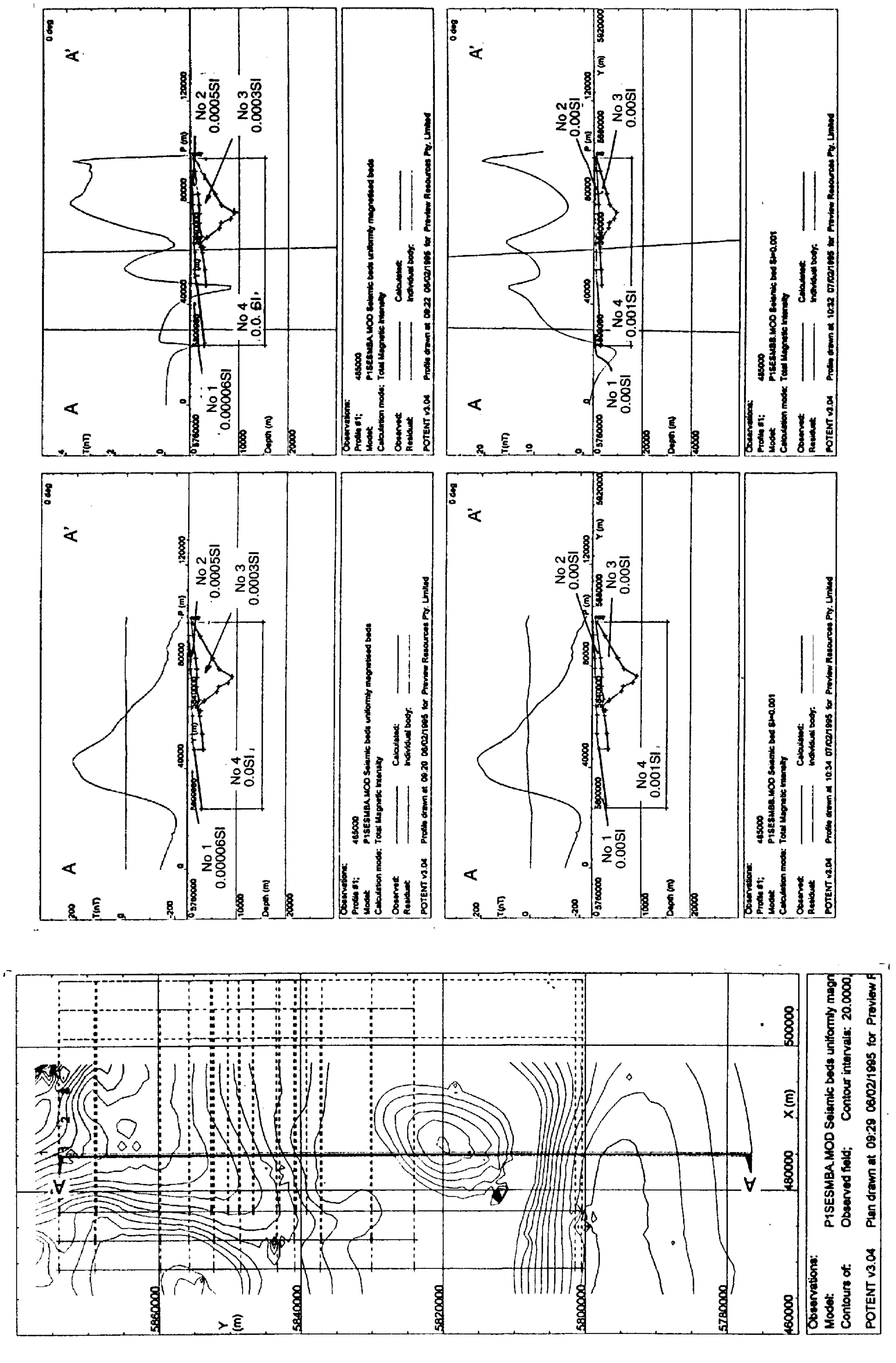
AMPOL EXPLORATION LTD.
CULTUS PETROLEUM N.L.
GFE RESOURCES LIMITED
LAKES OIL LIMITED
MINORA RESOURCES N.L.
OIL COMPANY OF AUSTRALIA LIMITED
SAGASCO RESOURCES LTD.

OTWAY BASIN - AEROMAGNETIC
AND RADIOMETRIC TEST SURVEY

TOTAL MAGNETIC INTENSITY
WITH CULTURE CONTOUR MAP

6263BF

Figure 10
95-1091 MESA

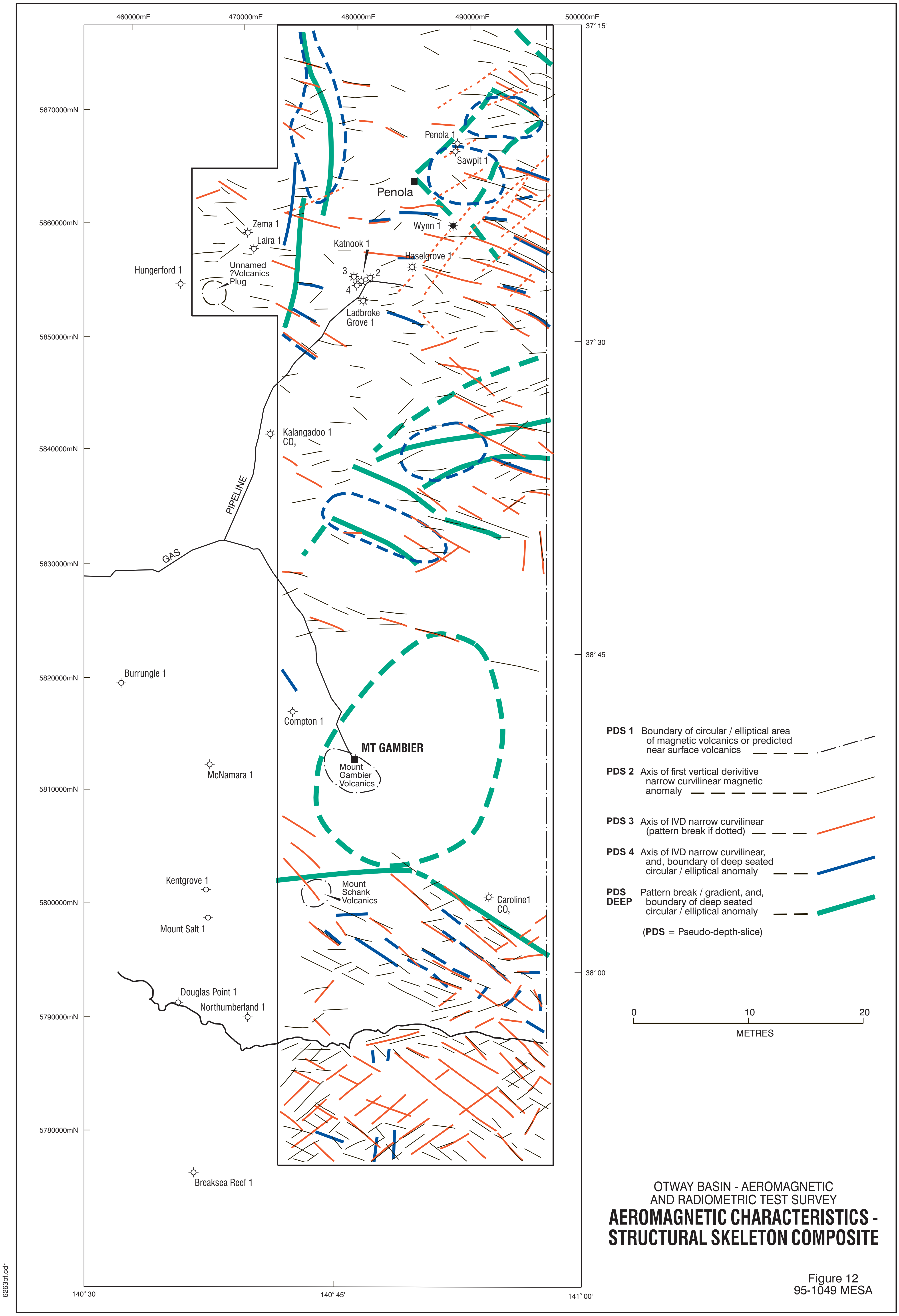


OTWAY BASIN - AEROMAGNETIC AND RADIOMETRIC TEST SURVEY

COMPARISON OF MODELLED MAGNETIC VALUES USING MEASURED SUSCEPTIBILITY AND AEROMAGNETIC DATA FOR REGIONAL SEISMIC LINE 1

Figure 11 95-885 MESA

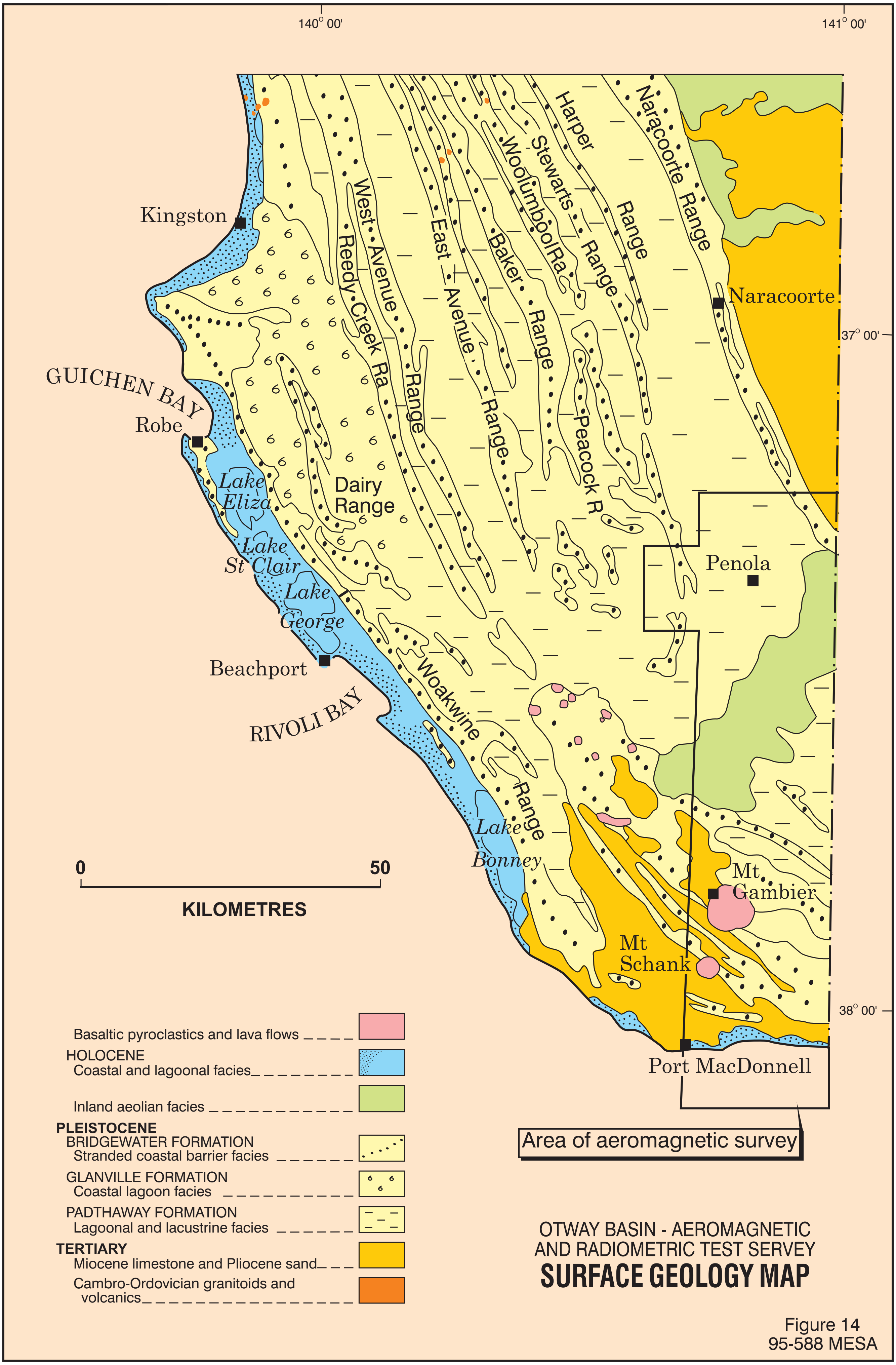
Job no. 6263bf



OTWAY BASIN - AEROMAGNETIC
AND RADIOMETRIC TEST SURVEY

AEROMAGNETIC CHARACTERISTICS - STRUCTURAL SKELETON COMPOSITE

Figure 12
95-1049 MESA

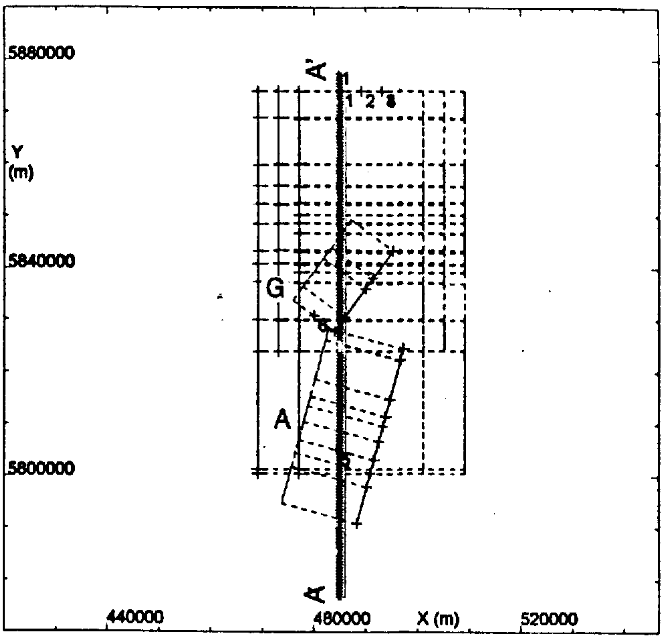


OTWAY BASIN - AEROMAGNETIC AND RADIOMETRIC TEST SERVEY

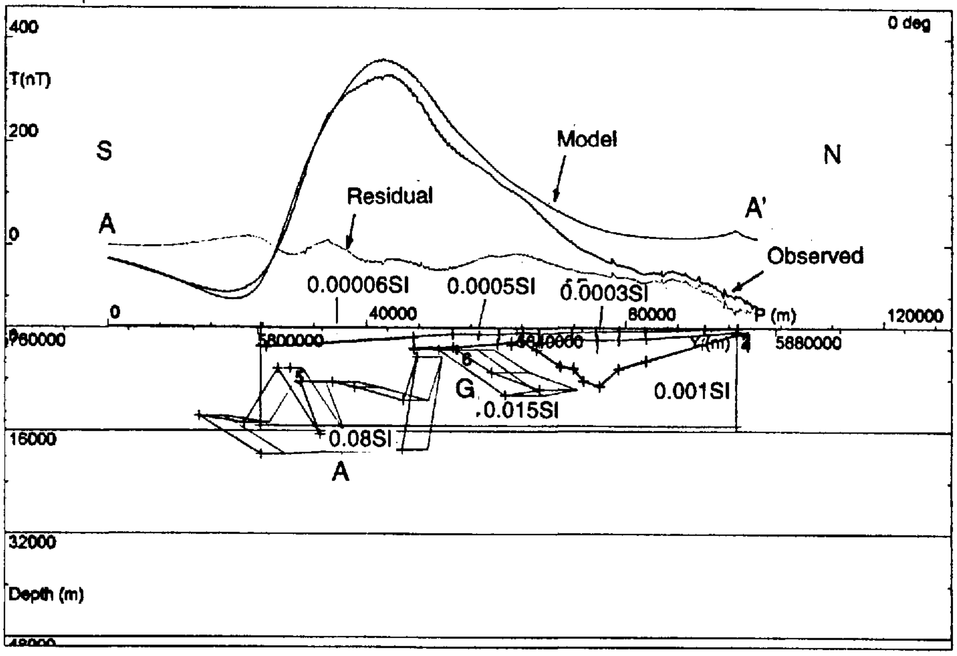
SURFACE GEOLOGY MAP

Figure 14

95-588 MESA



Observations: 485000
Model: ANOMALY A&G SEISMIC BEDS P1SES2B.MOD
POTENT v3.04 Plan drawn at 16:32 23/11/1994 for Preview Resources Pty. Lim



Observations: 485000
Profile #1; 485000E
Model: ANOMALY A&G SEISMIC BEDS P1SES2B.MOD
Calculation mode: Total Magnetic Intensity

Observed: ————— Calculated: —————
Residual: ————— Individual body: —————

POTENT v3.04 Profile drawn at 16:18 23/11/1994 for Preview Resources Pty. Limited

POTENT v3.04 Model Summary Report created at 16:38 23/11/1994 for Preview Resources Pty. Limited

Inducing field - Intensity = 60896
Azimuth = 10
Inclination = -69

Body type abbreviations and the shape parameters have the following significance:
Poly3 - 3-D POLYGONAL PRISM - (A,C) pairs represent vertex coordinates relative to vertex #1, B = length

Model title: ANOMALY A&G SEISMIC BEDS P1SES2B.MOD

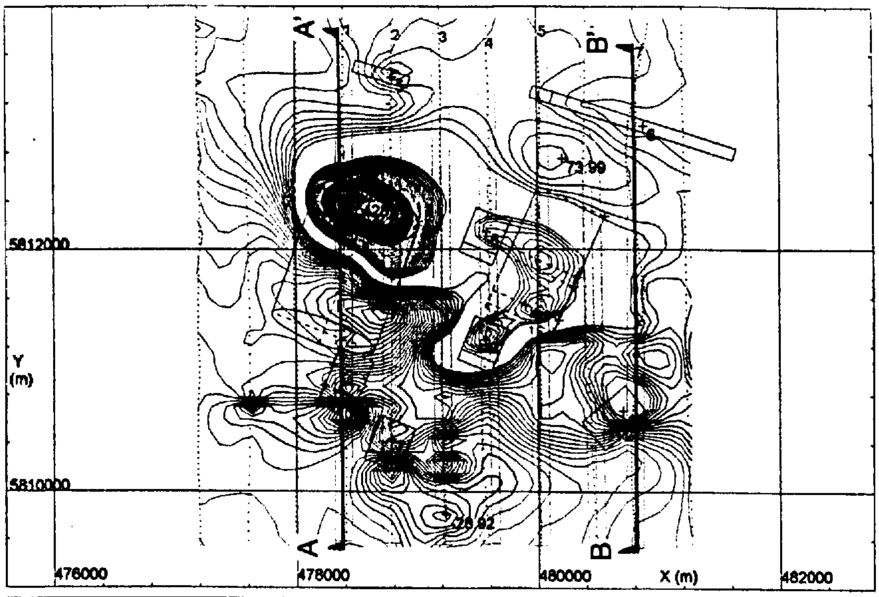
No.		Type	X	Y	Depth	Strike	Dip	Plunge	Susc.	A	B	C	D
			m	m	m	deg	deg	deg	SI				
1		Poly3	485111	5874157	7	90	90	0	0.00006	0	32000	0	
2		Poly3	489111	5874046	115	90	90	0	0.00050	0	32000	0	
3		Poly3	493111	5874083	662	90	90	0	0.00030	0	32000	0	
4		Poly3	493111	5874013	1061	90	90	0	0.00100	0	32000	0	
5	A	Poly3	484312	5805108	6321	-75	90	0	0.08000	0	15000	0	
6	G	Poly3	479963	5830856	3357	-54	90	0	0.01500	0	10000	0	

OTWAY BASIN - AEROMAGNETIC AND RADIOMETRIC TEST SURVEY

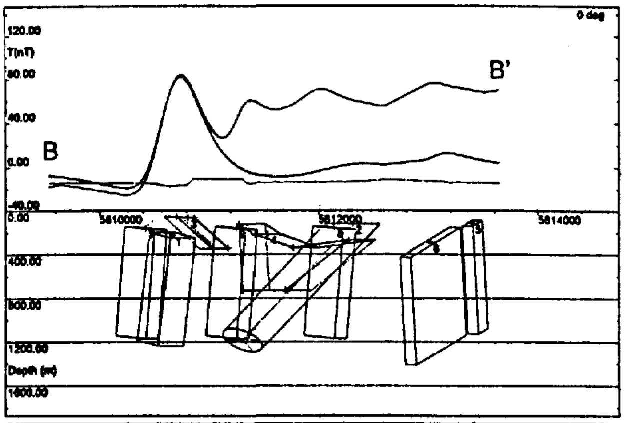
NON UNIFORMLY MAGNETISED BASEMENT - MODELLING OF INTRABASEMENT BLOCKS

Figure 15
95-888 MESA

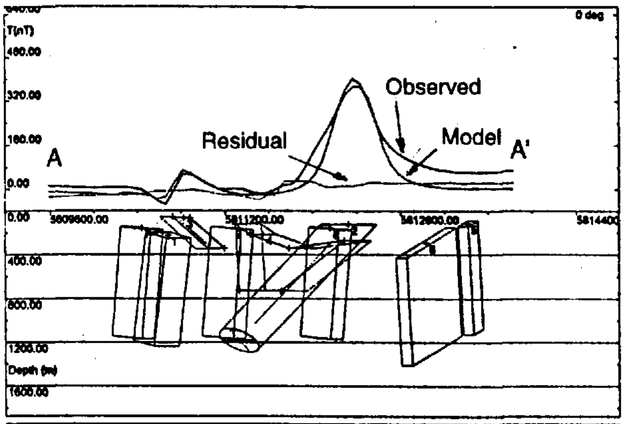
Job no. 6263bf.



Observations:
Model: Anom 'B' P1B1B.MOD Mt Gambier composite of near vertical plugs. Mag susc only 0.005-0.220 SI
Contours of: Observed field; Contour intervals: 5.0000, 50.0000 nT
POTENT v3.04 Plan drawn at 20:59 27/01/1980 for Preview Resources Pty. Limited



Observations:
Profile #7; 480800e/140/1
Model: Anom 'B' P1B1B.MOD Mt Gambier composite of near vertical plugs. Mag susc only 0.005-0.220 SI
Calculation mode: Total Magnetic Intensity
Observed: ——— Calculated: - - - -
Residual: ——— Individual body: ———
POTENT v3.04 Profile drawn at 21:10 27/01/1980 for Preview Resources Pty. Limited



Observations:
Profile #1; 478400e/140/1
Model: Anom 'B' P1B1B.MOD Mt Gambier composite of near vertical plugs. Mag susc only 0.005-0.220 SI
Calculation mode: Total Magnetic Intensity
Observed: ——— Calculated: ———
Residual: ——— Individual body: - - - -
POTENT v3.04 Profile drawn at 20:52 27/01/1980 for Preview Resources Pty. Limited

POTENT v3.04 Model Summary Report created at 21:13 27/01/1980 for Preview Resources Pty. Limited

Inducing field - Intensity =60100
Azimuth =6
Inclination = -63

Body type abbreviations and the shape parameters have the following significance:
Cylndr - CYLINDER - A, B are axes lengths; C = thickness; D = slope
Rect - RECTANGULAR PRISM - A = width, B = length, C = height
Poly3 - 3-D POLYGONAL PRISM - (A,C) pairs represent vertex coordinates relative to vertex #1, B = length

Model file: Anom 'B' P1B1B.MOD Mt Gambier composite of near vertical plugs. Mag susc only 0.005-0.220 SI

No.	Type	X m	Y m	Depth m	Strike deg	Dip deg	Plunge deg	Susc. SI	A	B	C	D
1	Rect	480709.7	5810672.9	222.7	-40	100	0	0.022000	300.0	300.0	1000.0	
2	Cylndr	478582.4	5812324.4	120.5	110			0.030000	300.0	900.0	1500.0	45.0
3	Poly3	478378.7	5810829.0	62.1	113	90	0	0.010000	0.0	300.0	0.0	
									174.0		-7.3	
									-182.7		284.7	
									-333.0		277.4	
4	Poly3	479805.3	5811542.7	215.4	-68	90	0	0.020000	0.0	600.0	0.0	
									383.6		124.1	
									935.1		51.1	
									303.7		511.1	
									-111.9		511.1	
									-151.9		-94.9	
5	Rect	478804.2	5813410.9	113.2	17	100	0	0.005000	300.0	100.0	1000.0	
6	Rect	480680.2	5813016.9	288.4	17	100	0	0.005000	1600.0	100.0	1000.0	
7	Rect	476790.7	5810439.4	157.0	-68	95	0	0.011000	300.0	300.0	1000.0	
8	Rect	479581.2	5812150.6	157.0	-68	95	0	0.011000	300.0	300.0	1000.0	
9	Rect	479567.1	5811281.2	157.0	-68	95	0	0.011000	300.0	300.0	1000.0	

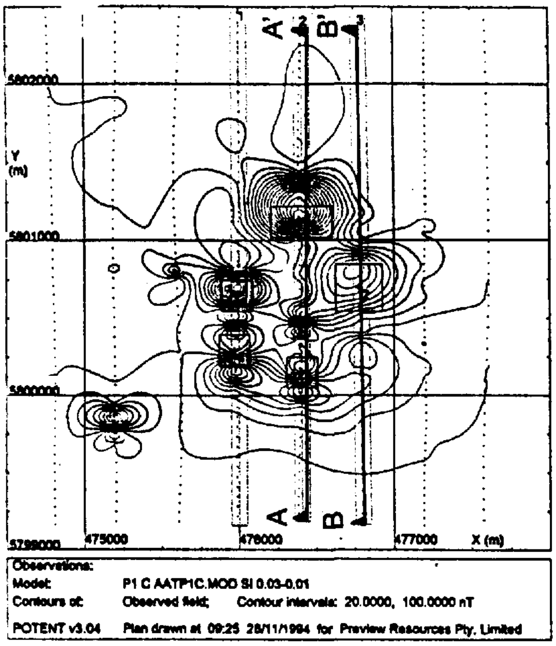
Job no. 6263bf

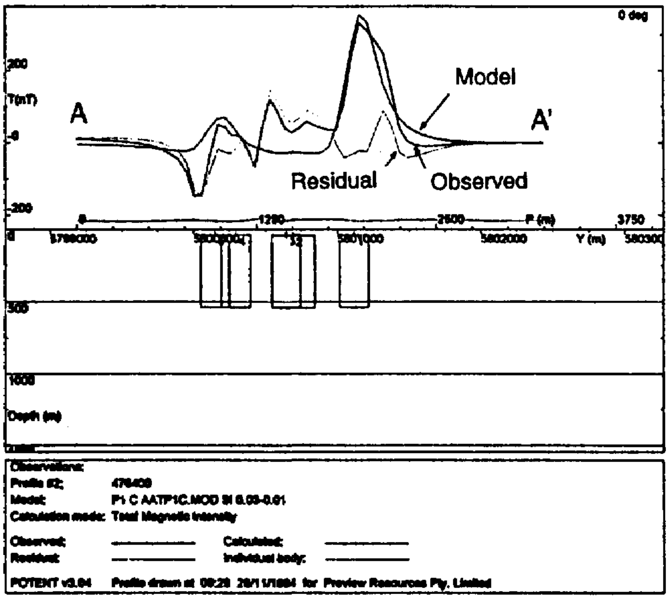
OTWAY BASIN - AEROMAGNETIC AND RADIOMETRIC TEST SURVEY

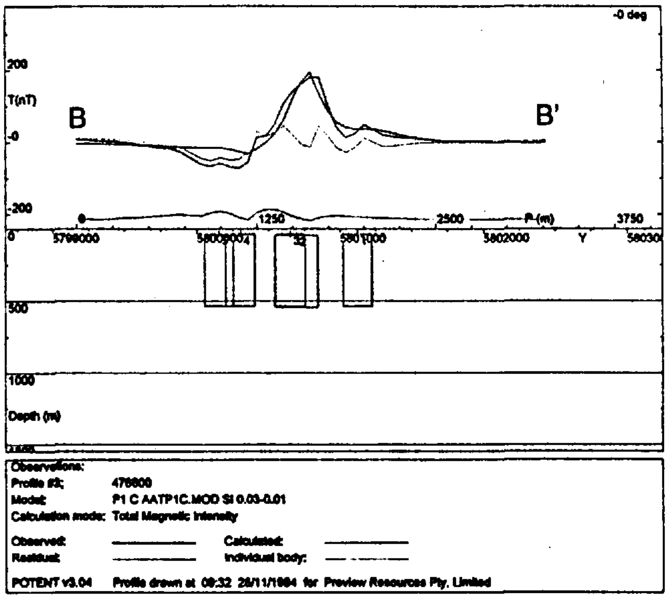
MODELLING OF MT GAMBIER MAGNETIC ANOMALIES

Figure 16

95-889 MESA







POTENT v3.04 Model Summary Report created at 09:34 28/11/1994 for Preview Resources Pty. Limited

Inducing field - Intensity = 60696
Azimuth = 10
Inclination = -69

Body type abbreviations and the shape parameters have the following significance:
Rect - RECTANGULAR PRISM - A = width, B = length, C = height

Model title: P1 C AATP1C.MOD SI 0.03-0.01

No.	Type	X m	Y m	Depth m	Strike deg	Dip deg	Plunge deg	Susc. SI	A	B	C	D
1	Rect	476410	5801120	35.71	0	90	0	0.0300	400.00	200.00	500.00	
2	Rect	476781	5800695	42.86	0	90	0	0.0170	300.00	300.00	500.00	
3	Rect	475991	5800647	35.71	0	90	0	0.0300	200.00	200.00	500.00	
4	Rect	475972	5800297	35.71	0	90	0	0.0150	200.00	200.00	500.00	
5	Rect	476410	5800152	35.71	0	90	0	0.0100	200.00	200.00	500.00	

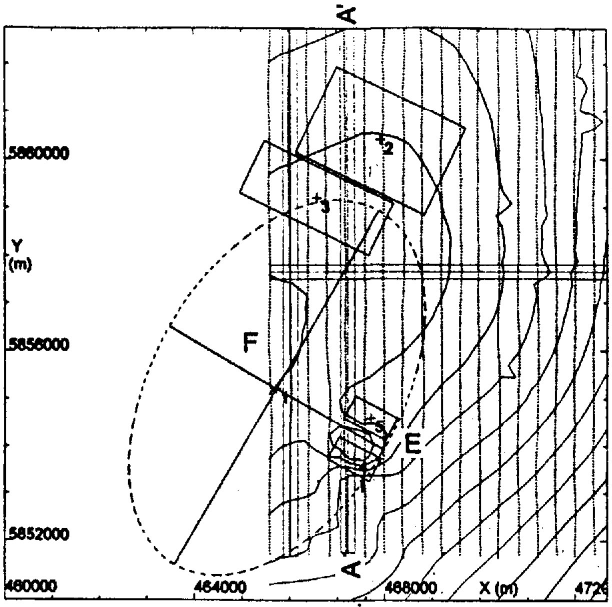
OTWAY BASIN - AEROMAGNETIC AND RADIOMETRIC TEST SURVEY

MODELLING OF MT SCHANK MAGNETIC ANOMALY (c)

Figure 17

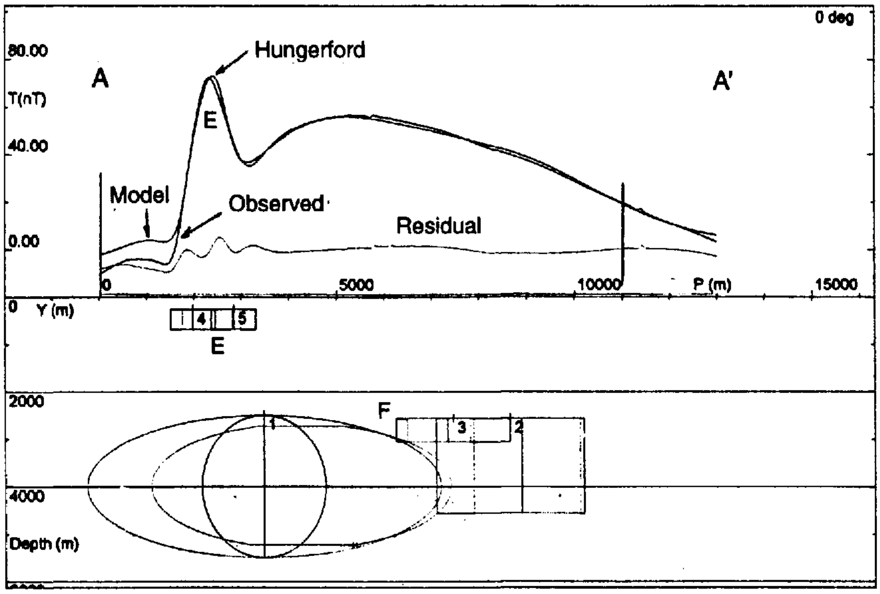
95-890 MESA

Job no. 6263bf



Observations:
Model: ANOMALIES F&E ABVP1F.MOD
Contours of: Observed field; Contour intervals: 20.0000, 100.0000 nT

POTENT v3.04 Plan drawn at 21:18 07/12/1994 for Preview Resources Pty. Lim



Observations:
Profile #2; 467200
Model: ANOMALIES F&E ABVP1F.MOD
Calculation mode: Total Magnetic Intensity

Observed: ———— Calculated: ————
Residual: — — — Individual body: ————

POTENT v3.04 Profile drawn at 21:24 07/12/1994 for Preview Resources Pty. Limited

POTENT v3.04 Model Summary Report created at 21:30 07/12/1994 for Preview Resources Pty. Limited

Inducing field - Intensity = 60696
Azimuth = 10
Inclination = -69

Body type abbreviations and the shape parameters have the following significance:
Ellpsd - ELLIPSOID - A, B, C are axes lengths
Rect - RECTANGULAR PRISM - A = width, B = length, C = height

Model title: ANOMALIES F&E ABVP1F.MOD

No.	Type	X m	Y m	Depth m	Strike deg	Dip deg	Plunge deg	Susc. SI	Rem f Amp/m	Rem az deg	Rem inc deg	A	B	C	D
1	Ellpsd	465741	5855214	2485	30	90	0	0.0125	0.000	0	0	5200.0	8600.0	3000.0	
2	Rect	467929	5860400	2556	26	90	0	0.0100	0.000	0	0	3000.0	2000.0	2000.0	
3	Rect	466588	5859200	2556	26	90	0	0.0100	0.000	0	0	3000.0	1200.0	500.0	
4	Rect	467370	5853720	266	-62	90	0	0.0000	0.350	0	-47	531.8	1001.5	418.0	
5	Rect	467717	5854583	257	-62	90	0	0.0000	-0.200	0	-47	531.8	1001.5	418.0	

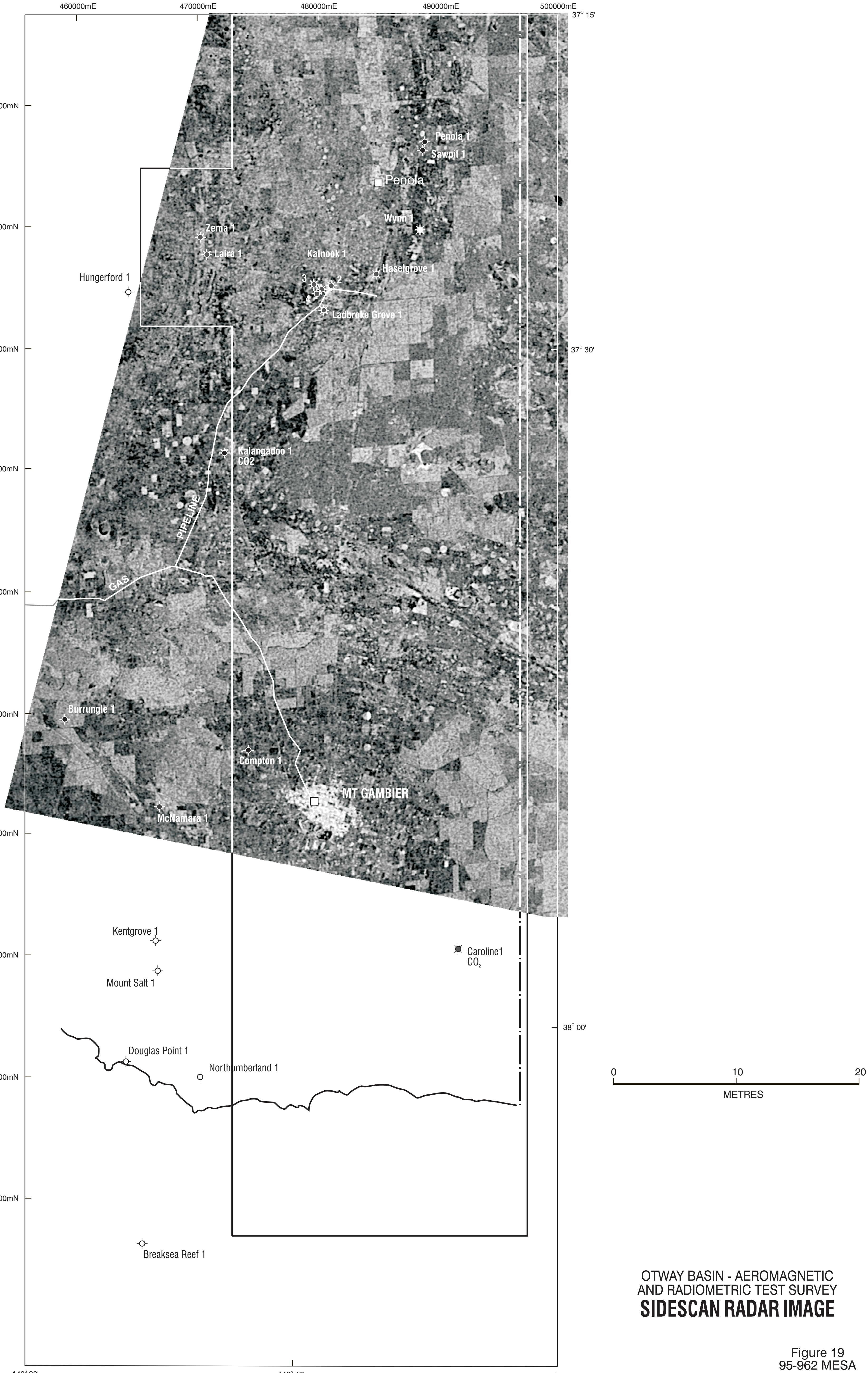
OTWAY BASIN - AEROMAGNETIC AND RADIOMETRIC TEST SURVEY

MODELLING OF HUNGERFORD MAGNETIC ANOMALIES

Figure 18

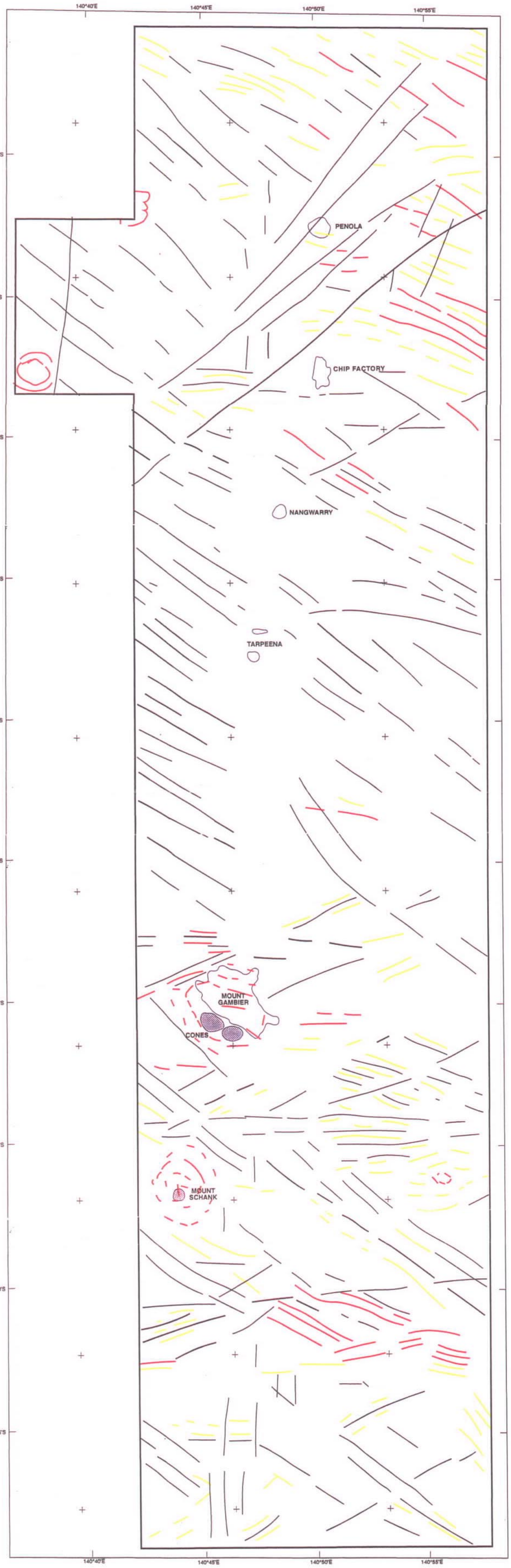
95-891 MESA

Job no. 6283bf.



OTWAY BASIN - AEROMAGNETIC
AND RADIOMETRIC TEST SURVEY
SIDESCAN RADAR IMAGE

Figure 19
95-962 MESA

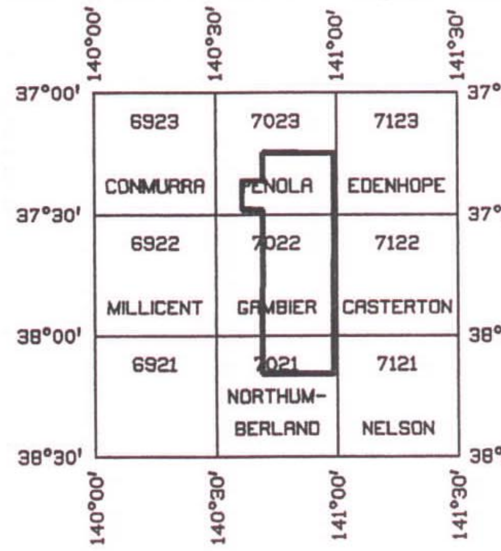


SOUTH AUSTRALIAN EXPLORATION INITIATIVE

1992-93 Airborne Geophysical Surveys

AREA P1

(part PENOLA and SJ54-10 1:250 000)



REFERENCE TO AUSTRALIA 1:100 000
STANDARD MAP SERIES

0 10 20
KILOMETRES

OBSERVED MAGNETIC FEATURES

- Well defined discontinuity, trend "contact zone"
- Discontinuity, trend
- Well defined linear magnetic high
- Weakly defined linear magnetic high
- Townships
- Known volcanics

OTWAY BASIN - AEROMAGNETIC
AND RADIOMETRIC TEST SURVEY

MAGNETIC LINEAMENTS MAPPED IN SECOND VERTICAL DERIVATIVE PDS-2

6263BF

Figure 20
95-886 MESA

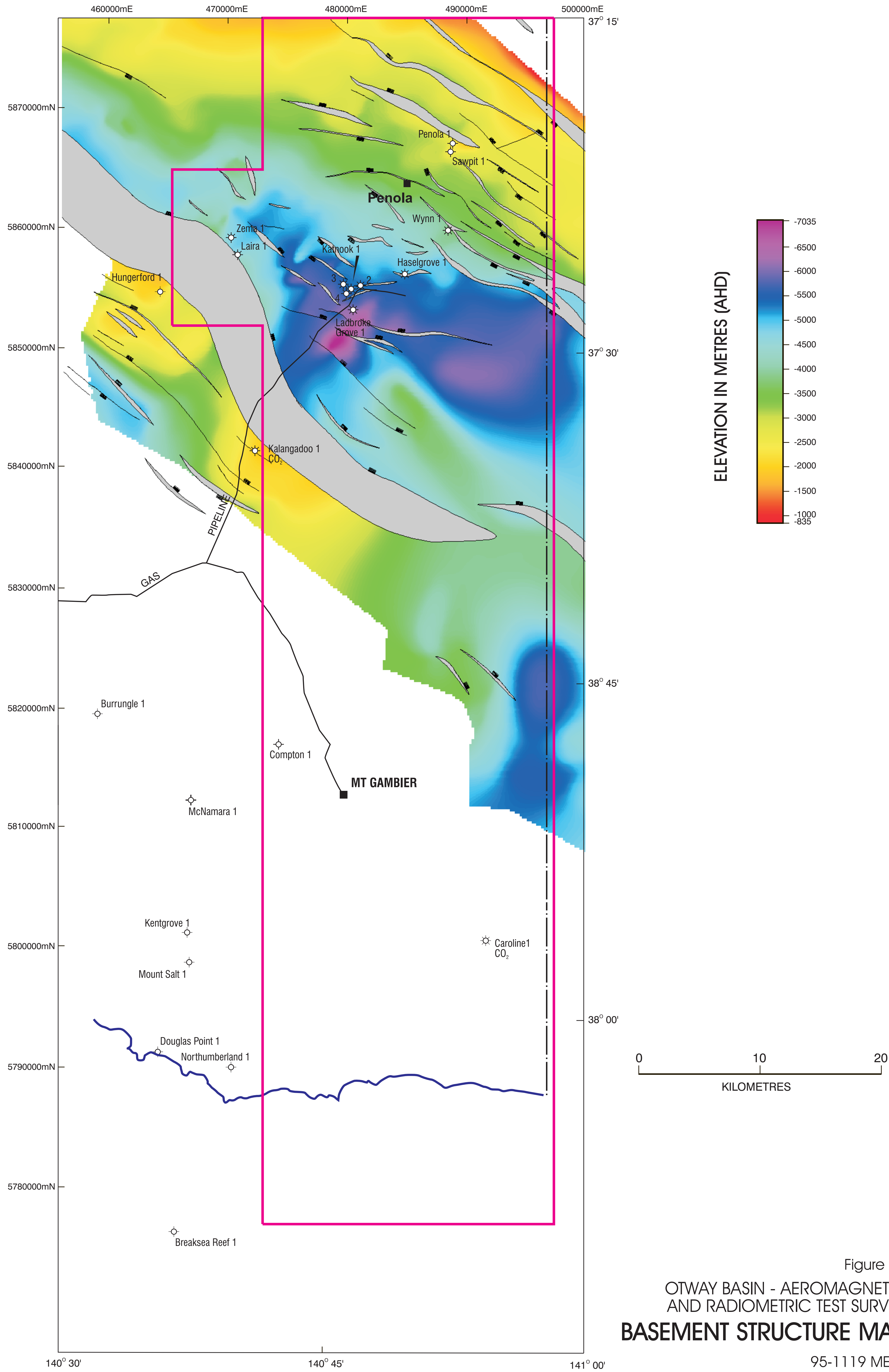


Figure 21

OTWAY BASIN - AEROMAGNETIC AND RADIOMETRIC TEST SURVEY

BASEMENT STRUCTURE MAP

95-1119 MESA

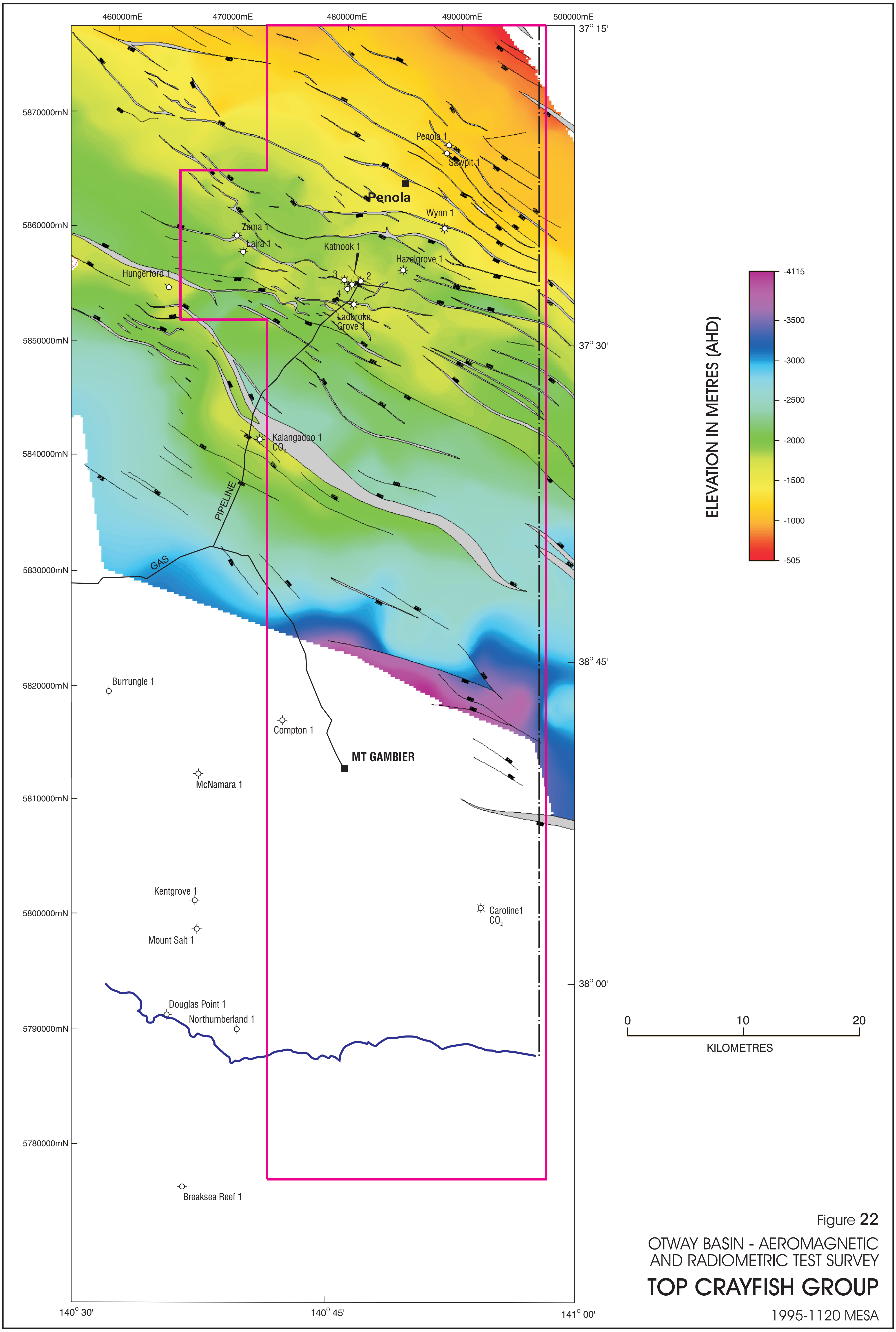


Figure 22

OTWAY BASIN - AEROMAGNETIC AND RADIOMETRIC TEST SURVEY

TOP CRAYFISH GROUP

1995-1120 MESA

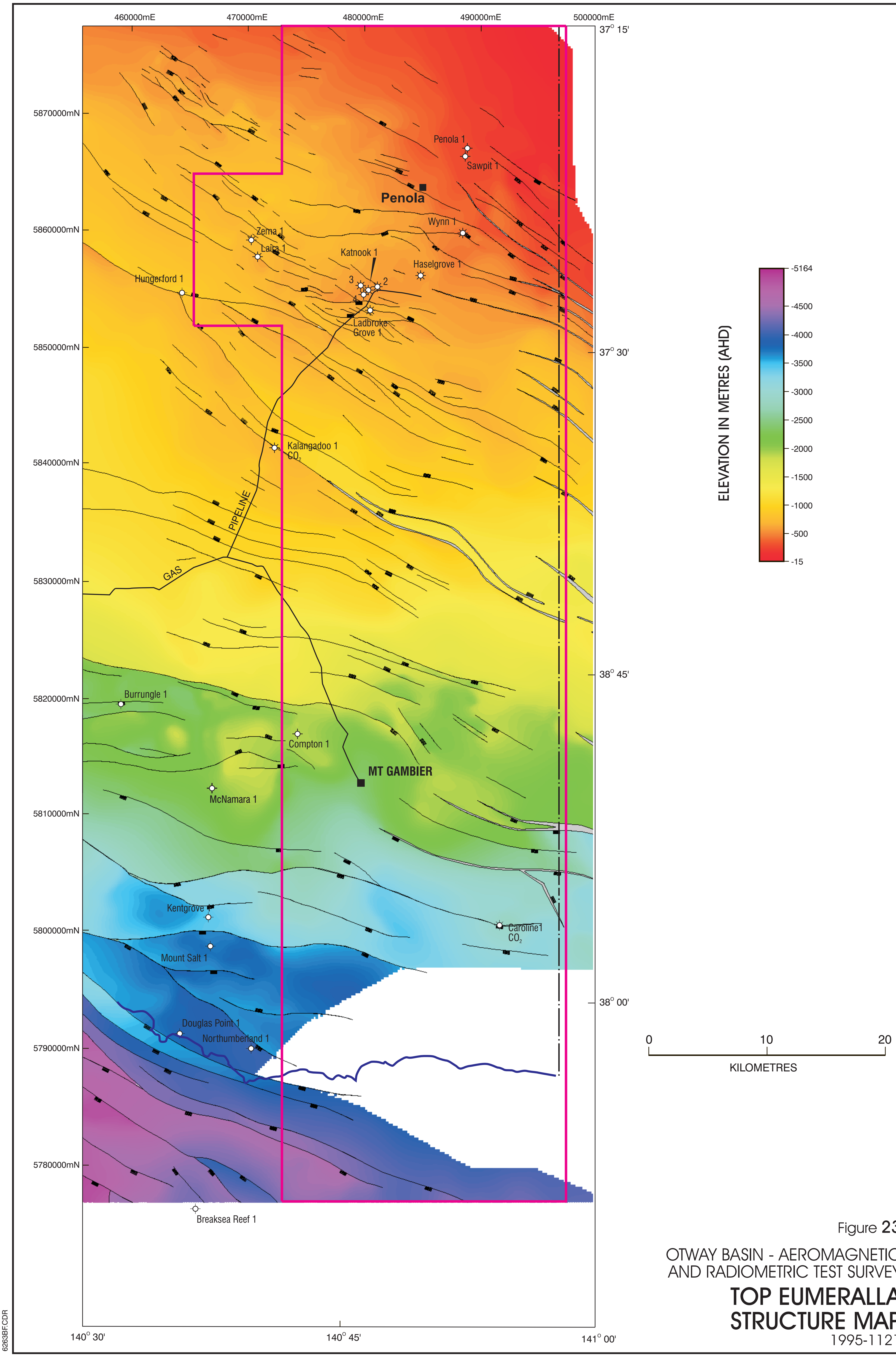


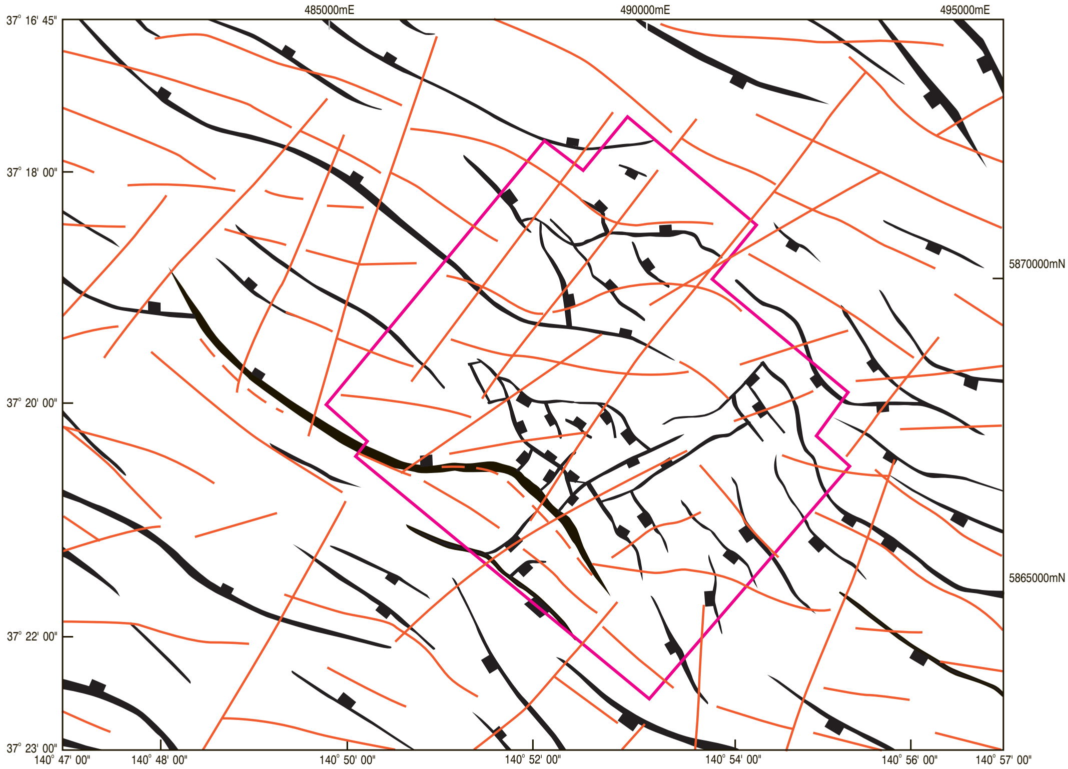
Figure 23

OTWAY BASIN - AEROMAGNETIC AND RADIOMETRIC TEST SURVEY

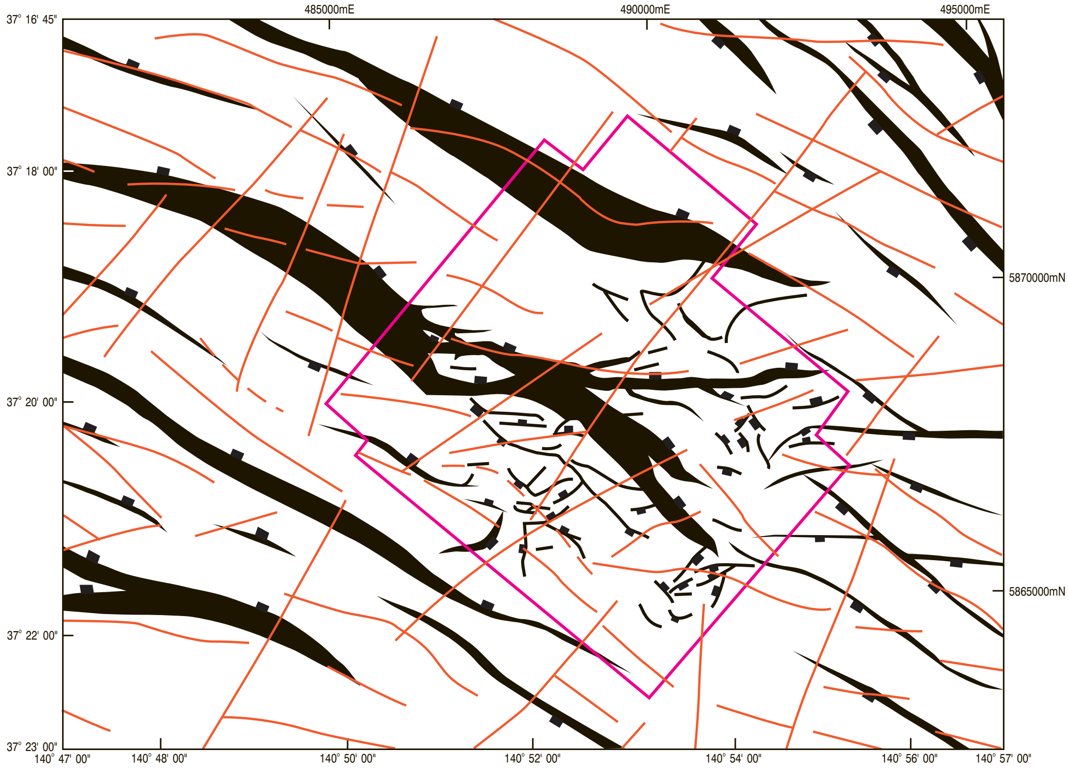
TOP EUMERALLA STRUCTURE MAP

1995-1121

TOP EUMERALLA



TOP BASEMENT



0 5 10

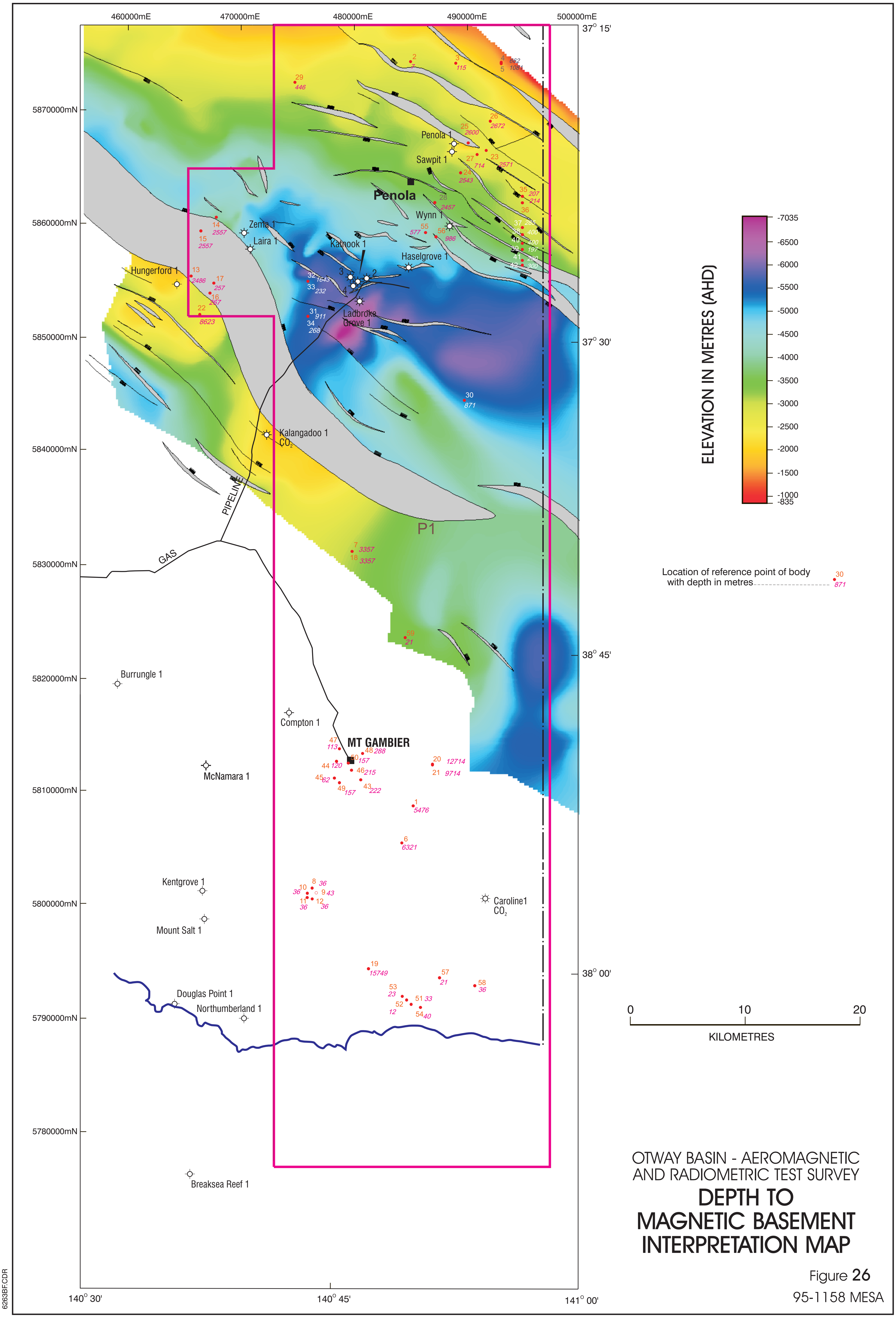
KILOMETRES

OTWAY BASIN - AEROMAGNETIC AND RADIOMETRIC TEST SURVEY

FAULT PATTERNS AT TOP EUMERALLA FM AND AT TOP BASEMENT, PENOLA 3-D SEISMIC SURVEY AND AEROMAGNETIC LINEAMENTS PDS-2

Figure 24
95-1157 MESA

6263bf.cdr

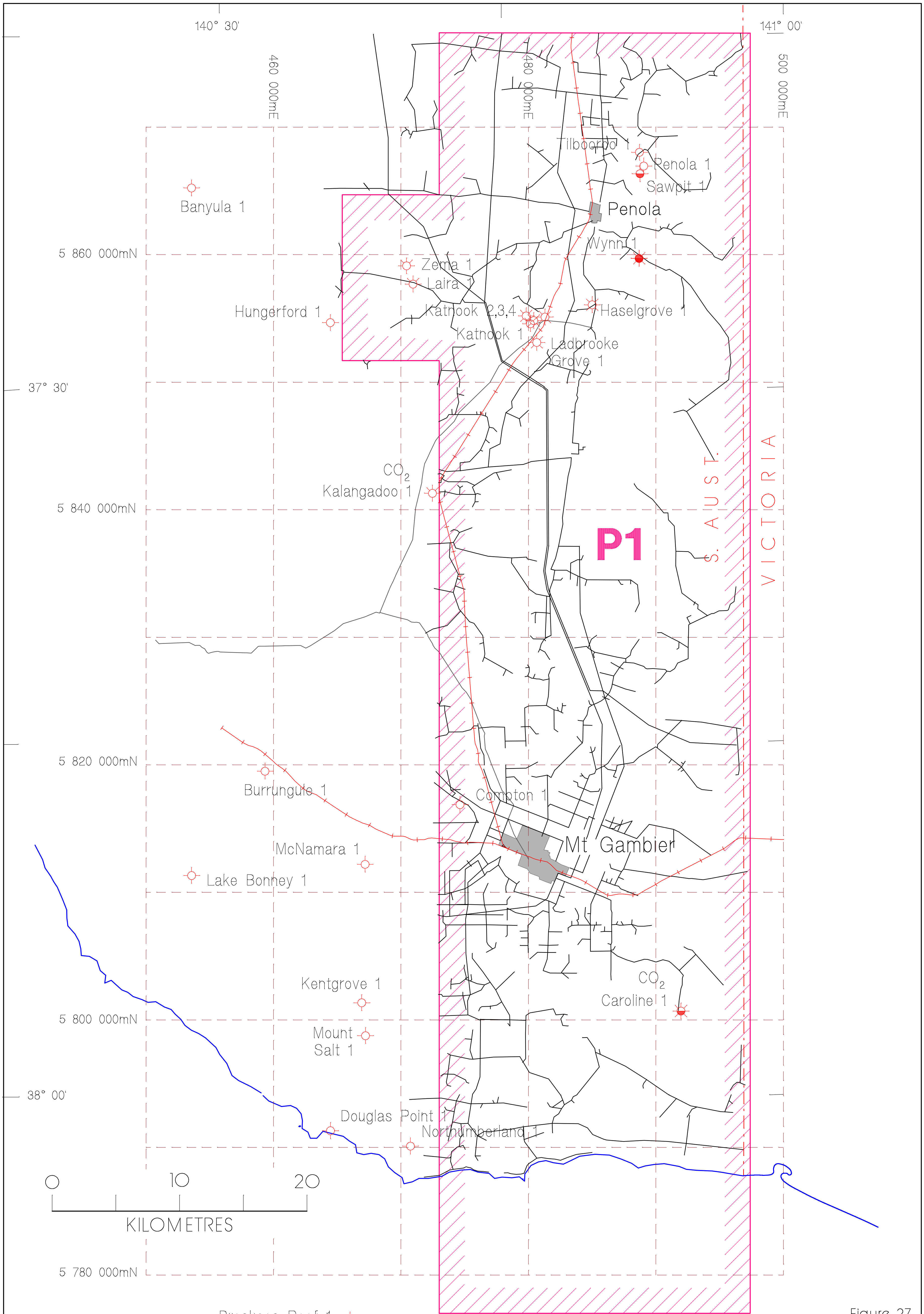


OTWAY BASIN - AEROMAGNETIC
AND RADIOMETRIC TEST SURVEY

DEPTH TO MAGNETIC BASEMENT INTERPRETATION MAP

Figure 26

95-1158 MESA



QD-TOJO 6263DT.DTA

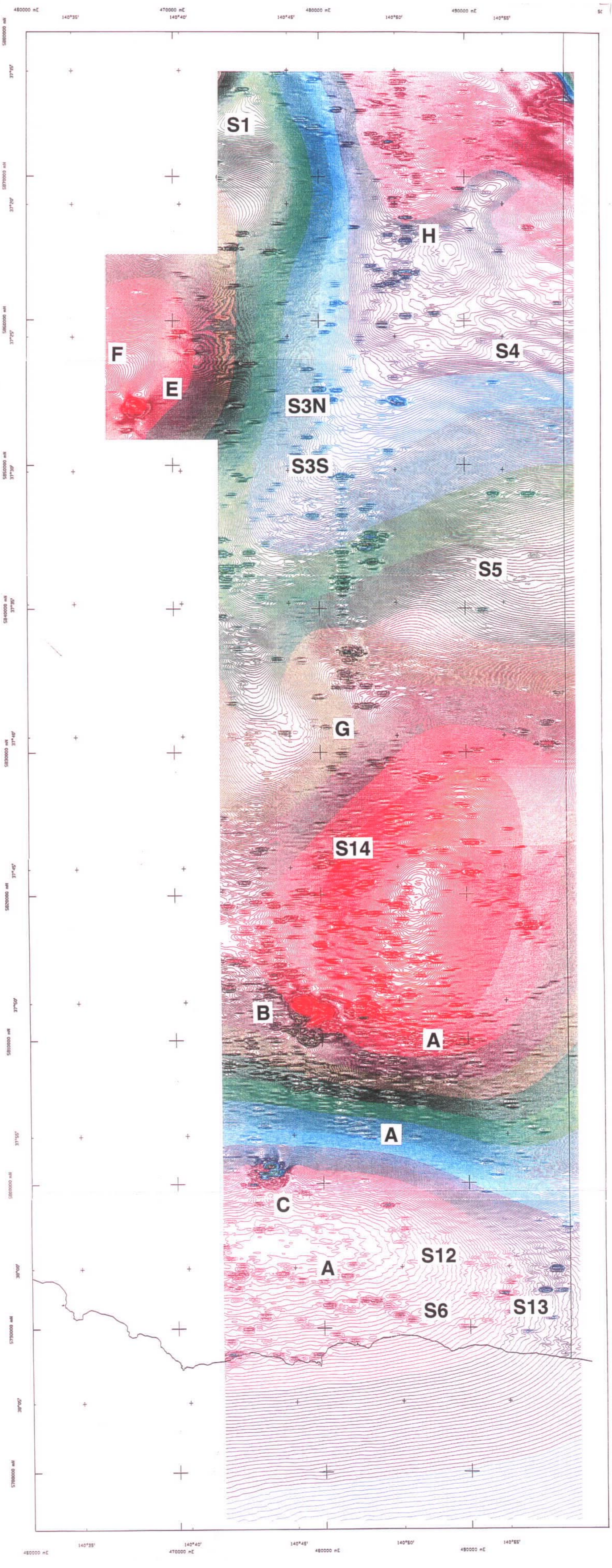
MINES and ENERGY RESOURCES SOUTH AUSTRALIA

Figure 27

OTWAY BASIN - AEROMAGNETIC AND RADIOMETRIC TEST SURVEY

SURFACE UTILITES MAP

95-135



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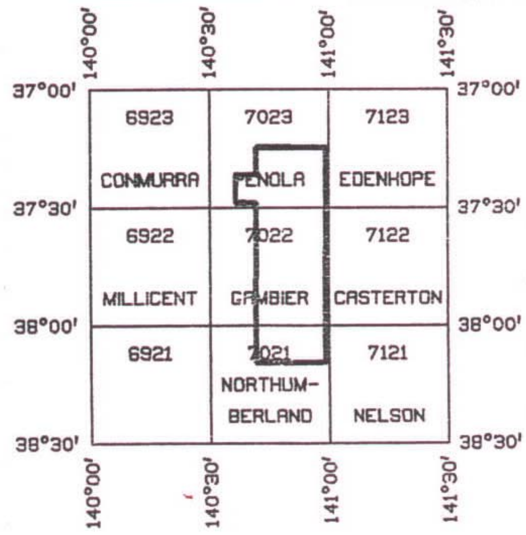
AREA P1

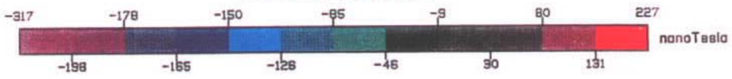
(part PENOLA and SJ54-10 1:250 000)



REFERENCE TO AUSTRALIA 1:100 000
STANDARD MAP SERIES

0 10 20
KILOMETRES

COLOUR LEGEND



SOUTH AUSTRALIA
DEPARTMENT OF MINES AND ENERGY

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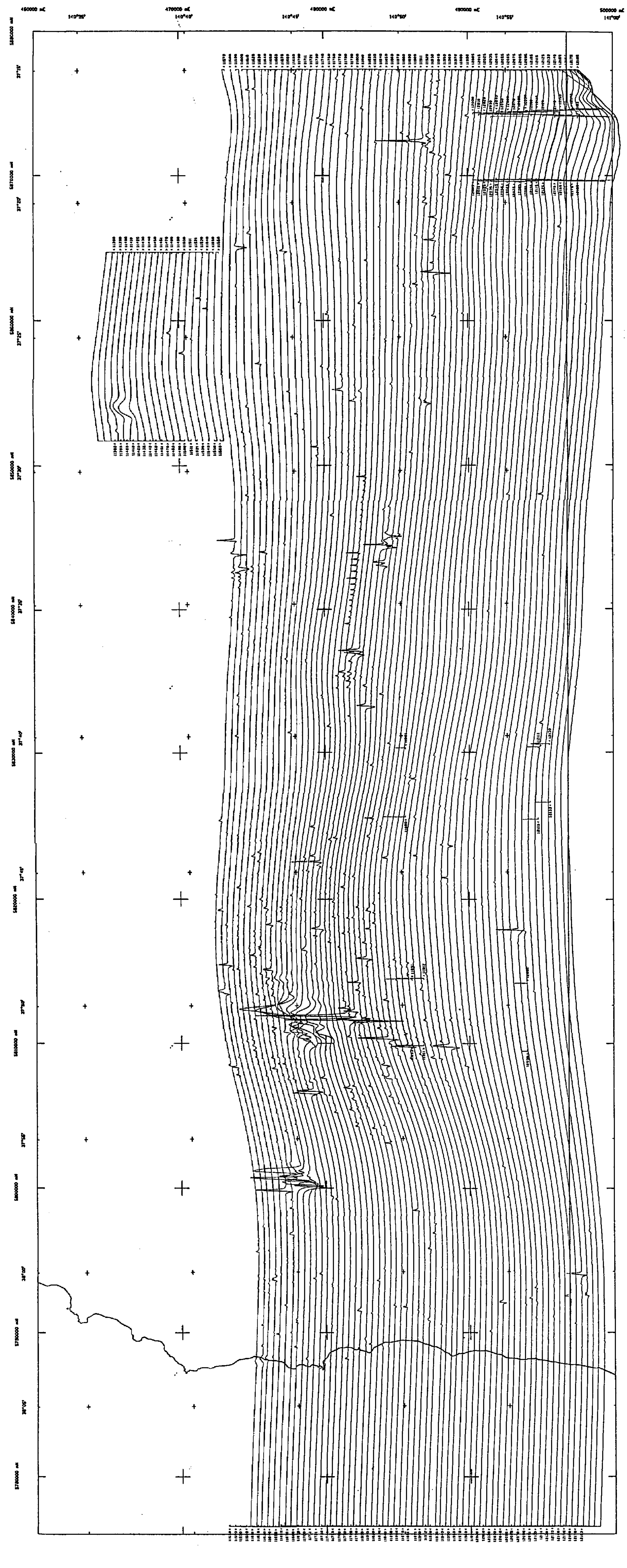
LAKES OIL LIMITED
MINORA RESOURCES N.L.
OIL COMPANY OF AUSTRALIA LIMITED
SAGASCO RESOURCES LTD.

OTWAY BASIN - AEROMAGNETIC
AND RADIOMETRIC TEST SURVEY

TOTAL MAGNETIC INTENSITY WITH CULTURE CONTOUR MAP AND ANOMALY IDENTIFICATIONS

Figure 28
95-892 MESA

6263BF



SOUTH AUSTRALIAN EXPLORATION INITIATIVE

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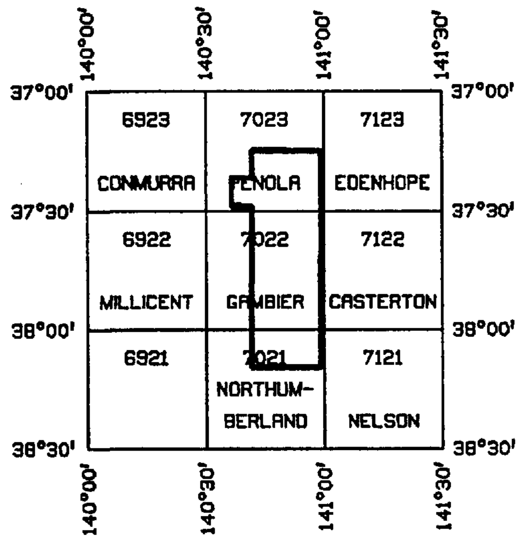
AREA P1

(part PENOLA and SJ54-10 1:250 000)



REFERENCE TO AUSTRALIA 1:100 000
STANDARD MAP SERIES

0 10 20
KILOMETRES

0 500 nT

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MINORA RESOURCES N.L.
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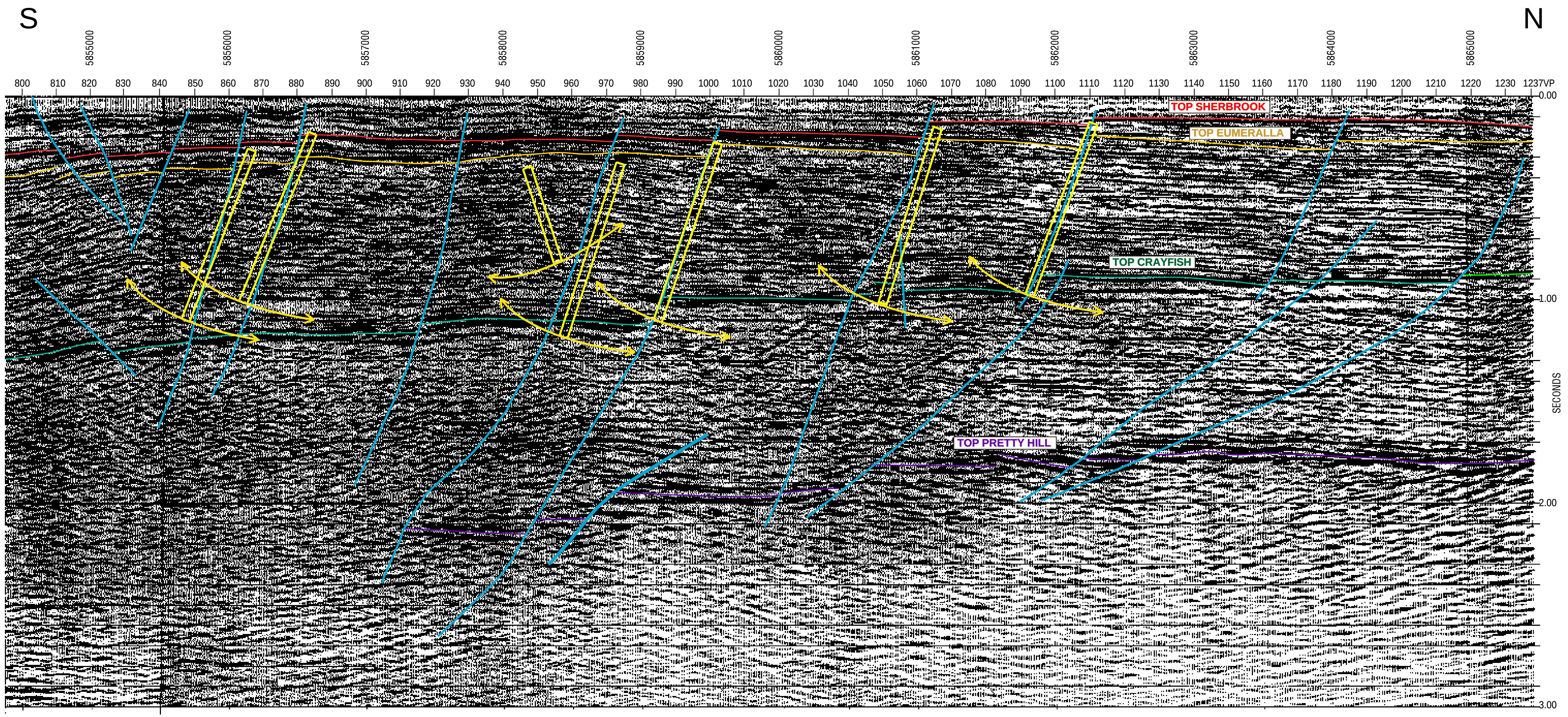
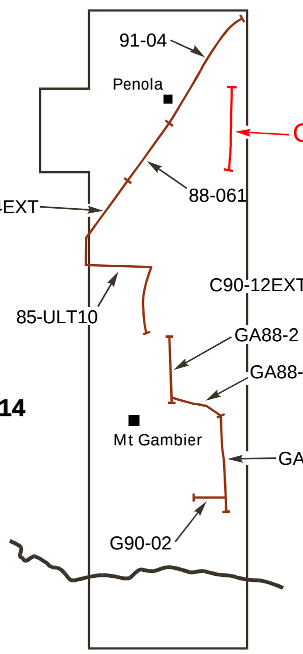
OTWAY BASIN - AEROMAGNETIC
AND RADIOMETRIC TEST SERVER

TOTAL MAGNETIC INTENSITY STACKED PROFILES

6263BF

Figure 29
95-893 MESA





LOCATION OF SEISMIC LINE OK90-414 WITHIN P1 AREA

Outline of modelled Magnetic Source. Arrow indicates range of dip of source

Fault interpreted from seismic

0 1000 2000

METRES

OTWAY BASIN AEROMAGNETIC - RADIOMETRIC TEST SURVEY

MODELLING OF FAULT PLANE MAGNETIC ANOMALIES ON SEISMIC LINE OK90-414, SOUTH EAST OF PENOLA

Figure 30

95-995 MESA

6263bl.cdr