

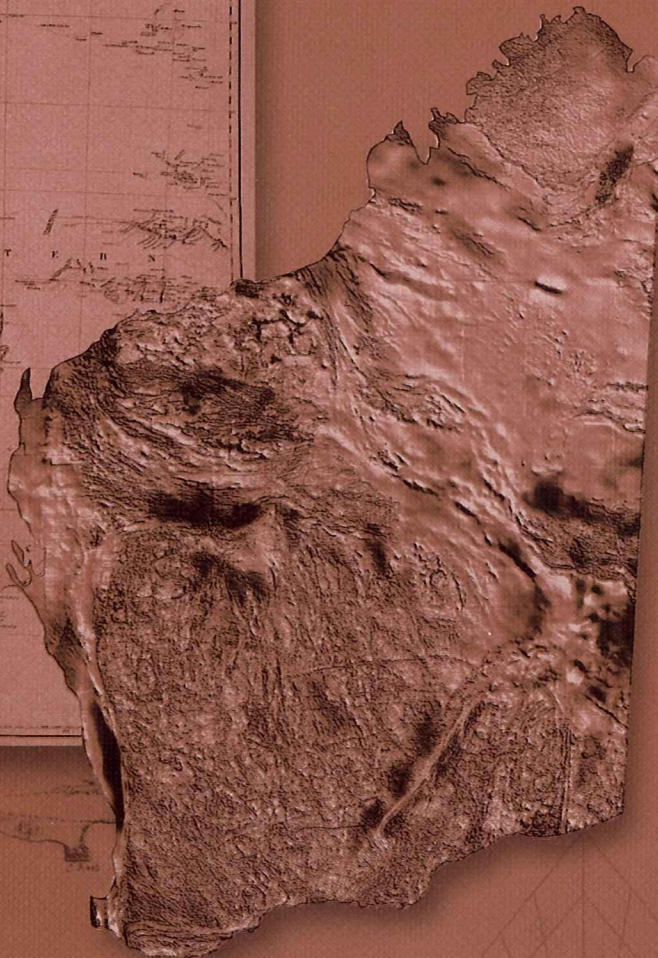
**RECORD  
2001/3**

# **GRAVITY DATA — WINNING POOL — MINILYA 1:250 000 SHEETS, WESTERN AUSTRALIA**



GOVERNMENT OF  
WESTERN AUSTRALIA

by **S. I. Shevchenko**



**GEOLOGICAL SURVEY OF WESTERN AUSTRALIA**

**DEPARTMENT OF MINERALS AND ENERGY**





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**Record 2001/3**

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WINNING POOL – MINILYA  
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**Perth 2001**

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**MINISTER FOR STATE DEVELOPMENT; TOURISM;  
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The Hon. Clive Brown MLA**

**DIRECTOR GENERAL, DEPARTMENT OF MINERALS AND ENERGY  
L. C. Ranford**

**DIRECTOR, GEOLOGICAL SURVEY OF WESTERN AUSTRALIA  
Tim Griffin**

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# Gravity data — Winning Pool – Minilya 1:250 000 sheets, Western Australia

by

S. I. Shevchenko

## Abstract

A total of 612 stations were recorded on an irregular  $4 \times 4$  km grid for the regional gravity survey conducted by the Geological Survey of Western Australia over the eastern part of the WINNING POOL 1:250 000 map sheet in July 1999. The accuracy of the Bouguer gravity measurements is  $\pm 1.4 \mu\text{ms}^{-2}$ . Two other gravity surveys were also used to compile the gravity map for WINNING POOL – MINILYA.

The four major tectonic units recognized on WINNING POOL – MINILYA are: granitic and metamorphic rocks of the Palaeoproterozoic Gascoyne Complex, low-grade metasedimentary rocks and dolerite sills of the Palaeoproterozoic–Mesoproterozoic Edmund Basin, Ordovician–Permian strata of the Merlinleigh Sub-basin, and Ordovician–Devonian sedimentary rocks of the Gascoyne Platform. All have specific gravity and magnetic signatures.

Most interpreted lineaments from gravity correlate with northerly trending faults, which form horsts and grabens at the eastern margin of the Merlinleigh Sub-basin. The Lockwood Fault is the major structure that separates the Gascoyne Complex from the Merlinleigh Sub-basin in the northern part of the area. The resolution and coverage of gravity data are insufficient to show any lithological variations in the rocks of the Gascoyne Complex.

Regional regolith chemistry, which suggests seven potential areas for base metal mineralization, can be related to regional faults interpreted from gravity, suggesting that these fault structures may be channels for mineralizing fluids.

**KEYWORDS:** gravity data, aeromagnetic data, gravity lineaments, structure, Carnarvon Basin, Gascoyne Complex, mineralization, regolith chemistry

## Introduction

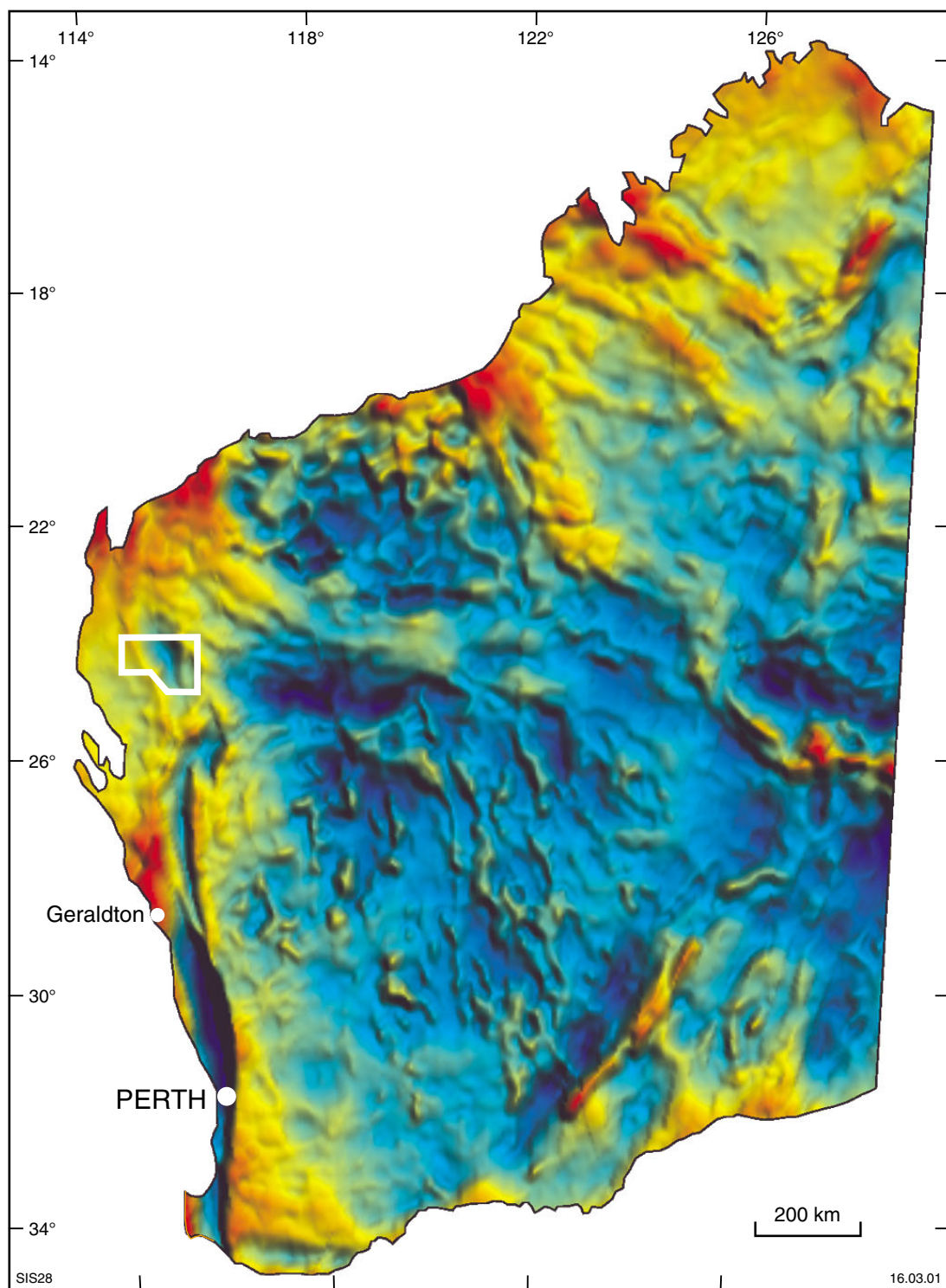
In 1999, the Geological Survey of Western Australia (GSWA) carried out a regional gravity survey of the eastern part of WINNING POOL\* (Fig. 1). Helicopters were used to transport the survey crews to sites, distributed on an irregular  $4 \times 4$  km grid. Gravity meters and dual-frequency Global Positioning System (GPS) units were provided by the Australian Geological Survey Organisation (AGSO) under the National Geoscience Mapping Accord (NGMA).

The survey was one of a series of combined regional regolith-geochemistry and gravity surveys conducted between 1998 and 2000. Howard and Shevchenko (2000) described the general survey methodology.

This Record describes details of acquisition and processing of the new gravity data collected over the eastern part of WINNING POOL. It also presents a structural interpretation based on the integration of the new data with two other gravity surveys, and existing aeromagnetic data previously collected from the western part of WINNING POOL and eastern part of MINILYA.

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\* Capitalized names refer to standard 1:250 000 map sheets.



**Figure 1.** Location of 1999 GSWA WINNING POOL gravity survey. Background image is the Bouguer gravity of Western Australia created from the AGSO national gravity database. Datum is in AGD84

The logistics and results of the geochemical program are reported in a separate publication by Sanders and McGuinness (2001).

## Geological setting

The four major tectonic units recognized on WINNING POOL – MINILYA are: the Palaeoproterozoic Gascoyne Complex, Palaeoproterozoic–Mesoproterozoic Edmund Basin, Ordovician–Permian Merlinleigh Sub-basin, and Ordovician–Devonian Gascoyne Platform (Fig. 2).

The Gascoyne Complex consists of metamorphic rocks and granitoids, and is part of the Palaeoproterozoic (2.0 – 1.6 Ga) Capricorn Orogen (Myers, 1990; Tyler and Thorne, 1990). On eastern WINNING POOL – MINILYA, the complex comprises numerous granitoid plutons, which mainly consist of granodiorite, monzogranite, granite, and pegmatite rocks that intrude metasedimentary rocks of the Morrissey Metamorphic Suite (Hocking et al., 1985). The metamorphic rocks include mainly schist, migmatite, gneiss, phyllite, and minor dolomite and amphibolite.

Sedimentary rocks of the Edmund Group (Bangemall Supergroup) unconformably overlie rocks of the Gascoyne Complex (Martin et al., 1999) and are exposed in the eastern part of WINNING POOL – MINILYA in the Mangaroon Syncline. Deposition of the basal part of the Edmund Group is thought to have taken place at c. 1640 Ma (Nelson, 1995). The Edmund Group mainly consists of sandstone, siltstone, shale, dolomite, and chert. The Edmund Group was intruded by dolerite sills at c. 1460 and 1070 Ma (Wingate, 2000, pers. comm.; Nelson, in prep.) and dolerite dykes at c. 750 Ma (Wingate and Giddings, 2000).

The Merlinleigh Sub-basin lies between the Gascoyne Complex and the Wandagee Fault System. The northern part of the sub-basin includes the area north of the Cardabia Transfer Zone, east of the Rough Range Fault, which is northwest of WINNING POOL – MINILYA, and west of the Marrilla Fault (Crostella and Iasky, 1997; Fig. 2). Sedimentary rocks deposited within the sub-basin are estimated to be 8000 m thick (Iasky et al., 1998a; Fig. 2). The rocks are Ordovician to Permian and comprise sandstone, shale, siltstone, carbonates, and glaciogene rocks with a veneer of Cretaceous and Tertiary strata, and superficial Quaternary deposits.

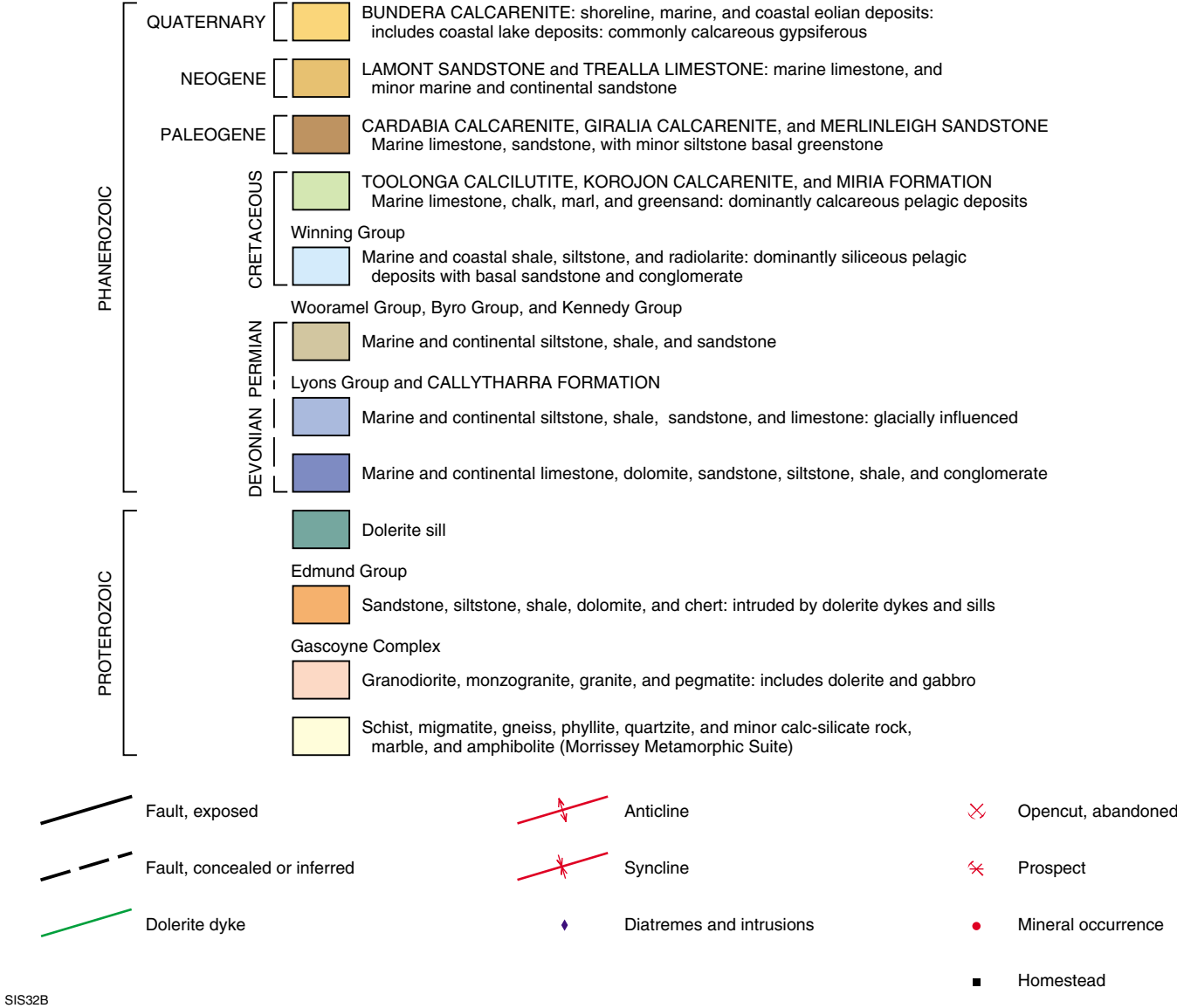
The Gascoyne Platform is separated from the Merlinleigh Sub-basin by the Wandagee Fault System and Cardabia Transfer Zone, and extends to the west 50–70 km offshore, where it is bordered by the Bernier Platform and Exmouth Sub-basin west and northwest of WINNING POOL – MINILYA respectively. The platform contains up to 5000 m of Ordovician–Permian clastic and carbonate rocks below a mostly thin cover of Cretaceous (up to 1000 m thick to the west) and Cainozoic sedimentary rocks (Hocking et al., 1985; Iasky et al., 1998b).

## Gravity data

### Previous data

In 1957, West Australian Petroleum (WAPET) conducted the Saltmarsh gravity survey in the western part of WINNING POOL – MINILYA to provide structural information over the Carnarvon Basin. The stations, which were spaced at an average interval of 800 m, were collected along seismic lines, tracks, and fence lines. Optical levelling was used for vertical control. These data were used in the western part of the WINNING POOL – MINILYA gravity images (Fig. 3).





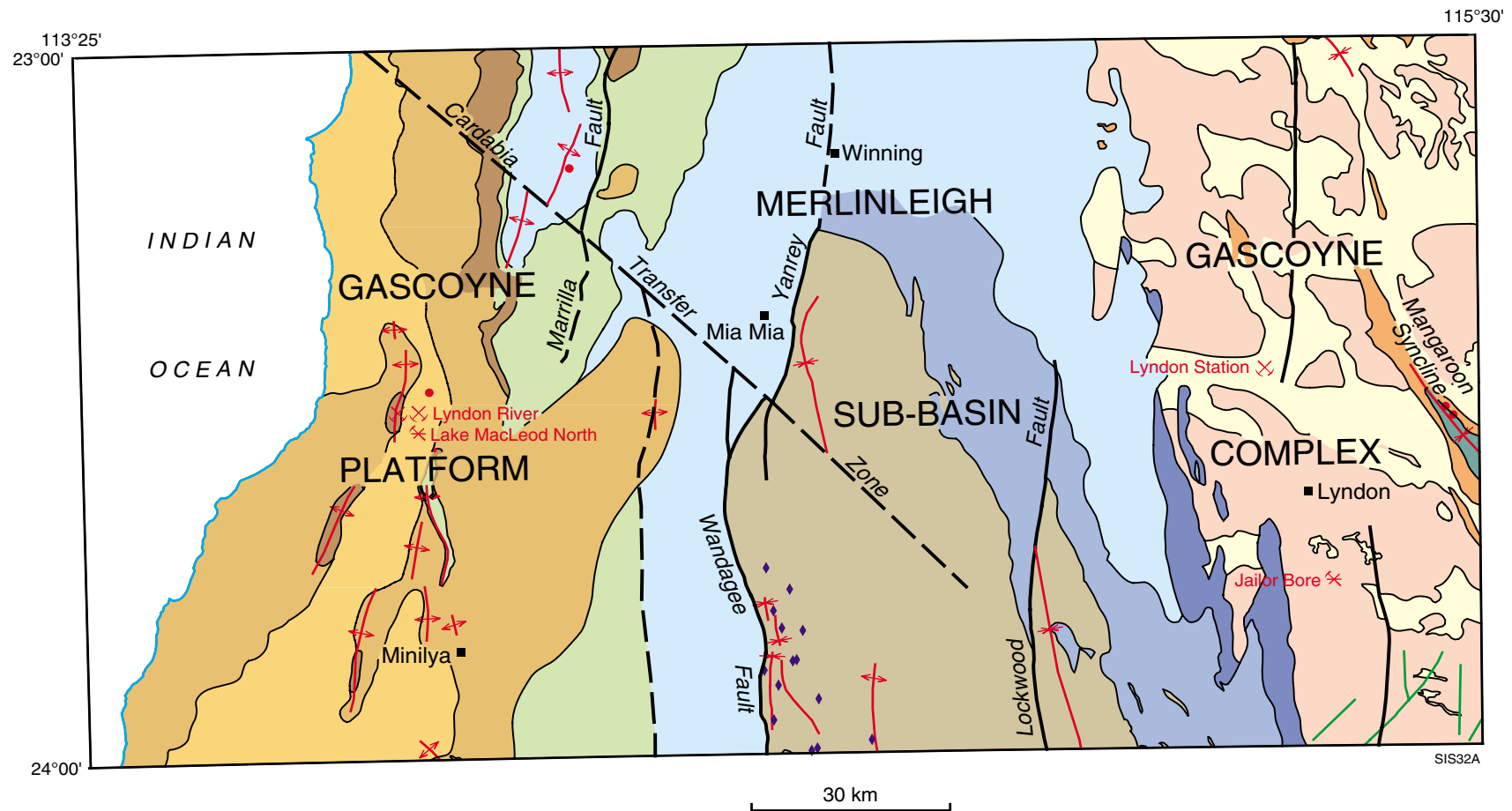


Figure 2. Simplified geology of the WINNING POOL – MINILYA 1:250 000 sheets (after Myers and Hocking, 1998, and Sanders and McGuinness, 2001)

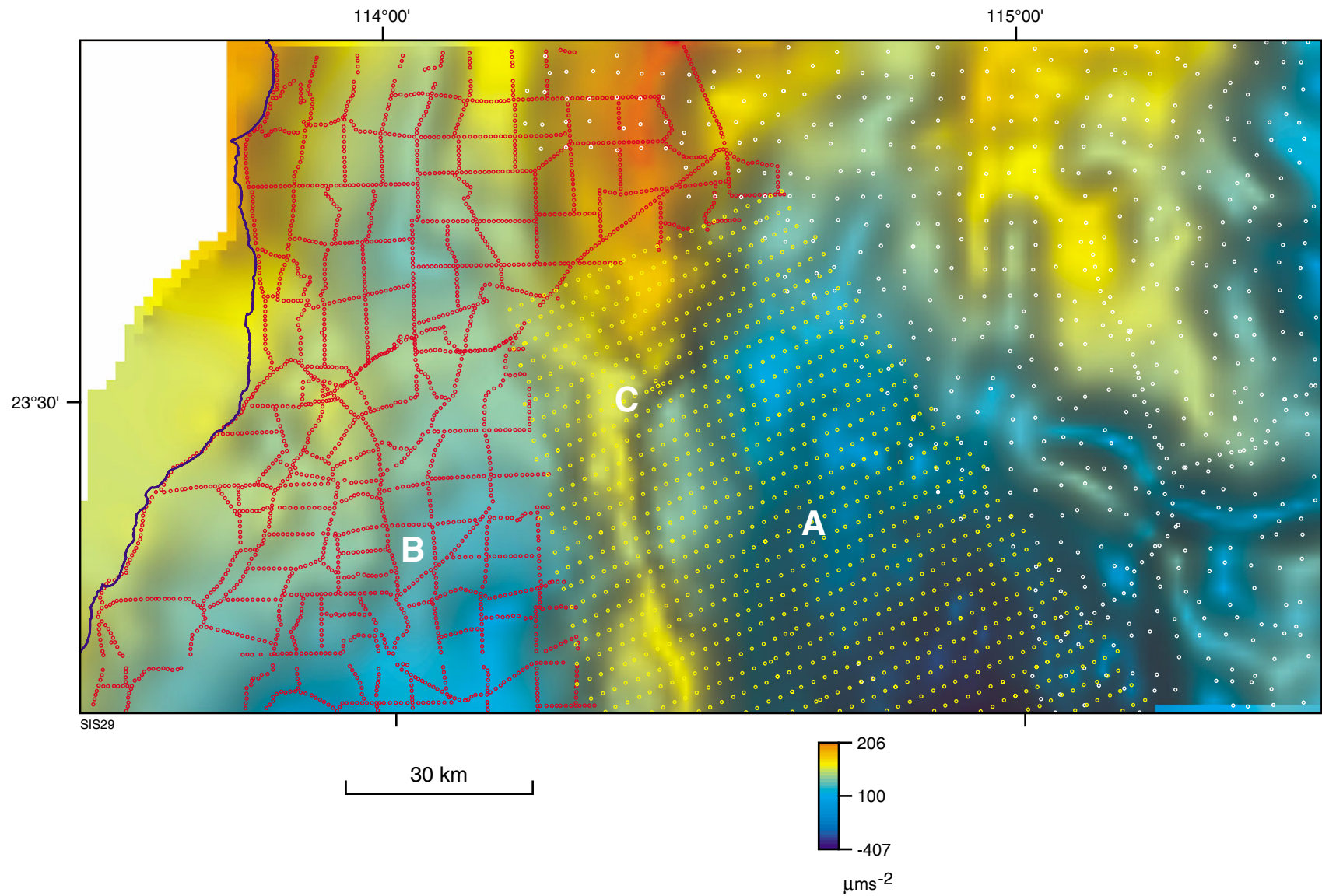


Figure 3. Bouguer gravity image of WINNING POOL – MINILYA. The image is a mosaic of the new WINNING POOL gravity survey with gravity stations shown as white circles, the Merlinleigh survey (Haines Surveys Pty Ltd, 1995) with stations shown in yellow, and the Saltmarsh survey with stations shown in red

As part of regional gravity surveys across parts of Western Australia, the Bureau of Mineral Resources (BMR, now AGSO) covered WINNING POOL – MINILYA with an  $11 \times 11$  km survey in 1969–70 (Fraser and Pettifer, 1980). The elevations for the stations were obtained by barometric techniques and the accuracy of the Bouguer gravity was estimated as  $\pm 10 \mu\text{ms}^{-2}$  (Darby, 1970).

In 1995, the GSWA contracted Haines Surveys (Haines Surveys Pty Ltd, 1995) to conduct a semi-detailed, helicopter-supported gravity survey over an area of the Merlinleigh Sub-basin for the purpose of structural interpretation (Fig. 3). The readings were taken over a  $2 \times 3$  km grid with the final accuracy of the Bouguer gravity as  $\pm 0.5 \mu\text{ms}^{-2}$ .

## **New gravity data**

In 1999, the GSWA conducted a helicopter-supported gravity survey, acquiring readings on an approximately  $4 \times 4$  km grid on the eastern part of WINNING POOL – MINILYA. Dual-frequency GPS equipment was used to obtain accurate positions for the stations. Some road traverses were conducted, mainly for the purpose of operator training, but also to fill in some gaps in the helicopter coverage. The survey specifications and procedures for the survey are listed in Appendices 1–4.

The data were reduced to Bouguer gravity values for a density of  $2200 \text{ kgm}^{-3}$  and gridded to a 1500 m cell size. The data from the Saltmarsh and Merlinleigh surveys were gridded at 1500 and 500 m respectively, and stitched to the new dataset using Intrepid software (Fig. 3). The first vertical derivative (1VD) of the Bouguer gravity is a mosaic image of three datasets (Fig. 4).

## **Magnetic data**

The BMR flew two regional airborne magnetic surveys with east–west oriented lines spaced 1600 m apart over the northern and southern parts of WINNING POOL – MINILYA in 1956 and 1958. A high-resolution aeromagnetic survey, with northeast–southwest oriented lines spaced 500 m apart, was conducted over the Merlinleigh Sub-basin in 1995 for GSWA (Tesla Airborne Geoscience Pty Ltd, 1995). The total magnetic intensity (TMI) mosaic image of the 400 m-grid cell size for regional surveys and 125 m-grid cell size for the Merlinleigh survey is shown in Figure 5.

## **Geophysical signatures**

Two major regional provinces — the combined Gascoyne Complex and Edmund Basin and the Carnarvon Basin — are recognized on WINNING POOL – MINILYA on the basis of gravity and magnetic anomalies.

The Gascoyne Complex is well defined on the TMI image (Fig. 5) by the northerly and northwesterly trending, high- and medium- frequency (1–4 km-wide) magnetic anomalies, most likely from near-surface sources in the basement such as mafic dykes. A regional gravity high of about  $75 \mu\text{ms}^{-2}$  (Fig. 3) over this area corresponds to high-density granitic and metamorphic rocks of the Gascoyne Complex, in contrast with lower-density sedimentary rocks of the Carnarvon Basin.

Northerly trending lineaments (ga–gf) on the 1VD gravity image (Fig. 4) of the Gascoyne Complex are interpreted as faults and correlate well with faults recognized at surface by Hocking et al. (1985). The Lockwood Fault (Fig. 2; ga on Fig. 4), which can be traced to the north, is a major structure in the northern part of WINNING POOL –

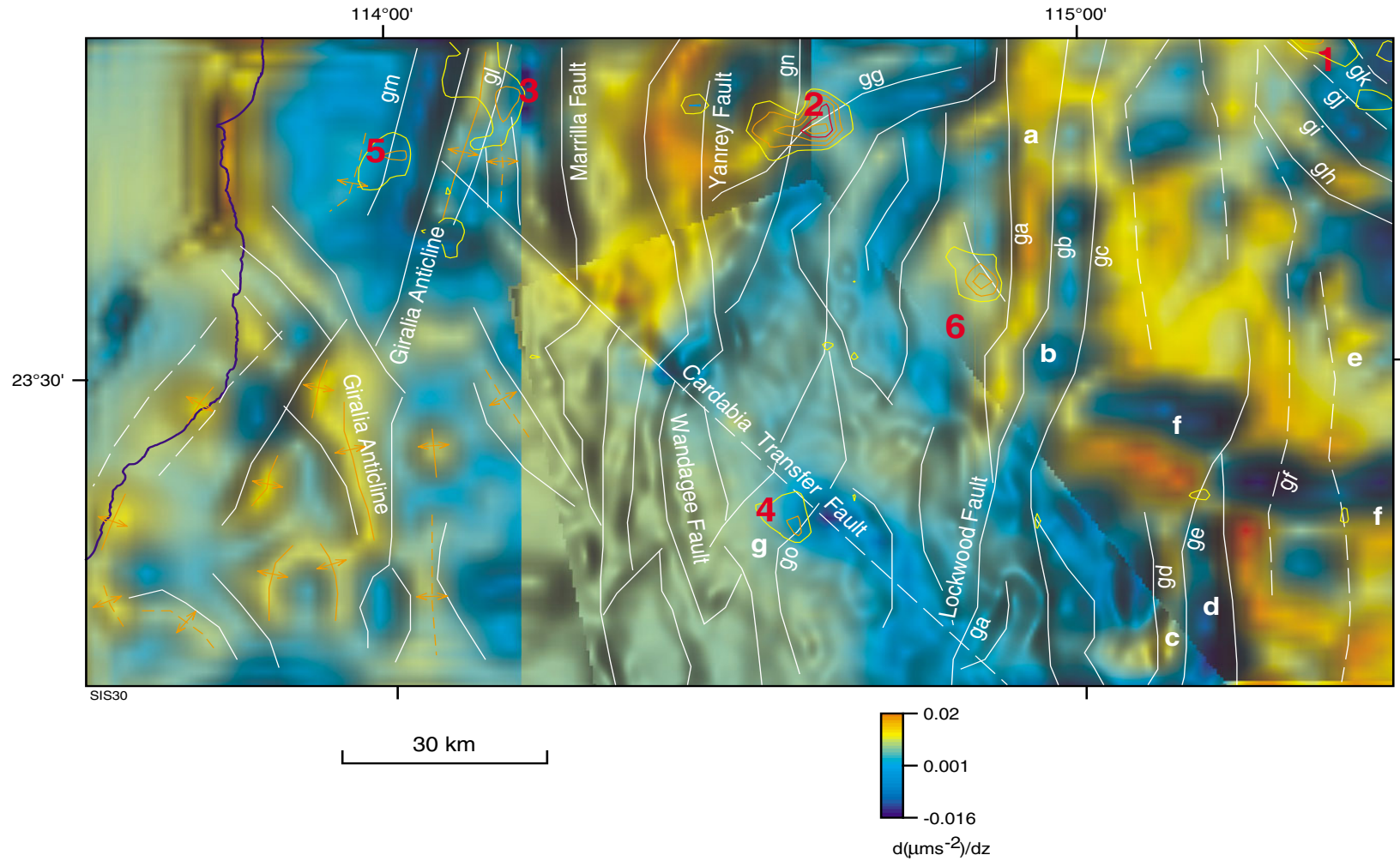
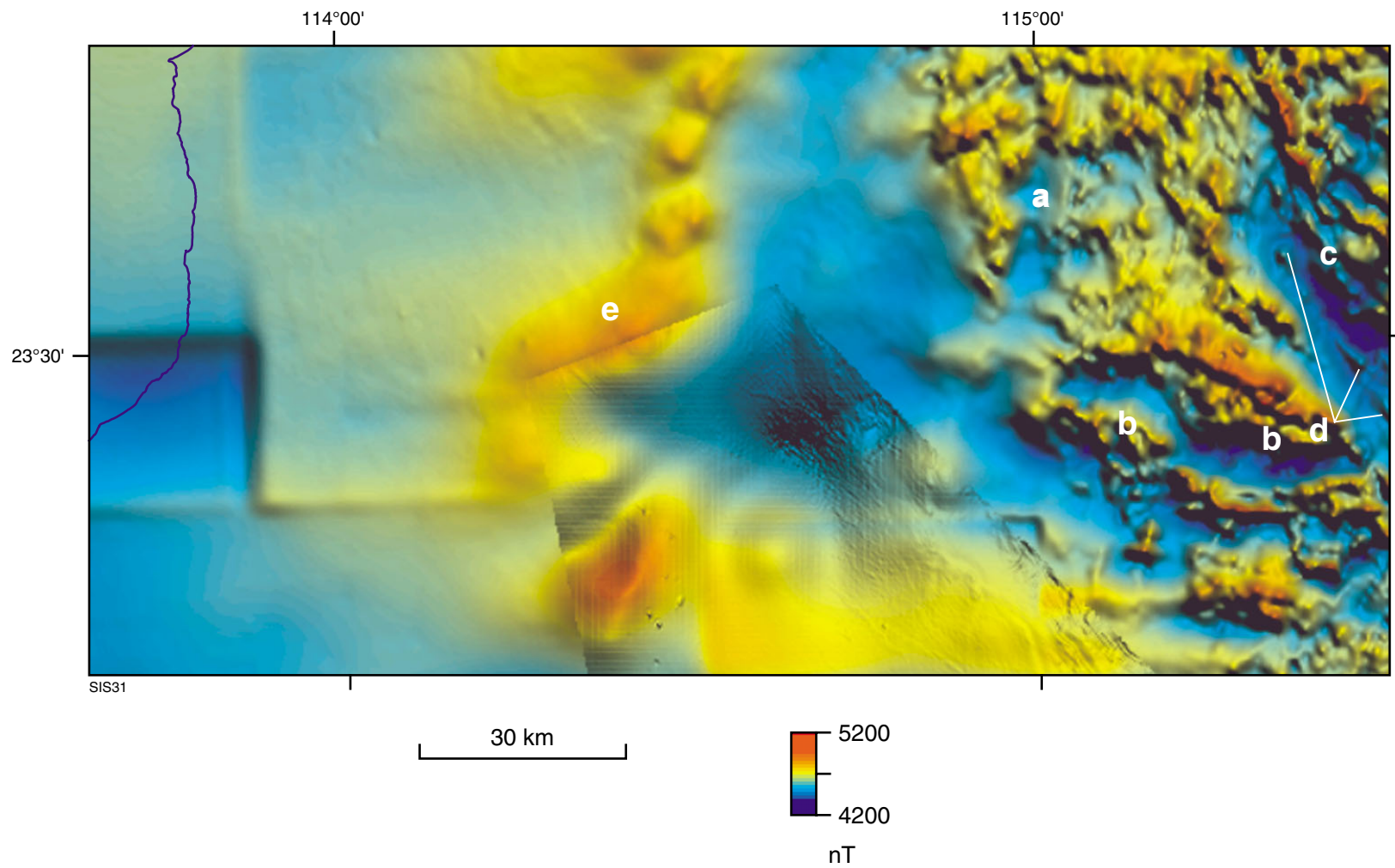


Figure 4. First vertical derivative of Bouguer gravity of WINNING POOL - MINILYA (solid lines — features interpreted with high confidence; dashed lines, with less confidence). The image is a mosaic of the new WINNING POOL, Merlinleigh (Haines Surveys Pty Ltd, 1995), and Saltmarsh gravity surveys. Contours are high-value anomalies (1–6) of a chalcophile-index map identified for potential base metal mineralization from regolith geochemistry (Sanders and McGuinness, 2001). White lines — interpreted faults (from gravity). Orange solid lines — anticlines mapped from surface. Dashed orange lines — interpreted anticlines





**Figure 5. Total magnetic intensity image of part of WINNING POOL – MINILYA**

MINILYA and separates the Gascoyne Complex from the Merlinleigh Sub-basin. These northerly trending faults control the positive (a and c; Fig. 4) and negative (b and d; Fig. 4) elongated anomalies produced by horsts and grabens respectively. They were formed possibly during Late Carboniferous – Early Permian rifting, similar to the en echelon Wandagee and Kennedy Fault Systems described by Iasky et al. (1998a) on the eastern flank of the Merlinleigh Sub-basin. A negative gravity anomaly (b; Fig. 4) correlates well with the non-magnetic signature (a; Fig. 5) of this area, confirming the presence of sedimentary strata in the graben.

The resolution and coverage of gravity and magnetic data are insufficient to show the lithological variations of the rocks of the Gascoyne Complex as mapped on WINNING POOL – MINILYA (Hocking et al., 1985).

Rocks in the Mangaroon Syncline near the eastern margin of WINNING POOL – MINILYA have a small, positive 20–30  $\mu\text{ms}^{-2}$  gravity anomaly (e; Fig. 4), indicating that the metasedimentary rocks of the Edmund Group and associated dolerite sills have a higher density than the surrounding granitic rocks. The TMI image shows a regional, negative, 15 × 40 km, northwesterly oriented anomaly of 350 nT (c; Fig. 5), which may be not related to this syncline. A narrow, 2 km-wide, positive intensity anomaly of 60 nT (d; Fig. 5) along the axis of the Mangaroon Syncline possibly relates to the presence of dolerite sills.

The group of parallel, northwesterly trending vertical gradients on the 1VD gravity image in the northeastern corner of WINNING POOL – MINILYA (gh–gk; Fig. 4) are interpreted as faults. These structures correlate with high chalcophile- and pegmatite-associated-elements anomalies in regolith (Sanders and McGuinness, 2001, figs 55 and 59), as shown on Figure 4 (anomaly 1).

An elongate, 7–10 km-wide, -100  $\mu\text{ms}^{-2}$  gravity anomaly (f; Fig. 4) in the Gascoyne Complex is coincident with a negative magnetic anomaly (b; Fig. 5). There is an apparent lateral displacement, of about 10 km, of both the gravity and magnetic anomalies along the ge fault on Figure 4. The anomaly cannot be explained by the mapped surface geology and is possibly caused by near-surface, low-density and non-magnetic felsic rocks. Elevated resistate-components and pegmatite indices scores described by Sanders and McGuinness (2001, figs 58 and 59) coincide with the southern edge of this anomaly.

In the Carnarvon Basin on WINNING POOL – MINILYA, two regional negative gravity anomalies, -400  $\mu\text{ms}^{-2}$  (A; Fig. 3) and -150  $\mu\text{ms}^{-2}$  (B; Fig. 3), outline the shape and basement topography of the Merlinleigh Sub-basin and Gascoyne Platform. These are separated by the Wandagee Ridge, which is shown as a positive ~200  $\mu\text{ms}^{-2}$  anomaly (C; Fig. 3). This structure is also identifiable from the TMI image as a positive regional anomaly (e; Fig. 5). Previous interpretation of seismic, gravity, and magnetic data show a good structural correlation of seismic and semi-detailed gravity in the Merlinleigh Sub-basin (Iasky et al., 1998a). Depth to basement on WINNING POOL – MINILYA was calculated using seismic and gravity data (Iasky et al., 1998b, fig. 8) with a maximum of 4000 m in the Gascoyne Platform and 7000 m in the Merlinleigh Sub-basin. The detailed Merlinleigh magnetic survey shows that high-frequency magnetic anomalies are from the surface, and low-frequency anomalies are from deep, intrabasement magnetic bodies (Iasky et al., 1998a). North-northwesterly trending lineaments on the 1VD gravity image, shown in white (Fig. 4), in the Southern Carnarvon Basin are interpreted as faults. The Wandagee Fault System and Marrilla Fault constrain the eastern and western parts of the Wandagee Ridge. The positive and negative, medium-wavelength (4–10 km) and long-wavelength (10–20 km) gravity anomalies in the Southern Carnarvon Basin are more likely to be associated with synclinal and anticlinal

structures in the sedimentary fill and basement. The anomalies marked in solid orange lines (Fig. 4) equate to anticlines mapped at the surface.

Six areas identified for potential base metal mineralization from regolith chemistry in the Carnarvon Basin (Sanders and McGuinness, 2001) correlate well with faults interpreted from the gravity data, which may have controlled the migration of mineralizing fluids. The strong chalcophile-index anomaly (2; Fig. 4) near Winning Homestead (Fig. 2) corresponds to the steep gradient of the northeasterly oriented structures gg and gn. Anomaly 3 corresponds to the regional Giralia Fault (gl; Fig. 4) and anomaly 4 in the Byro Group can be correlated to the interpreted major fault go. This fault defines the eastern margin of the upthrown block g. Anomaly 5 coincides with the interpreted fault gm on the western side of the Giralia Anticline. This area contains elevated As, Cd, Ni, Sb, Te, and V in regolith along the structure (Sanders and McGuinness, 2001).

The northern continuation of the Lockwood Fault on WINNING POOL – MINILYA is interpreted from gravity (Fig. 4) and correlates well to chalcophile-index anomaly 6 (Sanders and McGuinness, 2001). This anomaly may be of the type described by Harrison (1985) and Sanders and McGuinness (2001) where carbonates, siltstones, or shales at the edges of the basin are in contact with the basement rocks along faults, which may control the migration of mineralizing fluids.

## Conclusions

In conjunction with regional magnetic data, the new gravity survey on WINNING POOL provides additional regional structural information in an area where only readings from widely spaced (11 × 11 km) gravity stations have been previously collected.

The Gascoyne Complex and Carnarvon Basin, two major geophysical regional provinces, can be identified on WINNING POOL – MINILYA, based on patterns and sources of the gravity and magnetic anomalies.

In the Gascoyne Complex, the major gravity anomalies and lineaments have northerly trends and relate to faults. Horsts and grabens can be identified in the transient zone of the Gascoyne Complex and Carnarvon Basin. A large, strong, easterly trending gravity and magnetic anomaly in the Gascoyne Complex cannot be explained from the surface geological mapping, and probably relates to near-surface felsic rocks. Potential areas for base metal mineralization interpreted from regional regolith chemistry may be related to regional faults, which act as pathways for mineralizing fluids.

## Acknowledgements

The work of the field geologists and the crew of Helicopters (Australia) during the acquisition program is gratefully acknowledged (see Appendix 2).

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## Appendix 1

### Summary of operations and processing for the WINNING POOL gravity survey

Organization: Geological Survey of Western Australia

Start date: 21 July 1999

Completion: 28 July 1999

	<i>GPS</i>	<i>Gravity</i>
Equipment	4 × Ashtech Z12 receivers N223, N226, N900, N942	LaCoste and Romberg Model G × 5 units G20, G101, G132, G252, G460
Data recording and processing notebook computers	Pentium II 233 MHz, 32 Mb RAM; 80486DX 75 MHz, 8 Mb RAM; 80486DX 50 MHz, 4 Mb RAM	
Calibration		By AGSO 1998
Surveying Transport	Helicopters Bell 206B Jet Ranger × 2 Land Cruiser 4 wheel drive	
DOLA bench marks used	NMF 573 to transfer the coordinates and height to 9962.7001 Winning Pool 65 for the coordinates and height control 9962–7001 to transfer the coordinates and height to 9962–7002 Winning Pool 115, Winning Pool 117, Winning Pool 118 for the coordinates and height control	6792.0225 (Onslow isogal station)
New base stations	9963-7001, 9963-7002	9963-7001, 9963-7002
Survey method used to establish base stations	Static	4 gravimeters, two operators in one traverse
Survey method for ordinary stations	Kinematic with 100% repeats	1 gravimeter, 1 operator, two readings, 612 stations 4 × 4 km irregular grid
Software for reductions and field processing	PRISM (Ashtech proprietary software package)	SERGRAV (GSWA in-house suite of programs) SURFER v. 5.01 (from Golden Software Inc.)
Office processing software		INTREPID v. 3.4 processing and gridding program ER Mapper v. 6 image processing system
Accuracy	$\sigma_{\text{elevation}} = \pm 0.44 \text{ m}$ $\sigma_{x,y} = \pm 5 \text{ m}$	$\sigma_{\text{gravity base stations}} = \pm 0.4 \mu\text{ms}^{-2}$ $\sigma_{\text{stn}} = 0.6 \mu\text{ms}^{-2}$
Total Bouguer accuracy		$S_{\text{surveys}} = \pm \sqrt{(1.2^2_{\text{elev}} + 0.4^2_{\text{base stns}} + 0.6^2_{\text{ord}} + 0.1^2_{\text{abs.grav.transf}})} = 1.4 \mu\text{ms}^{-2}$



## Appendix 2

### Survey personnel

<i>Project manager</i>	<i>Gravity survey manager</i>	<i>Gravity observers</i>	<i>Gravity field assistant</i>	<i>Helicopter company</i>	<i>Chief pilot</i>	<i>Pilots</i>	<i>Engineer</i>
D. Howard	S. Shevchenko	R. Blackmore E. Bosanquet J. Hansen J. Moore E. Mikucki N. Nasev	T. Davis	Helicopters (Australia)	G. Causer	R. Nowland P. Legradi A. Regan	N. Luscombe

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## Appendix 3

### Bench mark data and repeat measurements

**Table 3.1. Coordinates of DOLA<sup>(a)</sup> bench marks used to establish base stations and isogal stations**

<i>Name</i>	<i>Comments</i>	<i>Type of mark</i>	<i>Type of datum/grid</i>	<i>Latitude (S)/ easting (m)</i>	<i>Longitude (E)/ northing (m)</i>	<i>WGS<sup>(f)</sup> height/ AMG<sup>(e)</sup> zone</i>	<i>Date surveyed</i>	<i>Method</i>	<i>Order</i>	<i>Horizontal/ vertical accuracy</i>	<i>Gravity value (<math>\mu\text{ms}^{-2}</math>)</i>	<i>Gravity error (<math>\mu\text{ms}^{-2}</math>)</i>
NMF 573 <sup>(b)</sup>	–	S <sup>(c)</sup>	WGS84 <sup>(d)</sup> AMG84 <sup>(e)</sup>	23°30'27.45590" 346399.695	115°29'49.12338" 7399327.173	256.50 51	16/07/99	GPS <sup>(i)</sup> SLEV <sup>(g)</sup>	3rd 2nd	30 ppm 0.1 m	–	–
Winning Pool 65 <sup>(b)</sup>	Control	S <sup>(c)</sup>	WGS84 <sup>(d)</sup> AMG84 <sup>(e)</sup>	23°25'42.61556" 334222.142	115°22'43.31389" 7407957.494	247.56 51	01/11/95	GPS <sup>(h)</sup> GPS <sup>(h)</sup>	4th 2nd	20 ppm 0.1 m	–	–
Winning Pool 115 <sup>(b)</sup>	Control	S <sup>(c)</sup>	WGS84 <sup>(d)</sup> AMG84 <sup>(e)</sup>	23°07'55.26512" 246010.673	114°31'15.87045" 7439553.167	74.62 51	–	GPS <sup>(h)</sup> GPS <sup>(h)</sup>	2nd 1st	10 ppm 0.05 m	–	–
Winning Pool 117	Control	SP <sup>(j)</sup>	WGS84 <sup>(d)</sup> AMG84 <sup>(e)</sup>	23°05'36.87843" 246372.528	114°31'31.12458" 7443818.733	69.36 51	–	GPS <sup>(h)</sup> GPS <sup>(h)</sup>	2nd 1st	10 ppm 0.05 m	–	–
Winning Pool 118	Control	SP <sup>(j)</sup>	WGS84 <sup>(d)</sup> AMG84 <sup>(e)</sup>	23°03'39.42864" 246962.819	114°31'54.00672" 7447443.692	60.89 51	–	GPS <sup>(h)</sup> GPS <sup>(h)</sup>	2nd 1st	10 ppm 0.05 m	–	–
9963-7001 Lyndon Station	GPS and gravity base	SP <sup>(j)</sup>	WGS84 <sup>(d)</sup> AMG84 <sup>(e)</sup>	23°37'54.69866" 320344.034	115°14'24.65508" 7385271.180	203.54 51	16/07/99	GPS <sup>(h)</sup> GPS <sup>(h)</sup>	– –	– –	9788094.2	0.1
9963-7002 Winning Station	GPS and gravity base	SP <sup>(j)</sup>	WGS84 <sup>(d)</sup> AMG84 <sup>(e)</sup>	23°09'12.21729" 247531.725	114°32'07.91262" 7437210.453	58.33 51	27/07/99	GPS <sup>(h)</sup> GPS <sup>(h)</sup>	– –	– –	9788263.0	0.4
6792.0225 Onslow	AGSO isogal station		AGD84 <sup>(k)</sup>	21°39.9'	115°6.7'	3.25	1967	MAP <sup>(i)</sup>	–	–	9787596.0	–

**NOTES:** (a) Department of Land Administration  
(b) Coordinates from DOLA  
(c) Standard survey mark  
(d) World Geodetic System 1984

(e) Australian Map Grid 1984  
(f) WGS Spheroidal Height  
(g) Spirit level  
(h) Global Positioning System

(i) Digitized from a map  
(j) Star picket and metal peg  
(k) Australian Geodetic Datum 1984

Table 3.2. Observed coordinate differences

<i>Bench mark (m)</i>	<i>DOLA<sup>(a)</sup></i>			<i>Observed GPS<sup>(b)</sup></i>			<i>Differences</i>		
	<i>Easting<sup>(c)</sup> (m)</i>	<i>Northing<sup>(c)</sup> (m)</i>	<i>WGS<sup>(d)</sup> height (m)</i>	<i>Easting<sup>(c)</sup> (m)</i>	<i>Northing<sup>(c)</sup> (m)</i>	<i>WGS<sup>(d)</sup> height (m)</i>	<i>d easting (m)</i>	<i>d northing (m)</i>	<i>d height</i>
Winning Pool 65	334222.142	7407957.494	247.56	334222.142	7407957.355	247.57	0.0	-0.14	+0.01
Winning Pool 115	246372.528	7443818.733	69.36	246371.974	7443818.156	69.45	-0.55	-0.58	-0.09
Winning Pool 117	246962.819	7447443.692	60.89	246962.285	7447443.157	60.99	-0.52	-0.54	+0.10
Winning Pool 118	246010.673	7439553.167	74.62	246010.121	7439552.552	74.73	-0.57	-0.61	+0.11

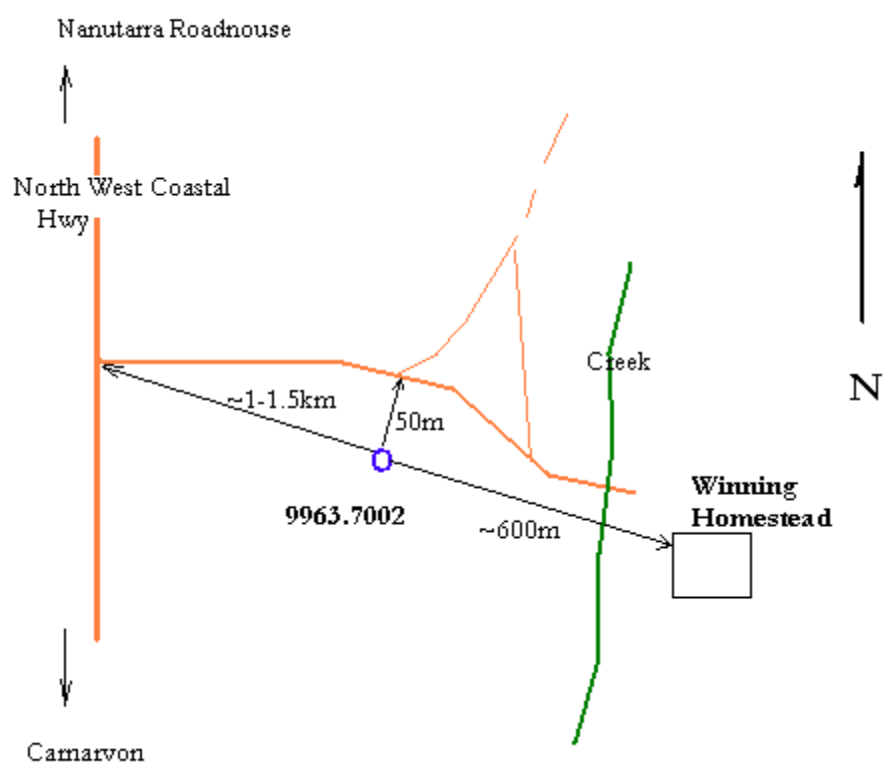
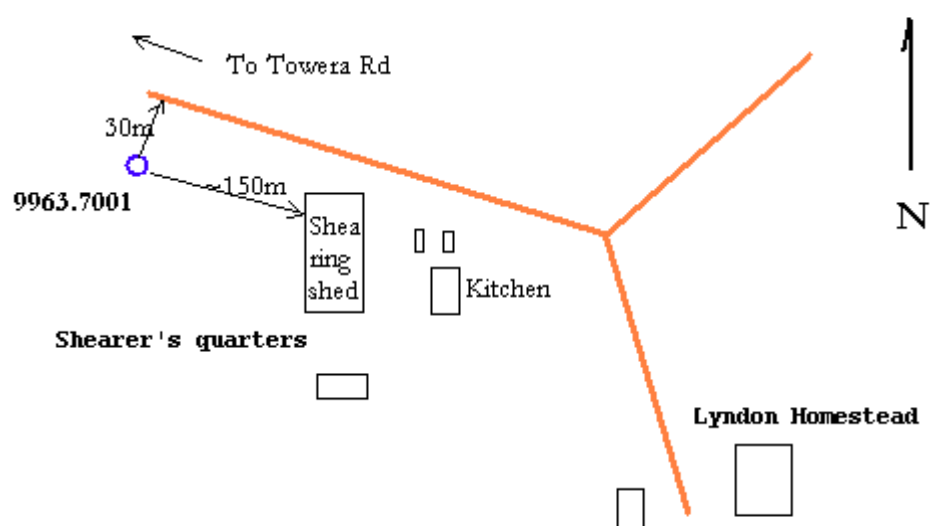
**NOTES:** (a) Department of Land Administration  
 (b) Global Positioning System  
 (c) Australian Map Grid, Zone 50  
 (d) World Geodetic System 1984, spheroidal height

**Table 3.3. Differences in gravity and GPS height repeat measurements**

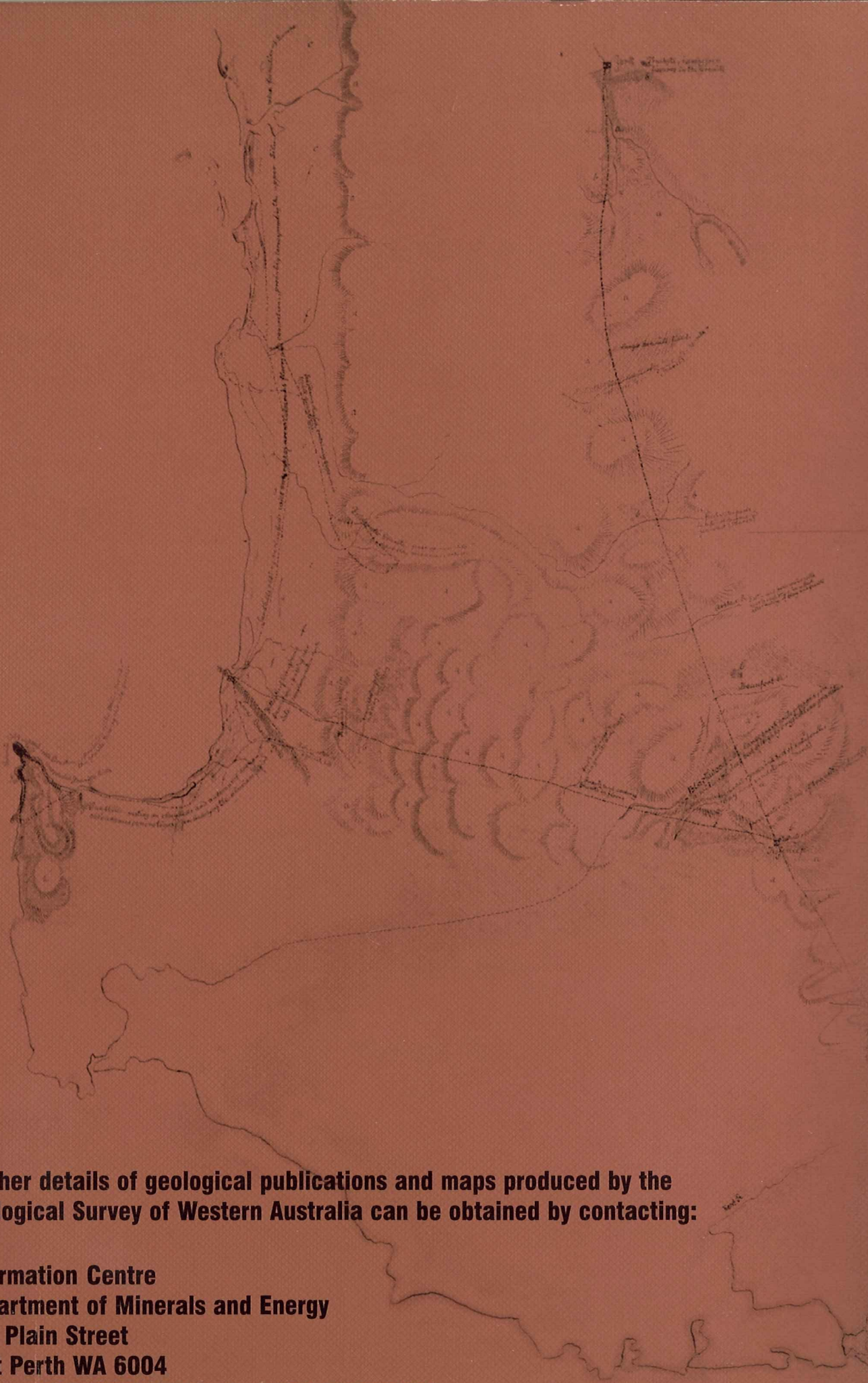
<i>Station number</i>	<i>Days between measurements</i>	<i>Elevation (m)</i>	<i>Observed gravity (<math>\mu\text{ms}^{-2}</math>)</i>
5054	1	+0.08	-1.1
5002	2	+0.80	-0.9
3047	2	-0.90	0.0
3091	1	-1.13	-0.1
2021	1	-0.24	-1.2
<b>Std</b>		<b>0.44</b>	<b>0.6</b>

## Appendix 4

### Description of the established gravity and GPS base stations







Further details of geological publications and maps produced by the Geological Survey of Western Australia can be obtained by contacting:

Information Centre  
Department of Minerals and Energy  
100 Plain Street  
East Perth WA 6004  
Phone: (08) 9222 3459 Fax: (08) 9222 3444  
[www.dme.wa.gov.au](http://www.dme.wa.gov.au)



