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INTERPRETATION OF MAGNETIC AND GRAVITY DATA. KINGOONYA 1:250 000 MAP AREA

by

PETER WOYZBUN

Geophysical Consultant
11 Lacey Place
Kamban ACT 2902

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PETER WOYZBUN

INTRODUCTION.

Investigation of magnetic and gravity data covering KINGOONYA (Fig. 1) was undertaken as a part of an interpretation of the northern Gawler Craton.

Observations set out below represent the results of the interpretation of the regional gravity and magnetic data over KINGOONYA plus an extension of 15 minutes into all adjacent 1:250 000 maps. This area will be referred to in the text as the working sheet. A number of detailed surveys of several areas, mostly in SW KINGOONYA, were also considered during the interpretation. Images of parts of the Kokatha survey became also made available toward the latter stages of this investigation.

Regional geological information used in this project was obtained from the recently published geological map of KINGOONYA (Cowley and Martin 1991).

With the exception of SW KINGOONYA interpretation is based mostly on the widely spaced (3.2 km) BMR aeromagnetic survey covering the major part of the sheet plus an old Adastra survey in the SW of the area flown at 1.6 km line spacing, together with the SADME gravity contour map with 1/2 mgal contour interval produced by Gary Reed.

SW KINGOONYA has been covered, in addition to the Adastra survey, by a number of detailed surveys which provide more accurate and reliable magnetic data.

Interpretation of KINGOONYA has been carried out without reference to any previous geophysical interpretation. The regional interpretation of South Australia at 1 million scale carried out under the auspices of AMIRA was not referred to during this work.

Following assessment of private mineral exploration data held in the SADME Open File Envelope system (Youles, 1992. Review of *mineral exploration, KINGOONYA 1:250 000 map area. SADME Report Book RB 92/37), geological comments have been added by Ian Youles to this report to facilitate understanding of the mineral exploration targets generated by Peter Woyzbun. These comments are given in italics.*

General Comments.

The KINGOONYA sheet has been divided into several separate provinces of differing magnetic and structural characteristics. The structural aspects have been given precedence in classification of the various provinces.

The provinces have been designated as K1, K2 etc up to and including K6 which represents SW KINGOONYA, All the provinces are shown on the Interpretation Map (Fig. 8) as well as on figure 2.

Of these provinces, K1 and K5 fall mostly outside KINGOONYA and will not be discussed in great detail.

Lineaments, Faults and Dykes.

In producing images John Pitt employed gridding at 45° to north-south in order to induce trending roughly in the direction of the dykes of the Gairdner Dyke Swarm to ensure that positions of the dykes could be determined more accurately. Normal gridding was to be used on SW KINGOONYA, where magnetic basement is shallow (area covered by the Adastra survey), but this did not eventuate.

The locations of the dykes are shown on figure 5. In the SE corner of KINGOONYA covered by the BHP detailed survey, the dykes appear to cris-cross and tend to bunch up, with two or more running close together. No such dyke patterns were discernible in the area covered by regional surveys.

The dykes reflect fracturing in the basement (?) and in Pandurra Formation. Within the latter, dykes appear to be wider, more pronounced and more numerous.

The lineaments (Fig. 6) have been determined from considerations of all image presentations of the magnetic data and from the 1/2 mgal gravity map. The lineaments may represent faults (e.g. R10), discontinuities, fractures or geological contacts.

With the exception of the arcuate lineaments, I have used the following convention in naming lineaments:

Lineaments trending north-south are called N1, N2 etc., those to the northwest are called L1, L2..., northeast are R1, R2..., and east-west are W1, W2...

There appear to be at least three or four families of arc shaped lineaments within KINGOONYA. Different symbols are used for each, but they have not been individually annotated.

Lineaments of groups N and R and possibly those arcs of large radii are almost completely limited to province K3, that is, in the area containing the shallow, thick, flat lying rocks of Pandurra Formation (as discussed later).

An exception to the above is presented by the lineaments GN1 and GN2 on SW KINGOONYA. The area between these is considered to represent a graben and here some Pandurra Formation rocks are known to be present. These two lineaments have been derived from consideration of gravity data, as a narrow gap in the magnetic coverage occurs in this area.

MAGNETIC AND STRUCTURAL ZONES.

The area of the sheet has been divided into six provinces, K1 to K6. This division was decided on after consideration of lineaments and dykes, rather than the general appearance of the TMI map. As a result magnetic zones do not fully agree with the boundaries of provinces. The division is based mostly on structural parameters i.e. on the shape and direction of the various lineaments and the direction, depth, and number of dykes of the Gairdner Dyke Swarm. Province K6 was defined from magnetic and gravity data.

The main magnetic zones are:

* The high magnetic zone represented by province K3 and westerly into province K4. The zone runs diagonally (SE to NW) across KINGOONYA and covers a major part of the map sheet. Its NE boundary is defined by lineament W24, a large radius arcuate lineament, and lineaments L14 and L17, while its SW boundary is defined by lineament L35 and another of the large radius arcs.

* The NE zone, province K2, which includes the crescent shaped magnetic-gravity high in the extreme north of the sheet.

* SW KINGOONYA, characterised by low magnetic background, high gravity and a large number of small in area, intense high and low magnetic anomalies.

Dykes: Some Observations.

Results from the detailed aerial magnetic survey in the extreme SE of KINGOONYA, (Austirex for BHP) suggest that the Gairdner Dyke Swarm consists of a number of sub-groups or families of dykes. These vary in intensity of magnetic signature, width and direction of individual dykes, and their separations.

The contour presentation of that survey further suggests that some of the dyke sub-groups consist of a different rock type or are of a different age. Other dykes have a very faint signature and appear to be at a depth equal to others with much more intense responses, suggesting that they consist of a different material.

While some of the dykes take a straight course (about 45 degrees west of north) others meander.

This reflects the fracture pattern into which dyke material was injected.

In the areas where basement is shallow, and where Pandurra Formation is absent, the dykes appear to be much narrower, assume a more westerly direction, and are far fewer in number.

Province K3 covers an area where the dykes appear to be almost straight and trend NW. Dykes of this area are abundant and generally quite closely spaced. The eastern and western boundaries of the province are defined by continuous features of very intense magnetic signature, which appear to be very close to the surface and consist, in each case, of two closely spaced dykes.

In province K2, dykes are less abundant and deeper seated. They are even less prominent in the northern part, which contains the tight arcuate lineaments of a crescent-shaped magnetic anomaly interpreted to be associated with basement uplift.

Faulting at lineaments R10 and R11 does not seem to have affected the directional continuity of the dykes, suggesting that faulting occurred prior to injection of the Gairdner Dyke Swarm.

The dykes of province K4 are similar to those of province K3 with one important difference. From south to north they progressively veer more westerly, commencing with the westernmost dyke of the province. The change in direction is particularly evident in the area south of lineament L30, which none of the dykes seem to cross. The area between lineaments L30 and L32 appears to be dyke free.

In province K5 the dykes are generally less pronounced.

The Diagonal High Magnetic Zone.

A wide belt of high magnetics extends diagonally across KINGOONYA from SE to NW and swings due west beyond 135 degrees 30 minutes East and between 30 and 30 degrees 30 minutes South.

The narrow well pronounced sub-parallel highs due to the Gairdner Dyke Swarm are seen throughout this zone. These have provided a method for structural interpretation of this area. Without the dykes the area would appear as a high magnetic plateau.

The high magnetics of this plateau are due to sediments of the Pandurra Formation. This finding is supported by examination of images of magnetic data of other areas where a significant thickness of Pandurra Formation is known to exist.

The magnetics of the area discussed here suggest that it is possibly the upper portions of the Pandurra Formation which exhibit the highest magnetic susceptibility.

The apparent high bulk magnetic susceptibility of rocks of the Pandurra Formation (as indicated by the magnetic data on KINGOONYA) probably indicates that constituents of these rocks have been derived from high magnetic susceptibility rocks of the Hiltaba Suite

The youngest member of Pandurra Formation contains heavy mineral bands with magnetite (Cowley, SADME report RB91/7).

The images show magnetics of the area to be of fuzzy appearance with little or no magnetic features, other than those due to the Gairdner Dyke Swarm. This appearance continues into the NW corner of TARCOOLA and into TORRENS. It is suggested that this is also due to Pandurra Formation.

A large gravity low covers most of the high magnetic plateau. In the NW corner of the sheet the gravity low is interrupted by a series of gravity highs trending NE and considered to be due to a shallow basement ridge located between two major faults R10 and R11. Several small, intense magnetic anomalies, both high and low, appear in this region. Unfortunately there are some gaps in the magnetic data and it is not possible to fully explain them.

The area SE of fault R10 appears to have been considerably downthrown in relation to the region NW of fault R11. The dykes of the Gairdner Dyke Swarm do not however appear to be displaced. Thus, the faulting does not seem to be accompanied by any horizontal movement or, as suggested previously, occurred prior to the dyke emplacement.

The responses due to the Gairdner Dyke Swarm are more numerous, closer together and much more intense in the region of province K3. This suggests that the Pandurra Formation occurs closer to the surface in this part of the area than it does in the remainder of the high magnetic zone. The dyke along the western boundary of K3 for example appears to be very near surface. The block of high magnetics of province K3 is thus considered to represent a long ridge in the Pandurra Formation.

Just north of the KINGOONYA border, rocks of the Pandurra Formation appear to dip steeply to the north. The magnetic responses decrease very rapidly suggesting that the Pandurra Formation pinches out in this zone, or alternatively that the high susceptibility component of the formation disappears. The former is considered more likely.

On the eastern side, within province K2, in the region between lineaments R7 and W13, the easterly dip of the Pandurra Formation is much shallower. This might explain its presence at 438 m in the Playford No.1 drillhole located at the southern rim of a small in amplitude magnetic high accompanied by a gravity trough extending from a low to its north.

A number of major basement uplifts seem to have occurred to the east of the various lineaments along the eastern boundary of province K3.

The gravity low, which covers most of the high magnetic zone of KINGOONYA, is at its deepest between fault R10 and lineament N16. This region may represent a mini-basin where Pandurra Formation is at its thickest and, considering the high amplitude of the low, is possibly underlain by older sediments.

Both gravity and magnetic intensity diminish markedly to the east of lineament N16 and remain more or less at this lower level as far as lineament N7. This suggests that Pandurra Formation is considerably thinner, possibly due to erosion of the upper, more magnetic layers.

East of lineament N7 magnetic intensity increases appreciably, while the gravity low gives way to a deep seated high, representing an abrupt change in basement rock types. The gravity low divides here into two branches. One continues due east on the northern flank of the gravity high, (and corresponds to the area of shallow dipping Pandurra Formation) while the other runs due south along the western limits of that high. Pandurra Formation appears once again to exhibit a shallow dip when coincident with this gravity low. In other parts of the area the dip is steeper.

The magnetics over the deep seated gravity high in the eastern part of the sheet are comparable in intensity to those in the west, described previously as a mini-basin. This suggests that Pandurra Formation is quite thick in this area and that it may directly overly a shallower basement.

To the east of the fault zone along the eastern border of province K3, where the magnetics indicate presence of Pandurra Formation, the gradient images indicate some dykes of the Gairdner Dyke Swarm. The magnetic signature of these is far less distinct, indicating that in this part of the area Pandurra Formation is under a much thicker cover.

On KINGOONYA geological map, Pandurra Formation is overlain by Adelaidian sediments in this area.

From gravity data it is apparent that a major basement uplift exists to the east of lineament N1. This uplift may be related to the "Andamooka Cluster" of anomalies.

It is noted that gravity values over the Acropolis prospect (west of Olympic Dam) appear to peak to the south of the magnetic high and are coincident with a deep magnetic low. The magnetic low, I believe, was considered to represent the negative part of the dipole anomaly. I think however, that the magnetic low/gravity high area corresponds to a zone of shallow non-magnetic basement.

The entire region apart from SW KINGOONYA and possibly the area between faults R10 and R11 is considered to be of minor interest for current mineral exploration, due to the combined thickness of the overburden and Pandurra Formation. However, a group of deep seated intrusives(?) is apparent in the extreme SE corner. Their depth is estimated to be in excess of 600 m.

The comment above is valid for pre-Pandurra mineralisation; the relatively shallow Archaean volcanics in province K2 are an exception. In addition, the region has potential for diamonds, opal and other non-metallic deposits.

The Northeastern Zone: Province K2.

In this province magnetic lineaments are of a completely different nature. Two groups of arcuate lineaments occur in this area. One is associated with the crescent uplift and the other seems to be related to the Acropolis prospect.

These lineaments are much tighter, are confined entirely to this zone and are all convex to the NW. Some similarities to the lineaments in the northern part of SW KINGOONYA are apparent. This reinforces the idea that the crescent uplift area might have been, an integral part of the structure of SW KINGOONYA. (see later comments).

The most interesting feature, in terms of geophysical signature, is the crescent shaped magnetic anomaly straddling the border between the Eba and Parakylia 1 : 100,000 sheets in the extreme north of KINGOONYA. The western arc of the crescent is accompanied by a strong gravity high associated with a major, albeit rather localised, basement uplift.

Archaean volcanics occur in Esso DP1 drillhole (from 166m to TD at 616m) near the northern edge of (but still within) the high magnetic anomaly and close to the peak of the gravity high. Four km south of Esso DP1, Esso DP2 intersected rocks of the Pandurra Formation (from 204.5m to TD at 860m) at a depth similar to that of the Archaean volcanics in DP1.

Contours of a detailed gravity survey carried out by Esso in this area show that DP1 and DP2 were sited on minor peaks located within the main gravity high. The subsidiary peaks are of 1 and 2 mgal amplitude respectively.

Drilling results do not explain these geophysical features. Volcanics of DP1 are andesites and rhyodacites, these rock types normally do not have high susceptibility. Further, the source of the main gravity anomaly appears to be considerably deeper than the depth at which Archaean rocks were intersected.

The peaks of the gravity and magnetic anomalies of the western part of the crescent feature are very nearly coincident. In other parts of KINGOONYA, Pandurra Formation rocks are associated with gravity lows and appear to be quite highly magnetic.

The gravity anomaly may represent a basement uplift. Basement material may not be magnetic. It is overlain by Pandurra Formation in the south and by Archaean andesites &c. to the north. The magnetic susceptibility of the andesites appears, (notwithstanding my statement re their normal susceptibilities), to be similar to that of rocks of the Pandurra Formation. Basement material uplifted in this area has not been intersected by either of the Esso drill holes

It is possible that basement of the crescent is similar to that uplifted in the area of the Acropolis prospect. If so, it is probably non-magnetic. (see comments on gravity associated with the Acropolis prospect).

Another possibility is that the gravity anomaly associated with the crescent was once a part of the gravity high occurring in SW KINGOONYA and was separated from it. Gravity contours match almost perfectly, as do magnetic patterns. This still does not explain the high magnetic responses (Pandurra Formation) of the crescent.

Magnetics of the eastern part of the crescent are considered to be due entirely to rocks of the Pandurra Formation.

Province K2 does not seem to offer any obvious geophysical targets for mineral exploration due mainly to overburden thickness, except for relatively shallow Archaean volcanics.

In addition, the whole region has potential for diamonds, opal and other non-metallic mineral deposits.

Province K4.

Province K4 contains the highly magnetic, deep double intrusion near the southern boundary of KINGOONYA. I consider this to be of considerable interest as a possible source of mineralisation. The depth to these bodies may be in excess of 600 m (DMLY-1 drilled by BHP bottomed at 675m in Pandurra).

The double (possibly treble) intrusion is coincident with a small gravity ridge extending from a large high (in area and amplitude). The high reflects a major basement uplift which might have been a part of the major structure observed in SW KINGOONYA. It is now separated from that quadrant by the narrow graben located between lineaments GN1 and GN2.

Province K5.

This small province appears to be a transition area between deep basement to the east and the shallow zone of SW KINGOONYA.

In addition to the large double (treble?) intrusions discussed under province K4, a number of other, smaller (in amplitude) magnetic bodies are apparent around the southern periphery of the gravity high described above. With one exception these appear from the regional data to be at a depth in excess of 1 000 m.

The exception occurs in the extreme SW corner of the Vivian 1 : 100,000 sheet just to the SE of the quarry shown on the KINGOONYA geological map. This magnetic anomaly is situated in an analogous position, relative to the gravity, as that coincident with the komatiite intersected by recent SADME drilling in the Lake Harris area (Daly and van der Stelt, 1992).

This magnetic anomaly is strongly recommended for further investigations. It is also shown as

Anomalous Area MG-1, figure 2, (Youles, 1992).

Another small (in area) magnetic high of large amplitude occurs in the south of the province on GAIRDNER at approximately 31 degrees 13 minutes South and 135 degrees 59 minutes East. This anomaly has been drilled by BHP, (one drillhole) and dolerite was intersected (from 23m to 127m TD). This feature deserves some further investigation (of contact zones and possible differentiation), as it appears to be caused by an intrusion of a considerably younger age than rocks in the surrounding area.

SOUTHWESTERN (SW) KINGOONYA

Introduction.

This area is covered by several detailed aerial magnetic surveys. As a result, the amount of geophysical information available, and its accuracy, is much greater than that in the remainder of KINGOONYA.

The geophysical interpretation indicates that SW KINGOONYA has considerable mineral potential.

The interpretation indicates the presence of a block of very dense material uplifted to a comparatively shallow depth, (but below that of any drilling to date), occupying a large part of the area. A variety of rock types, some likely to represent sources of mineralisation, were brought near to the surface by this block. Other rock types appear to have intruded the area at a later time. The nature of the dense uplifted material is not known.

Among the rocks recognised by the interpretation are:

* basic intrusions;
* at least two long belts of probable ultrabasics of very large negative magnetic amplitude, especially in the case of the anomalies of the southern belt;
* sediments;
* one known occurrence of peridotite;
* two or possibly three narrow, folded belts of minor bodies of probable basic composition.

Anomalous areas recommended for further investigations are indicated on figure 8.

The zone includes large areas covered by Gawler Range Volcanics (GRV). These volcanics exhibit no characteristic magnetic signature in this area, suggesting that they are fractured and probably of variable thickness.

In addition to the above, a seemingly circular magnetic feature, relatively small in area, occurs in the extreme NE corner of the province (eastern detailed survey). Only the southern half of this structure is covered by this survey. If this feature does close up in a circular shape, then I would suggest that it represents a large old volcano complete with ring dykes. This prospect is worthy of follow up and is described later as zone ZD.

This interpretation of the geophysics provides a comprehensive cover over the whole SW KINGOONYA. It improves understanding of the geology by providing a link-up for the sparse surface data available and by providing new ideas. The distinction of broad and narrow belts of geophysically similar rocks, intrusions and anomalous features allows a focussing of mineral exploration effort to more prospective zones.

Gravity Interpretation

SW KINGOONYA is controlled by a significant gravity high representing a major uplift of very dense material. The main part of the gravity anomaly is almost square in shape suggesting block faulting. The peak of the gravity anomaly occurs between two SADME drillholes, ERD8 and ERD9. The dense material causing the anomaly is seated at greater depth than that reached by drilling.

Two significant ridges extend from the main gravity anomaly (Fig. 9). One extends due west into TARCOOLA, just south of 30 degrees 30 minutes South. This ridge shows a uniform east-west gradient with gravity values gradually diminishing from -15 to -35 mgal. It may reflect a narrow sub-surface body consisting of the same material as that of the main uplift and extending from it, but dipping quite gently to the west. The peridotite intersected in CRA DD88 MEL, appearing as a magnetic low, occurs on the southern side of the ridge, and might have been intruded along a contact zone.

The other ridge is more complex and extends from the western edge of the main block to the south. This southern ridge contains two separate closures, each of significant amplitude, which seem to be superimposed on a similar feature to the northern ridge. The ridge is terminated abruptly by a large gravity low just to the south of the southern closure.

The first closure may be due to a massive basic intrusion with considerable depth persistence and appears as an elongated, undisturbed magnetic high coincident with this small gravity high.

The southern gravity closure, at the end of the ridge, appears to coincide with magnetic highs associated with komatiite in the Lake Harris area.

Interpretation Problems

In interpreting magnetic data from SW KINGOONYA, I attempted to delineate areas, of different or similar magnetic characteristics.

The magnetic data, as presented by Pitt Research and used in the interpretation, include TMI (colour), TMI with shadow (both colour and grey) and Total Magnetic Gradient (colour and grey).

Each type of image presentation accentuates somewhat different areas as being of similar character. I considered all of these and finally arrived at a conclusion that the Total Gradient images as produced by Pitt Research offer the highest degree of differentiation between the various areas. Whether these indicate changes in rock type, or changes within any given rock type (both in composition, thickness and/or attitude) is uncertain.

Of all the images, I consider that the Colour Gradient, in conjunction with the TMI (sun shadow) map, to be the most useful as it accentuates differences between various areas.

All zones of distinct magnetic character are shown on figure 8.

Data gaps and variations in flight line direction (between surveys) have hindered effective interpretation. For example to the NE the detailed survey stops short of fully describing the unusual circular(?) feature, zone ZD.

Magnetic Interpretation

General Comments

The magnetics of SW KINGOONYA are characterised by generally low background in keeping with the Archaean age of the rocks in the area, but individual anomalies exhibit considerable amplitudes. The Magnetic Gradient indicates considerable variations throughout much of the area.

A number of distinct belts of magnetic highs and lows are evident throughout the area. These are shown on figure. 8 as BH1, BL1 etc. (Belt High or Belt Low).

Magnetically quiet (i.e. no magnetic gradient) zones are annotated on the interpretation map as QH1... QL1.. etc. H stands for high TMI and L for low. In all, 11 quiet zones have been recognised including one named QI for intermediate. These zones occur over magnetically high and low areas. The flat zones might have a variety of causes. They may indicate sedimentary nature of the underlying rocks, or in the case of magnetically high zones, these might be caused by a series of uniformly magnetised, flat lying layers. Considerable thickness of overburden could also produce such an effect e.g. zone QH4 may reflect the presence of Pandurra Formation rock types.

In addition to the above, six zones of distinct magnetic character have been recognized. These are annotated as ZA to ZF on figure 8. Some fall just outside KINGOONYA but are within the working sheet.

Belts of Magnetic Highs and Lows.

A majority of the large (in amplitude) magnetic highs and lows of the area occur in a series of distinct belts.

Geological data within these belts, particularly from drilling, is given under 'Areas Suggested as Follow Up Targets'

Two of the high belts (BH1, and BH2) bear WSW, and follow gentle southerly arcs to the west. BH3 on the other hand appears to be almost straight but still of the same general bearing.

Belts BH4, BH5 and BH6 appear as much tighter arcs, draping themselves around the northern gravity ridge emanating from the main high covering most of SW KINGOONYA.

The high amplitude or "deep" magnetic lows, some of which seem to represent reversely magnetised bodies, also appear in groups forming three distinct belts.

BL1 extends from the tip of quiet zone QH3 (SE corner of TARCOOLA) within the northern portion of the gentle arc of belt BH1 and divides into two parts. One continues easterly, almost in a straight line, as far as the eastern edge of the Mt. Eba detailed survey, beyond which its extent is uncertain. The other portion of the BL1 belt of magnetic lows cuts across the eastern part of BH1, where it assumes an arc form but of a sharper curvature to that of the high belt.

Low belt BL2 appears in a straight line bearing east-west. It appears to completely cut off magnetic highs of belts BH2 and BH3.

The third, and last, of the belts of magnetic lows bears northerly from a point just north of the Lake Harris komatiite as far as belt BL2, at the western border of KINGOONYA, where it terminates.

* Belts BH1 and BL1.

The magnetic highs of this belt are considered to be due to basic and possibly altered ultrabasic rock types. The highs are contorted and indicate that the causative rocks have been subjected to considerable folding and faulting.

In contrast to the magnetic highs the lows belonging to belt BL1 intersecting this area appear quite undisturbed. The edges of the lows appear very sharp and well defined on the images.

A good example of this is offered by the complex magnetic high, appearing on the TMI map in the shape of a letter S (somewhat squashed) in the extreme SE corner of TARCOOLA. The low situated in the upper part of the S shape is quite undisturbed. A similar situation occurs immediately to the east of the above within the double magnetic high straddling the eastern border of TARCOOLA.

While the highs of BH1 are thought to be due to basic or altered ultrabasic rocks (or both), the lows of BL1 may represent ultrabasic intrusives. Due to their undisturbed character, these ultrabasics are thought to be considerably younger.

Belt BH1 is displaced northerly some 4 km by a major fault near the western edge of the worksheet. I have no data to indicate the westerly extent of the displaced part of the belt.

A large (in amplitude and comparative area) magnetic high is situated between belt BH1 and the end of BH4. This high represents a large massive intrusive body which appears to be undisturbed by any subsequent events and is probably unrelated to either of the belts. It may be due to a younger basic intrusive, and possibly is of the same age as those intrusives contained within belts BH2 and BH3.

Belt BL1 divides into two to the SW of this large high. While the main part of the belt continues to the east at the same angle, some minor lows appear to more or less follow the highs of BH1. The lows of this branch of BL1 are of considerably smaller amplitudes.

* Belt BH2.

This belt of magnetic highs occurs between two pronounced lineaments and transgresses almost all SW KINGOONYA. The magnetic highs of this belt appear to be well defined and sharper than those of belt BH1 and do not seem to have been individually disturbed to any degree. The one exception to the above is the magnetic high at the western end of the belt, which is not unlike some of the highs of belt BH1.

* Belt BL2.

Belt BL2 (magnetic lows) may represent ultrabasic intrusives. It abruptly terminates highs of belt BH2 as well as those of belt BH3.

* Belt BH3.

Belt BH3 is situated to the immediate north of belt BH2 and is limited in length between belt BL2 and the arcuate belt BH4. BH3 is not well defined as detailed magnetic surveys do not extend sufficiently far to the west. The anomalies within the belt appear to be similar to those of belt BH2 and are probably of the same origin and age.

* Belt BL3.

The magnetic lows of this belt are of much lower amplitudes than those of the other two. It seems to be draped along the western edge of the gravity ridge extending to the south from the main gravity high of SW KINGOONYA. The lows may therefore reflect ultrabasic intrusives emplaced along a deep seated contact zone.

* Belts BH4, BH5 and BH6.

These arc shaped belts all appear to be draped around the northern gravity ridge and, as such, are considered as a group.

The boundaries of belt BH4 are not well defined. Peaks of anomalies appear to represent the shallowest parts of deeper seated, wider bodies. Belt BH4 is also much wider than the other two. Apart from the fact that the magnetic susceptibility of the bodies is quite high, it is not possible to determine their composition. It is possible that they are connected at depth.

Belt BH5 is very narrow and contains small (both in area and amplitude) magnetic highs which are comparatively widely spaced along it.

The highest amplitude anomalies are situated along the northern limb of the belt. Some of the image presentations suggest that these anomalies might also be connected at depth. That is they may represent near surface remnants of what might be a continuous near vertical magnetic layer at depth.

To the south of the extremity of belt BH5, and along its southerly projection, there is a small in area but high in amplitude, near circular magnetic high, H2, (Fig 8) . This anomaly is considered worthy of follow up and is described later under 'Isolated Magnetic Highs'.

Belt BH6 is in many respects similar to belt BH5. It is somewhat wider, and the individual magnetic highs are of greater amplitude. The southern limb of the belt is not entirely defined. The regional survey (Adastra) indicates an interesting magnetic high, just to the east of the tightest bend in the belt. This may warrant further investigation.

Near the westernmost part of the arc formed by the belt there is a single, isolated and small (in area) magnetic low of significant amplitude, N2, (Fig. 8). This anomaly requires investigation and is described later under 'Isolated Magnetic Lows'.

The nature of the bodies giving rise to the high amplitude magnetic highs and the single low of this belt is not known.

Total Magnetic Gradient: Some Comments.

Before proceeding to the descriptions of the magnetically flat areas and zones of distinct magnetic characteristics, the nature of the Pitt Research Total Magnetic Gradient is described.

The Pitt method measures the maximum gradient at any given point and is non-directional. It is in effect a scalar quantity. It does not differentiate between highs or lows. A magnetic high of a given amplitude will look exactly the same as a low of the same or similar amplitude. Variations in the magnetic background are not seen, as is illustrated by the similar appearance of QL3 (low background) and QH3(high background). In that respect the Total Magnetic Gradient Image could be considered as a scalar form of a true residual map of the area

Magnetically Flat Zones.

The magnetically flat (or quiet) zones have been discussed in some detail in the preamble to this section of the report. Additional comments follow:

* Zone QH3.

The TARCOOLA 1: 250,000 geological map shows a number of scattered outcrops of Hiltaba Suite rocks throughout this area. It seems reasonable to assume that the flat nature of this zone reflects the existence of Hiltaba granitoids of considerable thickness, high magnetic susceptibility and uniform composition.

* Zones QL2 and QL3.

Although QL3 appears on the colour gradient images to be almost identical to QH3, it is situated in an area of very low background. This illustrates the background removal property of the total gradient. Some levelling problems are apparent near the eastern boundary of this zone which appear to separate it from zone QL2. It is probable that the two zones are due to the same rock type.

TARCOOLA geological map shows scattered exposures of Hiltaba Granite in zone QL2, confirming the similarity to zone QH3; zone QL3, therefore, is almost certainly Hiltaba Granite. The significance of the high versus low background is not explained.

* Zone QI1.

This zone exhibits a variable background, from low in the east, to quite high in the west. This may be due to a rock type of reasonably high magnetic susceptibility dipping gently to the east.

A major fault crosses the zone from SE to NW. This fault is interrupted by a near circular feature, C1, (Fig. 8), visible on the gradient and the TMI with sun shadow images. The circular pattern which is 2.5 km in diameter is a prime exploration target and is discussed later under 'Faint Circular Features'.

The area QI1, to the NW of zone ZA2 (Glenloth goldfield), also includes exposed Glenloth Granite. The difference between the two areas in terms of magnetics is likely to be the amphibolite bands, dykes and sills, in the Glenloth goldfield area which are related to some gold mineralisation.

Zones of Distinct Magnetic Characteristics.

The already described belts of magnetic highs and lows as well as the quiet, or flat, areas are all special cases of zones exhibiting distinct magnetic characteristics. In addition, other areas have been delineated as possessing distinct patterns. The Total Magnetic Gradient map and especially its colour version was used almost exclusively in the selection of such areas which are now discussed and also referred to under 'Follow up Targets'.

* Zone ZF.

This area contains the Glenloth goldfield. Boundaries of gradient patterns characteristic of this area are very sharp and distinct. This suggests that Glenloth rock types within the zone do not extend beyond its northern borders. It is possible however that the southern border of the zone represents an edge of younger rock types (Hiltaba Suite?) and that zone ZF might extend southerly under such cover.

The possibilities for secondary gold accumulations in the weathering profile of the Glenloth goldfield have been discussed elsewhere (Youles, 1992). Similarities in magnetics to zone ZA2 (see below and under 'Follow-up Targets') *suggest that the isolated magnetic anomalies might be due to BIF and present a new target for gold.*

Three isolated magnetic highs of high gradient, H4, H5 & H6 (Fig. 8), occur within this zone. They are out of character with the rest of the area, and as such deserve further investigation. These are described later under 'Isolated Magnetic Highs'.

* Zone ZE.

This is a most interesting area which shares its southern border with the Glenloth zone and contains the Lake Harris komatiite.

The zone is crescent shaped. At the northern peak of the crescent the high magnetics of the Lake Harris komatiite are very much in evidence. The eastern limb of the area consists of a deep magnetic low. Gradient images indicate the same, or very similar curvature of anomalies contained in this part of the zone.

The same applies to the western limb of the crescent of this zone. Here a small bulge of zone QI1 intrudes into ZE. South of this bulge the magnetics (TMI only - no shadow) indicate an area of magnetic intensity of the same order as that of the Glenloth block. The gradient images appear to follow the same curvature as that in the remainder of zone ZE, unlike that of Glenloth or other areas in the vicinity.

From all the above I conclude that zone ZE probably contains ultrabasic rocks similar to the Lake Harris komatiite. The high magnetics in the north reflect an area where these have been altered; in the western limb of the zone, komatiites are considered to have been only partly altered and those in the eastern limb unaltered.

A small magnetic high, H3, (Fig. 8), which is uncharacteristic of this area, occurs in the eastern limb of zone ZE, near the border of the Glenloth zone. This should be investigated and is described under 'Isolated Magnetic Highs'.

* Zone ZD.

Zone ZD is located in the extreme NE corner of province K6 (SW KINGOONYA).

The magnetics appear in a semicircular pattern which probably represents a portion of a circular magnetic feature of 10 km diameter.

Zone ZD may represent an old volcano, complete with at least one major ring dyke. This unusual magnetic feature is located at the intersection of two major lineaments W11 and NG2 which are considered to have been instrumental in block faulting connected with basement uplift of SW KINGOONYA. The circular magnetic pattern lies in the NE corner of the very intense gravity high reflecting this uplift.

In the vicinity of the suspected remnant volcano some dykes of the Gairdner Dyke Swarm appear to deviate from their normally straight course.

One of the dykes appears to terminate abruptly near the circular dyke(?), indicating that the volcano is younger than the dykes.

This area warrants intensive investigation and is referred to under 'Miscellaneous Features'.

* Zone ZC.

This small zone is characterised by shallow gradients within a general area of low magnetics and probably represents Archaean rocks of low magnetic susceptibility.

* Zones ZA2 and ZB.

On the images of TMI and TMI with shadow, the two zones appear to be almost identical. The Total Magnetic Gradient images on the other hand show very considerable differences.

ZB appears to be far more disturbed and the gradients much sharper. The zone contains several magnetic highs of considerable amplitude occurring in a meandering line, in a general north-south direction. The rocks causing these highs may connect at depth. This part of the zone needs further investigation.

Zone ZA2 is similar to the Glenloth area (Zone ZF). The gradients are somewhat sharper than in Glenloth, and the area contains a considerable number of isolated magnetic highs, not dissimilar to the three of the Glenloth area. Zone ZA2 may represent a similar geological environment to Glenloth.

* Zone ZA1.

This may represent an extension of zone ZA2 separated from it by the incursion of the quiet zones QL2 and QH3.

FOLLOW UP TARGETS.

General Comments.

The area outside SW KINGOONYA is overlain by a thick cover of sediments which include the high magnetic susceptibility rocks of the Pandurra Formation. The sedimentary cover blankets magnetic responses from the basement. Only major highly magnetic intrusions are detected. These deep seated intrusives (depths estimated to be in excess of 600m) have been discussed earlier. Other magnetic anomalies in the vicinity of faults R10 and R11 indicate intrusives at shallower depths. The inadequate data coverage in that area precludes full interpretation.

SW KINGOONYA is underlain by a variety of rocks including ultrabasics (fresh and altered), acid and basic volcanics, sediments of various ages and a number of isolated intrusions. The area is extensively faulted and fractured. Underlying the major part of the area is the very dense material reflected by the major gravity high, nearly square in general form. The area is considered to have significant mineral potential.

In addition to areas recommended for comprehensive follow up work, there are many isolated and anomalous magnetic targets (Fig. 8). These take a variety of forms: single magnetic anomalies occurring in generally undisturbed areas (e.g. H7, Fig. 8); a deep magnetic low appearing within a series of highs (e.g. N2, Fig. 8); or a typical dipole anomaly indicating its comparatively young age (e.g. D2, Fig. 8). Dipole anomalies are generally absent in Archaean and Proterozoic environments in South Australia.

Five faint, circular features, apparent only on the gradient images, are also indicated (C1-C5, Fig. 8). These are considered important as four may reflect zones of alteration and in one instance a possible pipe-like intrusion of low magnetic susceptibility material.

Other isolated anomalies which warrant further investigation were selected because they were not characteristic of the areas in which they occur.

Belts of Magnetic Highs and Lows.

The main regions of interest within these belts occur where interpreted ultrabasics intrude the older basics or altered ultrabasics.

Among those regions the more obvious are:

* Belts BH1 and BL1

- The area at and around Hopeful Hill where the TMI colour image indicates that the basics and/or banded iron formation occur in a large squashed 'S' shaped fold. The upper loop of the 'S' appears to have been intruded by a massive body of ultrabasic composition. The magnetic expression of the intrusion appears as a single, well defined and undisturbed magnetic low.

- An area around a double magnetic high separated by a sharp low straddling the TARCOOLA-KINGOONYA border.

TARCOOLA geological map shows the western end of BH1 to include exposures of meta-basalt, BIF and gneiss, belonging to the Mulgathing Complex, and intruded by Hiltaba Granite.

Geophysical and geochemical surveys by Abadon Holdings (ENV 2276) identified several anomalies near Kenella Rocks, 5km NNE of Hopeful Hill and close to the double magnetic high separated by a sharp low straddling the TARCOOLA/KINGOONYA border. One drillhole intersected 1.8% Zn, 0.07%Pb and 0.02%Cu in K-felspar-quartz gneiss, fractured and altered (chlorite and hematite) with quartz/chlorite veining from approx. 140m to 149m; 3 other holes intersected 0.13%Pb and 0.28%Zn, 0.18%Pb and 0.39%Zn and 0.11%Pb respectively. Similar surveys by Abadon outlined weaker anomalies in the Hopeful Hill area.

Abadon's exploration concentrated on areas in which bedrock was exposed or very close to surface; the remainder of the belt is covered by Cainozoic sediments. The results show that significant base metal mineralisation occurs close to the magnetic features and that *exploration of those features in the covered areas within belts BH1 & BL1 is warranted.*

- Area around the point where belt BL1 divides into two parts. (WSW of AMOCO KRP 4&5)

AMOCO drillhole KRP5 intersected 0.06ppm Au in weathered quartz-felspar gneiss; unweathered rock in KRP4&5 is chloritized and sericitized quartzo-felspathic gneiss, locally with garnet, sillimanite, pyrite or magnetite, with some mylonitic zones; S.G. 3.09; weakly anomalous in Cu and Zn with Ba 1000-1400ppm.

This anomalous gold intersection in altered country rock close to the split in the interpreted ultrabasic belt within Archaean rocks, indicates that significant gold mineralisation may be present. Bedrock sampling across the geophysical target zones is recommended.

* Belts BH2 and BL2

- The area around the westernmost magnetic high of belt BH2 where it is cut off by the weak BL2. This magnetic high, unlike other highs along BH2, appears to be considerably distorted. The other highs appear as solid, massive blocks apparently unaffected by faulting or folding.

  The area suggested for investigations should include the elongated, narrow magnetic highs in the immediate vicinity of the target area defined above, on the southern side of belt BL2. The highs are considered to be near surface.

- Area at the eastern end of BL2, near the eastern boundary of the Mt. Eba detail survey where some interesting anomalies are indicated (based on poor quality contours, AMOCO - Geoex 1980).

BL2 is coincident with a major zone of geological discontinuity, marked by the linear southern limit of the Lower Proterozoic Tarcoola Beds on TARCOOLA. No geological data are available. Mineralisation similar to belts BH1 and BL1 is possible at the western end of BH2.

BHP drilled one percussion hole, PK-30, on a magnetic anomaly near the eastern end of BL2 and intersected extensively chloritized and sericitized basalt with 10-15% magnetite completely altered to leucoxene. Geochemical analyses show 120ppm Ni, 100ppm Cr and 120ppm Zn, which are anomalous amongst the results reported and similar to, but weaker than results for a control kimberlite analysed at the same time.

This drillhole shows that extensive alteration has occurred which may be related to lamprophyric activity; further bedrock sampling by drilling of the anomalies identified near the eastern end of BL2 is recommended.

* Belts BH4, BH5 and BH6.

The nature of at least one anomaly in each of the three different belts should be investigated.

Drilling of two magnetic highs by BHP in belt BH4 intersected altered trachytic and rhyolitic lavas assigned to the Gawler Range Volcanics; drilling at a third high intersected weakly sericitized granodiorite with accessory allanite near to exposed Hiltaba Granite. Geochemical analyses (Cu Pb Zn Ni Co & Cr) gave background values.

Miscellaneous Features

* Two areas containing magnetic highs of intermediate amplitude and annotated as "LH?" on figure 8 are suspected to contain komatiite rocks similar to those at Lake Harris. The total magnetic gradient patterns show strong similarities to those encountered in zone ZE.

* Zone ZE; this entire zone may contain komatiite rocks and warrants detailed investigation.

Drilling by SADME within this zone at Lake Harris intersected probable Archaean komatiite, prospective for nickel, chromium and gold, including secondary accumulations of gold in the weathering profile. Data from this work is contained in the Northwest Gawler Craton data package released by SADME in March, 1992.

* Zone ZA2 shows similarities to the Glenloth goldfield. The possibility that it is of a similar nature to that area should be seriously examined. *Tarcoola Gold carried out exploration for gold (SADME ENV 6882) on circular magnetic features in the western part of this area, which are not visible on the 1991-1992 images. Drill cuttings indicate granite and gneisses, some of which contain magnetite. 6 holes out of 32 recorded >0.03ppm Au (max 0.09), mostly in the magnetite-rich gneisses; depth to bedrock was 5-50m. The mixture of granite (Glenloth?) and magnetite-rich gneisses grading to possible BIF (quartz-magnetite rock intersected in 2 holes) shows a potential for gold in these Archaean rocks.*

* Zone ZD containing the suspected old volcano in the NE corner of SW KINGOONYA.

CEC drilled two holes (BB-3&4) in the NW quadrant of the structure, near the margin. Both intersected greater than 225m of dark red-orange sandstone logged as Pandurra, but later assigned to Labyrinth Formation (Cowley, W.M. & Martin, A.R., 1989. Definition - the Proterozoic Labyrinth Formation, north of Kingoonya. South Australia. Geological Survey. Quarterly Geological Notes, 110:12-17). At the base (294m-304m TD), BB-4 intersected a rhyolite, which assayed Pb 220-460ppm (Cu Pb Zn analysed) - quite anomalous for rhyolite.

These results suggest that the magnetic ring structure is buried below the sandstone. Sirotem or IP surveys are recommended to test for major sulphide deposits, massive or disseminated, associated with the ring or core of the structure. Immediately west of the volcano(?) there is a region of quite high magnetic responses. A sharp isolated magnetic high occurs between that region and the interpreted ring dyke. Both this high and the region of high responses reflect the existence of some basic material. The high region is suspected to contain basalts.

Further investigation of all of the area covered by the AMOCO - Aerodata (1981) survey, to the NE of the strongly pronounced dyke is recommended.

Faint Circular Features.

Circular magnetic features of this appearance are rare and are only recognised by careful examination of the gradient images. Once pinpointed on these images, they can then be recognised on the TMI images.

Four of these features represent very small changes in the magnetic susceptibility of the material enclosing them (i.e. they represent zones of alteration rather than pipes, or other types of intrusion). I am basing this on the fact that in four cases (C1, C2, C4 and C5) the circular features occur in areas of different TMI intensities but, in all cases, quite flat gradient. The changes in the gradient giving rise to the circular shapes are very small and are best seen, or perhaps only seen around the circumference of the individual circles.

There is a possibility that such alteration patterns might reflect existence of deeper seated pipes of low magnetic susceptibility.

C3 is different as the gradient shows quite high values inside the circle indicating the existence of a body of considerable depth persistence and significantly different magnetic susceptibility, indicating a possible intrusive character.

The magnetic patterns indicate alteration zones rather than intrusions, but the nature of these zones is obscure. Intrusions, which do not reach the surface are possible as suggested; they could be kimberlitic type vents, which quite commonly do not significantly affect magnetic or gravity patterns; using magnetic gradient in this way might be a new method to locate kimberlites; alternatively, they could also be impact structures, with slight changes induced in the rock. Uranium occurs in such structures in Canada and should be checked at these localities.

Bedrock sampling at least for diamonds and uranium, is recommended across each feature.

* Circular Feature C1.

C1 is located at the corner of the four sheets, TARCOOLA, KINGOONYA, GAIRDNER and CHILDARA. It interrupts a well pronounced fault crossing the area at about 45 degrees from the SE. The feature can just be seen on the TMI images with sun shadow and is well pronounced on the gradient images.

The cause of this faint magnetic feature is uncertain but it may be a zone of alteration.

* Circular Feature C2.

C2 is located about half way between Renton Hill and Tomato Camp Rockhole. It falls at the western boundary of zone QH1. It too may represent a zone of alteration.

* Circular Feature C3.

This feature, perhaps more oval than circular, straddles a track leading from 218 Mile Bore to Lake Harris Bore, south of the Trans-Australian Railway, and represents a pipe-like intrusive.

* Circular Feature C4.

This occurs outside the working sheet and is located on TARCOOLA, just south of Black Camp Hill. It is situated between two well pronounced SE-NW trending faults.

This feature, the largest of all five, shows on the gradient images as a well pronounced circle enclosing some very small (in area and magnitude) magnetic highs. Other small magnetic anomalies seem to be situated along its circumference with the exception of the northernmost part. This part of the area, covered by the Kokotha survey, suffers from some bad levelling due probably to errors in flight line altitude. Had the amplitude of these anomalies been much higher, the circular feature would have the appearance of a carbonatite intrusion.

C4 probably represents a zone of alteration accompanied perhaps by some local enrichment and depletion in the mineral content, which would include magnetite.

* Circular Feature C5.

This is located on CHILDARA, to the immediate east of Arcoordaby Well and Tank and just south of the well pronounced long, curved geological contact zone.

Apart from the well defined circular boundaries the gradient images show little; no magnetic variations either around, or within the feature are apparent. A weak zone of alteration is suggested as its cause.

Isolated Magnetic Anomalies.

These generally small in area magnetic highs and lows have been selected as targets on the grounds that they are not characteristic of the areas in which they occur.

Fifteen isolated anomalies are recommended for further investigation. They comprise eight magnetic highs (annotated H1 to H8), four lows (N1 to N4) and three dipole type magnetic high/lows (D1 to D3).

These anomalies are in covered areas and mostly present targets for mineralisation associated with intrusions of basic, ultrabasic or kimberlitic rocks. All merit further ground investigation.

Isolated Magnetic Highs.

* Anomaly H1.

The anomaly is located about half way between AMOCO KRP8 drillhole and No. 16 Bore. It represents an isolated but distinct magnetic high of low amplitude but moderately high gradient within quiet zone QL5. It is estimated that its depth is less than 50 m.

* Anomaly H2.

The anomaly is situated 3 km west of SADME ERD2 drillhole. It probably reflects Wilgena Jaspilite, a small outcrop of which is shown at the southern edge of the anomaly.

* Anomaly H3.

This is located in the middle of Lake Harris. The anomaly is of moderate amplitude but quite sharp gradient, suggesting that its magnetic susceptibility is not very high. Its depth is estimated to be less than 50 m. It occurs within zone ZE and abuts one of the dykes of the Gairdner Dyke Swarm.

* Anomalies H4 and H5.

Located in Lake Harris, within zone ZF. The anomalies are shallow (possibly less than 50 m) with high amplitude and sharp gradients. Both are of considerably higher magnitude than other magnetic highs in the Glenloth magnetic zone.

* Anomaly H6.

This anomaly is located 3.5 km west of the Government Battery. It falls within the Glenloth magnetic zone and like the previous two anomalies is shallow seated and exhibits much higher amplitude than other magnetic highs of this zone.

* Anomaly H7.

Located on CHILDARA, 9 km west of Yerda Outstation. It is a small in area isolated magnetic high of high amplitude and sharp gradient. It is quite shallow (<50m.)

* Anomaly H8.

This double peak magnetic high occurs on GAIRDNER, 3.5 km SSE of Anomaly H6. H8 occurs at or near a geological contact at a depth of possibly less than 50 m.

Isolated Magnetic Lows.

All the magnetic lows listed below probably represent reversely magnetised bodies.

* Anomaly N1.

The source of this anomaly is peridotite as intersected by CRA in drillhole DD88 ME2. Only one hole tested this anomaly and a small very sharp and shallow elongated magnetic high partly encircling the low on the southern side needs further investigation.

DD88 ME2 intersected a carbonate/chlorite altered peridotite intruded by dykes, porphyritic andesites and basalts containing xenoliths; both ultramafic and dykes are intruded by lamprophyre-related dykes; traces of pyrite, chalcopyrite and pyrrhotite occur in peridotite and basalts.

Max values are Cu 790ppm, Ni 550ppm, Au 0.038ppm, Pd 0.004ppm; elevated Ba >1000ppm max 4280ppm, Ce >60ppm max 466ppm, La >40ppm max 290ppm & Nb >10ppm max 31ppm in carbonate altered zones.

A programme of bedrock sampling to determine rock type distribution and metal concentrations is recommended, with particular attention to contact zones. Depth to bedrock is about 70 m and part of the anomalous area extends under Lake Labyrinth.

* Anomaly N2.

This anomaly is located 2.5 km NW of SADME ERD1 drillhole. It occurs at the sharpest part of the arc forming belt BH6. The low is displaced to the west from the arc and appears to present an interesting target. The anomaly source is very shallow and may be peridotite.

* Anomalies N3 and N4.

These are located on CHILDARA, in a generally quiet magnetic zone with many similarities to zone ZI1. N3 is situated 1.5 km NW of Yerda Well and Tank and N4 7 km WSW of Yerda Outstation. Both anomalies are due to bodies less than 50 m deep, and may be intrusions of ultrabasic material.

Dipole Anomalies.

Three typical dipole anomalies have been so far recognised in the SW part of the working sheet. The Gawler Craton was magnetised at a time when it was located close to the south magnetic pole. As a result, most of the magnetic responses are due to bodies magnetised in a nearly vertical direction. The dipole anomalies are considered to be probably due to some much younger intrusives. They should be further investigated.

These anomalies are in covered areas and mostly present targets for mineralisation associated with intrusions of basic, ultrabasic or kimberlitic rocks. All merit further ground investigation of the intrusions and their contact zones.

The three anomalies are:

* Anomaly D1.

D1 is located just east of drillhole BHP PK37, which intersected rhyolite; this is unlikely to be the source of the anomaly.

The imaged data suggests that this hole should have been drilled further to the SE. Ground survey data shows that the hole was close to the high of the dipole. Drilling is recommended about 1km south from PK 37, at the inflection point of the dipole.

* Anomaly D2.

This anomaly is situated on TARCOOLA 2 km NE of SADME ERD 5 drillhole.

* Anomaly D3.

This dipole feature is on TARCOOLA in the area covered by the Kokatha survey. It is situated 10 km WSW of Bulpara Hill.

All three anomalies are considered to be due to young intrusives at comparatively shallow depth.

ACKNOWLEDGMENTS.

I am indebted to Ian Youles who provided additional geological guidance and who, through our numerous consultations, greatly assisted in the interpretation. I would also like to express my gratitude to a number of SADME officers, Reg Nelson, Ric Horn, Wayne Cowley, Warwick Newton and Sue Daly among them, for their help during the course of this project. My special thanks go to John Pitt of Pitt Research for the compilation of all the image maps used in this interpretation, and to Gary Reed of SADME for the construction of the gravity map of the area.

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APPENDIX 1

LIST OF DETAILED AERIAL GEOPHYSICAL SURVEYS

MAP NO	SURVEY NAME	SURVEY CODE	EL NO	CONTRACTOR	COMPANY	FLIGHT LINE SPACING (m)	ALTITUDE (m)	SURVEY YEAR
1	Hawks Nest	85SA03	1277	Geoterrex	CRA	300 (N-S)	120	1985
2	Mount Eba	86SA06	1315	Geoterrex	CRA	300 (N-S)	80	1986
3	Kingoonya	91SA05	594/711	Aerodata	Amoco	400 (E-W)	90	1981
4	Billakalina	82SA01	799	Geoex	Stockdale	250 (NNE-SSW)	70	1982
5	Reedy Lagoon	87SA02	1380	Geoterrex	Reedy Lagoon	200 (N-S)	70	1987
6	Peephabie	88SA03	1441	Geoterrex	Reedy Lagoon	200 (N-S)	70	1988
7	Harcus Hill	84SA09	1224	Austirex	BHP	300 (N-S)	80	1984
8	Lake Hart North	82SA01	710	Austirex	Afmeco	400 (E-W)	125	1982

See figure 13 for Map No. reference

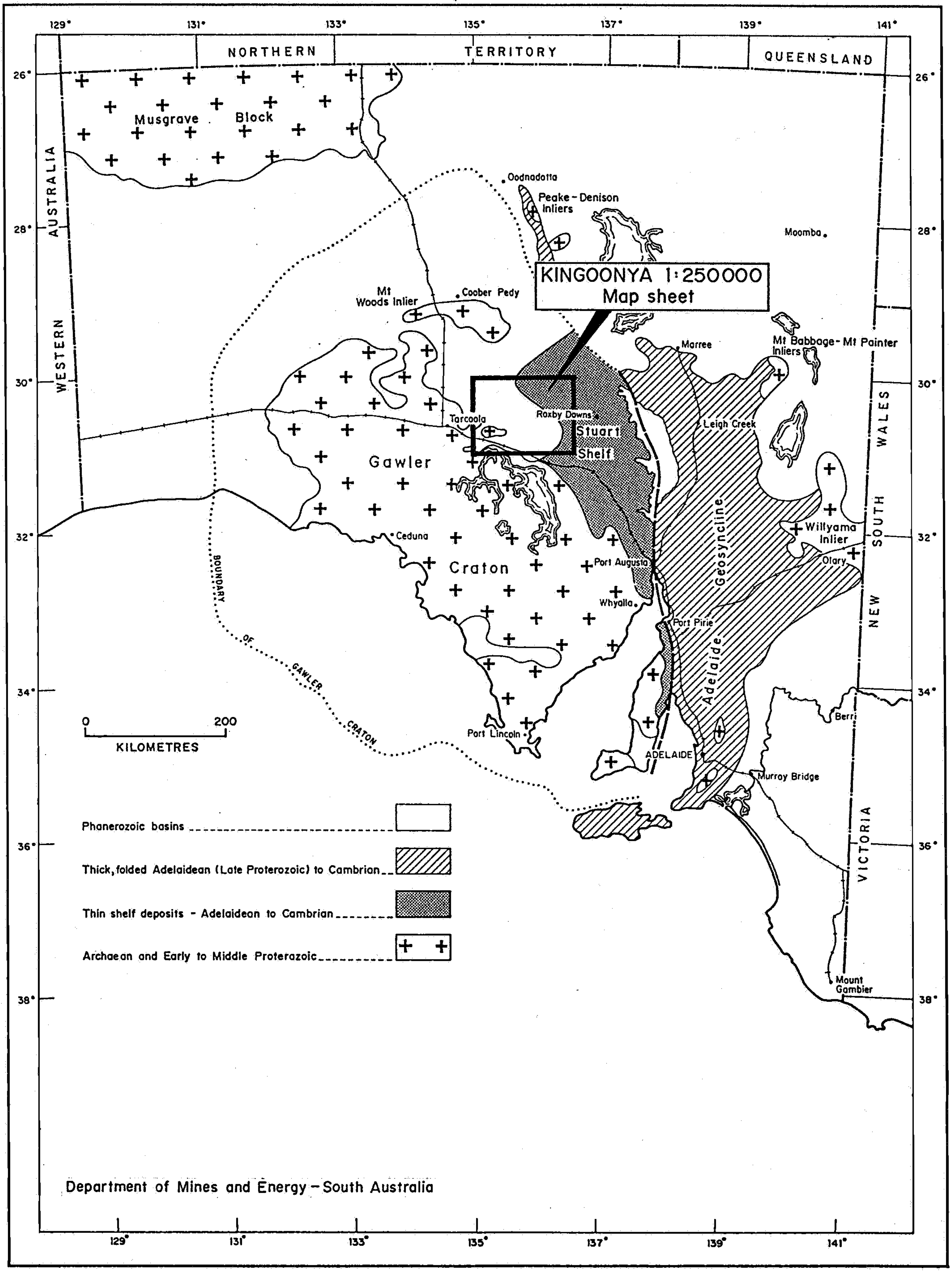


Figure 1. Locality plan showing KINGOONYA 1: 250 000 map sheet

S22635

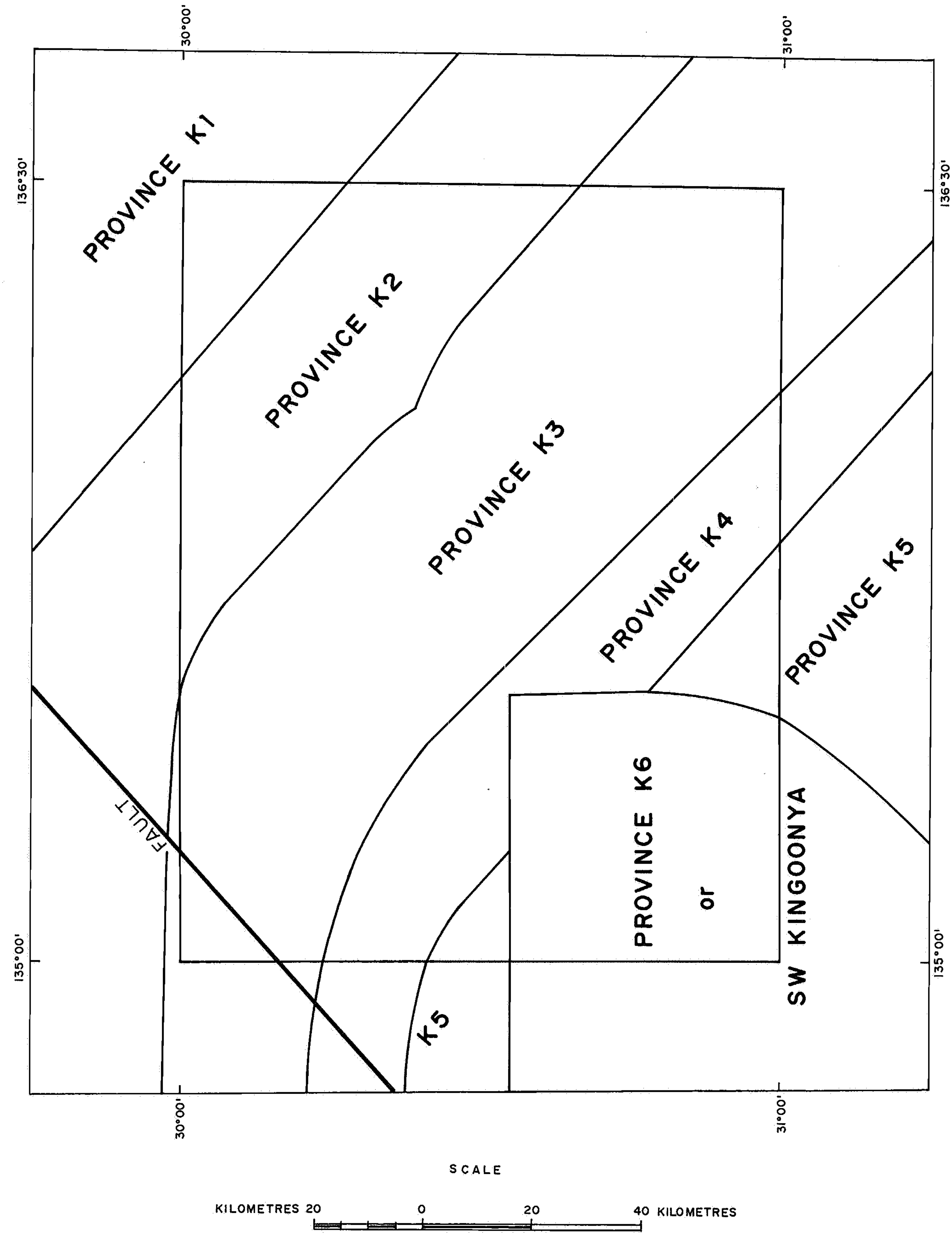
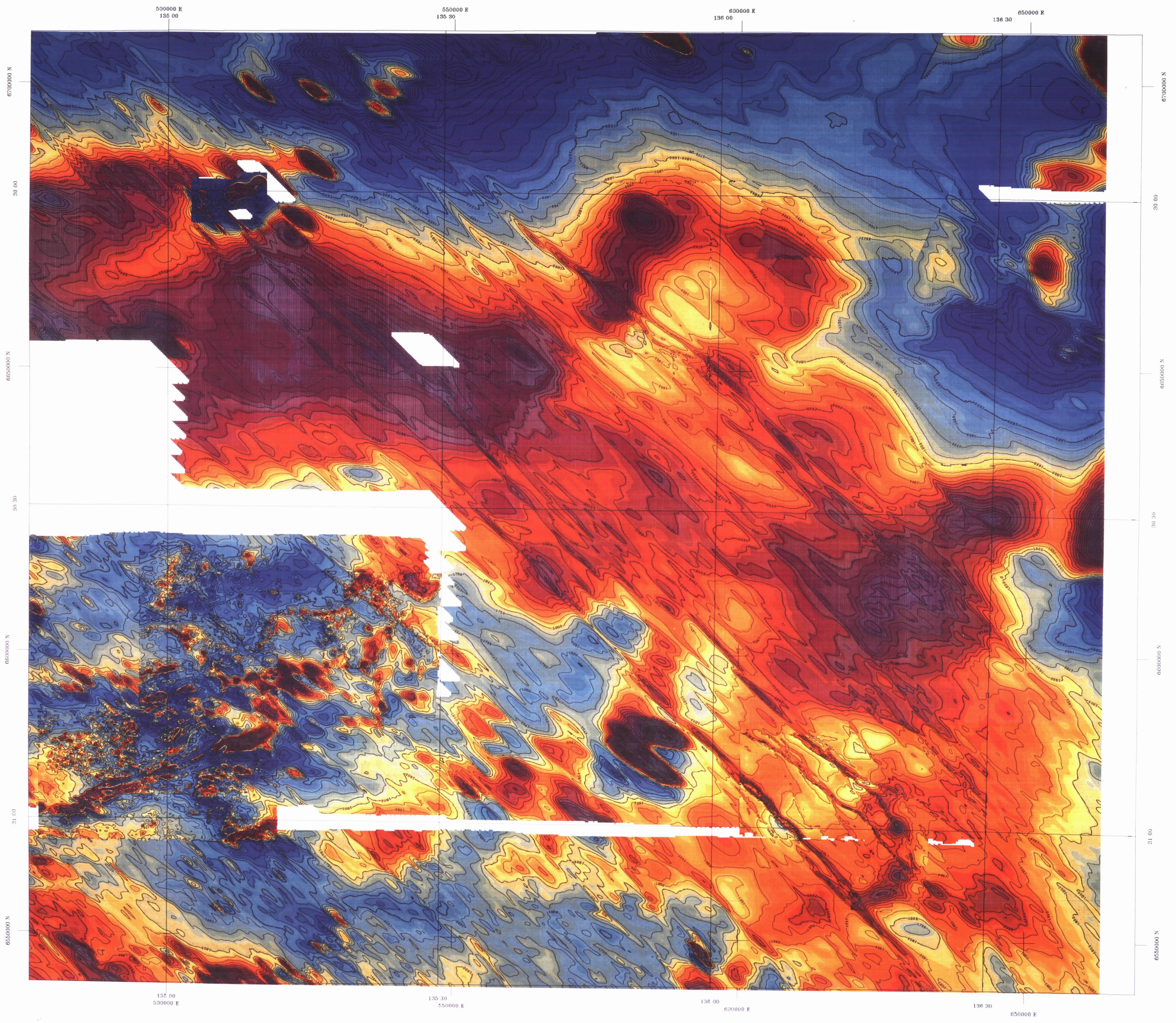


Fig. 2

DEPARTMENT OF MINES AND ENERGY SOUTH AUSTRALIA	COMPILED P. Woyzbun	6.7.92 C.D.O. DATE
MAGNETIC AND GRAVITY INTERPRETATION - KINGOONYA 1:250 000	DRAWN J. Gray	SCALE 1:1 000 000
GEOPHYSICAL PROVINCES	DATE May 1992	PLAN NUMBER
	CHECKED	92 - 652

5447



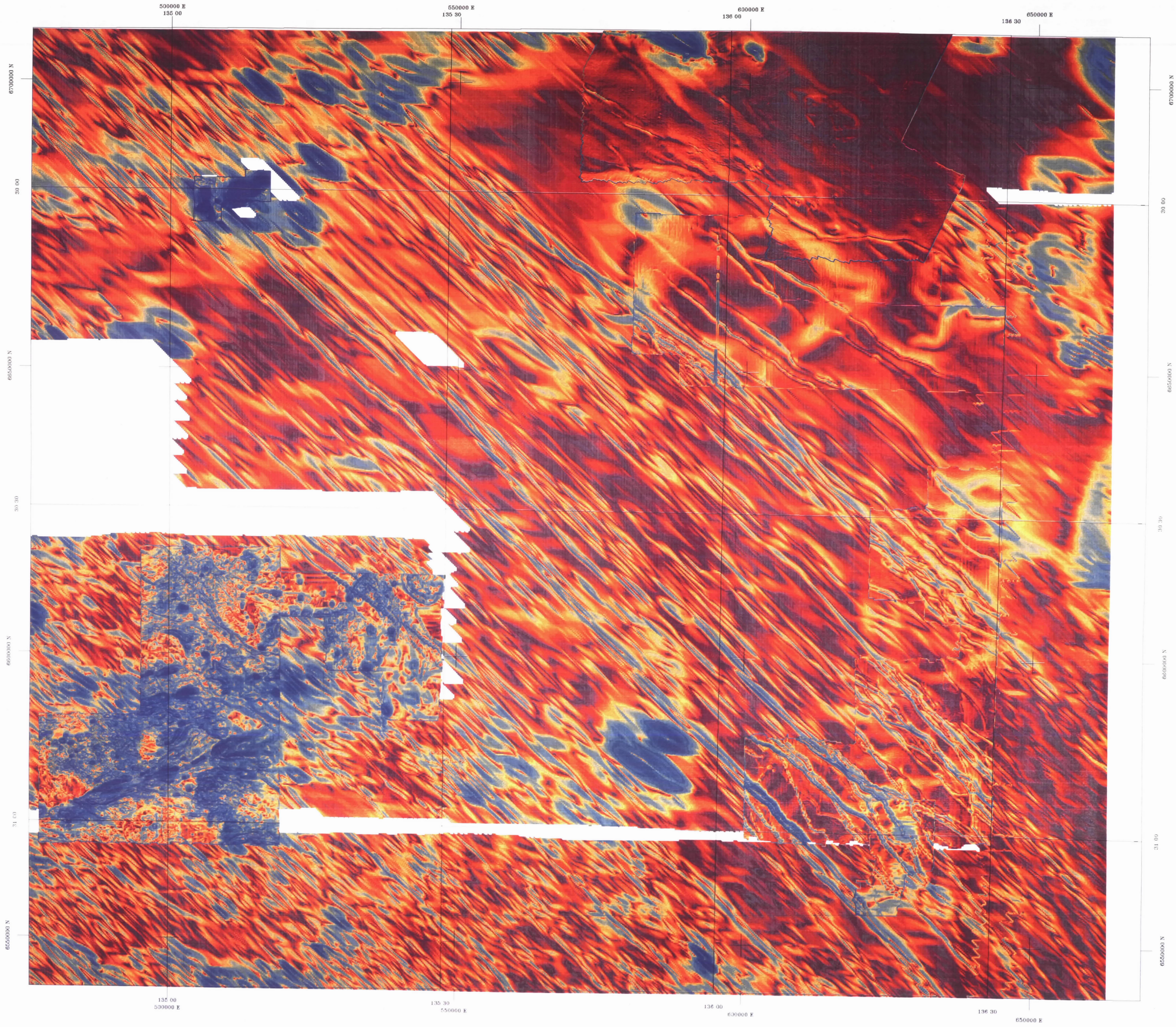
KINGOONYA
TOTAL MAGNETIC INTENSITY PIXEL MAP — *** PRELIMINARY ONLY ***
1:250 000 Scale

Prepared for
South Australian Department of Mines and Energy

Figure 3

92-772

Pitt Research Pty Limited
June 1992



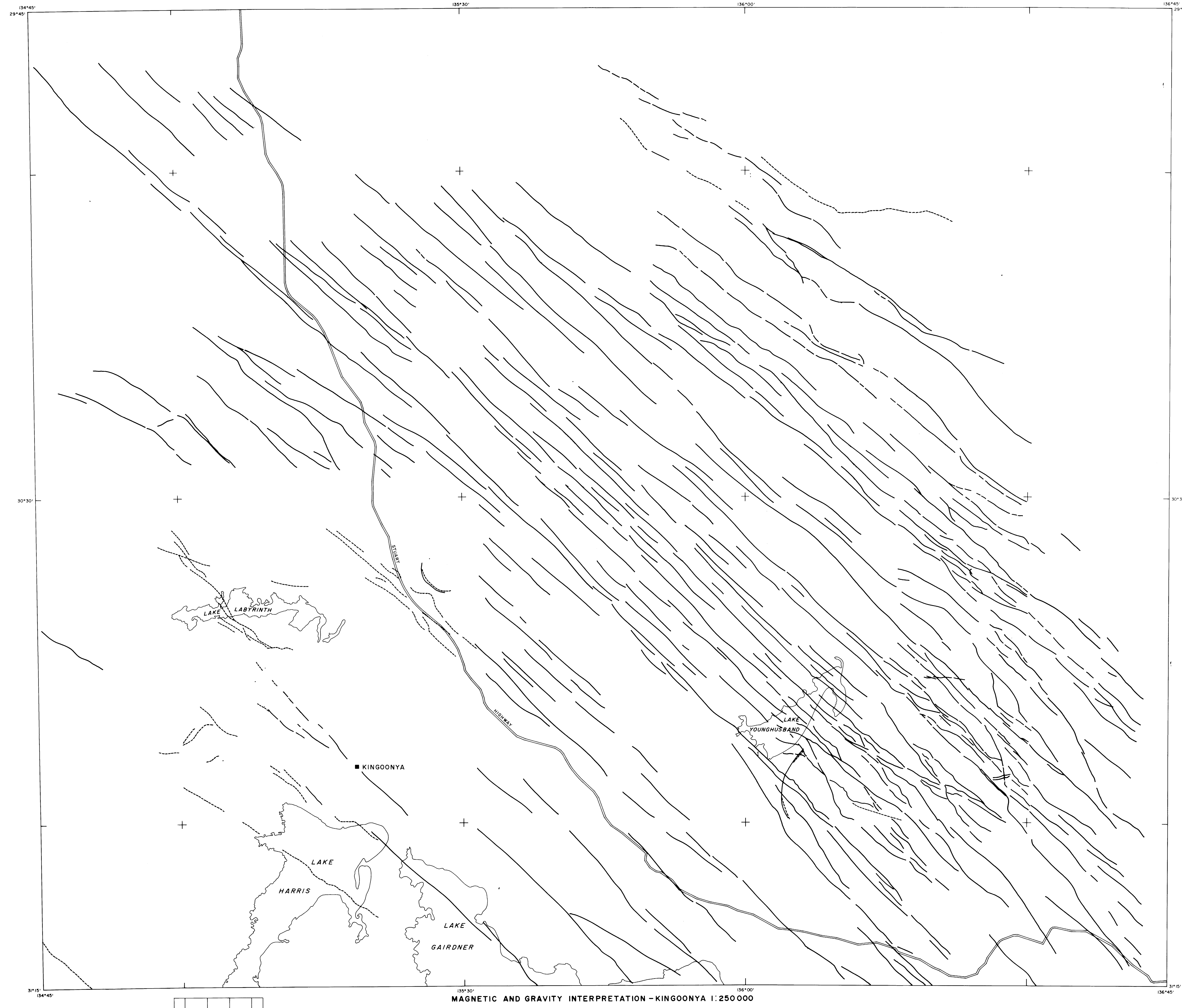
KINGOONYA
MAGNETIC GRADIENT PIXEL MAP — *** PRELIMINARY ONLY ***
1:250 000 Scale

Prepared for
South Australian Department of Mines and Energy

Figure 4

92-773

Pitt Research Pty Limited
January 1992



MAGNETIC AND GRAVITY INTERPRETATION – KINGOONYA 1:250 000

INTERPRETED DYKES

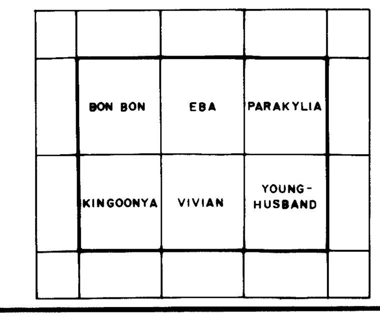
SCALE

KILOMETRES 5 0 5 10 15 20 25 KILOMETRES

Geophysical Interpretation by P. Woyzbun

Position from detailed surveys

Position from regional surveys



S A Department of Mines and Energy

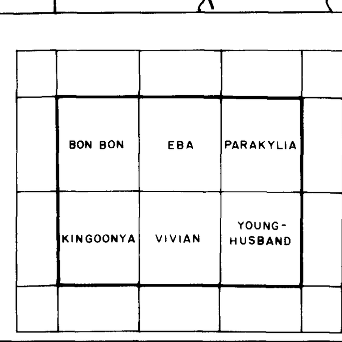
5447

FIGURE 5

92-654

MAGNETIC AND GRAVITY INTERPRETATION - KINGOONYA 1:250 000

INTERPRETED LINEAMENTS



SCALE

KILOMETRES 5 0 5 10 15 20 25 KILOMETRES

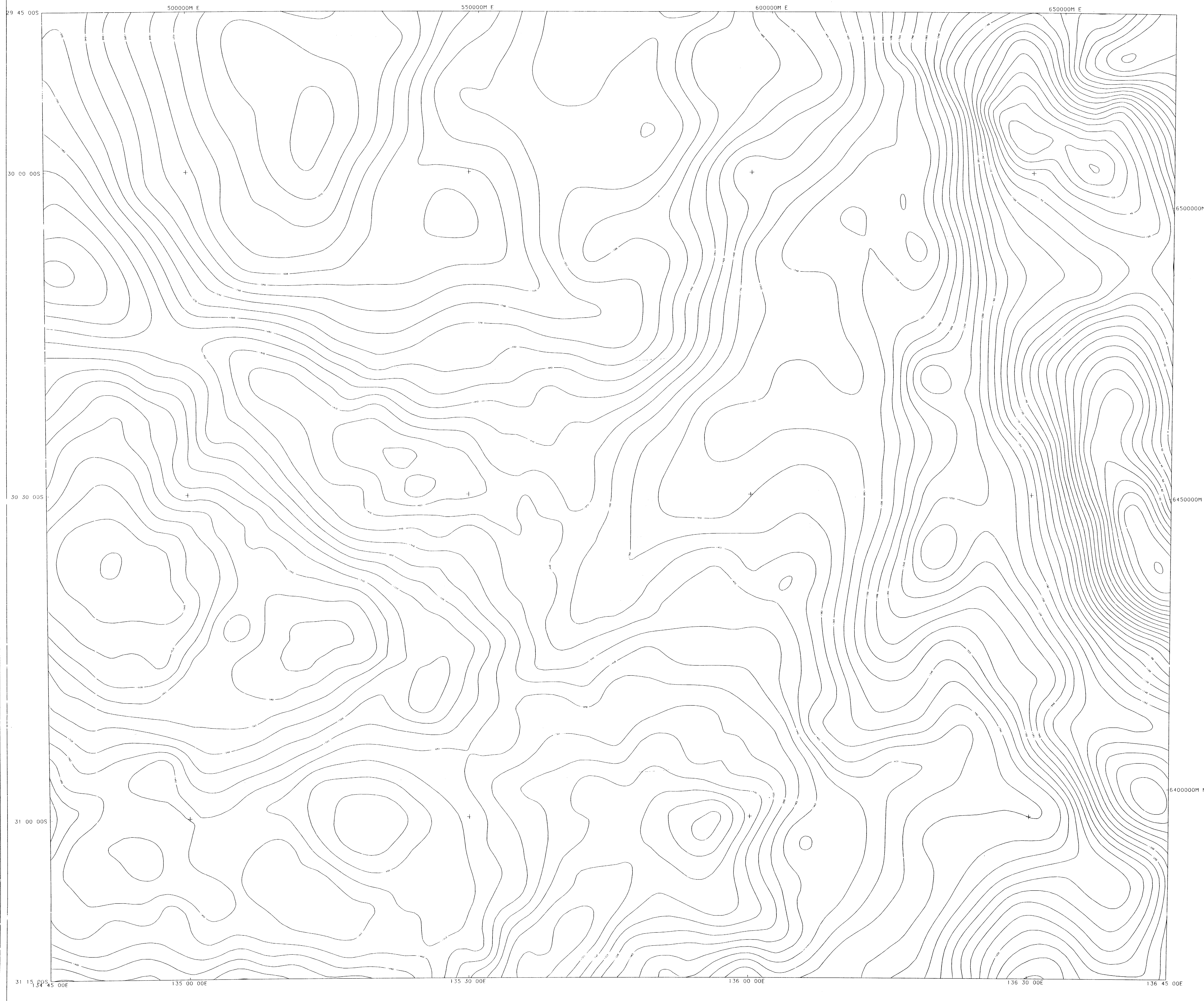
Geophysical Interpretation by P. Woyzbun

S A Department of Mines and Energy

FIGURE 6

92-655

KINGOONYA



1:250000
0 5 10 15 20 25
KILOMETRES
0 2 4 6 8 10
MILES
LAMBERT CONFORMAL CONIC PROJECTION
AUSTRALIAN NATIONAL SPHEROID SPHEROID
PARALLELS 28 00 00S AND 36 00 00S, CENTRAL MERIDIAN 135 00 00E

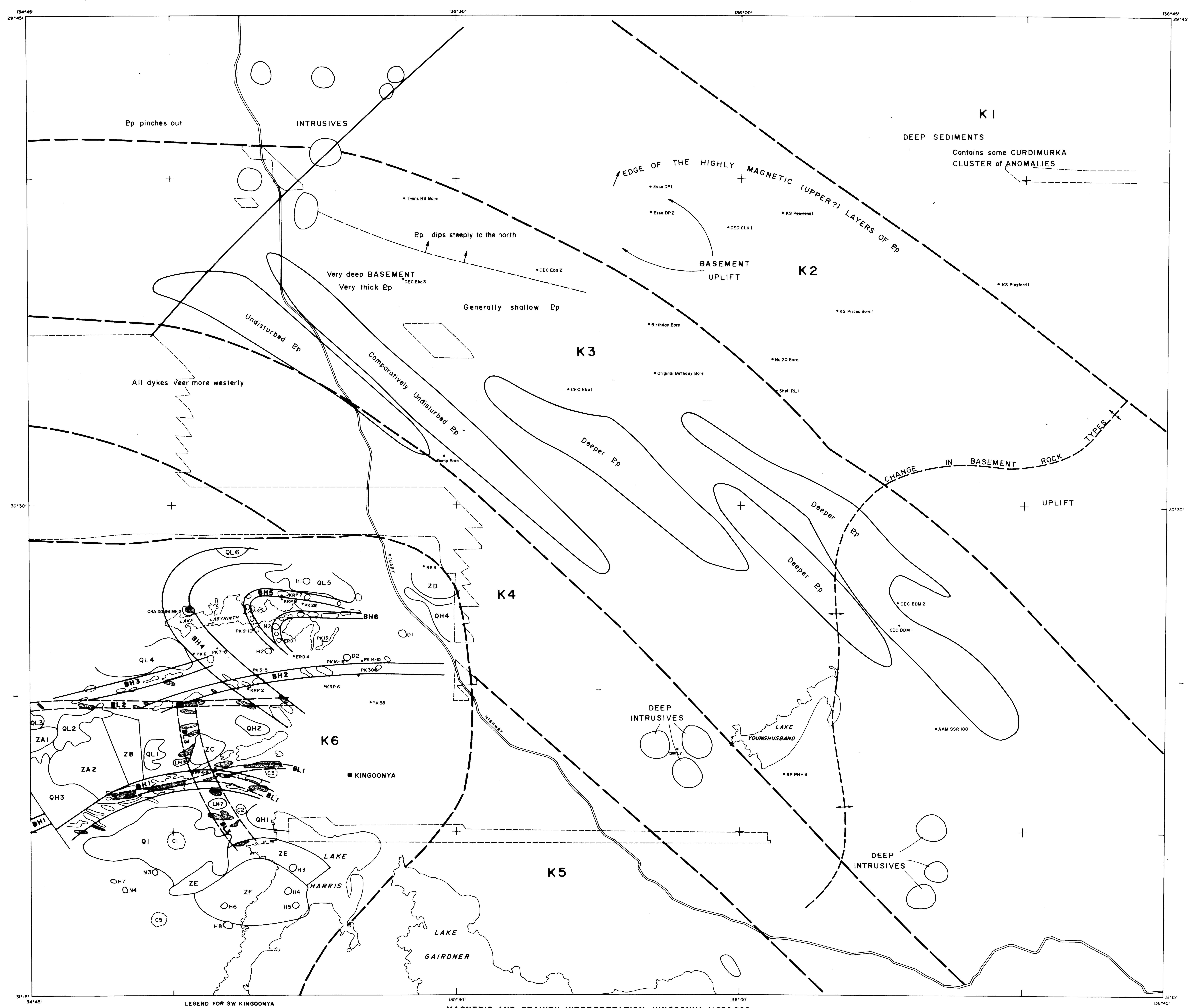
SA DEPARTMENT OF MINES AND ENERGY

MAGNETIC AND GRAVITY INTERPRETATION
KINGOONYA 1:250000

BOUGUER GRAVITY CONTOURS

FIGURE 7

92-656



LEGEND FOR SW KINGOONYA

BH1	Belt of magnetic highs
BL1	Belt of magnetic lows
	Basic body
	Magnetic low - Ultrabasic ? body
QL4	Magnetically quiet zone - low magnetic background
QH2	Magnetically quiet zone - high magnetic background
ZE	Zone of distinct magnetic character
C1	Faint circular feature
H2	Isolated high
N1	Isolated low
D3	Isolated dipole anomaly
LH?	Possible Lake Harris rock types

C1, H2, N1, D3: Anomalous occurrences recommended as exploration targets

Gaps in aeromagnetic coverage

MAGNETIC AND GRAVITY INTERPRETATION - KINGOONYA 1:250 000

REGIONAL INTERPRETATION

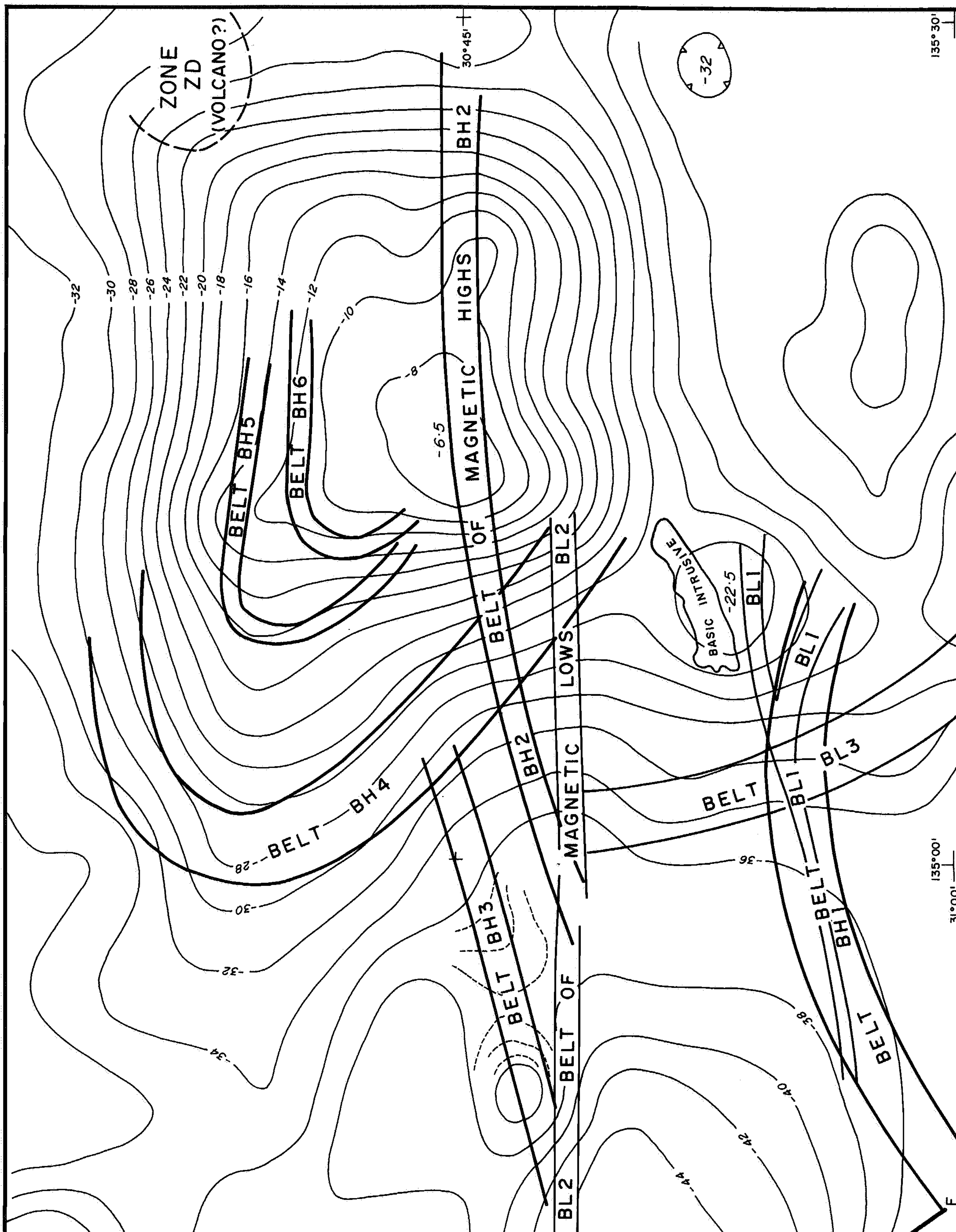
SCALE

KILOMETRES 5 0 5 10 15 20 25 KILOMETRES

Geophysical Interpretation by P. Woyzbun

FIGURE 8

S A Department of Mines and Energy 92-657



Contour interval - 2milligals

SCALE

KILOMETRES 5 0 5 10 KILOMETRES

Fig. 9

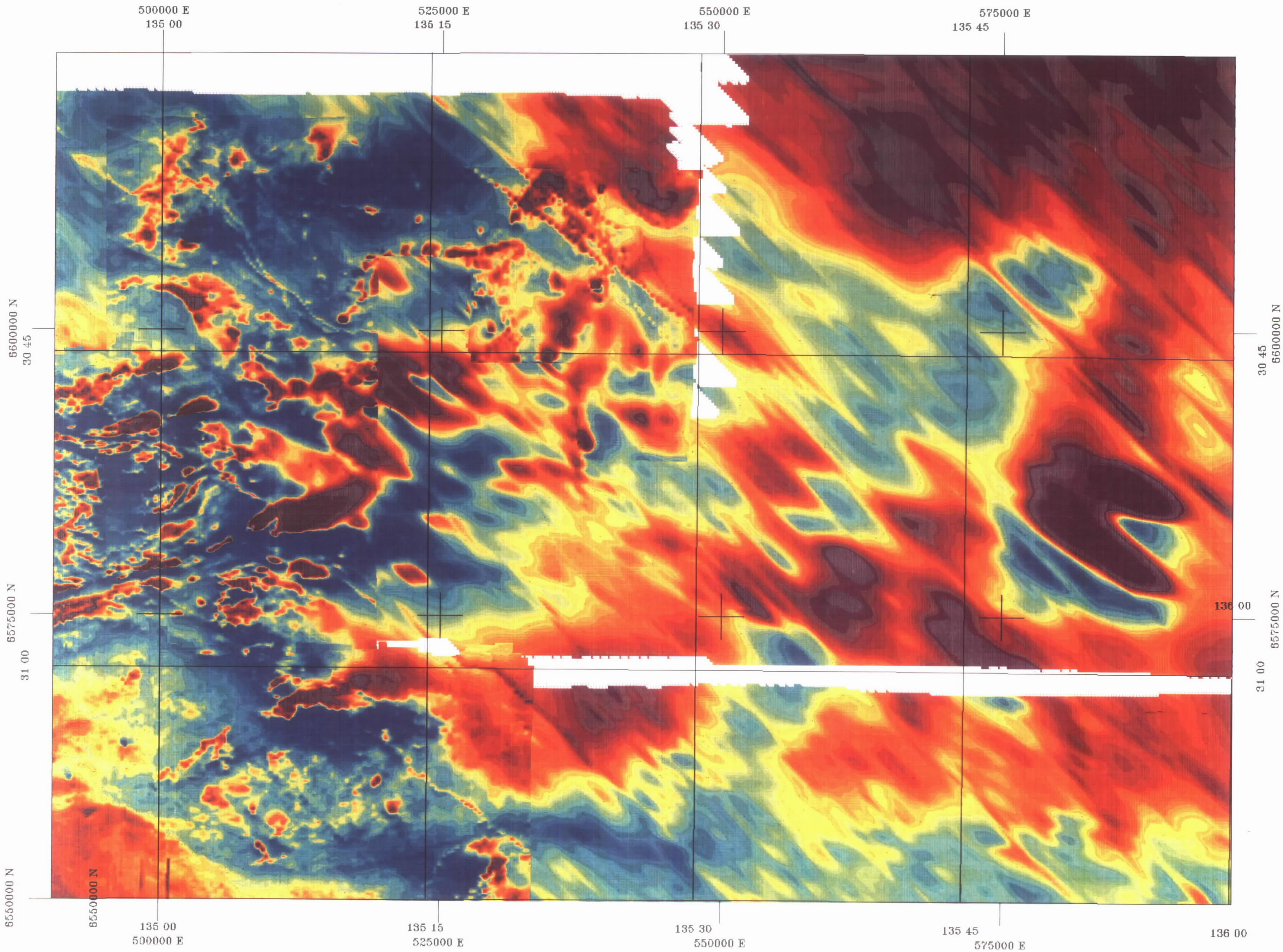
DEPARTMENT OF MINES AND ENERGY
SOUTH AUSTRALIA

MAGNETIC AND GRAVITY INTERPRETATION - KINGOONYA 1:250000

BELTS OF MAGNETIC HIGHS AND LOWS
IN RELATION TO GRAVITY

COMPILED P. Woyzbun	C.D.O.	DATE 6-7-92
DRAWN J. Gray	SCALE As shown	
DATE May 1992	PLAN NUMBER 92-653	
CHECKED		

5447



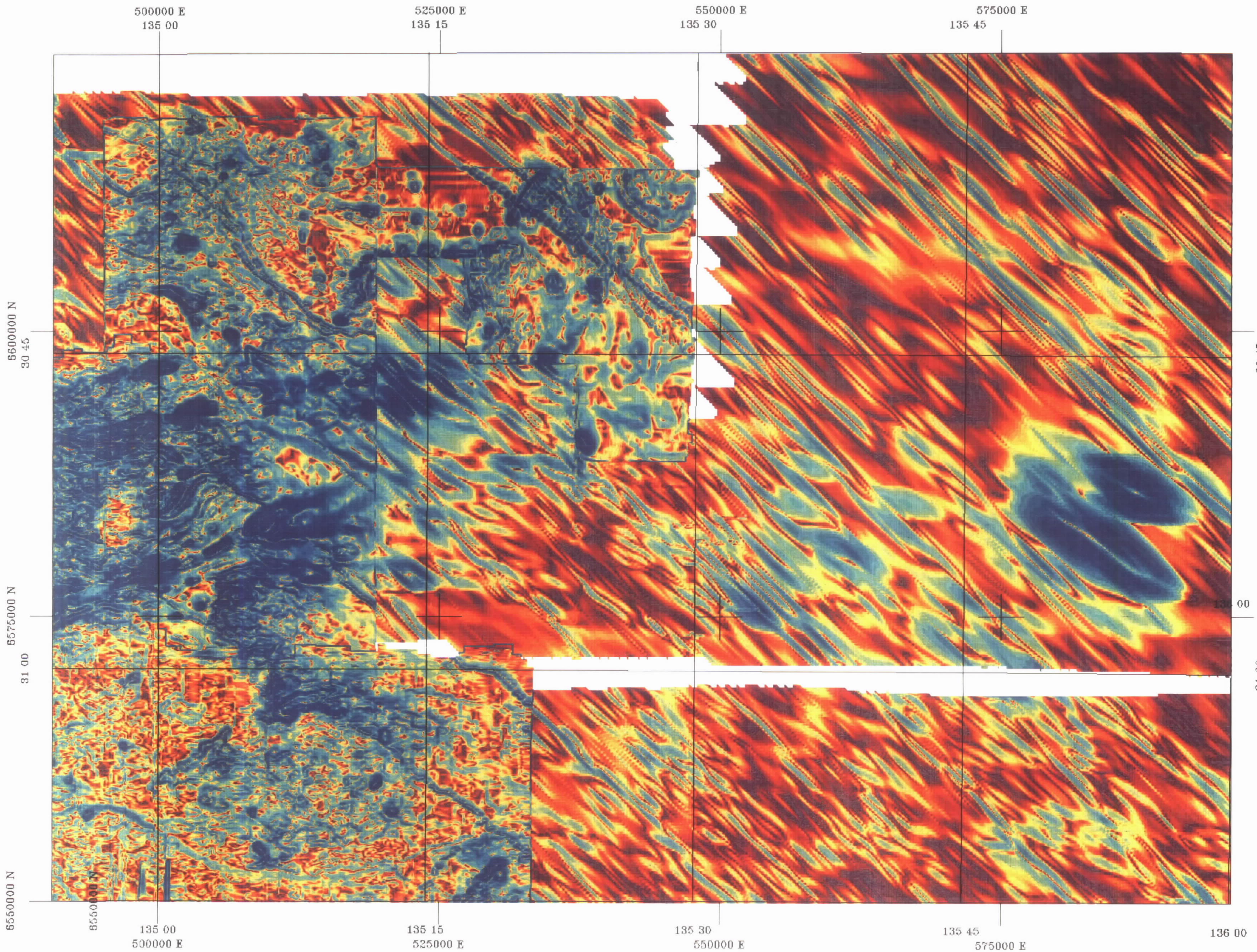
SOUTH–WEST KINGOONYA
TOTAL MAGNETIC INTENSITY – PIXEL MAP – PRELIMINARY ONLY
1:250 000 Scale

Figure 10

Prepared for
South Australian Department of Mines and Energy

92-774

Pitt Research Pty Limited
June 1992



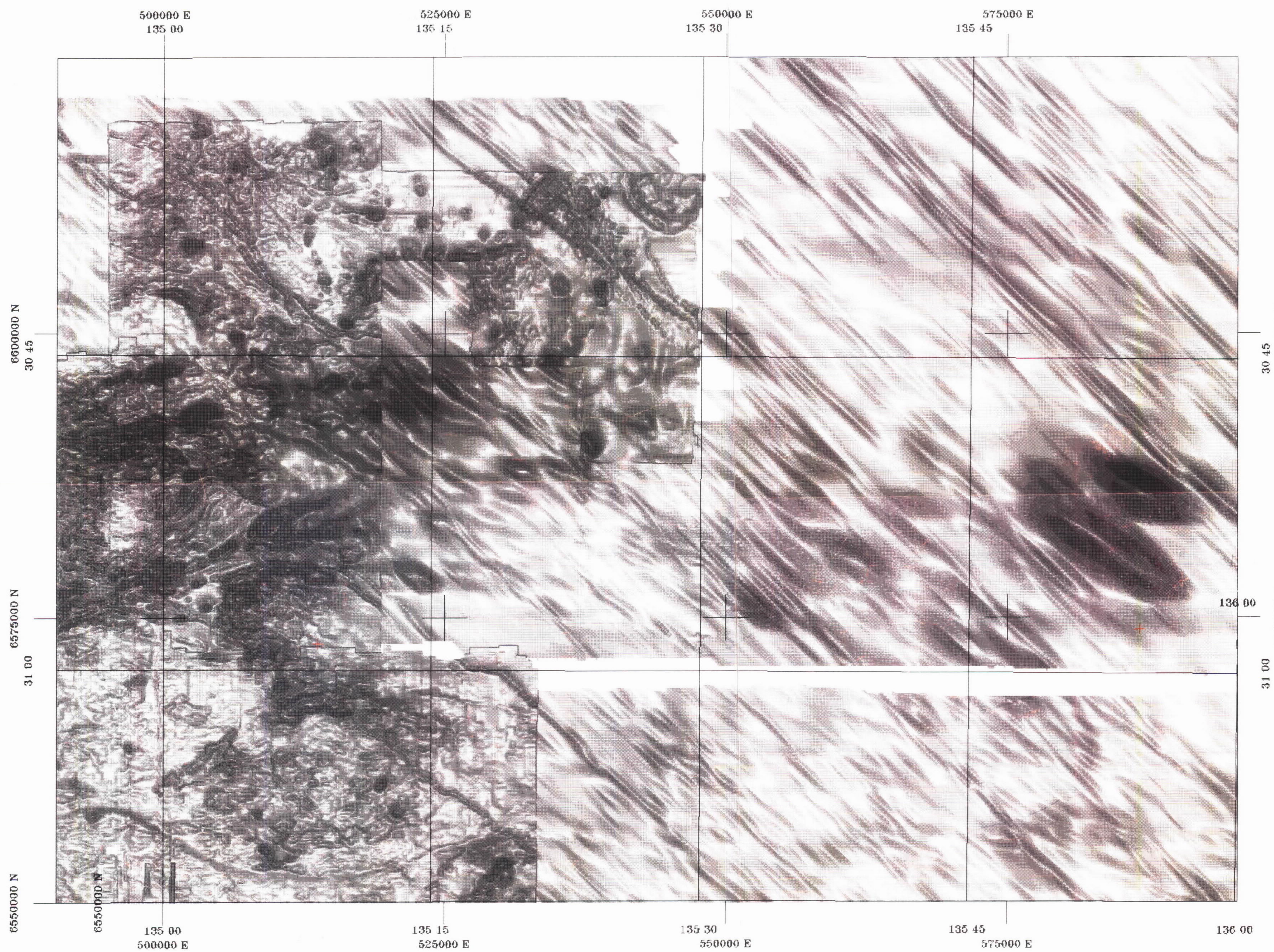
SOUTH–WEST KINGOONYA
MAXIMUM MAGNETIC GRADIENT – PIXEL MAP – PRELIMINARY ONLY
1:250 000 Scale

Figure 11

Prepared for
South Australian Department of Mines and Energy

92-775

Pitt Research Pty Limited
June 1992



SOUTH–WEST KINGOONYA
MAXIMUM MAGNETIC GRADIENT – PIXEL MAP – PRELIMINARY ONLY
1:250 000 Scale

Prepared for
South Australian Department of Mines and Energy

Pitt Research Pty Limited
June 1992

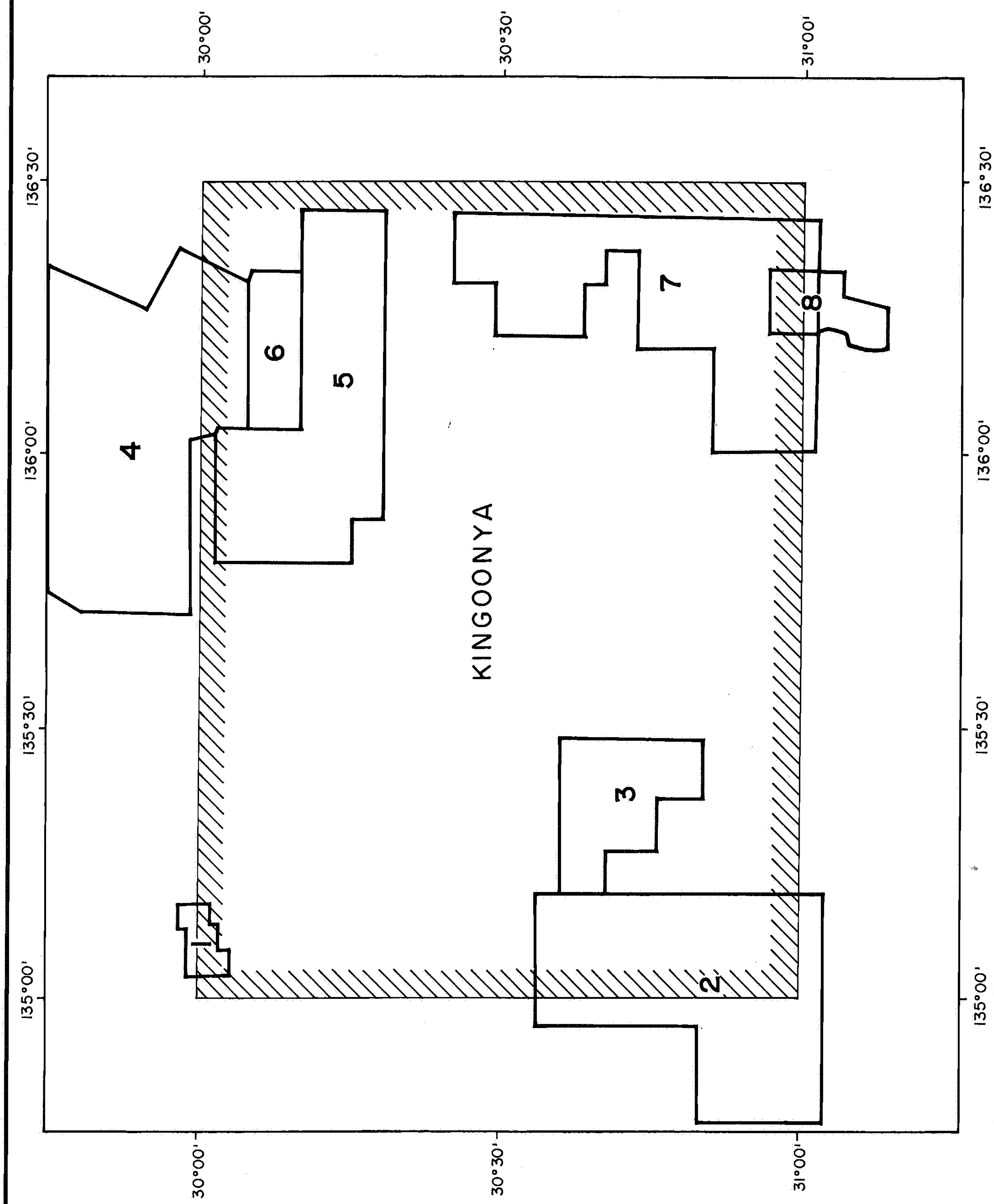


Fig. 13

DEPARTMENT OF MINES AND ENERGY
SOUTH AUSTRALIA

MAGNETIC AND GRAVITY INTERPRETATION - KINGOONYA 1:250000

DETAILED AERIAL GEOPHYSICAL SURVEYS

COMPILED P. Woyzbun	6-7-92 C.D.O. DATE	
DRAWN J. Gray	SCALE	
DATE June 1992	PLAN NUMBER	92-777
CHECKED		

5447