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GEOPHYSICAL RESULTS FROM THE GREAT AUSTRALIAN BIGHT

by

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SUMMARY

Gravity, magnetic, and reflection seismic records were obtained in the Great Australian Bight as part of the Continental Margin Survey. This report presents data from the area between 120° and 141°E. The survey lines were oriented north-south, were separated by about 20 minutes of longitude, and ran from near the coast out to a water depth of about 5 km. Systematic measurements were made of water depth, gravity, and total magnetic field and continuous seismic reflection data were obtained on the continental shelf, continental slope, continental rise, Eyre Plateau, Ceduna Plateau, and a small area of the abyssal plain.

Gravity and magnetic records are of good quality. Seismic records tend to be noisy on the continental shelf, but elsewhere resolution is good.

Sediments are about 300 to 500 m thick over most of the continental shelf but exceed 1 km off Eyre and in the offshore Denman Basin, and probably in the eastern parts of Spencer Gulf and Gulf St Vincent within the Pirie-Torrens and St Vincent Basins. Sediments are known to be 2.5 km thick in the polda Trough but this is not apparent on seismic sections from this survey. Thick sedimentary sections are present in the Duntroon Basin and in the Otway Basin.

The Eyre Plateau is underlain by 500 m of sediments in the west and by 1 to 2 km of sediments in the east. On the continental rise south of the Eyre Plateau a 2 km thick sedimentary section, comprising an upper prograded unit unconformably overlying a moderately folded unit, overlies horizontal basement.

On the Ceduna Plateau a relative Bouguer anomaly low and regionally dipping seismic reflectors within the sedimentary section indicate that the sedimentary section could be 3 or 4 km thick. About 600 m of prograded sediments unconformably overlies a moderately folded and faulted unit, which probably also includes an unconformity. The upper unit extends into the Denman Basin, and both the upper and lower units probably extend into the Duntroon Basin, permitting the unconformities to be dated as pre-Upper Cretaceous and probably early Tertiary.

The lower sedimentary unit contains several anticlines and a dome with about 800 m closure near the southern edge of the Ceduna Plateau. This section is prospective but not as yet exploitable, because of water depth.

The Eyre and Ceduna Plateaus are built on downthrown basement, which is divided into rift blocks by easterly-striking faults. The surfaces of these blocks are tilted northwards and in general steepen towards the southern edge of the plateaus. The faulting is truncated by the late Tertiary sedimentary section. Basement ridges lie close to the sea-bed beneath the continental slope and rise and appear similar to those along the southern edge of the Duntroon and Otway Basins.

Bouguer anomalies and magnetic anomalies associated with the Polda Trough, Denman Basin, and Adelaide Geosyncline extend from the shore across the continental shelf. A Bouguer anomaly ridge, which forms an arc around the northwest margin of the Gawler Block, extends southwards across the continental shelf, then southeast along the continental slope. It could arise from an ancient mobile belt around the Gawler Block, incorporating high-density basic rocks.

The Polda Trough is observed on only two seismic profiles, but it has pronounced gravity and magnetic expression. Easterly trends in the Bouguer and magnetic anomalies suggest that the faults which bound the Polda Trough extend westward along the northern edge of the Ceduna Plateau.

Bouguer anomalies and seismic sections confirm that the Denman Basin extends southward beneath the continental shelf for about 50 km.

Gravity anomalies indicate that the crust which underlies the Eyre and Ceduna Plateaus is of almost continental thickness, and that the depth to the base of the crust under the continental rise covers the approximate range 10 to 20 km.

The predominant easterly orientation of faults and grabens, landward-tilted fault blocks beneath the marginal plateaus, and an unconformity of probable early Tertiary age are consistent with the rifting apart of Australia and Antarctica about 50 m.y. B.P., and taphrogenic collapse of their continental margins.

1. INTRODUCTION

The Continental Margin Survey was carried out by the Bureau of Mineral Resources (BMR) between December 1970 and January 1973. Its objective was to provide reconnaissance gravity, magnetic and reflection seismic data around the margin of Australia, in order to outline regional structures and to provide means of defining boundaries of the Australian continent. About 90 000 n miles of traversing was completed along the lines running generally from the coast to 4000 to 5000 m water depth, and separated by 20 to 30 n miles.

The survey was contracted to Compagnie Generale de Geophysique (CGG). The vessel used was a converted North Sea trawler, the MV Lady Christine.

This report covers the area of the Great Australian Bight and adjacent waters off the south coast between longitudes 120° and 141°E (Pl.1). It provides a brief geological and geophysical setting and description of the data collected on the 12 000 n miles of traverses in that area. A preliminary interpretation is proposed for the data.

1.1 Equipment

Primary navigation control was based upon the U.S. Navy TRANSIT satellite navigation system. Satellite transmissions were received on an ITT satellite ratio receiver and processed in a PDP8 computer together with known parameters provided on board ship, to give fixes at two-hourly average intervals. Intermediate positions were computed using the ship's gyro-compass and sonar Doppler, Chernikeeff electromagnetic log, or ship's pressure log, in order of reliability. Gravity data were obtained using LaCoste & Romberg marine gravity meter S24 mounted on a gyro-stabilized platform. Analog computers in the meter compute corrections for beam motions and accelerations and apply these to measured gravity so that corrected gravity is produced directly.

A Varian proton precession magnetometer towed about 200 m behind the boat was used to measure the total magnetic field.

All gravity, magnetic and navigational data were sampled at 10-s intervals by a Hewlett Packard HP2116B computer and then checked, and recorded on magnetic tape. This data acquisition computer also provided the ship's dead-reckoned position at 10-minute intervals, plus data for on-line assessment of systems performance and for geophysical computations.

The seismic system consisted of a 120-kJ sparker energy source, a six-channel cable for deep reflections, and a short single-channel cable (Geotech) for resolution of near-surface structure, a multi-channel analog amplifier bank and a 14-channel FM tape recorder for permanent recording of the seismic data. Four EPC electrostatic paper recorders were used for monitoring purposes. Aquatronix SM42 sonobuoys were used to obtain refraction data from the sparker energy source out to a few miles. A more detailed report on survey equipment is being written by L.A. Tilbury.

There were no significant failures of the magnetometer while working in the Bight. Lack of diurnal data from the shore magnetic station, from 16.741000-16.771730 (i.e. Survey 16, survey day 74, 1000 hours, etc.), while not greatly affecting the presentation of data in profile from, will not enable it to be used in final contour maps. This affects principally lines 16/151 to 16/153, which comprise the near-shore tie-line in the eastern Bight, and the lines 16/154 to 16/156.

Two significant changes were made to the seismic system during work in this area:

(i) The sparker was changed from a four-electrode to a single-electrode system with the same 120 kJ discharge. The most readily observable effect was a reduction in dominant frequency from 80 Hz to 50 Hz.

(ii) The change to SIE PT 700 seismic amplifiers from Sercel AS626X amplifiers was made which made possible the use of automatic gain control adjustable on each channel, fixed gain for refraction recordings, and a high frequency pass band for the Geotech channel.
An equipment list is given in Appendix I.

1.2 Operations

The Great Australian Bight was surveyed in two major blocks. The eastern half (east of 130°E) was covered during the period 8 April to 5 June 1972 (Survey 16, days 11 to 69), and the western half from 10 June to 24 June 1972 (Survey 16, days 74 to 88) see Plate 2. Lines near Esperance, and tie-lines in the western half were surveyed between 24 December and 3 January 1973 (Survey 19, days 12 to 22).

During a port call at Adelaide on 25 April 1972 the sparker was changed from a four-electrode to a single-electrode system, still producing a 120 kJ spark. Seismic recordings from Survey 16, day 31 onwards were obtained using the single-electrode system.

At a further call to Adelaide on 16 May, the Sercel AS626X amplifiers were replaced with SIE PT700 amplifiers.

A new data acquisition computer program (Briggs, in prep.) was tested at sea from 19 to 23 May 1972 (Survey 16, days 52 to 56), but was not implemented until 4 July 1972 (Survey 17, day 02). It provided automatic updating of positions after an acceptable satellite fix, on-line free-air anomalies and magnetic anomalies, and easier operator communications.

The shore magnetic monitor station was first located at Coffin Bay on the Eyre Peninsula, but was moved to Albany on 6 June (Survey 16, day 0).

1.3 Data Quality

About half the area surveyed is on the continental shelf and the rest is over the continental slope, marginal plateaus, and the continental rise. The sonar Doppler operates on bottom-lock in water depths of 200 m or less, and it is expected that navigational accuracy should be about 0.2 n miles following post-survey processing of the satellite fixes. In water depths greater than about 200 m the sonar Doppler operates from back-scatter of the sonar signal from water layers of varying density. It is estimated that the currents in these layers will reduce the off-shelf accuracy to about 1 n mile.

The hourly gravity values are affected by errors in the latitude and Eotvos corrections, caused by uncertainities in position and velocity. The positions were determined from the sonar Doppler and ship's logs tied to the preliminary satellite fixes. The velocities used have been determined from the sonar Doppler, from 10-minute averages before and after the hour. Errors due to currents are still present in areas where the sonar Doppler was operating of back-scatter. A 7.5mGal error in the Eotvos correction results from a 1-knot error in eastward component of velocity.

In addition, the gravity data can be downgraded by intense short-period oscillations due to rough seas which cause the meter beam to operate beyond its normal range. The most reliable gravity data were obtained from lines close to the coast as the seas were calmer there. Generally, the noise level ranges from 0 to 4 mGal peak-to-peak, but on lines 16/138 and 16/047 along 130°20' and 139°E noise levels average 6 mGal and in some places on lines 16/047 and 19/049 exceed 10 mGal.

Magnetic data had noise levels which were generally less than 5 gammas peak-to-peak.

An overall estimate of the accuracy of the bathymetry, gravity, and magnetic data can be obtained from the misties at intersections, which are shown in histogram form in Plate 3. Should the errors be random, as one would expect, the mean should be insignificantly different from zero at the

95% level of probability, and it is unlikely that the maximum mistie would depart from the mean by more than three standard deviations.

Of the three distributions the bathymetry and magnetics show significant departures of their means from zero. The bathymetry mean shows the largest departure, but this is obviously due to a few isolated large misties in areas of steep gradient. Three large bathymetric misties occur over the steep continental slope south of the Eyre Plateau, and are probably caused by small but systematic navigational errors in the tie-line. Three large magnetic misties occur on the inner tie-line over intense anomalies off Eyre, and are again caused by minor navigational errors. If these large misties are ignored the distributions are approximately normal.

Table 1

Mistie Statistics

	Mean	Std Dev.	Max. mistie
Bathymetry	6.17 m	23.19 m	130 m
Gravity	0.01 mGal	3.88 mGal	13.7 mGal
Magnetics	3.27 gammas	21.96 gammas	106 gammas

1.4 Reduction techniques

The data presented in this report are only preliminary. Bathymetric, gravity, and magnetic data were obtained by hand-scaling of analog records at hourly intervals, or directly from on-line printouts produced by the data acquisition computer. The data were processed by computer, and contour maps prepared on a flat-bed plotter. In the triangular contouring program a triangular plate is defined by three adjacent stations whose circumscribing circle contains no other stations. Linear interpolation is then used on the triangular plate. On the continental shelf in the Great Australian Bight, regions of intense magnetic anomalies form densely packed triangular contours making less satisfactory maps than do the bathymetry and Bouguer anomalies.

Single-channel monitor sections were made from the seismic system as the data were collected. These have been inspected and interpreted briefly to extract regional information. On the continental shelf the monitor records are of poor quality, with 'ringing' and multiple reflections obscuring much of the deep structure. Elsewhere, the records show a penetration of about 2 seconds below the sea-bed. The shooting configuration will permit six-fold common-depth point stacking of the multichannel seismic signals recorded on magnetic tape, which should improve resolution and penetration.

2. GEOLOGY AND PREVIOUS GEOPHYSICS

2.1 Geology

The tectonic framework of southern Australia is shown in Plate 4 (Thompson, 1970).

The continental shelf and slope in the Great Australian Bight are underlain by Precambrian crystalline basement which crops out onshore as the Fraser-Albany Province, Musgrave Block, and Gawler Block. Sediments of probable Jurassic to Permian age were deposited in grabens, which trend easterly in the Polda Trough, Duntroon Basin, and Otway Basin; and northerly in the Denman Basin. Sedimentation was widespread in Cretaceous and Tertiary time.

Easterly-trending rift faults, bounding the grabens and probably the edge of the continental shelf and marginal plateaus, are believed to have formed in Permian and Jurassic time, possible associated with the subsequent rifting apart of the Australian and Antarctic continents.

A summary of the main characteristics of sedimentary basins in the survey area is given in Table 2.

Table 2

Sedimentary Basins

Basin	Age	Depth	Sediment & structure
Adelaide Geosyncline	Adelaidian, L. Cambrian, Tertiary	up to 10 km (aeromag.)	Decollement folds & diapirism: flanked by Tertiary grabens truncated in south by Cygnet-Snelling Fault. Cambro-Ordovician fold belt in south-east (Kanmantoo Trough)
Denman Basin	Adelaidean, Palaeozoic & Permian, under Eucla Basin sediments	1.5 km (bore)	North-south trending depression at head of Bight (Scott & Speers, 1969)

Basin	Age	Depth	Sediment & structure
Eucla Basin	Tertiary, over some Mesozoic & Permian	0.5 - 1 km (bores)	Flat-lying limestone, sand, & clay occupying most of central Bight
Otway Basin (Gambier Embayment)	Permian or Jurassic, L Cretaceous, U Cretaceous, & Tertiary	6 km (aeromag.), 0.6 km N. of 37°S	Initial rift with later broadening of basin and migration of depositional axis to south & west. Basin-wide unconformities between each depositional phase
Polda (Elliston) Trough	probably post-Jurassic (Wopfner, 1969)	2 km (aeromag.)	East-west graben-like basin definitely faulted along N. edge. Sediments thicken westwards where Tertiary unit overlies (?)Mesozoic unit with slight angular unconformity (Smith & Kammerling, 1969; Harris, 1964).
Duntroon Basin	probably Jurassic, Cretaceous & Tertiary (Smith & Kammerling, 1969)	6 km (aeromag.)	Offshore basin west of Kangaroo I., overlying downfaulted basement block on continental shelf and slope. Unconformity separating 4.5 km intensely folded (?)Jurassic and L. Cretaceous sediments and 1.5 km of slightly folded (?)U. Cretaceous and Tertiary sediments.

2.2 Previous Bathymetry

The bathymetry of the Great Australian Bight has been described in detail by Conolly and von der Borch (1967) and Connolly et. al. (1970). They describe the continental shelf as a gently dipping plain which breaks into the continental slope at between 125 and 165 m. Seaward of the Eucla Basin the continental slope is interrupted by two marginal plateaus: the Eyre Plateau in the west and the Ceduna Plateau in the east. The slope south of the plateaus adjoins the continental rise at a depth of 3.6 km. The abyssal plain is abnormally deep in this area, reaching depths of about 5.7 km.

2.3 Geophysical Surveys

Several aeromagnetic and many small detailed seismic surveys have been carried out over the continental shelf in the Great Australian Bight. The results of the largest aeromagnetic survey and of the major seismic surveys are summarized below. Two survey vessels the Oceanographer and the Diamantina recorded seismic reflection, gravity, and magnetic data along regional profiles over the continental slope and their results are reported by Conolly et al. (op. cit.).

Aeromagnetic surveying by Geophysical Associates (1966) between Eucla and Kangaroo Island, indicated basement depths of about 1 km. Basement depressions were located south of Eyre and near the head of the Bight. An elongate depression striking easterly, with depths of over 2 km, corresponded with the seismically defined Elliston Trough. A basin lying across the continental slope west of Kangaroo Island was indicated by basement depths of 5 to 6 km (Duntroon Basin).

Early reflection and refraction siesmic surveys (Tenneco, 1966; Shell, 1966, Tenneco, 1967a) largely confirmed the aeromagnetic interpretation. The average depth to basement was about 1 km with a few troughs containing 2 km of sediments. There was no sign of structure within these sediments. 'T delta T' analysis showed that the seismic velocity in the sedimentary section was about 2.3 km/s.

The basement depression off Eyre, shown on the Tectonic Map of Australia and New Guinea (Geological Society of Australia, 1971) was investigated by Genoa Oil N.L. (1970) and Hartogen Exploration (1971) using a 12-fold Common Depth Point (CDP) technique. Mainly structureless sediments were found above a basement reflector at about 00 m depth. Offshore, a north-easterly-trending trough about 5 n miles wide, contains up to 2.3 km of sediments.

The Polda Basin 2 seismic survey (Target 1971) gave 24-fold CDP coverage over the Polda (Elliston) Trough. An apparently smooth basement was found at about 2.0s record time, corresponding to a minimum depth of 2 km. In the eastern part of the trough a structure with about 150 m closure was located 670 m below sea level. Refraction records showed velocities of 5.5 to 6.1 km/s at depths of about 2 km. The reflection seismic section character and the low seismic reflection velocities below these refractors show that they are high-velocity intrasediment layers, possibly volcanics. A survey along the edge of the continental shelf, west of the Polda Trough, showed less than 1 km of sediments (Shell, 1971).

In the Duntroon Basin extensive surveying has been carried out by Shell (1971, and five unsubsidized surveys). This has shown that about 6 km of sediments overlie downfaulted basement blocks. Tertiary sediments about 1.5 km thick are separated from a folded Mesozoic section by a pronounced angular unconformity. Several trends and potential traps for hydrocarbons have been recognised. Two unsubsidized wells have been drilled; one in the northern part of the basin, and the other close to the centre.

In Spencer Gulf seismic records are generally poor. A maximum sediment thickness of 370 m was found in a possible graben in the northeast of the Gulf (Tenneco, 1967b; Delhi, 1967).

In the Gulf St Vincent most seismic records are unusable (Beach, 1967, 1969); however, there is a slight indication of 1.5 km of sediment in one area.

High-quality seismic records are available in the Gambier Embayment of the Otway Basin from work (Esso, 1964/65) which showed a sedimentary section 4.5 km thick, with marked angular unconformities in the pre-Cretaceous, pre-Upper Cretaceous and pre-Tertiary. Several stratigraphic traps were identified. Other surveys (Esso, 1967, 1968a, 1968b, 1969) have proved the presence of shallow basement in Encounter Bay, allowed interpretation of complex faulting in the Upper Cretaceous, and provided details over individual prospects.

3. DESCRIPTION OF RESULTS

3.1 Bathymetry

The survey confirms that the continental shelf is almost featureless, forming a gently dipping plain to between 110 and 170 m (Pl. 5). In the Esperance area the shelf is about 60 km wide, falling away steeply at its edge. From the Archipelago of the Recherche eastwards to the Eyre Peninsula it forms a large arcuate plain attaining a maximum width of 200 km. Farther to the southeast the width of the shelf varies from 50 to 200 km, and in the extreme southeast of the map area narrows to about 20 km.

The continental slope is variable in width, gradient, and form. South of the Archipelago of the Recherche, gradients are up to 6°. Inflections in the contours indicate that extensive canyons run predominantly down the slope, but these are poorly defined in Plate 5 probably owing to use of hourly values and sparseness of lines parallel to the slope. The base of the slope is reached at about 3.0 km.

The major part of the slope between Eyre and Ceduna is occupied by the Eyre Plateau and Ceduna Plateau, in the west and east respectively.

Off Eyre, the continental slope dips at about 2° in a south-south-easterly direction from the 200-m isobath. At 400 m it flattens out to about 1° to form the Eyre Plateau. This is an oval feature about 60 km wide and about 300 km long. Its outer limit occurs at the 1.6 -km isobath. Beyond this the slope steepens to 5° and merges with the continental rise at about the 3.5-km level.

The much larger Ceduna Plateau is a better defined feature about 130 km wide and about 600 km long. The gradient across the plateau is 0.5° with depths increasing to the south and southwest. The upper limit of the Ceduna Plateau also occurs at about the 400-m isobath but the lower limit lies close to the 2.0-km isobath. The lower slope has a gradient averaging 3°, and is much gentler than that below the Eyre Plateau. The slope merges with the continental rise at about 4.0 km.

The continental slope off Kangaroo Island is similar to that found in the west, having gradients of up to 6° and canyon development. Here, however, the slope extends down to about 4.6 km.

Farther east the gradient of the slope decreases to about 2° and the width increases to 120 km. South of Kangaroo Island some canyons are indicated by inflections in the contours but sparsity of lines parallel to the coast prevents adequate definition. At the southern limits of the lines surveyed in this area water depths of 4.8 km were recorded without reaching the continental rise.

The continental rise is a smooth sediment-formed apron lying between the continental slope and the abyssal plain. The upper limit of the rise was delineated by the survey, except in the area east of 138°E where the survey lines did not extend sufficiently far south. The top of the rise is at about 3.0 km off Esperance but deepens progressively to the east, possibly reaching 5.0 km in the extreme southeast of the map. South of the Eyre Plateau the rise is abnormally broad, probably exceeding 120 km. In contrast, south of the Ceduna Plateau it is only about 50 km wide. The lower limit of the rise and the edge of the abyssal plain were only encountered on a few survey lines.

The abyssal plain appears to be reached at about 5.0 km and deepens to at least 5.4 km. It is deeper than elsewhere around the Australian coast.

3.2 Bouguer anomalies

Plate 6 shows Bouguer anomalies contoured at 10-mGal intervals. The computation procedure is given in Appendix II.

Two major zones can be recognised in the Bouguer anomalies; a broad undulating pattern over the continental shelf, and a steep regional gradient which extends from east to west across the map. Over much of the continental shelf, the upper edge of the continental slope, and the Ceduna Plateau the anomalies range over + 50 mGal and have a predominant wavelength of about 100 km. Northerly and easterly trends occuring in the eastern half of the map can be readily traced onshore (Pettifer & Fraser, 1974). In general, these trends appear to be truncated at the edge of the continental shelf. Between the top of the continental slope and the abyssal plain, the anomalies increase from +20 to +220 mGal and form a uniform gradient. Such gravity gradients are typical of most continental margins and originate at the crust-mantle interface. They tend to obscure the gravity effects of near-surface geology.

West of Eucla a regional gravity platform with Bouguer anomalies varying between -10 and +30 mGal corresponds with the continental shelf. Weak southeasterly trends are seen in a series of en echelon Bouguer anomaly ridges north of the Eyre Plateau.

A regional Bouguer anomaly depression overlies the coast about Eucla. It is 250 km wide and extends 150 km offshore, being bounded by the zero mGal contour level. The minimum value of -40 mGal lies 100 km east of Eucla and overlies the axis of the Denman Basin (Plate 4).

An intense Bouguer anomaly ridge with northerly trend and a crest value of +50 mGal stretches from the coast midway between Eucla and Ceduna to the northern edge of the Ceduna Plateau. It joins the broad onshore Bouguer anomaly ridge which runs northeasterly around the margin of the Gawler Block; the southwest end of this ridge can be seen as a +50 mGal anomaly off the coast at the head of the Bight. The eastern flank of the offshore ridge is marked by a linear gradient of 4 mGal/km, which corresponds with the Pintumba Fault (Plate 4).

A regional Bouguer anomaly depression lies east of the steep gradient and extends across the coast. It consists of a broad northern lobe and a southern trough, which has a pronounced easterly trend. Both features attain minimum values of -50 mGal. The Bouguer anomaly trough appears to be the gravity expression of the Polda Trough. A series of minor gravity lows along the edge of the continental shelf indicates that the Polda Trough structure could extend westwards.

A gravity platform extends over much of the Ceduna Plateau. Bouguer anomalies form a rough horseshoe which opens to the west, with values at the edge of the plateau 20 to 30 mGal higher than those over the central area. The anomalies have similar characteristics to those on the continental shelf, suggesting that the Ceduna Plateau is a natural extension of the continental mass.

Parallel to the edge of the continental shelf, stretching northwestwards from Kangaroo Island, is a series of Bouguer anomaly lows flanked on the northeast by a series of small highs. These anomalies seem to follow the trace of the Cygnet-Snelling Fault (Plate 4) as indicated by previous seismic surveys. The particular low, about 50 km northwest of Kangaroo Island, is the only obvious gravity expression of the Duntroon Basin.

At the head of Spencer Gulf and in Gulf St Vincent the Bouguer anomalies have a northerly trend. The Bouguer anomaly lows of -20 and -40 mGal are probably caused by the Pirie-Torrens and St Vincent Basins. About 100 km east-southeast of Kangaroo Island a Bouguer anomaly low overlies the basement shelf just north of the Gambier Embayment.

The southern zone of Bouguer anomalies consists of a regional gradient with values increasing southward. Generally, the gradient is steepest in areas corresponding with the continental slope and less steep to the north and south. South of Esperance, only the central and southern part of the feature were recorded, approximately overlying the continental slope and rise. The central part consists of gradient of about 2 mGal/km and in the southern part this decreases to about 1 mGal/km. Minor Bouguer anomaly troughs which run across the regional trend correspond with canyons on the continental slope. The gravity effect of the canyons has not been completely removed by the Bouguer correction as it approximates the water layer to a plain parallel slab. The decrease in gradient in the southern Bouguer anomaly field is largely due to levelling of the base of the crust. The salient in the 180-mGal contour is caused by relatively thick sediments on the continental rise.

The Eyre Plateau is almost entirely within the northern part of the regional Bouguer anomaly gradient. It appears to lie near the margin of the continental mass, and is underlain by basement rocks which are nearer sea-bottom than those beneath the Ceduna Plateau. There is some indication that northwesterly trends, similar to those south of Eyre, may extend onto the Eyre Plateau. The increased separation of contours south of the continental slope is caused at least partly by a thick wedge of sediments in this area. The rise in Bouguer anomalies at the southern end of lines 16/064 and 16/066 correlates with a basement ridge or band of igneous bodies.

Relatively smooth Bouguer anomaly contours lie between the southern edge of the Ceduna Plateau and the continental rise. The northern and southern ends of the regional Bouguer anomaly gradient have gradients of about 1 mGal/km, with an intervening gradient of almost 2 mGal/km. The smoother Bouguer anomaly contours over the continental slope in the area are caused by a smooth sea-bottom free of canyons.

Off Kangaroo Island, only the northern and central parts of the regional Bouguer anomaly gradient have been recorded. The gradient is about 3 mGal/km. Southeast of Kangaroo Island re-entrants in the contours are probably caused by large canyons. The easterly-trending re-entrant in the 60 mGal and 70 mGal contours south of Kangaroo Island is aligned with the fault or hingeline along the northern edge of the Gambier Embayment.

In the southeast of the map there is a fairly uniform gradient of 1.5 mGal/km, from just off the coast to 140 km or more offshore. The gravity effect of thick sediments in the Otway Basin is largely obscured by that of crustal thinning.

3.3 Magnetic anomalies

The magnetic anomaly is computed as the difference between the measured field, corrected for diurnal variation, and the International Geomagnetic Reference Field (IGRF) (Appendix II). The magnetic anomalies are shown in Plate 7.

Numerous high-amplitude anomalies about 10 km across were recorded on the continental shelf. However, use of hourly values for preparation of contour maps has caused aliasing of wavelengths less than about 30 km. Also, there is a tendency for contours to be aligned in an easterly direction owing to the northerly orientation of the survey lines.

In the Great Australian Bight the annual change in total intensity used in calculating the IGRF differs from the changes measured at Gnangara and Toolangi Observatories and primary magnetic stations by a maximum of 30 gammas/year. At several primary magnetic stations around the Bight the IGRF and the observed field are diverging year by year, with the IGRF up to 500 gammas above the observed regional field at the time of the survey. Use of the IGRF as the regional field is believed largely responsible for the preponderance of negative anomalies in the area; the anomaly values shown in Plate 7 are about 75 percent negative on the continental shelf and Eyre Plateau, and almost entirely negative on the Ceduna Plateau continental slope and rise.

The magnetic anomalies form two major groups. West of the Eyre Peninsula, the continental shelf and the Eyre Plateau are associated with intense anomalies which have predominant wavelengths of 30 to 60 km. In general, amplitudes range from -500 to +500 gammas although individual anomalies may exceed 3000 gammas, as at the head of the Bight. On the Ceduna Plateau, continental slope, and rise, a regional magnetic low attains values of about -750 gammas. It extends across the shelf near Eyre Peninsula and gives rise to the complex negative pattern in Spencer Gulf and about Kangaroo Island. A poorly defined magnetic ridge with values of about -250 gammas lies at the foot of the rise.

Intense short-wavelength anomalies characteristic of most of the continental shelf were recorded off Experance; however, the picture is incomplete as surveying did not extend into the Archipelago of the Recherche.

Off Eyre, the continental shelf and Eyre Plateau are occupied by intense magnetic anomalies which form poorly defined ridges and troughs with northwesterly and westerly trends. About 50 km east of Eyre a northerly-trending band of negative anomalies correlates vaguely with an area of sediment-filled channels determined by previous seismic surveys.

Between Eucla and the head of the Bight the magnetic anomalies are very intense but are without well defined trends. Over most of the shelf there is no correlation with Bouguer anomalies.

Midway between Eucla and Ceduna a northerly-trending band of negative anomalies attains a minimum of -1150 gammas. Near the coast it is truncated by an intense positive anomaly of +2700 gammas, which appears to form a dipole field with a low of -750 gammas to its southwest. The negative band corresponds with the intense Bouguer anomaly ridge described above.

Off Ceduna the anomalies are less intense but have a well defined easterly strike. A magnetic dipole with values ranging from +200 to -550 gammas overlies the Polda Trough about 100 to 150 km offshore. An intense linear gradient of 25 gammas/km strikes along latitude 33°S. Although this easterly trend is disrupted in some areas it probably extends westwards as far as 128°E. The trend correlates with the line of Bouguer anomaly lows and it probably related to the structural trend associated with the Polda Trough.

A triangular area of magnetic highs lies between the southern edge of the Polda Trough and the Ceduna Plateau. It corresponds to an area of the Gawler Block shown on the Tectonic Map of Australia and New Guinea (Geological Society of Australia, 1971).

A northerly-trending magnetic anomaly low occupies Spencer Gulf and the tip of Yorke Peninsula, and extends south to Kangaroo Island. Intense positive anomalies attaining values of +600 gammas, with gradients of 25 gammas/km, are found in eastern Spencer Gulf. In Gulf St Vincent a very marked northerly trend is formed by a gradient of 25 gammas/km. This is truncated at 35°30'S.

The regional magnetic low over much of the continental slope is caused by relatively deep basement. Off Esperance the anomaly consists of a series of lows which could result from pockets of sediment. The broad low south of the Eyre Plateau and over the Ceduna Plateau is related to relatively thick sediments seen on the seismic sections. Near the Eyre Peninsula the anomaly breaks up into a series of small lows which trend through Kangaroo Island to the coast. These approximately overlie the Duntroon Basin and part of the Kanmantoo Trough. It is believed that the broad magnetic low cannot be caused entirely by the relatively deep water in the area, but must be partly due to deep basement beneath thick sediments.

A magnetic ridge of up to -150 gammas was observed on six lines south of the Eyre and Ceduna Plateaus at about 36°S. This could be a continuous easterly-trending anomaly, but this cannot be confirmed by the existing lines, which terminate north of the area. The magnetic ridge seems to correlate with shallow intrusive basement seen on the seismic sections.

A further magnetic ridge about 50 km south of Kangaroo Island also correlates with intrusions. This extends eastwards into a magnetic platform over shallow basement immediately north of the Gambier Embayment.

3.4 Seismic data

The sediment thickness map used as the basis for Plate 8 was drawn by P. Petkovic from a preliminary interpretation of the single-channel seismic monitor records from the Continental Margin Survey. Sediment thicknesses have been estimated by assuming a seismic velocity of 2 km/s. The reliability of the data has been categorized as follows:

GOOD - basement reflector visible; true thickness of sediments measured.

FAIR - basement reflector obscured by multiples; thickness of sediments estimated.

POOR - basement beneath depth of seismic penetration; minimum sediment thickness measured.

Bathymetric provinces, basement ridges, major faults, and the most prominent gravity and magnetic trends have been added using data from this survey. Faults found in previous surveys, taken mainly from the Gravity Map of Australia and New Guinea (1973), are also included. Most probable thicknesses of sediments were determined from all data available to the author. In many places depths to basement were available from aeromagnetic surveys, but seismic data, gravity anomalies, and borehole data have also been used.

In this area very little deep structure can be discerned on the continental shelf and mostly a veneer of sediment, 300 to 500 m thick, probably overlies crystalline Precambrian basement. The nearness of basement to the sea-bed over most of the shelf is confirmed indirectly by the presence of refraction events preceding the sea-bed reflection on the seismic profiles. However, some areas of relatively thick sedimentary rocks are evident.

The basement surface is fairly horizontal over most of the continental shelf, but between longitudes 128° and 133°E it dips gently southward to about 800 m at the shelf break.

On the continental shelf near Eyre, sediments about 1 km thick overlie rugged basement in an area corresponding with a depression in aeromagnetic basement (Geological Society of Australia, 1971), which has been explored by Genoa Oil N.L. (1970) and Hartogen Exploration (1971).

At the head of the Bight, on lines 16/136 and 16/138, possibly 1.5 km of sedimentary rocks overlies basement. The basement contains reflecting horizons which indicate that it is not igneous. It may consist of stratified Proterozoic volcanics, shales, and arkoses, similar to those intersected in the Mallabie No. 1 bore, in the adjacent Denman Basin. The sedimentary rocks consist of a slightly folded unit overlain unconformably by a flat-bedded unit, about 200 m thick. Most of the lower unit appears to terminate at 32°S against an area of elevated basement, but the uppermost beds overlie basement and dip southward at 0.5 degrees. The unit above the unconformity thickens to 600 m at the edge of the continental shelf and extends beneath the Ceduna Plateau.

These sedimentary rocks are part of the offshore Denman Basin. The unconformity probably lies within Eucla Basin sediments, possibly separating either Upper Cretaceous from Eocene, Eocene from lower Miocene, or within the lower Miocene section itself. Sedimentary rocks beneath the unconformity could range in age from Lower Tertiary to Proterozoic. The (?)late Tertiary unit extends beneath the Ceduna Plateau, but only the uppermost beds of the unit beneath the unconformity, possibly of Lower Tertiary and Cretaceous age, can be traced towards the Ceduna Plateau with any reliability.

A graben containing more than 1 km of sedimentary rocks occurs on line 16/077 and is vaguely seen on line 16/095, but definition is poor owing to high noise levels on the seismic sections. It represents the eastern end of the Polda Trough.

On the continental shelf 50 km west of Kangaroo Island, in the area of the Duntroon Basin, only 1 to 1.5 km of sedimentary section is visible down to the limit of seismic penetration, although a 6-km section has been recorded (Smith & Kamerling, 1969). However, about 2 km of section are seen beneath the continental slope in the southern Duntroon Basin and the horizons dip northward, probably extending beneath the continental shelf. A moderately folded unit, possibly of early Tertiary and Cretaceous age (Smith & Kamerling, op.cit.), lies unconformably beneath 100 to 200 m of flat-bedded sediments of late Tertiary and Quaternary age.

The Cygnet-Snelling Fault, the boundary between shallow crystalline basement and the northern edge of the Duntroon Basin, is not evident on the seismic sections.

In the area adjacent to the Eyre Peninsula, and in the southwestern parts of Spencer Gulf and Gulf St Vincent the seismic records are degraded by multiple reflections. However, the records show a high-velocity refraction preceding the sea-bed reflection, which indicates shallow basement; probably an offshore part of the Gawler Block. There is a vague indication of relatively thick sedimentary rocks in the northeastern parts of the Gulfs corresponding with the Pirie-Torrens and St Vincent Basins.

In the area southeast of Kangaroo Island, the Cape Jaffa Hinge Line, which divides shallow basement on its northern side from thick Otway Basin sediments on its southern side, lies along the southern edge of an area of refraction first arrivals, caused by the shallow basement.

Between 120° and 124°E, the continental slope is formed by major faults. The continental rise is at about 100 km wide, and is formed by sediments which are at least 1 km thick.

The structure across the Eyre Plateau is exemplified by Line 16/166, which is shown interpreted in Plate 9. The Eyre Plateau appears to be built on a rugged basement block downthrown by about 500 m. Basement almost crops out along the continental slope, south of the plateau. In the western part it underlies 500 m of sediment and contains erosion channels or grabens, but in the eastern part it underlies 1 to 2 km of sedimentary section and appears to be formed of two or three blocks, faulted and tilted towards the coast. The lowermost sediments infill the 'grabens' and between the peaks of the tilted basement blocks, and are overlain unconformably by a prograded unit. By analogy with the section in the offshore Eucla Basin, the unconformity probably lies within the early Tertiary. Hartogen Exploration (1971) has suggested that the sediments which infill channels offshore from Eyre are of Permian age, although there is no real supporting evidence, and this age could also apply to sediments which infill 'grabens' on the Eyre Plateau.

The continental slope south of the Eyre Plateau dips at 5-6° and is formed by one or two faults with a total throw of about 2.5 km. The continental rise is exceptionally broad, extending for about 120 km. It consists of a sedimentary section 1 to 2 km thick, comprising an upper flat-bedded sediment wedge extending from the continental slope, overlying with angular unconformity a lower disturbed unit. Basement is flat-lying over most of the area. Near the foot of the continental rise, elevated igneous basement, at least 60 km across, comes to within 100 m of the sea-bed. The igneous bodies are flanked by upturned beds within the lower sedimentary section, which could have been caused by intrusion of the bodies or as depositional bedding postdating the intrusion. They penetrate flat-bedded sediments within the upper section, which they appear to antedate. This feature has both gravity and magnetic expression and lies approximately on an easterly extension of the Diamantina Fracture Zone, which is a band of rough topography extending approximately along latitude 37°S from the Ninety East Ridge (Heezen & Tharp, 1965, 1966) and which Hayes & Conolly (1972) considered to terminate at about 120°E.

Plate 10 shows an interpretation of Line 16/136, typical of those across the central Ceduna Plateau. A minimum thickness of 2.5 km is estimated for the sedimentary section, but basement is beyond the limit of seismic penetration. The dips within the lower unit and gravity anomalies over the plateau indicate that the section could be 3 or 4 km thick. The sedimentary section consists of an upper unit of prograded sediments, about 600 m thick over most of the plateau but thinning out at the southern edge, overlying unconformably a lower moderately folded and faulted unit. On line 16/138 there is evidence that the lower unit includes another angular unconformity. Easterly-trending faults within the lower unit and basement have divided it into several blocks which have a slight tilt towards the north. Faulting intensifies towards the southern margin and tilting is more pronounced. Several large anticlines occur in the lower unit, particularly along the edge of the plateau. One such structure, with a closure of about 800 m, was crossed near the southern edge of the plateau on Line 16/136 (Pl. 10). Tie-line 16/142 suggests that this particular structure is a dome.

The upper unit can be traced onto the continental shelf and eastwards into the Duntroon Basin. The underlying unconformity is probably within the early Tertiary. The lower unit also seems to extend into the Duntroon Basin and its upper beds can be vaguely traced into the Denman Basin. By analogy with the section in the Otway Basin the lower unconformity, seen on Line 16/138, may be pre-Upper Cretaceous.

The continental slope south of the Ceduna Plateau is controlled by major faults. On several seismic sections basement comes to within a few hundred metres of sea-bed near the foot of the slope. The continental rise appears to be about 50 km wide and is formed by sediments 1 to 1.5 km thick.

On the continental slope in the Duntroon and Otway Basins the structure in the sedimentary section is similar to that beneath the Ceduna Plateau. The major unit is moderately folded and faulted, with faulted blocks tilted towards the north. Basement rises occur along the southern margins of these basins.

4. INTERPRETATION AND CONCLUSION

On the continental shelf most new information has been provided by the Bouguer anomaly and magnetic anomaly maps. On the Eyre Plateau, Ceduna Plateau, and continental slope the seismic records have been most valuable, as in these areas they are largely free of multiples.

Intense short-wavelength magnetic anomalies on the continental shelf are probably caused by relatively shallow magnetic basement. The seismic data on the continental shelf west of 135°E show shallow basement beneath about 300 m of sediments. This depth estimate is based on a seismic velocity of 2000 m/s, which is assumed to be characteristic of recent sediments. 'T-delta-T' analyses carried out by Tenneco (1966) have given a slightly higher value of 2300 m/s. In general, seismic basement seems to be about 500 m above magnetic basement as determined on the aeromagnetic survey by Geophysical Associates (1966). The two would be brought into coincidence if a sediment velocity of 3000 m/s were assumed; however, this seems unreasonably high. Basement is presumably a subsurface extension of the Fraser-Albany Province and the Gawler Block.

The western offshore limit of the Gawler Block may be marked by the intense north-trending gravity ridge, the eastern edge of which corresponds closely to what is probably a seaward continuation of the Pintumba Fault. The source of the anomaly is not known, but as there is little sediment cover in the area it must originate in the basement. It may result from an ancient mobile belt incorporating high-density rocks which are probably basic. Gravity highs have been recorded on the flanks of similar cratonic blocks in Western Australia. The southern and southwestern limits of shallow Gawler Block basement probably lie along a weak Bouguer anomaly ridge which corresponds to the Cygnet-Snelling Fault.

The nature of basement in the western half of the Bight remains conjectural. Thompson (1970) has proposed that the Gawler Craton extends as far west as the Archipelago of the Recherche, but there is little evidence to support this hypothesis. In fact, the Bouguer anomalies south of Eyre exhibit weak southeasterly trends similar to these over the Yilgarn Block.

It is probable that Gawler Block basement has been downfaulted to the south along the Cygnet-Snelling Fault, and underlies the Duntroon Basin and the Ceduna Plateau.

The Polda Trough gives rise to a well defined Bouguer anomaly and magnetic anomaly. The Bouguer amplitude, 40 mGal below the surrounding values, is consistent with a basement depth of 2.5 km determined from aeromagnetic data, providing a density contrast of 0.3 gm/cc occurs between sediments and basement. The trend of both Bouguer anomalies and magnetic anomalies indicates that faulting along the Polda Trough probably extends westwards, passing along the northern side of the Ceduna Plateau.

The Bouguer anomaly low about 100 km east of Eucla coincides with an area of relatively thick sediment in the offshore Denman Basin. However, the section is unlikely to be more than 1 to 1.5 km thick, and almost all strata beneath the thin late Tertiary unit are truncated against elevated basement at 32°S, about 50 km offshore. The magnetic field is relatively disturbed, indicating shallow magnetic basement over most of the area.

The northerly-striking magnetic gradient in Spencer Gulf is in alignment with a series of anticlines within the Gawler Block, and may be caused by a continuation of these structures beneath Spencer Gulf. Truncation of this northerly trend near Kangaroo Island coincides with the edge of the Gawler Block and the Cygnet-Snelling Fault, as shown on the Tectonic Map of

Australia and New Guinea. Evidence of the fault is seen vaguely in both the Bouguer and the magnetic anomalies but not on the seismic sections. The arcuate magnetic anomaly low which passes through Kangaroo Island is probably caused by relatively deep magnetic basement beneath the Kanmantoo Trough.

In Gulf St Vincent the northerly-trending magnetic contours follow the grain of the Torrens Lineament and the Adelaide Geosyncline.

The small Bouguer anomaly low seen in Plate 6 immediately west of Kangaroo Island is the sole gravity expression of the 6km pile of sediments known to be present in the Duntroon Basin (Smith and Kamerling, 1969) and is surprisingly weak, even though it may be partly masked by steep gradients across the continental slope.

The magnetic anomaly high at 139°E, 36°20'S overlies the basement shelf adjacent to the Gambier Embayment.

All data indicate that there is a contrast between sediment thickness on the Eyre and Ceduna Plateaus. The intense high-frequency magnetic anomalies, comparatively high Bouguer anomalies, and the seismic sections over the Eyre Plateau all show that this is an area of shallow basement, overlain by about 500 m of sediment. It is probably built on a group of downfaulted basement blocks with their surfaces tilted towards the continent, caused by taphrogenic collapse of the continental margin. The thin prograded upper sedimentary unit extends onto the continental shelf and is probably composed of Tertiary sediments. Early Tertiary to Permian sedimentary rocks possibly infill basement depressions on the plateau.

On the other hand, the gravity anomalies over the Ceduna Plateau, and also the dips with the lower basin-shaped unit indicate that the sedimentary section could be 3 or 4 km thick. This would be consistent with the magnetic anomalies which form a broad band of negative values over the Kanmantoo Trough, Duntroon Basin, Ceduna Plateau, and the area south of the Eyre Plateau. The negative values are presumably caused by deep basement and thick sediments.

The Ceduna Plateau is underlain by about 600 m of prograded sediments which can be traced into the Denman and Duntroon Basins, and are thought to overlie an unconformity of early Tertiary age. The sedimentary section beneath the unconformity is moderately folded and faulted, and probably consists of 1 to 1.5 km of early Tertiary and Upper Cretaceous rocks unconformably overlying Lower Cretaceous. The section is probably equivalent to that in the Duntroon Basin.

The sediments beneath the upper unconformity were deposited under fluviatile and shallow marine conditions on Gawler basement, and were possibly folded, and faulted into landward-tilted blocks during taphorgenic collapse of the continental margin. The upper unit postdates this movement.

The broad anticlinal fold at the edge of the plateau on lines 16/136 and tie-line 16/142 is a dome of amplitude 800 m, which although prospective is not yet exploitable as the water depth is 2000 m. The original depth of burial of the sediments was sufficient for generation of hydrocarbons. A prospective section probably lies beneath the entire Ceduna Plateau in water depths ranging from 600 to 2000 m.

Basement ridges are found beneath the continental slope south of the Ceduna Plateau, Kangaroo Island, and the Otway Basin. The ridge south of Kangaroo Island probably corresponds to the ridge along the southern edge of the Duntroon Basin, described by Smith & Kamerling (1969).

As mentioned above, water depths are 1 to 2 km over the Ceduna Plateau, and the sediments are probably 3 or 4 km thick. Sediments thus overlie a basement block with its surface close to the level of the abyssal plain. However, this basement is not likely to be oceanic.

Simple estimates of the depths to the base of the crust have been made from the Bouguer anomaly values, assuming a standard crust of 33 km and that the area is in isostatic equilibrium. The figures given may be in gross error if the area is not in isostatic equilibrium or if there have been any large-scale geological movements; however, in the absence of any deep crustal refraction data, they provide a reasonable estimate of the variation in crustal thickness across the continental margin.

Gravity anomalies over both the Eyre and Ceduna Plateaus indicate crustal thicknesses of 25 to 30 km, which are typically continental. The thickness of crust beneath the continental rise is estimated at between 10 and 20 km. The change from continental to oceanic thickness is more gradual south of the Eyre Plateau, where the continental rise is broader.

The thick sediments on the continental rise south of the Eyre Plateau are unlikely to be typical deep-ocean sediments as structurally they are quite similar to those beneath the Ceduna Plateau. A moderately folded lower section is unconformably overlain by a flat-bedded upper section. The northern edge is bounded by faults along the continental slope and a group of intrusions, possibly an easterly extension of the Diamantina Fracture Zone, (Heezen & Tharp, 1965), occurs in the south. Without bore-hole data it may be presumed that these sediments are related to those beneath the Ceduna Plateau and in the Duntroon Basin.

Widespread unconformities appear to be present within the sedimentary section over most of the Bight. Seismic sections indicate that the Lower Cretaceous/Upper Cretaceous unconformity identified in the Otway Basin probably lies beneath the Ceduna Plateau and may also occur beneath the continental rise south of the Eyre and Ceduna Plateaus. However, it has not been recorded in the Duntroon Basin. The unconformity which probably separates Upper Cretaceous from Eocene or lies within the early Tertiary, and is overlain by mildly deformed sediments, seems to extend over the offshore Eucla Basin, Polda Trough, Eyre and Ceduna Plateaus, Duntroon Basin, and Otway Basin.

In the Great Australian Bight, glacial, fluviatile, and shallow marine sediments of Permian to probably early Tertiary Ages were deposited above Precambrian basement. Several grabens with easterly-trending axes have developed since Permian and Jurassic times, probably in response to a tensional phase associated with the first stage of rifting within the Australian-Antarctic continent. Rifting apart of the continent appears to have taken place in the Lower Tertiary as sediments deposited before this are downthrown progressively to the south along a series of normal faults which have easterly strikes. Further, a possible easterly extension of the Diamantina Fracture Zone, which is probably associated with the early stages of rifting (Hayes & Conolly, 1972), lies along the southern edge of the continental rise, and this is flanked by magnetic anomaly 19 (Weissel, 1972), implying that the Fracture Zone existed before anomaly 19, or 47 m.y.B.P.

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APPENDIX 1

Equipment List M/V Lady Christine

Seismic

Amplifiers : SERCEL AS626. replaced by SIE PT700 from 16/5200

Recorders : four EPC 4100

6-channel hydrophone streamer : CGG manufacture

Single-channel streamer : Geotech

Tape recorder : 14-channel Ampex FM

Sparker : Teledyne 120 kJ, 4-electrode pairs replaced by single electrode from 16/3100

Gravity and Magnetics

Gravity Meter : La Coste & Romberg stabilized platform air-sea gravity meter (S-24)

Magnetometer : Varian proton procession

Data Acquisition System

Computer : HP2116B 8K

Interface : SERCEL

A/D Converter : HP2301 B

Tape recorder : HP2020 B, 32-channel, 556 bpi

Teletype : ASR 35

Navigation

Satellite receiver : ITT

Computer : Digital PDP 8/1

Gyrocompass : Anschutz

Sonar doppler : Marquardt

Electronic Log : Chernikeeff

Pressure Log : Hartmann and Braun

VLF receivers : Tracor (used in range-range mode)

Other Equipment

Fathometers : one Elac, one Atlas Edig, one EDO Western Digitrack

Anemometers : Alcyon

Analog recorders : Westronic and Linax

D/A converters : SERCEL and HP 580A

APPENDIX II

Computation of Bouguer anomalies and magnetic anomalies

The Bouguer anomalies were computed by applying latitude corrections and Eötvös corrections (Glicken, 1962) to the observed gravity data, and then applying a Bouguer correction. They are given by the formula:

$$(BA) = 978.049\,(1 + 0.0052884 \sin^2 \phi - 0.000005 \sin^2 2\phi) + 7.5\,Ve + 2\pi G \Delta\rho\, d$$

where, (BA) = Bouguer anomaly

Ve = eastward component of velocity in knots

G = Universal Gravitational Constant,

$\Delta\rho$ = difference in density between water and sediments, assumed to be 1.2 g/cm^3.

d = water depth in metres

The magnetic anomalies were computed using the formula:

(magnetic anomaly) = (observed total magnetic field) - (IGRF) - (diurnal),

where (IGRF) is the International Geomagnetic Reference field,

and (diurnal) is the departure of the field from its mean value, at a shore monitor station.

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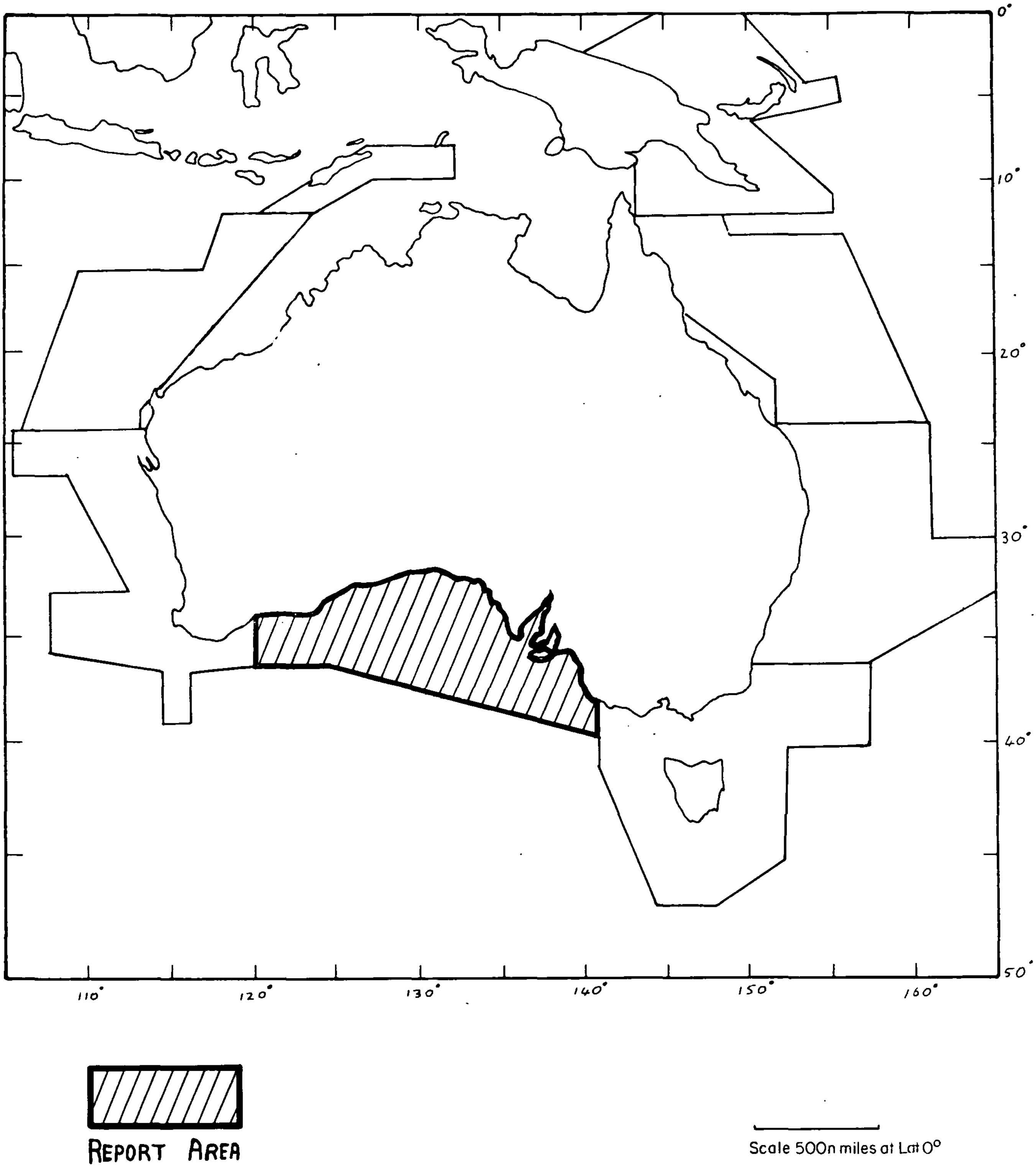
PLATE I



GEOPHYSICAL RESULTS FROM THE
GREAT AUSTRALIAN BIGHT

LOCALITY MAP

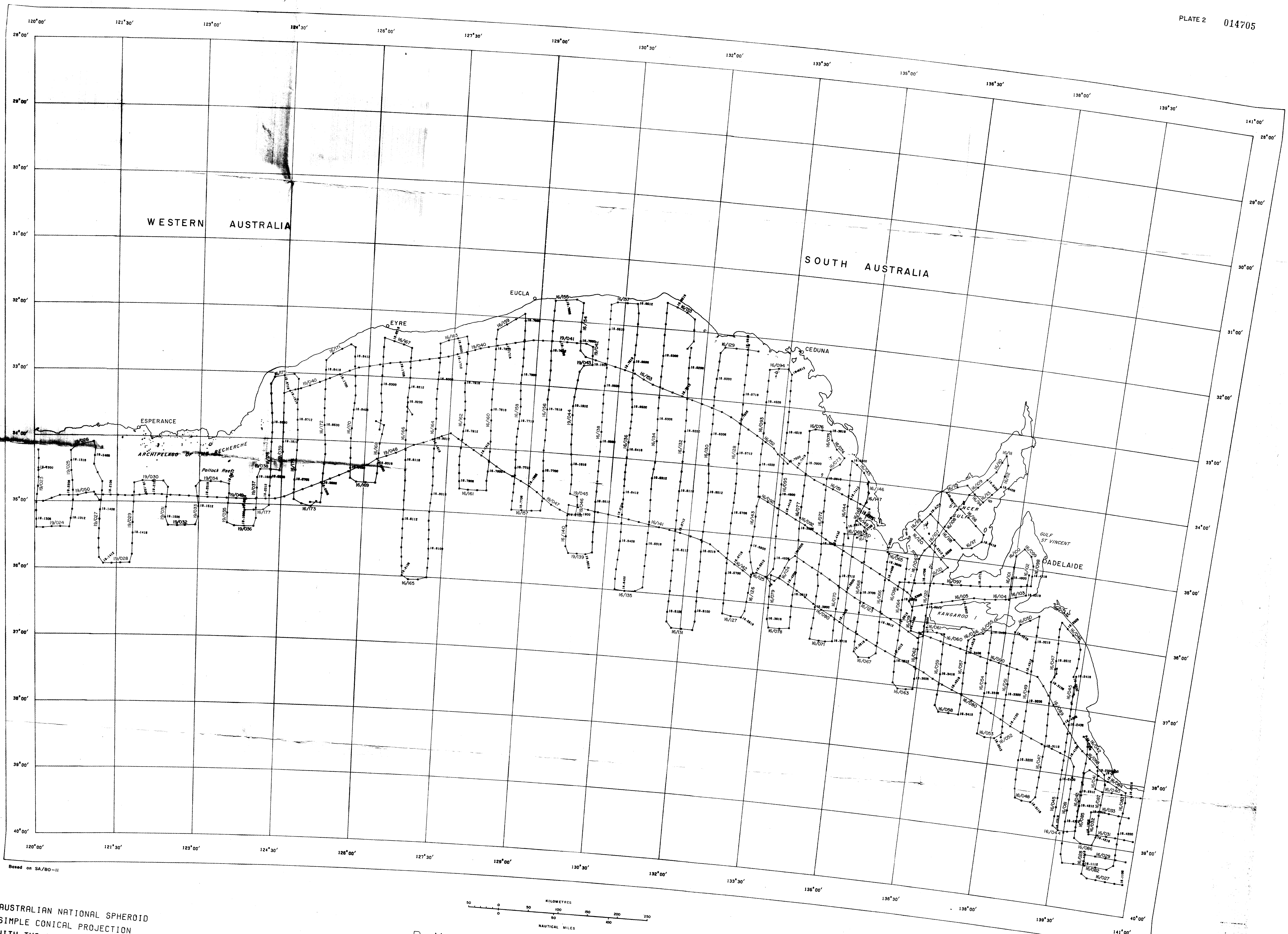
(Based on A/BO-62A) Record No.1974/147

A/B8-75A

PLOTTED 73/07/26

AUSTRALIA 1: 2500000

GREAT AUSTRALIAN BIGHT



AUSTRALIAN NATIONAL SPHEROID
SIMPLE CONICAL PROJECTION
WITH TWO STANDARD PARALLELS
AT 18° 0′ AND 36° 0′ SOUTH

Record No.1974/147

NOTE: ***The** information contained in this map has been obtained **by the** Department of Minerals and Energy, as part of the **policy** of the Australian Government, to assist in the **exploration** and development of mineral resources. **It may** not be published in any form or used in a company **prospectus** or statement without the permission in **writing** of the Director, Bureau of Mineral Resources, **Geology** and Geophysics.*

B M R 1970-73 MARINE SURVEYS

TRACK CHART

Contour interval

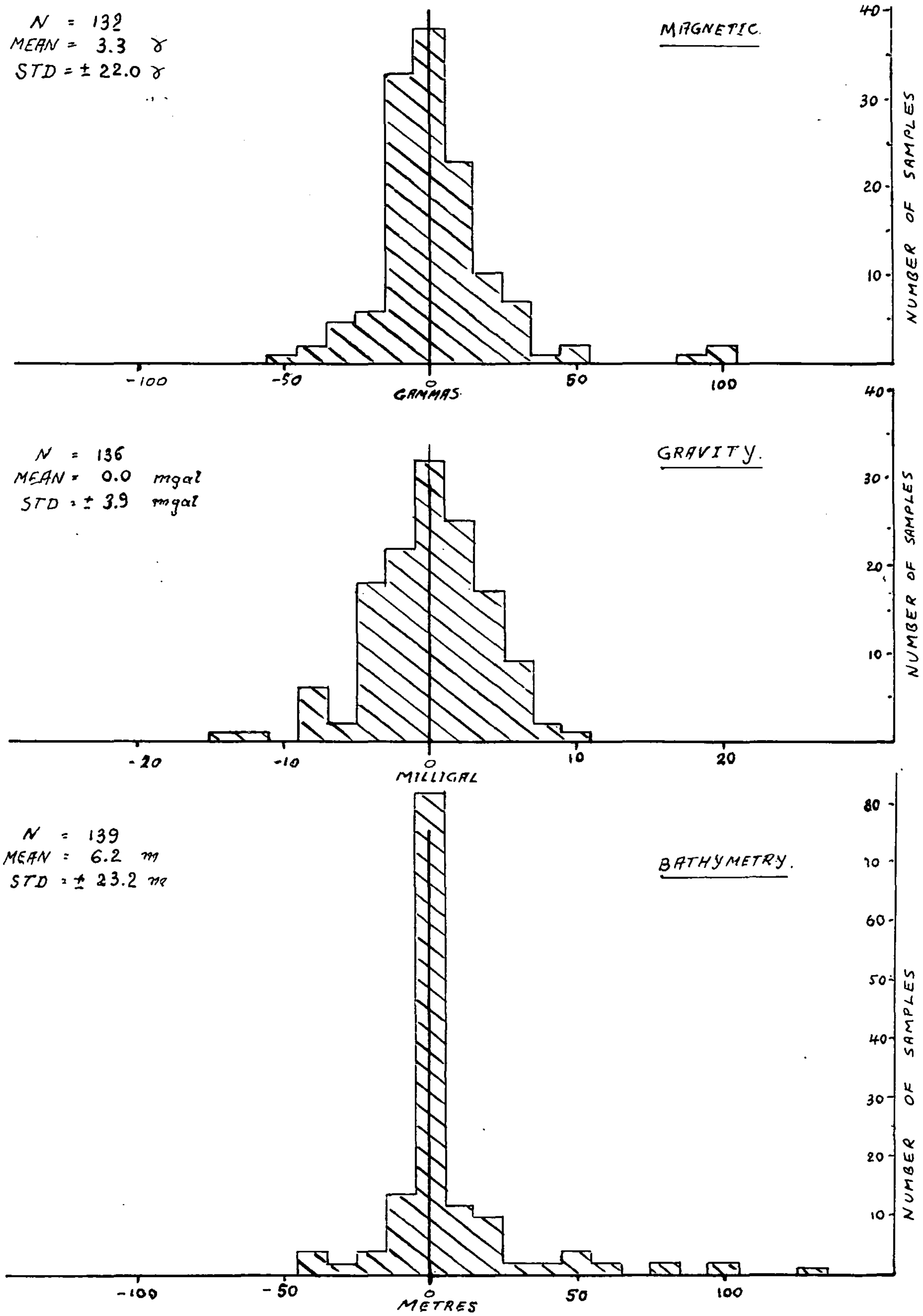
The ship's position is plotted from hourly values based on preliminary data and tied to the satellite navigation fixes. The track line is a linear interpolation between these hourly positions. No adjustments have been applied for misties at traverse intersections.

GREAT AUSTRALIAN BIGHT

AREA 5

SA/BB-18-1

PLATE 3



MAGNETIC, GRAVITY, & BATHYMETRIC MISTIES

Record No.1974/147

TECTONIC FRAMEWORK OF SOUTHERN AUSTRALIA

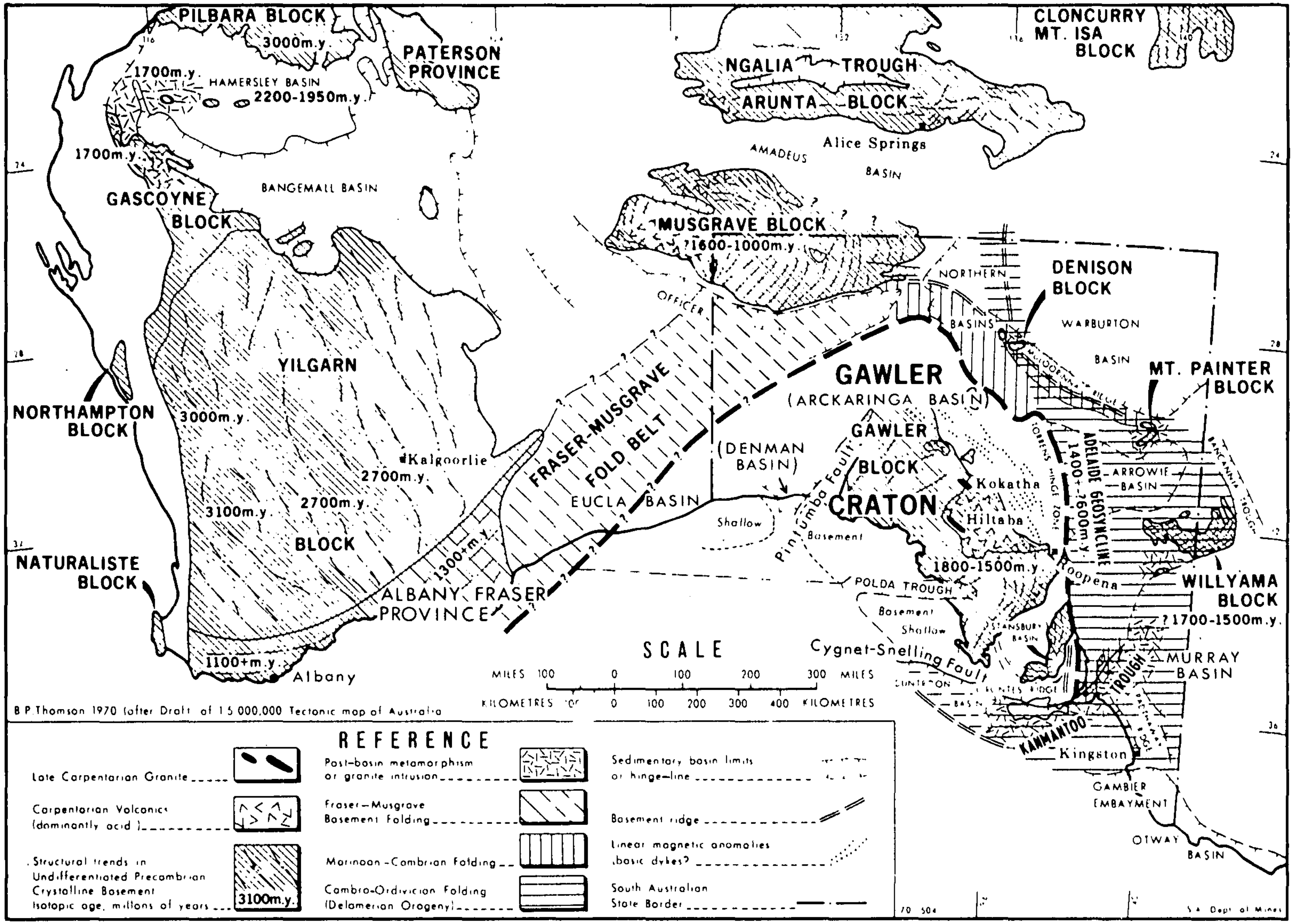


PLATE 4

014705

SA/B8-2A

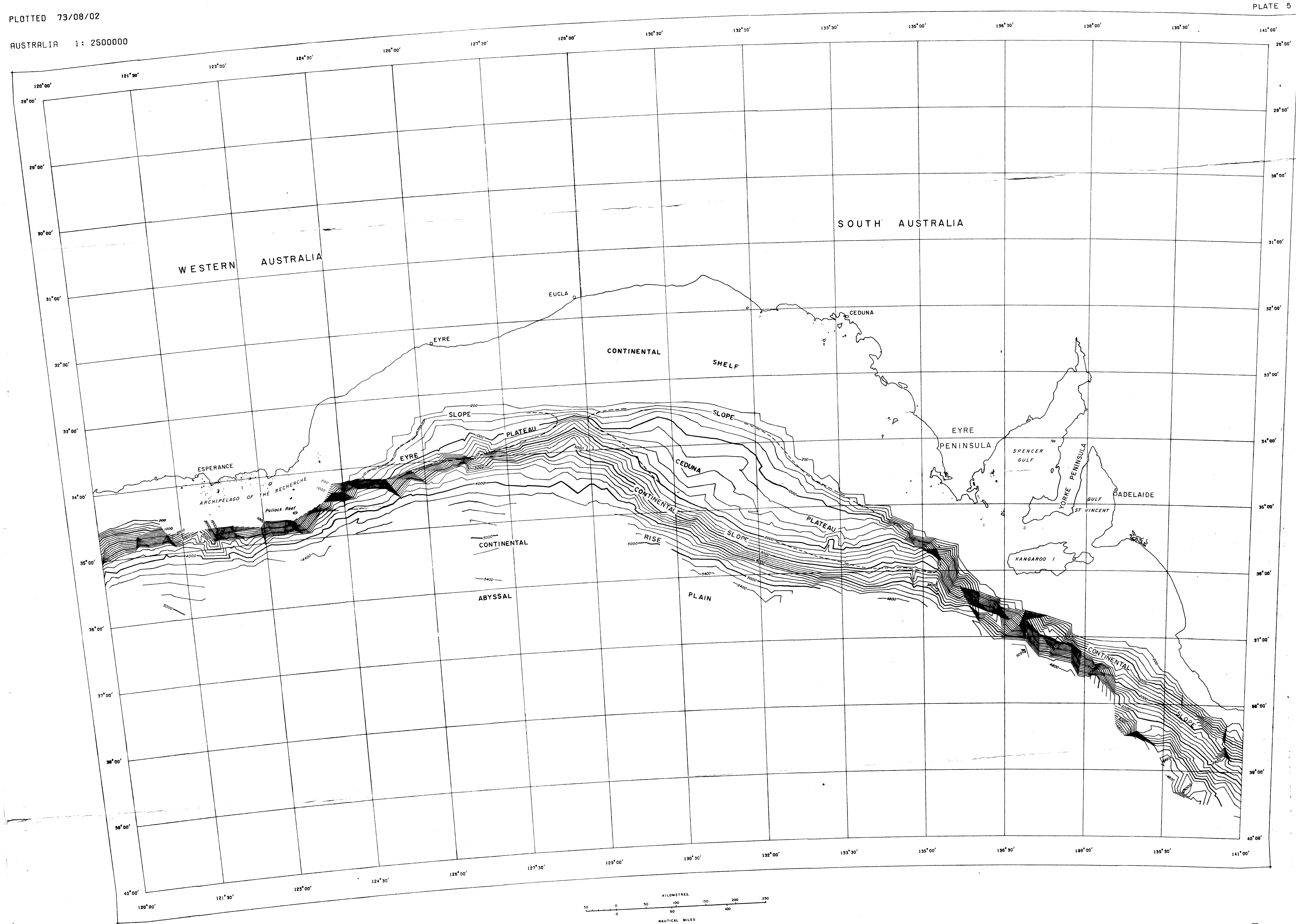
GREAT AUSTRALIAN BIGHT

014705

PLOTTED 73/08/02

PLATE 5

AUSTRALIA 1: 2500000



B M R 1970-73 MARINE SURVEYS

GREAT AUSTRALIAN BIGHT

AREA 5

SA/B8-17-2

AUSTRALIAN NATIONAL SPHEROID
SIMPLE CONICAL PROJECTION
WITH TWO STANDARD PARALLELS
AT 18° 0' AND 36° 0' SOUTH

NOTE: The information contained in this map has been obtained by the Department of Minerals and Energy, as part of the policy of the Australian Government, to assist in the exploration and development of mineral resources. It may not be published in any form or used in a company prospectus or statement without the permission in writing of the Director, Bureau of Mineral Resources, Geology and Geophysics.

WATER DEPTH (METRES)

Contour interval : 200 metres

Data used are preliminary, and are based on hourly values extracted on board the survey vessel. No adjustments have been applied for misties at traverse intersections.

Contour lines are drawn by computer using a triangular contouring program. A triangular plate is defined by three adjacent stations whose circumscribing circle contains no other stations. Linear interpolation is then used on the triangular plate. Should any side of an acceptable triangle exceed 40 nautical miles, that plate is not contoured.

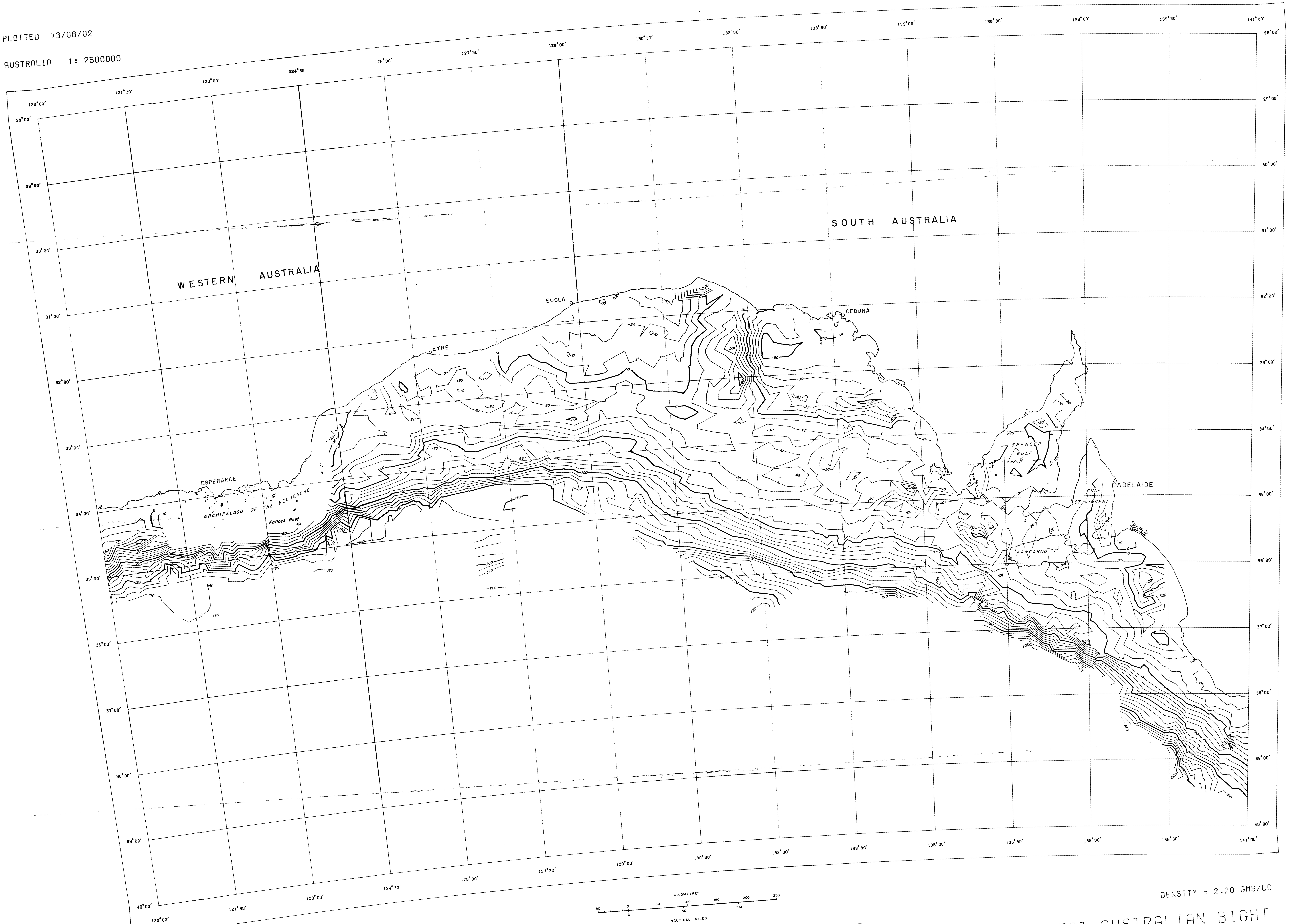
Record No. 1974/147

014705
PLATE 6

GREAT AUSTRALIAN BIGHT

PLOTTED 73/08/02

AUSTRALIA 1: 2500000



Based on SA/BO-11

DENSITY = 2.20 GMS/CC

B M R 1970-73 MARINE SURVEYS

GREAT AUSTRALIAN BIGHT

AREA 5

SA/B2-41-1

AUSTRALIAN NATIONAL SPHEROID
SIMPLE CONICAL PROJECTION
WITH TWO STANDARD PARALLELS
AT 18° 0' AND 36° 0' SOUTH

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BOUGUER ANOMALIES

Contour interval: 10 milligals

Data used are preliminary and are based on hourly values extracted on board the survey vessel. No adjustments have been applied for misties at traverse intersections.

Contour lines are drawn by computer using a triangular contouring program. A triangular plate is defined by three adjacent stations whose circumscribing circle contains no other stations. Linear interpolation is then used on the triangular plate. Should any side of an acceptable triangle exceed 40 nautical miles, that plate is not contoured.

Record No.1974/147

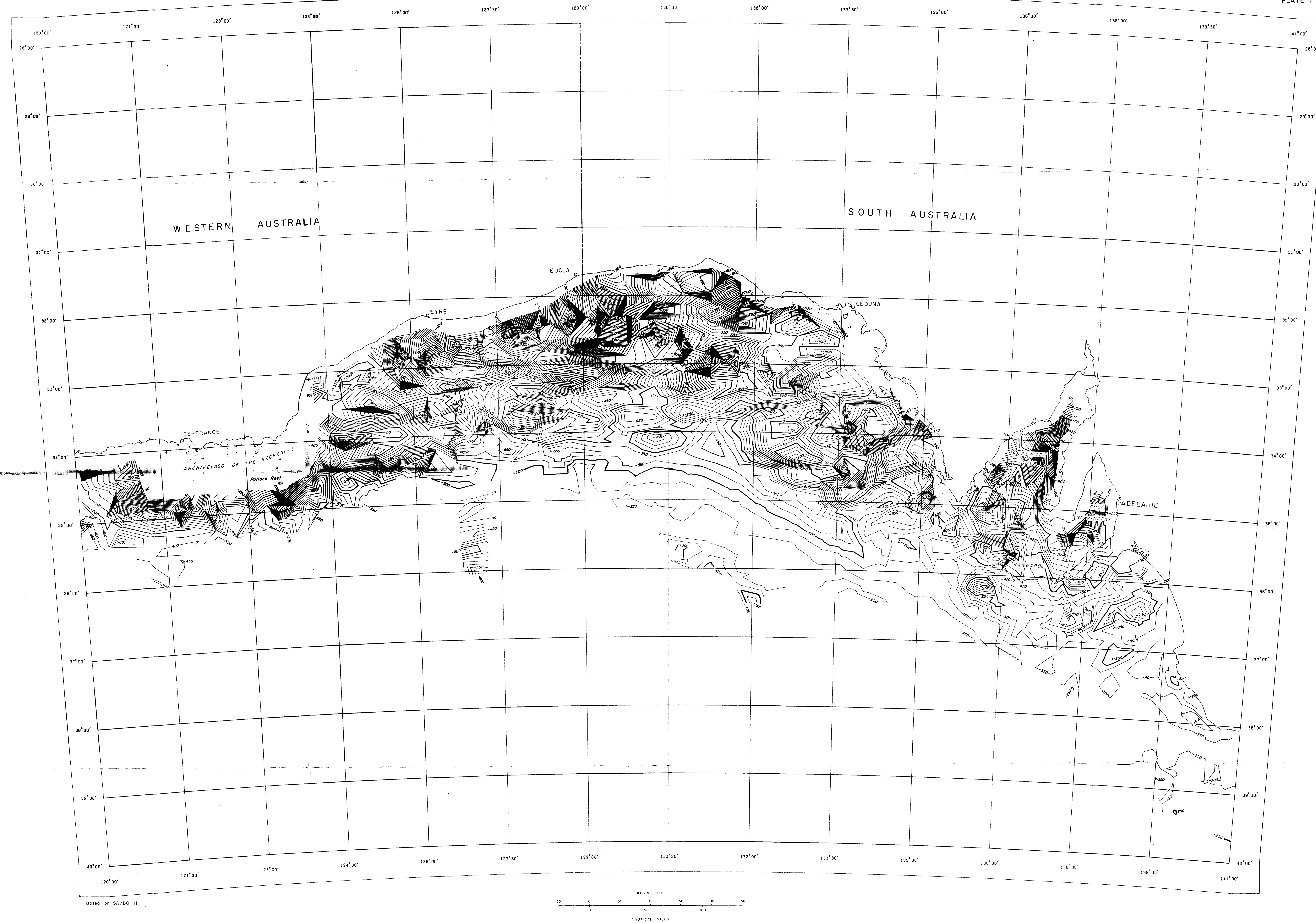
GREAT AUSTRALIAN BIGHT

PLOTTED 73/07/13

AUSTRALIA 1: 2500000

014705

PLATE 7



Based on SA/BO-II

AUSTRALIAN NATIONAL SPHEROID
SIMPLE CONICAL PROJECTION
WITH TWO STANDARD PARALLELS
AT 18° 0' AND 36° 0' SOUTH

Record No 1974/147

B M R 1970-73 MARINE SURVEYS

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MAGNETIC ANOMALIES

Magnetic values reduced to the International Geomagnetic Reference Field
Contour interval 50 gammas

Data used are preliminary, and are based on hourly values extracted on board the survey vessel. No adjustments have been applied for misties at traverse intersections.

Contour lines are drawn by computer using a triangular contouring program. A triangular plate is defined by three adjacent stations whose circumscribing circle contains no other stations. Linear interpolation is then used on the triangular plate. Should any side of an acceptable triangle exceed 40 nautical miles, that plate is not contoured.

GREAT AUSTRALIAN BIGHT

AREA 5

SA/BI-2-I

014705

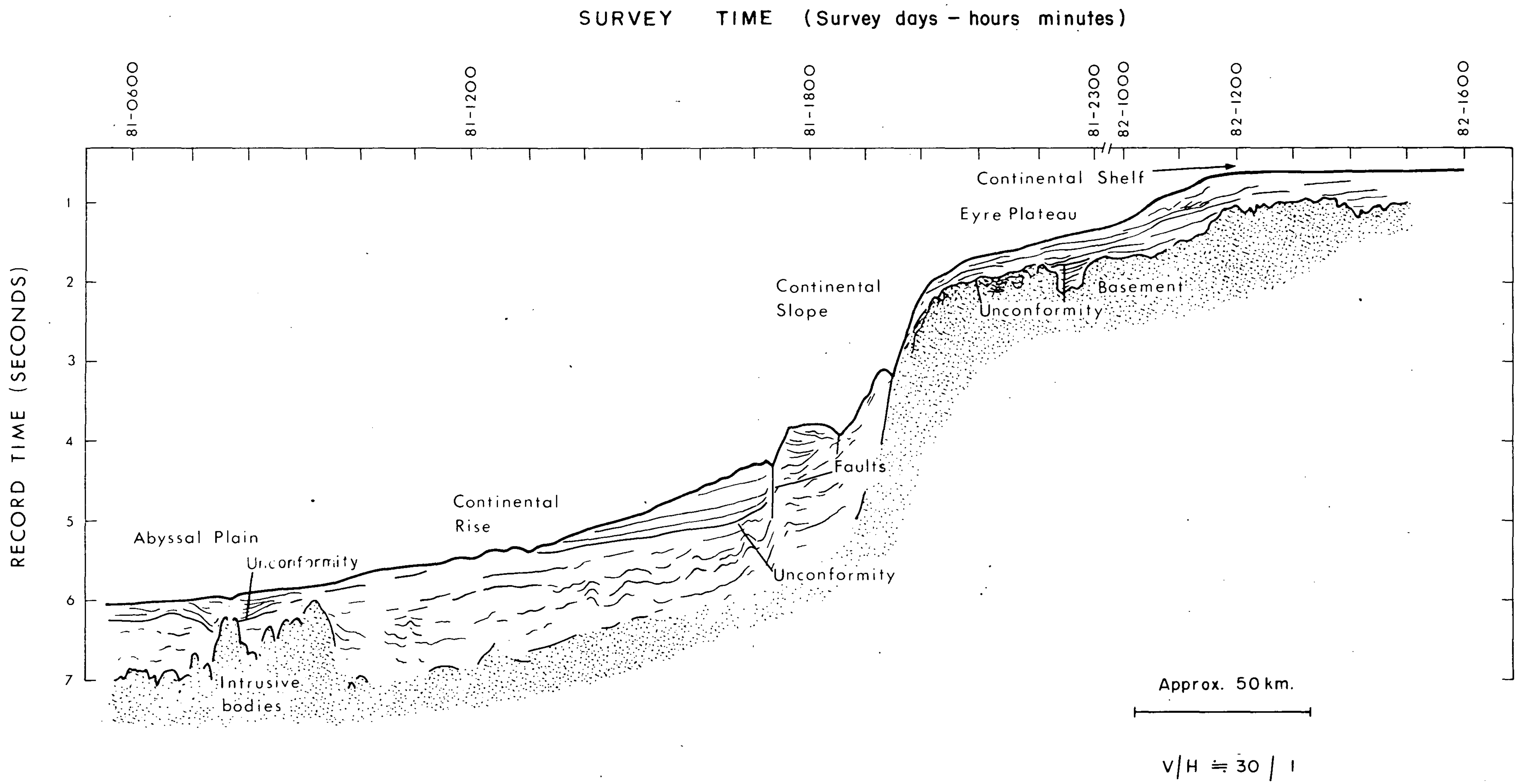
PLATE 8

SEDIMENT THICKNESS & STRUCTURAL SKETCH

Record No.1974/147

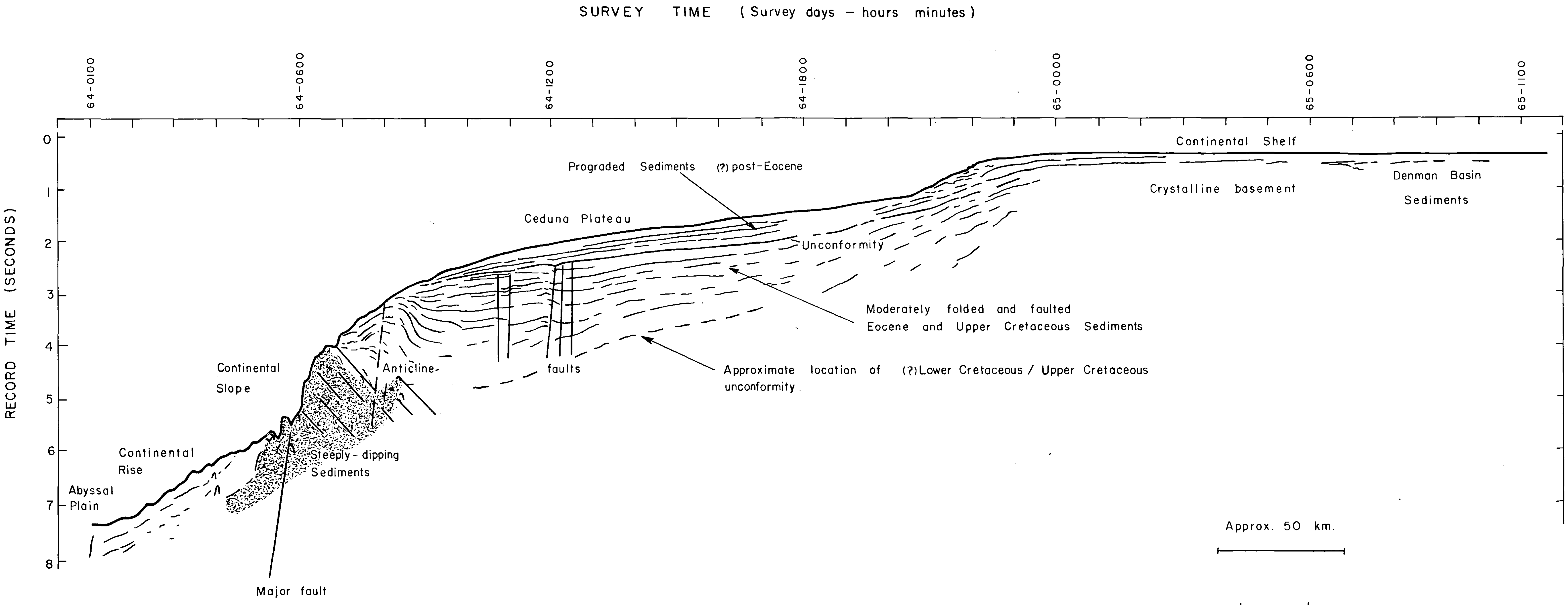
SA/B8-12-1

PLATE 9



LINE 16/ 166 INTERPRETATION

014705 PLATE 10



LINE 16/136 INTERPRETATION

Record No.1974/147

SA /B8–14