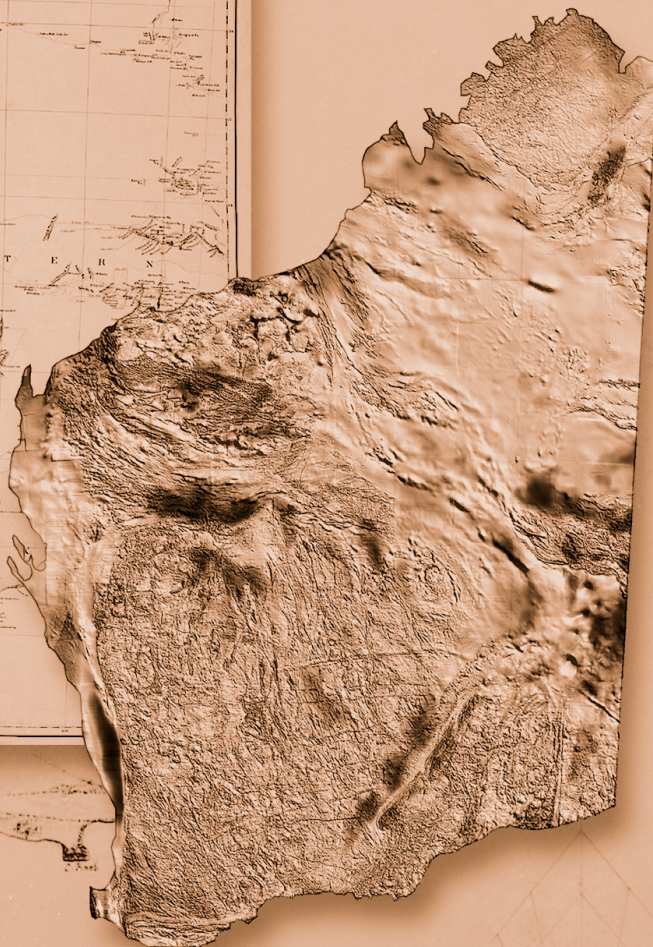




by S. I. Shevchenko



DEPARTMENT OF MINERALS AND ENERGY



GEOLOGICAL SURVEY OF WESTERN AUSTRALIA

Record 2000/12

GRAVITY DATA — AJANA 1:250 000 SHEET WESTERN AUSTRALIA

by

S. I. Shevchenko

Perth 2000

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Gravity data — Ajana 1:250 000 sheet Western Australia

by

S. I. Shevchenko

Abstract

A regional gravity survey was conducted by the Geological Survey of Western Australia over the AJANA 1:250 000 sheet area in July–August 1998. A total of 877 new stations were recorded on an irregular 4×4 km grid. The accuracy of the Bouguer gravity measurements is $\pm 2.3 \mu\text{ms}^{-2}$.

The data provide constraints on models for the regional geological units and structures for the northern part of the Northampton Complex and the Gascoyne Platform to the west—where only an 11×11 km gravity survey had been previously collected. Beneath the Gascoyne Platform, basement is shallow, and lineaments, which trend northeast and northwest, may be related to mafic intrusions in the basement, basement faults, or both. The Hardabut Fault, the western boundary of the Northampton Complex, is a steep normal fault with 2–3 km of throw. Gravity and magnetic data indicate that the Urella Fault cuts through the Northampton Complex into the Gascoyne Platform. In the Coolcalalaya Sub-basin, most gravity anomaly trends are parallel to the Darling Fault and probably related to faults.

KEYWORDS: gravity data, aeromagnetic data, gravity and magnetic lineaments, structure, Coolcalalaya Sub-basin, Gascoyne Platform, Northampton Complex

Introduction

In July and August 1998, the Geological Survey of Western Australia (GSWA) carried out a regional gravity survey of the AJANA* 1:250 000 map sheet (Fig. 1; Plate 1). Helicopters were used to transport the survey crews to sites, distributed on an irregular 4×4 km grid, with gravity meters and Ashtech Z12 differential Global Positioning System (GPS) units 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 of standard 1:250 000 map sheets conducted in 1998 and 1999. The general survey methodology is described by Howard and Shevchenko (2000). This report describes specific details of acquisition and processing of the gravity data from the survey over the AJANA 1:250 000 map sheet and includes a structural interpretation of the new gravity and existing aeromagnetic data.

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

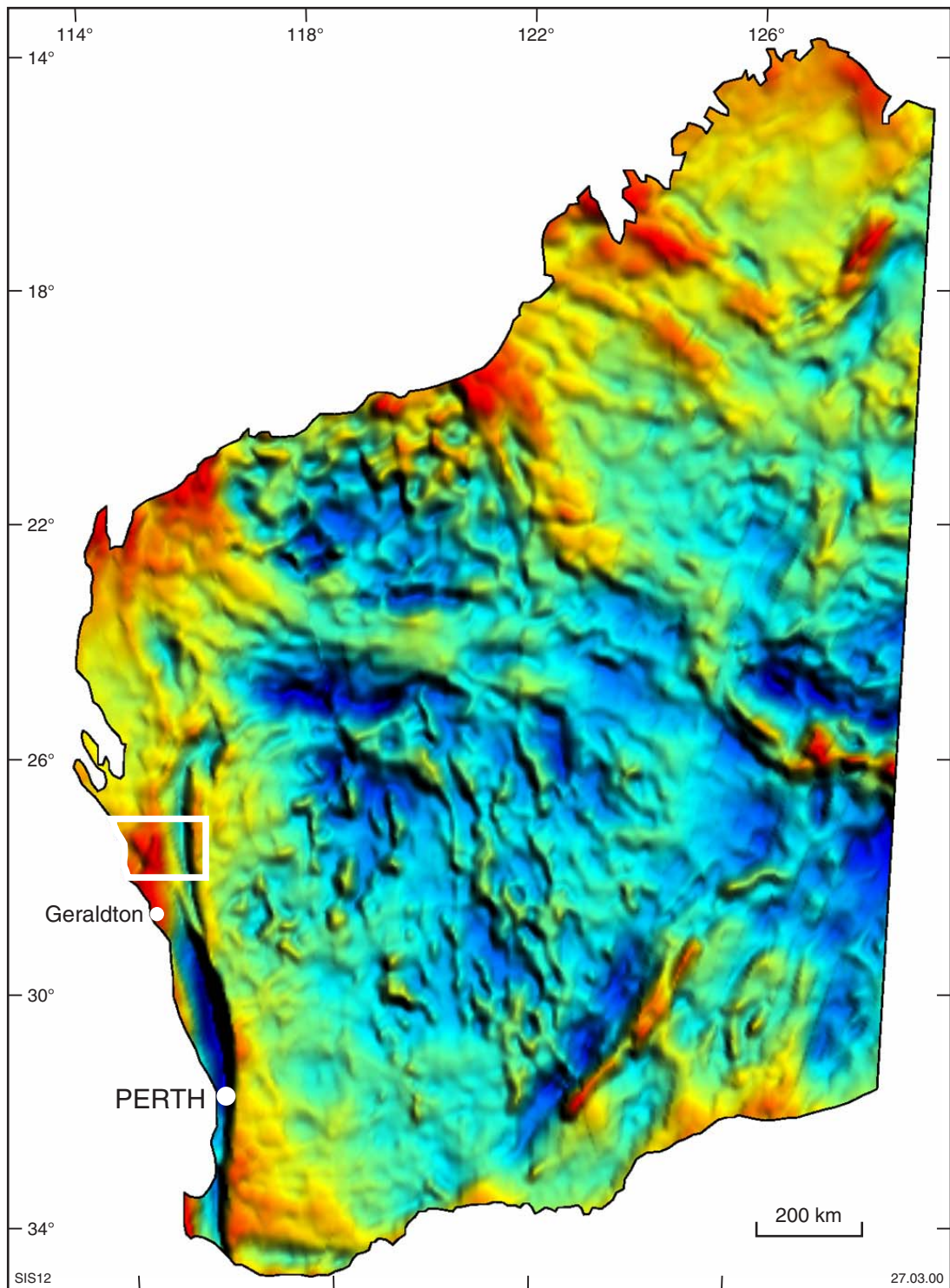


Figure 1. Location of the AJANA gravity survey. Background image is the Bouguer gravity of Western Australia created from the AGSO national gravity database

The logistics and results of the geochemical program are reported in a separate publication by Sanders and McGuiness (2000).

Geological setting

The simplified geology and tectonic elements of AJANA are shown in Figure 2.

There are four major geological provinces on AJANA: the Archaean Yilgarn Craton, Proterozoic Northampton Complex, Carboniferous-Permian Coolcalalaya Sub-basin, and Ordovician–Devonian Gascoyne Platform (Southern Carnarvon Basin).

The Yilgarn Craton, along the eastern margin of the sheet area, forms part of the Archaean (3730–2630 Ma) Narryer Terrane of Myers (1990a, 1993). The segment of Yilgarn Craton on AJANA consists mainly of quartz-feldspar-mica gneiss and foliated granite with minor mafic

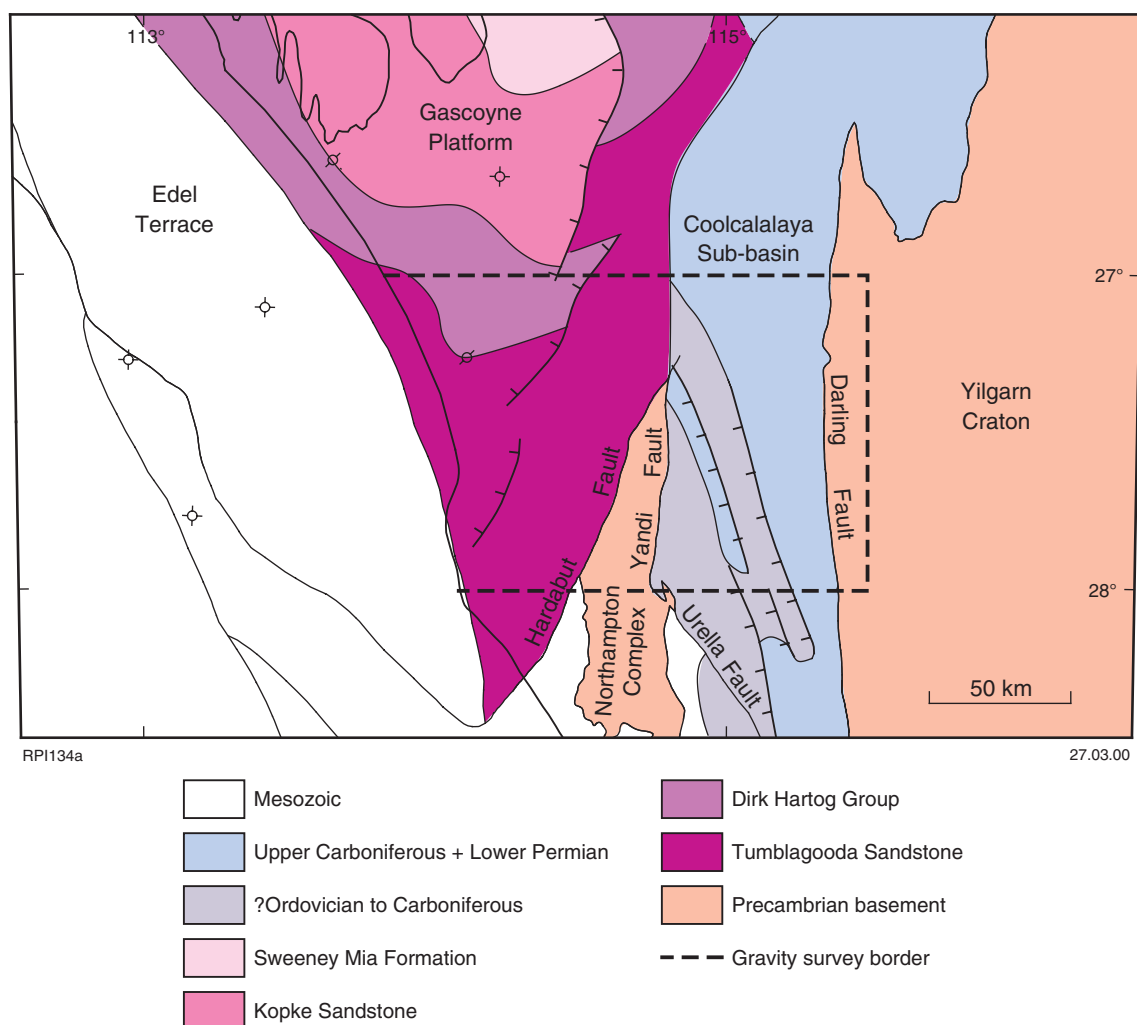


Figure 2. Simplified geology of AJANA and surrounding area (from Iasky and Mory, 1999)

amphibolite and ultramafic rocks (Hocking et al., 1982). The western boundary of the Yilgarn Craton is marked by the Darling Fault, a steep normal fault with a 5-6 km throw down to the west.

The Northampton Complex is exposed in the central south of AJANA and extends to the north under thin Cainozoic cover. Playford et al. (1976) thought that it represented the exposed top of a horst block, bounded by the Hardabut Fault to the east and Yandi Fault to the west. The complex consists of high-grade metamorphic rocks, mainly paragneisses, and also mafic granulites, granites, and pegmatites. It has been included in the Pinjarra Orogen of Myers (1990b), and represents an isolated Proterozoic basement inlier dated at 1150–990 Ma (Bruguier et al., 1999), within the Phanerozoic Perth Basin.

The Coolcalalaya Sub-basin lies between the Northampton Complex and Yilgarn Craton. On the basis of the gravity data, it appears to deepen eastwards and is estimated to contain up to 8500 m of sedimentary rocks. It consists of ?Ordovician to Permian sedimentary rocks with a veneer of Tertiary rocks and Cainozoic sand (Fig. 3; Hocking, 1990; Mory et al., 1998).

The Gascoyne Platform is separated from the Northampton Complex by the Hardabut Fault to the south, and from the Coolcalalaya Sub-basin by the Ajana Fault to the east. It extends to the coastline where it borders the Edel Terrace. The platform contains up to 5000 m of Ordovician–Devonian strata below a thin Cretaceous–Cainozoic cover (Fig. 3; Iasky et al., 1998; Iasky and Mory, 1999).

Gravity data

Previous data

Four gravity surveys were conducted between 1970 and 1997 on different parts of AJANA.

In 1970, AJANA was covered by an 11×11 km survey as part of the Bureau of Mineral Resources (BMR, now AGSO) regional gravity survey across parts of Western Australia and South Australia (Fraser and Pettifer, 1980). The relatively poor accuracy of the Bouguer gravity ($\pm 10 \mu\text{ms}^{-2}$) is mainly the result of the errors in the barometrically measured station heights (about ± 1.8 m; Darby, 1970).

Three other ground surveys cover two thirds of AJANA. The Murchinson–Gascoyne survey was conducted by Oceania Petroleum Pty Ltd in 1972 to provide structural information over the Southern Carnarvon Basin. The stations, at 800 m intervals, were collected along tracks and fence lines. Optical levelling was used for vertical control with an estimated accuracy of ± 0.15 m. Sinningdale Pty Ltd conducted the Coolcalalaya gravity survey in 1973 over the Coolcalalaya Sub-basin south of the Murchinson River with similar data quality. In 1997, GSWA conducted a survey over the Coolcalalaya Sub-basin north of the Murchinson River as a part of an evaluation program of the area. Readings were taken along roads with a station spacing of 2 km and vertical control of ± 0.1 m.

Figure 3. Palaeozoic stratigraphy and correlations, Coolcalalaya Sub-basin and Gascoyne Platform (from Mory et al., 1998)

N		S	
AGE	GASCOYNE PLATFORM	COOLCALALAYA SUB-BASIN	
PERMIAN			
		Byro Group	
		Wooramel Group	
		Callytharra Formation	
CARBONIFEROUS	Lyons Group	Lyons Group/ Nangetty Formation	
		?	
		Willianbury Ss. equivalent	
		?	
DEVONIAN		Willaradie Fm. equivalent	
	Munabia Fm.		
	Gneudna Formation	Gneudna Fm. equivalent	
	Nannyarra Ss.		
		?	
	Sweeney Mia Fm.		
	Kopke Ss. Faure Fm.	?Kopke Sandstone	
	↓		
SILURIAN	Dirk Hartog Group	?	
ORDOVICIAN	Tumblagooda Sandstone	Tumblagooda Sandstone	

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The distance between the along-road gravity traverses of these surveys varies from 2 to 20 km and is often in the range of 10–20 km. The uneven distribution of stations makes grid processing difficult. Using a 3 km grid size, which is optimum for these datasets, some information is not utilized where traverses are close to each other. Conversely, artificial anomalies are introduced where traverses are more than 10 km apart.

New gravity data

The 1998 GSWA helicopter-supported survey acquired readings on an approximately 4×4 km grid using dual-frequency GPS equipment to obtain accurate positions for the gravity stations. The survey specifications, personnel, and procedures are listed in Appendices 1–4. The detailed survey methodology is described by Howard and Shevchenko (2000).

The data were reduced to Bouguer gravity values for a density of 2200 kg/m^3 and gridded to a 2000 m cell size (Fig. 4). The first vertical derivative (1VD) of the Bouguer gravity is shown in Figure 5.

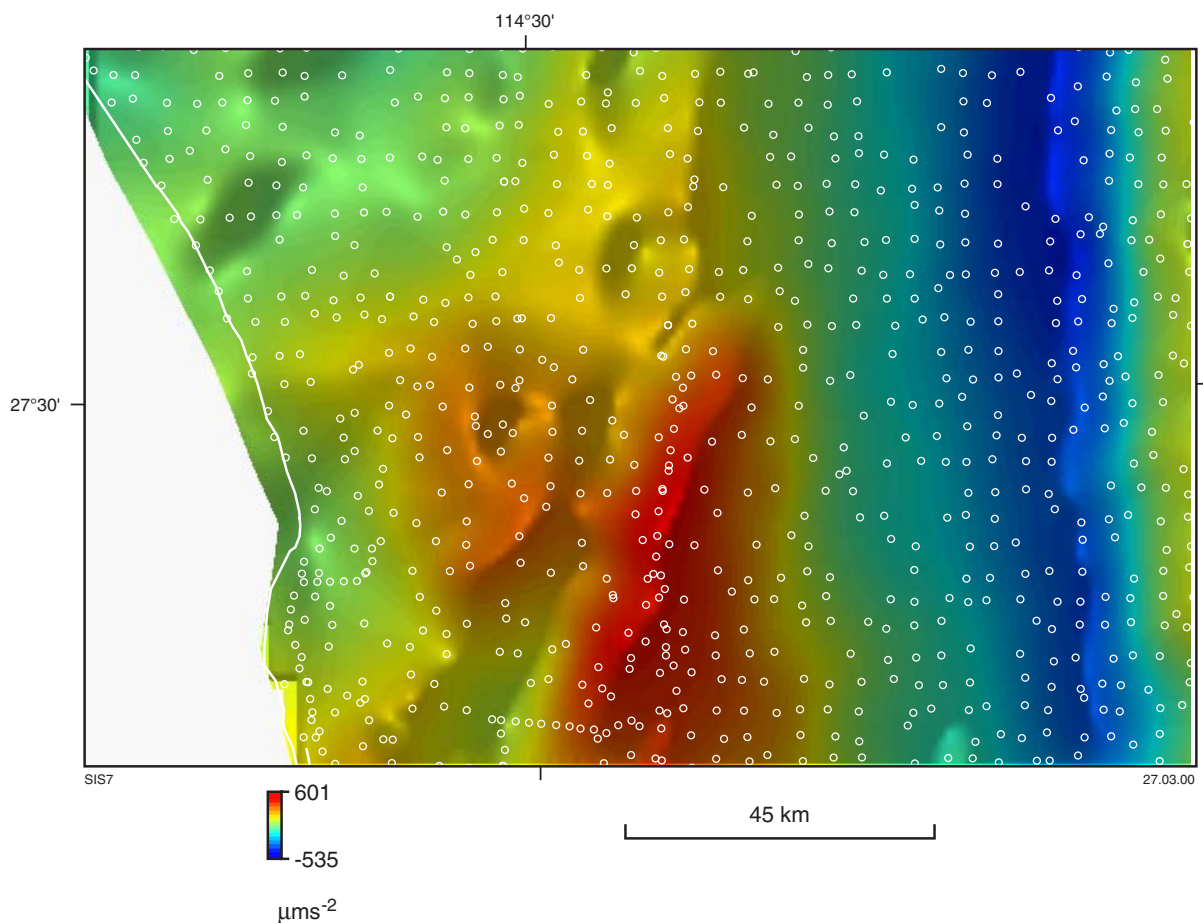


Figure 4. Bouguer gravity image of the AJANA gravity survey showing the locations of the gravity station (circles). The coast is shown as a white line

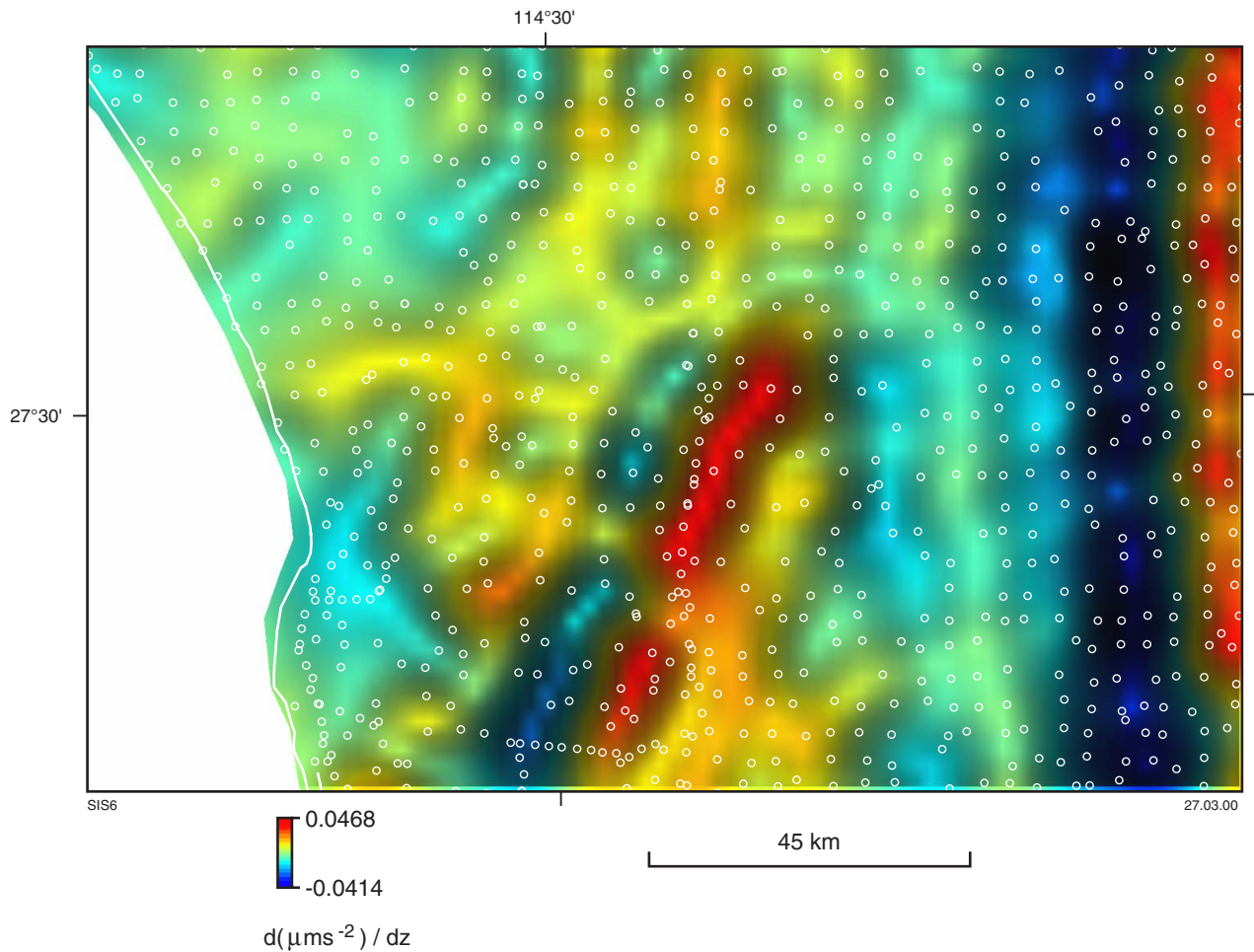


Figure 5. First vertical derivative of Bouguer gravity. The coast is shown as a white line

Magnetic data

A regional airborne magnetic survey, with east-west oriented lines spaced 1600 m apart, was flown over the Southern Carnarvon Basin by BMR in 1959. Two detailed surveys were conducted by CRA in 1979 and 1980 over the Coolcalalaya Sub-basin and Northampton Complex: the Yuna aeromagnetic survey with north-east oriented lines spaced 350 m apart, and the Northampton survey with east-west oriented lines spaced 600 m apart.

A mosaic of images from the three surveys was made to produce the total magnetic intensity (TMI) image of AJANA (Fig. 6).

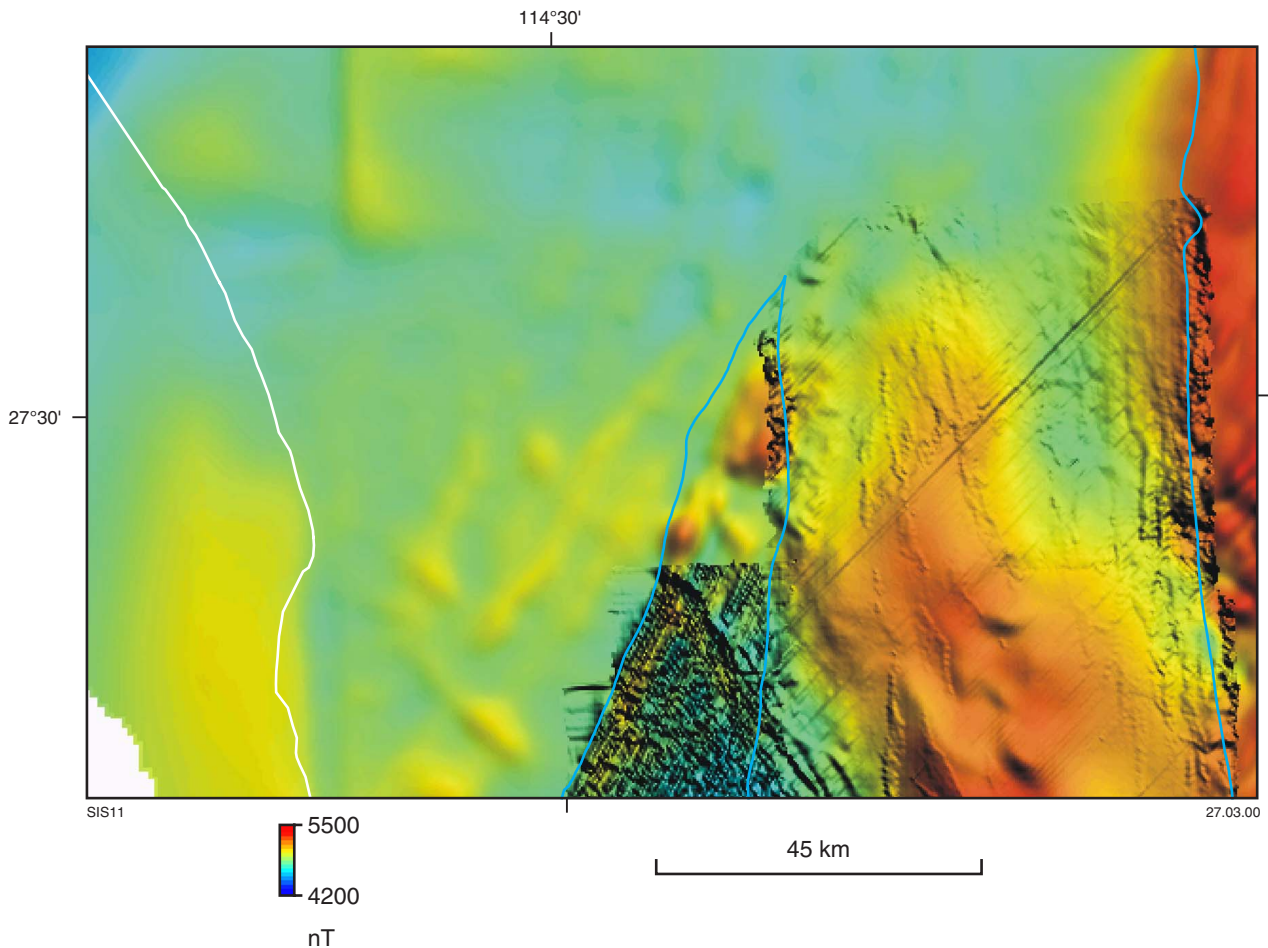


Figure 6. Total magnetic intensity of AJANA. The image is a mosaic of the BMR regional, Northampton, and Yuna surveys. Blue lines show the extent of outcropping Precambrian basement, the coast is shown as a white line

Geophysical signatures

The major regional geological features on AJANA have distinctive geophysical signatures.

Yilgarn Craton

A gravity high of about $130 \mu\text{ms}^{-2}$ (Fig. 4) along the eastern margin of AJANA corresponds to high-density granite and gneissic rocks of the Yilgarn Craton. These rocks are separated from the Coolcalalaya Sub-basin to the west by the Darling Fault, which causes a very steep gravity gradient. On AJANA, the data resolution and coverage are insufficient to show any lithological and structural variations that may occur in the rocks.

Northampton Complex

Another positive anomaly of $\sim 600 \mu\text{ms}^{-2}$ in the central part of AJANA (Fig. 4) represents the paragneisses, granulites, granites, and pegmatites of the Northampton Complex. The stronger anomaly, compared with that over the rocks of the Yilgarn Craton, may be the result of a higher density contrast with the adjacent rocks or, more likely, because of thickening of the crust under the Yilgarn Craton, which would decrease the regional gravity field over the craton.

The elongate, 7-10 km-wide, $100 \mu\text{ms}^{-2}$ gravity anomaly along the western flank of the Northampton Complex (ga on Fig. 7) is coincident with a magnetic anomaly (ma on Fig. 8). The anomalies cannot be explained by the mapped surface geology. There is an apparent lateral displacement, of about 2 km, of both the gravity and magnetic anomalies by a northwesterly trending lineament (gb on Fig. 7, mb on Fig. 8). This lineament has a strong magnetic response (anomaly mb on Fig. 8), which truncates all the high-frequency, north-northeasterly oriented magnetic anomalies caused by the dolerite dykes in the Northampton Complex. The magnetic and

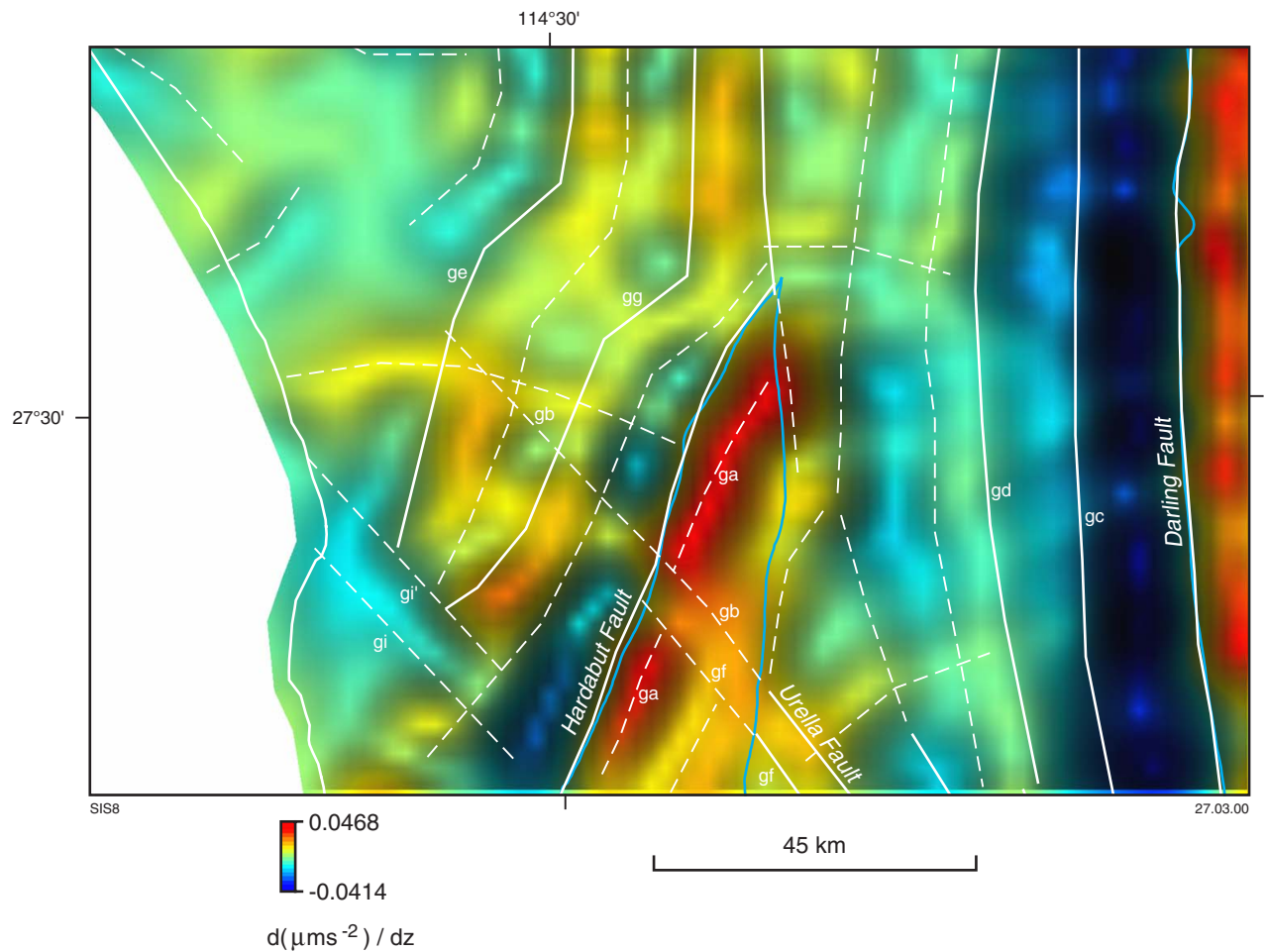


Figure 7. First vertical derivative of Bouguer gravity showing major gravity lineaments (in white). The solid lines are lineaments of a high confidence. The coast is shown as a white line in the west. Blue lines show the extent of outcropping Precambrian basement

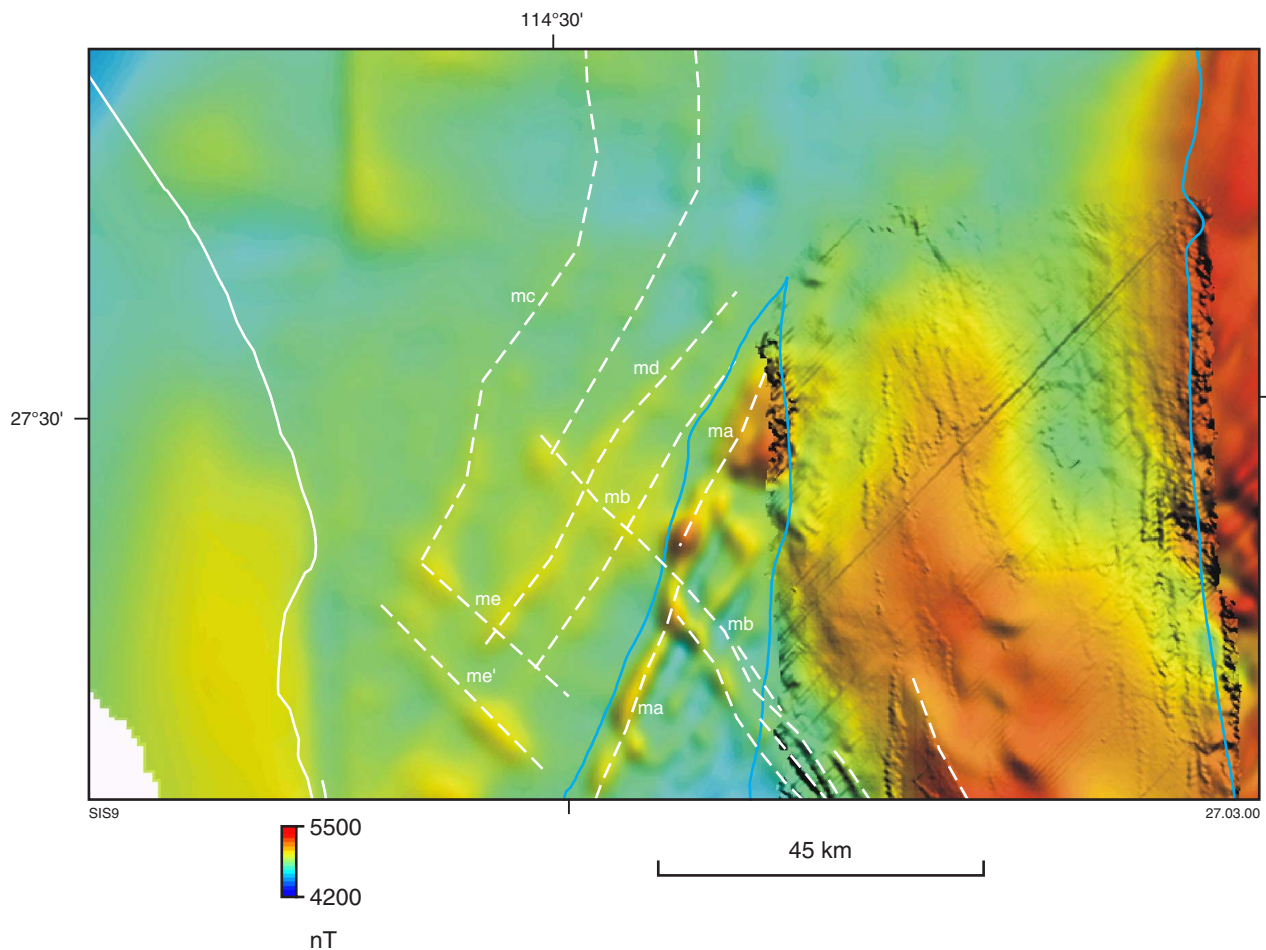


Figure 8. Total magnetic intensity of AJANA showing major magnetic lineaments (in white). The Northampton magnetic survey is not included. Blue lines show the extent of outcropping Precambrian basement

gravity response of this structure can be traced 30 km to the northwest into the Gascoyne Platform. It also extends southeast into the Coolcalalaya Sub-basin, where it appears to join with the Urella Fault, suggesting that it is a continuation of this fault. On AJANA, the highest values of resistate components of TiO_2 , Ce, La, Nb, Th, Y, and Zr in the regolith were recorded along this structure (Sanders and McGuiness, 2000) suggesting that it may be a shear zone, which could have potential interest for exploration for rare earth minerals.

The Yandi Fault, the eastern boundary of the Northampton Complex (Fig. 2), does not show as a strong gravity gradient, which implies that it does not have a significant throw.

The Hardabut Fault, the western limit of the Northampton Complex, was defined by Playford et al. (1976) as a steep normal fault with an estimated maximum throw of 1000–2300 m based on geological data. Modelling of the new gravity data, using the infinite plate body formula and assuming a 200 kg/m^3 density contrast between crystalline basement and the Ordovician–Devonian strata of the Gascoyne Platform, suggests a vertical throw of 2–3 km. A local depocentre is evident

immediately west of this fault from the new gravity data (Figs 4 and 7) and possibly represents local thickening of the Ordovician Tumblagooda Sandstone.

Coolcalalaya Sub-basin

The Coolcalalaya Sub-basin is apparent on the Bouguer gravity image as a gravity low with a minimum Bouguer gravity of $\sim -600 \mu\text{ms}^{-2}$ (Fig. 5) and has an estimated maximum depth of about 8500 m (Mory et al., 1998).

There are two major orientations of the gravity lineaments visible in the 1VD Bouguer gravity image: northerly trending gravity gradients (gc and gd on Fig. 7), which do not have any associated intrabasement magnetic anomalies and probably represent the faults creating two major basement terraces; and northwesterly trending anomalies (gb and gf on Fig. 7), which have been discussed in relation to the Northampton Complex.

Gascoyne Platform

On the Gascoyne Platform there are two prominent, elongate positive gravity anomalies that trend north-northeast, parallel to the Hardabut Fault (Fig. 7). In the north, their orientation changes to a more northerly direction. The western flanks of these anomalies (represented by the lineaments ge and gg on Fig. 7) correspond to faults in outcrops of the Tumblagooda Sandstone (Hocking et al., 1982). It is possible that the eastern flanks of these anomalies also reflect faults. Two narrow, positive TMI anomalies (mc and md on Fig. 8) are coincident with these gravity anomalies, which suggests the presence of highly magnetic, intrabasement bodies similar to those indicated by the gravity and magnetic anomalies on the Northampton Complex. The similar pattern of low-frequency gravity and magnetic anomalies in the Northampton Complex and between the Northampton Complex and the area immediately to the west, suggests that basement similar to the Northampton Complex underlies the southern part of the Gascoyne Platform.

The northwesterly trending gravity lineaments (gi and gi' on Fig. 7) coincide with magnetic anomalies (me and me' on Fig. 8), and also indicate basement structures.

Because there is no magnetic response over the gravity anomalies in the northwestern corner of AJANA, they most likely represent structures in the sedimentary section rather than lithological variations in the basement.

Conclusions

The new regional gravity survey, in conjunction with regional magnetic data, provide new structural information in an area where previously only 11×11 km gravity stations had been collected.

Despite significant areas of AJANA having been covered by detailed gravity along roads and tracks, the new survey data have provided some additional information in the areas of unevenly distributed data.

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Appendix 1

Summary of operations and processing for the AJANA gravity survey

Organization: Geological Survey of Western Australia
Start date: 22 July 1998
Completion: 8 August 1998

	<i>GPS</i>	<i>Gravity</i>
Equipment	4 Ashtech Z12 receivers N223, N226, N900, N942	LaCoste and Romberg Model G x 5 units G20, G101, G132, G252, G460 Worden W169
Data recording and processing notebook computers	Pentium II 233 MHz, 32 Mb RAM; 80486DX 75MHz, 8 Mb RAM; 80486DX 50 MHz, 4Mb RAM	
Calibration		By AGSO 1998
Surveying transport	Helicopters J Bell 206B3 (Jet Ranger) x 2 Land Cruiser 4 wheel drive	
DOLA bench marks used	Ajana 97 to transfer coordinates to 9862-7000 Ajana 101 for position and height control Ajana 62 to transfer coordinates to 9862-7002 Ajana 48 for position and height control Ajana 17 to transfer coordinates to 9862-7003 Ajana 16 for position and height control	2792-9207 (Hamelin Pool)
New base stations	9862-7000, 9862-7002, 9862-7003	9862-7001, 9862-7002, 9862-7003
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, 877 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. 6.0 image processing system
Accuracy	$\sigma_{\text{elevation}} = \pm 0.7 \text{ m}$ $\sigma_{x,y} = \pm 5 \text{ m}$	$\sigma_{\text{gravity base stations}} = \pm 0.3 \mu\text{ms}^{-2}$ $\sigma_{\text{gravity ordinary stations}} = \pm 0.53 \mu\text{ms}^{-2}$
Total Bouguer accuracy		$\sigma_{\text{survey}} = \pm \sqrt{(2.2^2_{\text{elev}} + 0.3^2_{\text{base stns}} + 0.5^2_{\text{ord stns}})} = 2.3 \mu\text{ms}^{-2}$

Appendix 2

Survey personnel

<i>Project manager</i>	<i>Gravity survey manager</i>	<i>Gravity observers</i>	<i>Helicopter company</i>	<i>Chief pilot</i>	<i>Pilots</i>	<i>Engineer</i>
P. Morris	S. Shevchenko	S. Baesjou M. Fetherston A. Franchitto F. Irimies A. Lee S. McGuinness	Helicopters Australia	G. Causer	P. Legradi R. Humphrey A. Franchitto A. Regan	S. Ritter

Appendix 3

Bench mark data

Table 3.1. Coordinates of DOLA^(a) bench marks used to establish base stations and Isogal station

Name	Comments	Type of mark	Type of grid	Latitude (S)/ easting (m)	Longitude (E)/ northing (m)	AHD ^(f) height (m)/ AMG ^(e) zone	Date surveyed	Method	Order	Horizontal accuracy/vertical accuracy	Gravity value (μms^{-2})	Gravity error (μms^{-2})
Ajana 97 ^(b)	–	S ^(c)	AGD84 ^(d) AMG84 ^(e)	27°10'02.09070" 263611.419	114°36'51.43940" 6992782.025	160.207 50	–	GEOD ^(g) SLEV ^(h)	3rd 3rd	30 ppm 12 $\sqrt{\text{K}}$ (mm)	–	–
Ajana 101 ^(b)	Control	S ^(c)	AGD84 ^(d) AMG84 ^(d)	27°06'20.08090" 264370.590	114°37'23.71160" 6999632.961	179.895 50	–	GEOD ^(g) SLEV ^(h)	3rd 3rd	30 ppm 12 $\sqrt{\text{K}}$ (mm)	–	–
Ajana 62 ^(b)	–	S ^(c)	AGD84 ^(d) AMG84 ^(e)	27°47'51.00640" 274890.529	114°42'54.39650" 6923124.475	258.176 50	29/06/1989	GEOD ^(g) SLEV ^(h)	1st 3rd	7.5 ppm 12 $\sqrt{\text{K}}$ (mm)	–	–
Ajana 48 ^(b)	Control	S ^(c)	AGD84 ^(d) AMG84 ^(e)	27°43'23.90668" 270732.174	114°40'28.17679" 6931271.822	239.433 50	13/07/1991	GEOD ^(g) SLEV ^(h)	3rd 3rd	30 ppm 12 $\sqrt{\text{K}}$ (mm)	–	–
Ajana 17 ^(b)	–	S ^(c)	AGD84 ^(d) AMG84 ^(e)	27°32'23.25550" 301660.628	114°59'29.33310" 6952157.050	202.179 50	23/07/1988	GEOD ^(g) SLEV ^(h)	2nd 3rd	10 m 12 $\sqrt{\text{K}}$ (mm)	–	–
Ajana 16 ^(b)	Control	S ^(c)	AGD84 ^(d) AMG84 ^(e)	27°32'12.52720" 303507.742	115°00'36.84920" 6952517.159	205.758 50	23/07/1988	GEOD ^(g) SLEV ^(h)	2nd 3rd	10 m 12 $\sqrt{\text{K}}$ (mm)	–	–
9862-7000 Neren Neren st ^(l)	GPS base only	SP ^(k)	AGD84 ^(d) AMG84 ^(e)	27°07'46.18020" 264749.061	114°37'35.63256" 6996988.806	159.364 50	24/07/1998	GPS ⁽ⁱ⁾ GPS ⁽ⁱ⁾	– –	– –	–	–
9861-7001 Neren Neren st ^(l)	Gravity base only	SP ^(k)	AGD84 ^(d)	27°07'46"	114°37'35"	159	22/07/1998	MAP ^(j)	–	–	9 790 899.7	0.3
9861-7002 Mount View st ^(l)	GPS and gravity base	SP ^(k)	AGD84 ^(d) AMG84 ^(e)	27°55'33.245265" 263022.990	114°35'30.67652" 6908661.960	208.733 50	05/08/1998	GPS ⁽ⁱ⁾ GPS ⁽ⁱ⁾	– –	– –	9 791 690.1	0.4
9861-7003 Coolcalalaya st ^(l)	GPS and gravity base	SP ^(k)	AGD84 ^(d) AMG84 ^(e)	27°31'31.76187" 307975.948	115°03'20.41927" 6953842.947	205.058 50	06/08/1998	GPS ⁽ⁱ⁾ GPS ⁽ⁱ⁾	– –	– –	9 790 736.1	0.2
2792-9207 Hamelin Pool	AGSO Isogal station		AGD84 ^(d)	26°25.5'	114°12.4'	27.64	1967	MAP ^(j)	–	–	9 790 344.4	–

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

(e) Australian Map Grid 1984
(f) Australian Height Datum
(g) Geodetic
(h) Spirit level

(i) Global Positioning System
(j) From a map
(k) Star picket and metal peg
(l) Station

Table 3.2. Observed coordinate differences

<i>Bench mark</i>	<i>DOLA^(a)</i>			<i>Observed GPS^(b)</i>			<i>Differences</i>		
	<i>Easting</i> <i>(m)</i>	<i>Northing</i> <i>(m)</i>	<i>AHD height^(c)</i> <i>(m)</i>	<i>Easting</i> <i>(m)</i>	<i>Northing</i> <i>(m)</i>	<i>AHD height^(c)</i> <i>(m)</i>	<i>d easting</i> <i>(m)</i>	<i>d northing</i> <i>(m)</i>	<i>d height</i> <i>(m)</i>
Ajana 101	264370.590	6999632.961	179.895	264370.24	6999633.54	179.71	-0.35	+0.42	-0.18
Ajana 48	270732.174	6931271.822	239.433	270732.22	6931272.45	239.51	+0.05	+0.63	+0.08
Ajana 16	303507.742	6952517.159	205.758	303507.78	6952517.09	205.66	+0.04	-0.06	+0.09

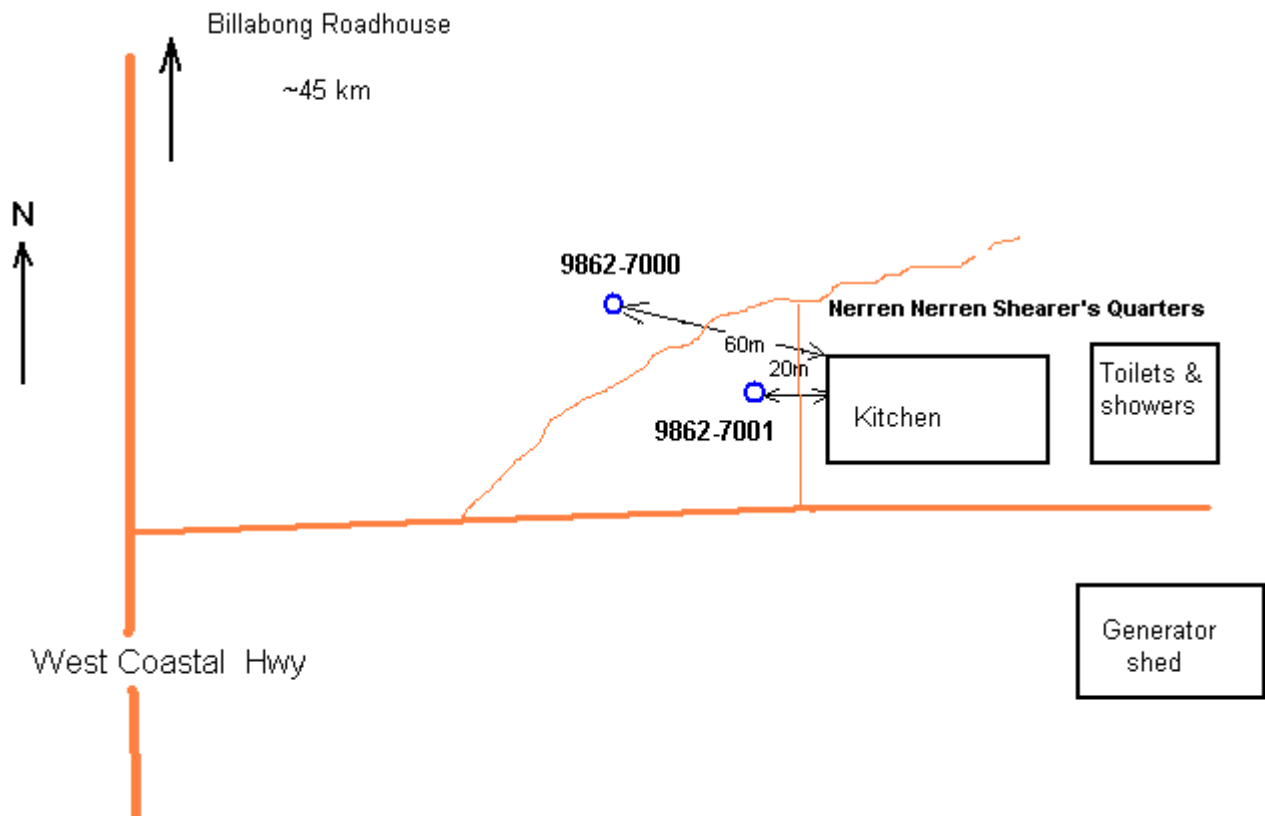
NOTES: (a) Department of Land Administration
(b) Global Positioning System
(c) Australian Height Datum

Appendix 4

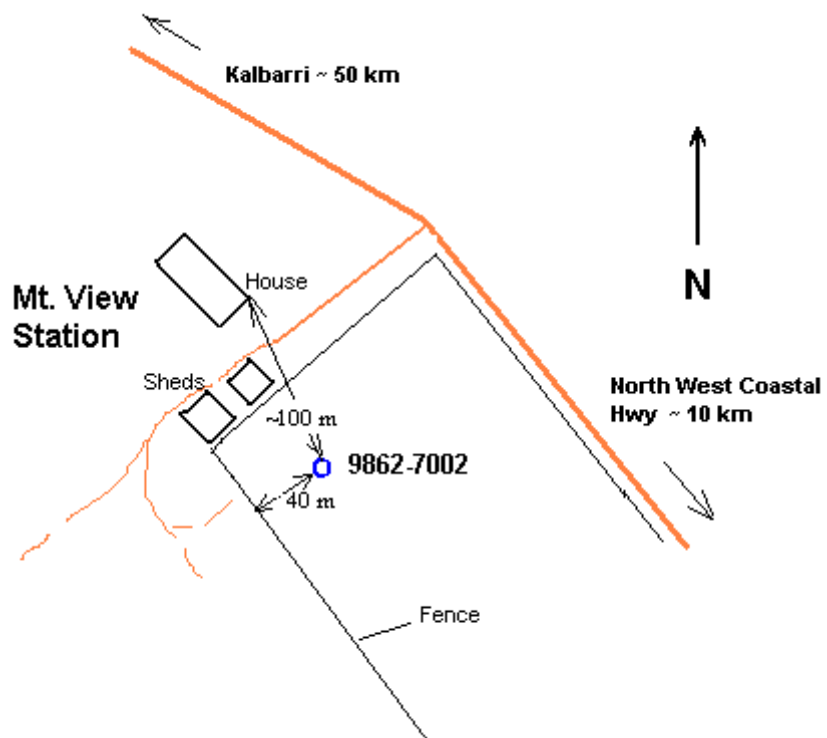
Description of the established gravity and GPS stations

Nerren Nerren base station

(Schematic)



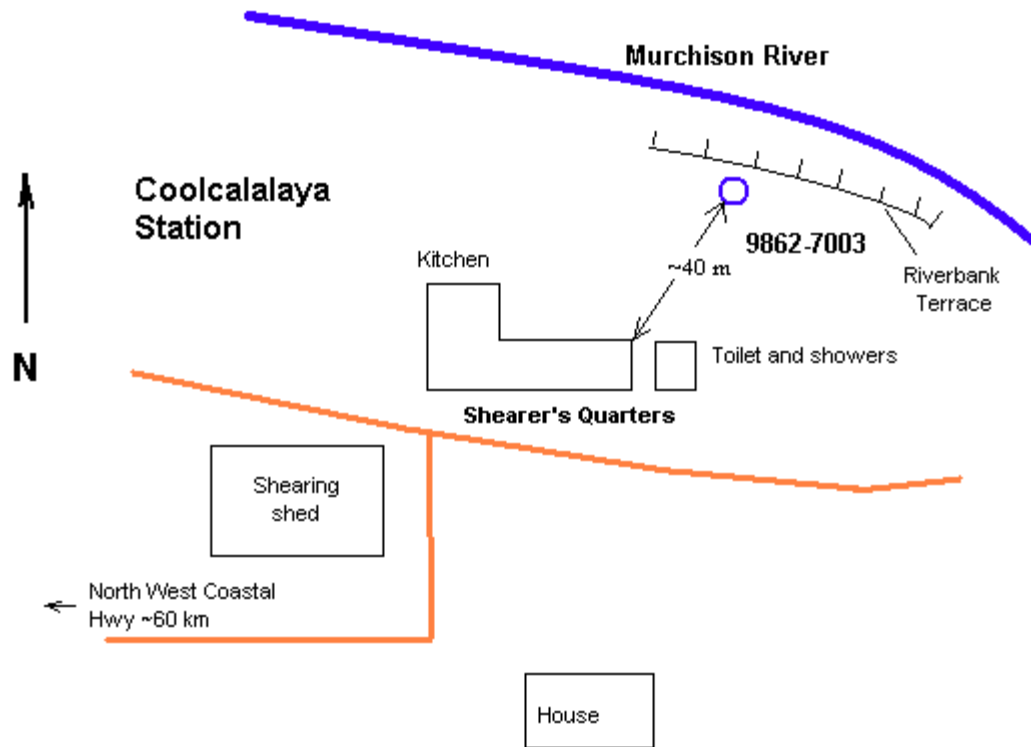
Appendix 4 (continued)
Mount View base station
(Schematic)

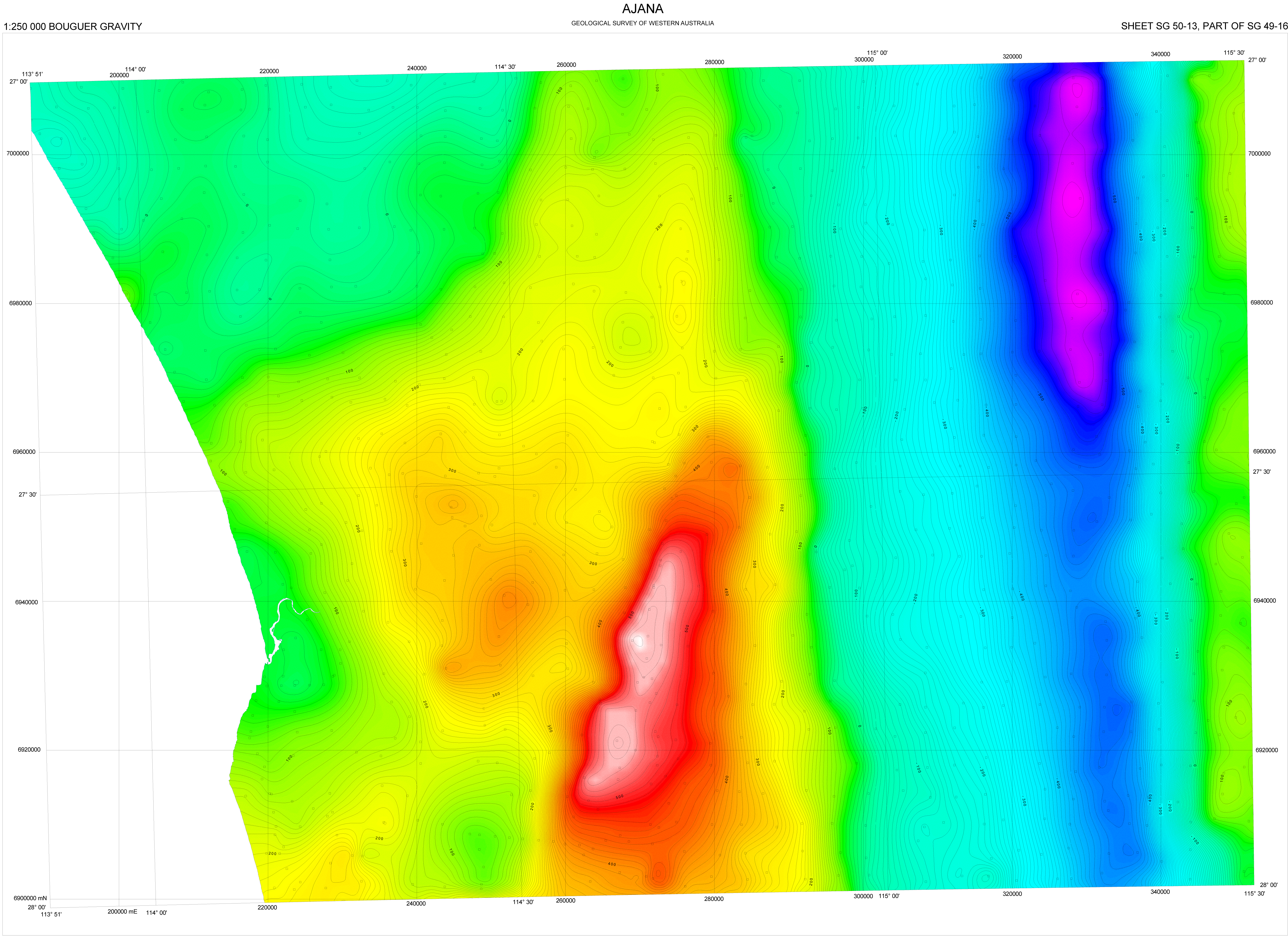


Appendix 4 (continued)

Coolcalalaya base station

(Schematic)





Gravity unit	1µms ⁻²
Contour value	200
Gravity station	□

Acquisition date	July-August 1998
Acquired by	Geological Survey of Western Australia
Nominal station spacing	4 km
Gravity meter	LaCoste and Romberg G
Gravity survey accuracy	2.3µms ⁻²
Positioning	Ashtech Z-12 dual frequency GPS
Horizontal accuracy	5 m
Vertical accuracy	0.7 m

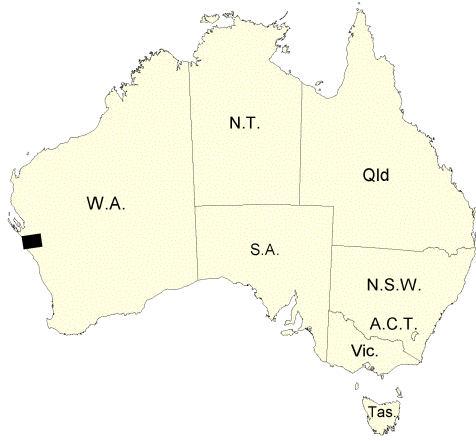
Data reduction by	GSWA
Bouguer density	2200 kgm ⁻³
Terrain correction	Not applied
Geodetic datum	WGS84
Height datum	AHD
Gridding software	Intrepid 3.4
Grid cell size	1500 m
Contour interval	10µms ⁻²
Image processing software	ER Mapper 5.5

Project geophysicist	S. Shevchenko
Processing	S. Shevchenko
Map compilation	J. H. Watt

Published by the Geological Survey of Western Australia. Copies available from the 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

These data are also available in digital form from the Geophysical Mapping Section, AGSO
GPO Box 378, Canberra, ACT 2601
Phone (02) 6249 9222, Fax (02) 6249 9913, www.agso.gov.au/geophysics/gravimetry

Recommended Reference is: GEOLOGICAL SURVEY OF WESTERN AUSTRALIA, 1999,
Ajana, W.A.: Western Australia Geological Survey, 1:250 000 Bouguer Gravity Image



SHEET INDEX		
EDIEL SF 49-12	YARRINGA SG 50-9	BYRO SG 50-10
ZUYTDORP SG 49-18	AJANA SG 50-13	MURGOO SG 50-14
HOUTMAN ABROLHOS SH 49-4	GERALDTON SH 50-1	YALGOO SH 50-2

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MINISTER FOR MINES



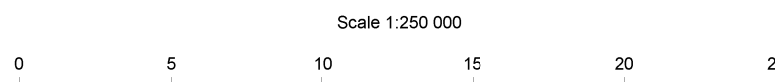
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GEOLOGICAL SURVEY OF
WESTERN AUSTRALIA
DAVID BLIGHT, DIRECTOR



TRANSVERSE MERCATOR PROJECTION
HORIZONTAL DATUM: WORLD GEODETIC SPHEROID 1984
Grid lines indicate 20 000 metre interval of the Map Grid Australia Zone 50

The Map Grid Australia (MGA) is based on the Geocentric Datum of Australia 1984 (GDA84).
GDA84 positions are compatible within one metre of the datum WGS84 positions.

GEOLOGICAL SURVEY OF WESTERN AUSTRALIA

BOUGUER GRAVITY
AJANA
SHEET SG 50-13, PART OF SG 49-16

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