BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS

RECORD

Record 1983/6

Geophysical Branch Summary of Activities
October 1981 to 30 June 1982

Acting Assistant Director, Geophysical Branch

J.C. Dooley

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PREFACE

On 1 July 1982, a new structure was introduced in BMR. The Marine Geophysics Group was separated from the previous Geophysical Branch, and combined with the Marine Geology Group to form the new Division of Marine Geoscience and Petroleum Geology. The rest of the Geophysical Branch became the new Division of Geophysics.

Dr M.W. McElhinny, of the Australian National University Research School of Earth Sciences, was selected as Chief of the Division of Geophysics, but was not available to take up this position until later in 1982.

Future annual reporting by BMR will be based on the financial year, instead of the calendar year. To maintain continuity in annual reporting this Summary of Activities covers the operations of the Geophysical Branch for the period October 1981 to 30 June 1982. However, activities of the Marine Surveys Group are not included here, but will be reported elsewhere.

The convention has been used of referring to 1:250 000 scale standard map areas in the text by their names in capital letters, without using the words 1:250 000 Sheet area each time.

SUMMARY

Metalliferous and Airborne Section

G.A. Young

In the first six months of 1982 there was a net gain of science and technical staff in the Section, reversing the trend of previous years. Recruitment was at base grades, necessitating an increase in training activities within the Section for the year.

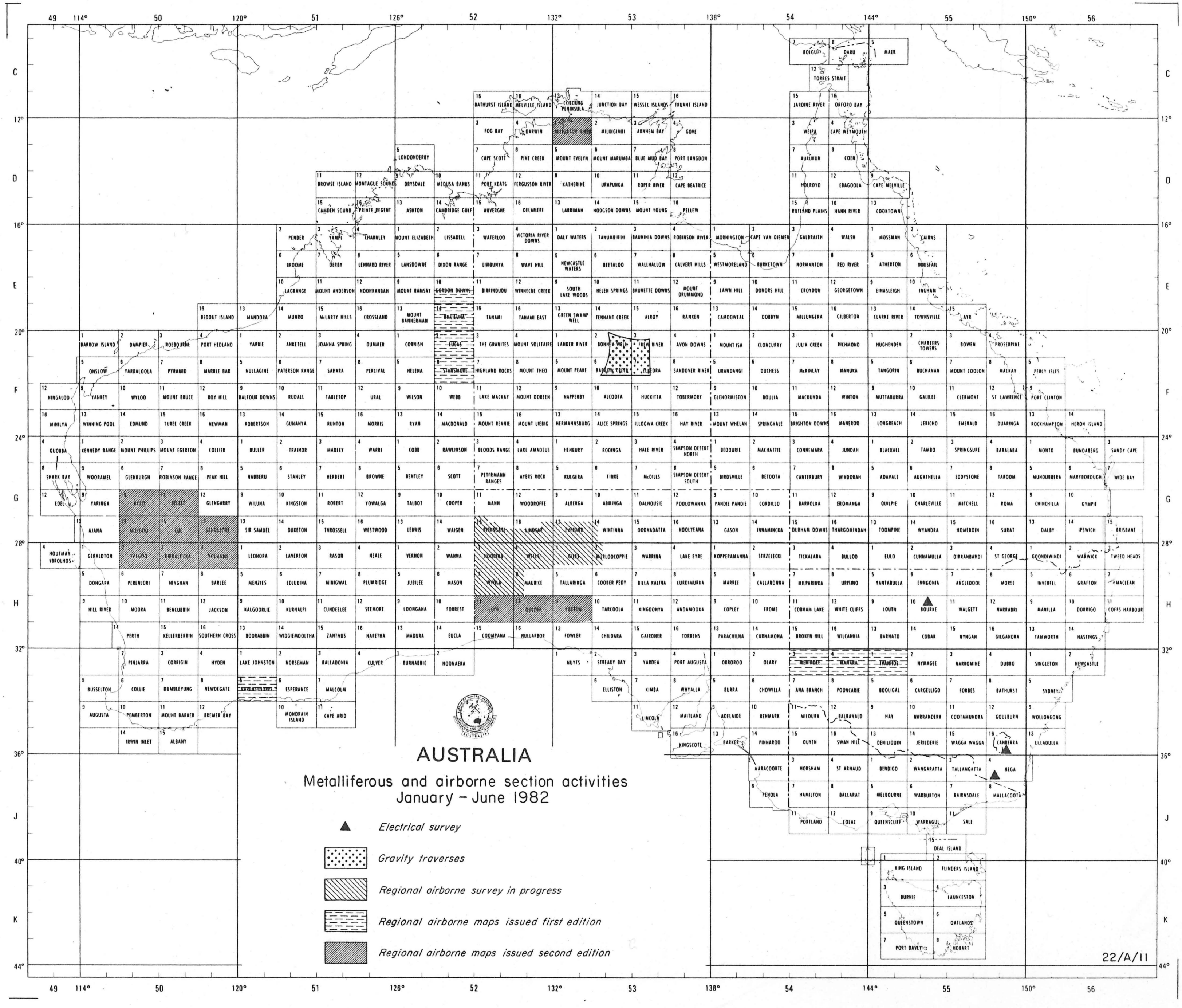
A small field program was planned for the Metalliferous Subsection in this period, with the main work emphasis being given to clearing reporting backlogs.

Airborne surveys which had been programmed to commence in March-April were delayed until May. Factors which contributed to this were, firstly, the temporary withdrawal of operational funds in February and early March, which caused an interruption to the interfield-season overhaul of aircraft and equipment and test flying of all systems; secondly, the complications of establishing a new contract, with H.C. Sleigh Aviation, to crew and maintain BMR aircraft; and thirdly, the introduction of an improved gamma-ray spectrometer system and a doppler navigation unit into the Aero Commander.

Figure MA 1 shows the location of field activities of the Section in the first half of 1982. The late start to the survey season dictated that all these activities would continue into the second half of 1982. Figure MA 1 also indicates map sheets for which data were released in the six month period.

Reporting assignments, which accounted for the major component of manpower in the Metalliferous Subsection, fell into two basic categories. The first involved regional geological-geophysical studies carried out in 1980 and 1981. This included the regional geological synthesis, and interpretation of geophysical transects in the Lachlan Fold Belt; and the

Fig AM I



AUSTRALIA
Metalliferous and airborne section activities
January - June 1982
Electrical survey
Gravity traverses
Regional airborne survey in progress
Regional airborne maps issued first edition
Regional airborne maps issued second edition
22/A/11

regional overview of geophysics of the Mount Isa Inlier plus a more detailed study of the Duchess Special Sheet area.

The second category involved the findings of methodological research projects. These included assessment of BMR's downhole omnidirectional EM probe, which involved additional fieldwork near Cooma and Michelago, NSW; experimental magnetometric resistivity (MMR) surveys with additional fieldwork near the Doradilla copper mine (near Bourke, NSW); radiometric methods research involving migration of radon in soils, equilibrium properties of rocks from the Pine Creek Geosyncline, and interpretation aids; and the development of a vehicle-borne magnetometer and associated data acquisition system and the interpretation of survey results from the Eromanga Basin.

The multidisciplinary project involving BMR and the Northern Territory Geological Survey (NTGS) to carry out research into the geology of the Davenport Geosyncline and its mineral resources continued into 1982. Work comprised the processing of data acquired in 1981, and a gravity survey carried out in May and June. Results of this study will become available in 1983.

Both BMR survey aircraft were assigned to the completion of coverage of East Officer Basin in South Australia as the first of two major projects for the 1982 calendar year. At the end of June 34 000 line-km of surveying had been flown out of 57 000 line-km required to complete the project. Maps showing survey results are expected to become available in the first half of 1983.

Following the release of aeromagnetic maps by BMR in 1980 for the adjacent area of West Officer Basin in Western Australia, Shell Development (Australia) Ltd issued a contract to Huntings Geology and Geophysics for the interpretation of these data in mid-1981. BMR participated in this project by supplying a copy of the data base in digital form on magnetic tape. At the completion of the project in mid-1982, Shell made a copy of the interpretation report available to the public through BMR.

As in recent years, most Airborne Subsection personnel contributed to work in the Airborne Reductions Group for long periods. Processing was undertaken on 24 1:250 000 sheet areas, 6 of which were processed to completion. Work was also undertaken on two special purpose surveys. 73 maps were released resulting from this processing as indicated in Figure MA 1 and Table MA 2.

Requests by outside organisations for the supply of copies of airborne geophysical data or access to inspect original analogue charts dropped marginally in the first half of 1982. Most requests were for recent digital data.

Airborne Subsection personnel were also involved in the development of computer programs to deal with specialised processing and interpretation of airborne geophysical data.

Interpretation of airborne geophysical data was confined to the final analysis of survey results from the Glenormiston area, Queensland, and the commencement of a study of the East Canning Basin-Tanami Granites region about the Western Australia-Northern Territory border. The former project involved a special purpose survey flown in 1977 to investigate the extension of the Mount Isa Inlier as basement under sediments of the Georgina Basin. The aim of the latter project was to obtain a better understanding of basement composition and geometry in a region which is assessed as having a high potential for petroleum accumulation.

Seismic, Gravity and Marine Section

F.J. Moss

The Seismic and Gravity Groups continued the 1981 field surveys in the central Eromanga Basin until November and recommenced survey operations in the same area in June 1982. The groups were involved mainly in processing, interpreting and reporting on the results of this work in association with other groups in BMR and GSQ.

Seismic and gravity information obtained in 1981 on traverses over the eastern margin of the Cooper Basin, and over the Thomson Syncline and Quilpie Trough, were processed and integrated with previously obtained and new information from surveys by petroleum lease holders in the project area. In addition to the new seismic data, consisting of 343 km of 6-fold CDP recordings, analogue data from a number of seismic traverses shot previously were transcribed to digital form and reprocessed to modern standards. The new and reprocessed seismic data were released through the Government Printer and have been of considerable assistance to industry with interests in the area. Reviews were made of geological and geophysical information from the Adavale Basin in preparation for the 1982 survey. A reconnaissance visit to the survey area was necessary to plan traverses in the extremely rugged terrain.

Deep seismic reflection data, recorded to 20 s by extending the reflection records from the 1980 traverses, were processed on the DISCO system at the Virginia Polyteconic Institute (VPI) in the USA. Work continued on the analysis and interpretation of the deep data recorded in the central Eromanga Basin in attempts to provide information on the properties and structure of the crust and upper mantle in the area and its evolution. Some publications were prepared on improvements in recording deep reflection data and on the results of work in northeast Australia in 1975-78.

An Australian Continental Reflection Profiling (ACORP) Program Workshop was organized to review the status of deep seismic reflection profiling in Australia and overseas, and to present and discuss proposals for lithosphere transect studies of the Australian continent. The studies would be based mainly on the results of new major deep seismic reflection profiles.

Reporting tasks on work done in cooperation with the Geological Branch in the Ngalia and McArthur Basins were finished.

Activities in support of these projects included preparation of shotpoint and well location maps, upgrading of the seismic field data acquisition system, and development on an in-field seismic processing system capable of producing sections for CDP recordings.

The Well-logging Group logged holes in the Northern Territory and Queensland, drilled mainly for the NERDDC Oil Shale Project.

Geomagnetism, Seismology and Regional Geophysics Section

D. Denham

During the report period the Section comprised seven main disciplinary groups. The main activities in these areas are given below:

Geomagnetism. The normal magnetic observatory programs in both Australia and Antarctica were maintained, and Observatory Reports for May 1981 to November 1981 were published. Plans to establish a new magnetic observatory at Charters Towers were formulated and funds were committed to carry out the necessary building modifications at the site.

A third-order survey of Yorke Peninsula was carried out in February 1982, thus completing the third-order coverage of southern Australia. In June first-order observations were made at Mallacoota (Vic.), where a new station was established.

The chart of total intensity (F) was completed and published, but only slight progress was made on the chart for horizontal intensity (H) because recent H standards have not been determined. The Rossbank Observatory site in Hobart, which was used in the 1840s, was re-occupied and a review of the old observatory was started.

Earthquake seismology. The normal seismological programs were maintained. Phase data continued to be telexed to the National Earthquake Information Service in USA for the preliminary determination of hypocentres, and final data for the Australian and Melanesian regions were despatched on magnetic tapes to the International Seismological Centre in UK, for the period January to September 1980.

No large damaging earthquakes took place in Australia during the report period, but the Appin earthquake of 15 November (ML 4.6) and the Cadoux earthquake of 6 February (ML 4.9) were large enough to be felt over 50 000 square kilometres. The Appin earthquake was associated with thrust faulting caused by east-west compressive stress. A workshop on Australian earthquake magnitudes was convened in BMR on 2 May 1982 and 30 people attended from all States, but not the Northern Territory.

P. McGregor attended the 13th session of the Geneva Group of Scientific Experts (on the detection and identification of seismic events) in March, and chaired a study group which conducted a workshop on a large-scale seismological data exchange experiment in November-December 1981.

Explosion seismology. Field work during October-November was carried out in the Eromanga Basin to study the crustal structure of the Basin. Interpretation of data acquired in the Pilbara, McArthur Basin, Mount Isa/ Tennant Creek and Eromanga Basin regions continued and several papers were produced. In May most members of the explosion seismology group attended a workshop in Canberra to consider proposals for undertaking deep seismic profiling in Australia.

Gravimetry. Checking gravity data in 1:250 000 sheet areas continued and the 1:1 million sheet areas Tasmania, Armidale and Canberra were completed. Geophysical maps of the Prince Charles Mountains and MacRobertson and Enderby Lands were completed.

Papers on hot-spot volcanism, Enderby Land geophysics, and isostasy and crustal thickness in Australia were produced in the group.

P. Wellman attended a meeting of the International Association of Geology in Tokyo, Japan, in May.

Palaeomagnetism. No field work was undertaken and most of the resources of the group were concentrated on:

1. Proterozoic rocks from the Stuart Dykes (NT), Edith River Volcanics (NT), Kombolgie Formation (NT) and the Morowa Lavas (WA).
2. Tertiary rocks from weathered profiles and the Otway Basin.
3. Dykes from the Vestfold Hills and Enderby Land, Antarctica.
4. Development of a computer system to assist in the analysis of the palaeomagnetic data.

A revised polar wander path for the Proterozoic was developed and a determination of the Cainozoic pole path almost completed.

Magnetotellurics. A new 4P2100E computer was installed and the MT software system successfully generated. Interpretation of the 1978 and 1979 McArthur Basin surveys was completed.

Geothermal. Holes near Lancefield (Vic.) and Bombala (NSW) were logged, and measurements were made in the Mount Isa Mine to determine thermal gradients beneath the current mine-workings. However, lack of manpower precluded any substantial progress in this discipline.

1. METALLIFEROUS AND AIRBORNE SECTION

G.A. Young

The Section comprises two Subsections: Metalliferous and Airborne. Both Subsections contribute to the Australia-wide Airborne Geophysical Mapping Project reflecting the importance given recently to accelerate this program to assist research into the geology of Australia and its mineral deposits. The Airborne Subsection is principally concerned with providing basic airborne geophysical data coverage of the continent at a regional scale, publishing results in map form, and contributing to multidisciplinary interpretative studies of Proterozoic and Phanerozoic sedimentary provinces. The regional group of the Metalliferous Subsection contributes to complimentary multidisciplinary studies of hard-rock metalliferous provinces, carrying out ground geophysical surveys as required to support airborne results. Action is current to recruit research scientists to strengthen the Section's ability to produce detailed interpretative reports, which are seen as an essential component of background information required to assist mineral exploration and for the assessment of mineral potential.

The Metalliferous Subsection also engages in research into the development and application of improved ground geophysical methods to assist mineral exploration.

METALLIFEROUS SUBSECTION

D.C. Stuart

Lachlan Fold Belt interpretation project (1421)

Following the completion in 1981 of most field work, data reduction and analyses, work was concentrated on completing outstanding reports in 1982. Owing to other commitments work was carried out on a part time basis only.

<u>Regional geological synthesis</u> (A. Yeates, R. Almond, I. Hone). A draft report and a series of 1:1 000 000 maps synthesizing the principal geological and geophysical features of the region were prepared, and the related rock-property data base was completed. These studies illustrate the time and spatial correlations between geological facies/ units and observed geophysical characteristics, and provide new insights into the evolution of the region.

<u>Interpretation of transect data</u> (R. Almond, A. Yeates). Analyses of the airborne magnetic and radiometric, and gravity transects conducted during 1980 continued, and a draft report was prepared. The results indicate localised variations in geophysical characteristics which are related to the evolution of the region and generally preclude definite geophysical correlations over large distances. Interpretation of magnetic and gravity anomalies associated with granites suggests that the thickness of the fold-belt sequences varies from 15 km to as shallow as 6 km.

<u>Gamma-ray spectrometer characteristics of granitoids</u> (A. Yeates). A small program of radiometric investigation of granitoids in the New England area NSW, was undertaken and results were compared with similar studies in the Lachlan Fold Belt. A report on this work was completed.

<u>Mount Isa Inlier geophysical studies</u> (1017)

A review of geophysical data from the Mount Isa Inlier was commenced in 1981 in support of a geological synthesis of the region being carried out by the Geological Branch, BMR. Three distinct investigations have been undertaken.

1. A regional overview of the geophysical characteristics of the Inlier to provide a general guide to the principal geological factors controlling the magnetic, gravimetric, and radiometric anomalies.

2. A more detailed study of the geophysical data available in, and to the immediate west of DUCHESS.

3. An interpretation of semi-detailed aeromagnetic data acquired in part of GLENORMISTON.

Figure MA 2 shows the respective study areas.

Regional overview of the geophysics of the Mount Isa Inlier (I.G. Hone) This investigation was attended to in 1981 with the more significant results published in the 1981 Geophysical Branch Summary of Activities (Report 238). The final report for this project continued to be prepared in the first half of 1982 and is expected to be completed in 1983.

Duchess Special Sheet area (I.G. Hone). A report was commenced describing the geological interpretation of geophysical data from the Duchess Special Sheet area. This will be included in a BMR Bulletin on the geology of the Duchess Special Sheet area. The final manuscript is expected to be completed in early 1983.

Geological interpretation of geophysical results, Glenormiston area airborne survey (G.A. Young). A semi-detailed airborne magnetic survey was flown over part of GLENORMISTON in 1977 in a region where Phanerozoic sediments overlie Proterozoic rocks of the Mount Isa Inlier. The principal aims of the survey were: to define relief, structure and composition of the Proterozoic basement, which may have controlled Lower Palaeozoic sedimentation; to define the distribution of non-outcropping granite; and to define the western margin of the Mount Isa Inlier. Analysis of the semi-detailed magnetic and regional gravity data has enabled these aims to be met.

The Proterozoic-Palaeozoic basement unconformity is interpreted from the magnetic data to form a broad ridge (Fig. MA 3) which extends through the survey area from $22^{0}05$'S, $139^{0}10$E to

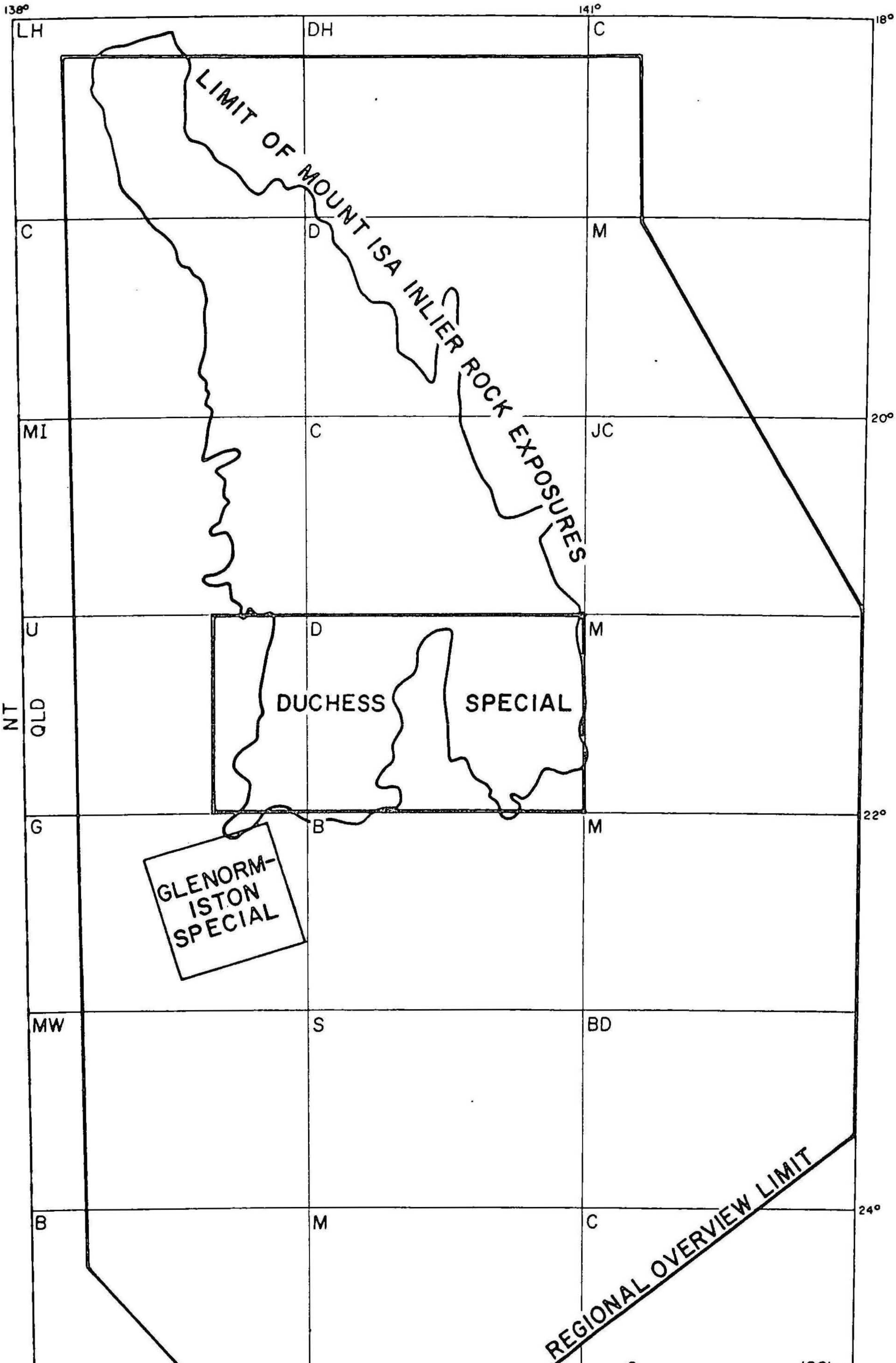
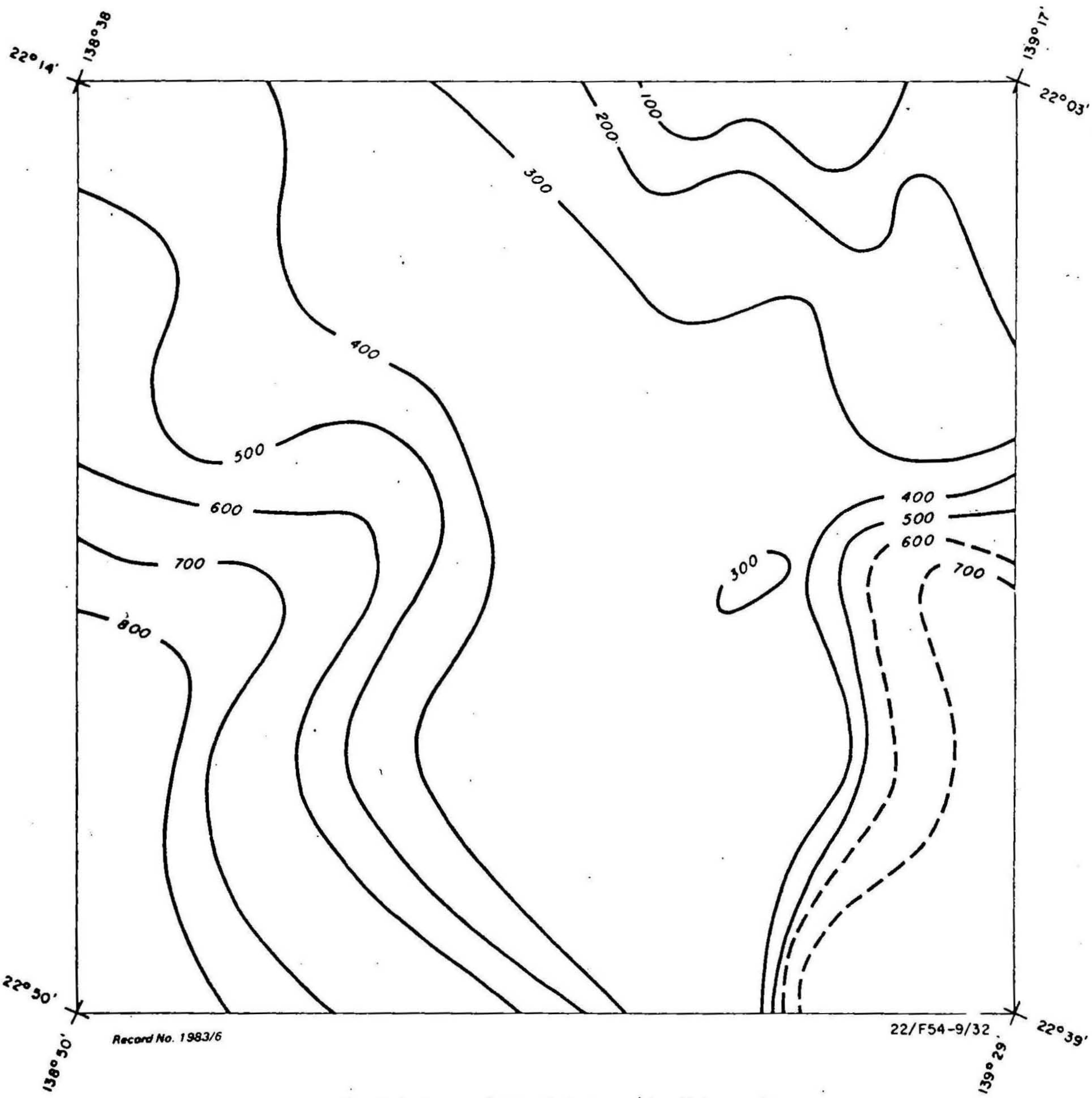


Fig. MA 2 Mt Isa Inlier geophysical study area



Depth below surface of Proterozoic-Palaeozoic unconformity in metres. Broken line indicates depth to be less certain

GLENORMISTON SPECIAL AIRBORNE SURVEY

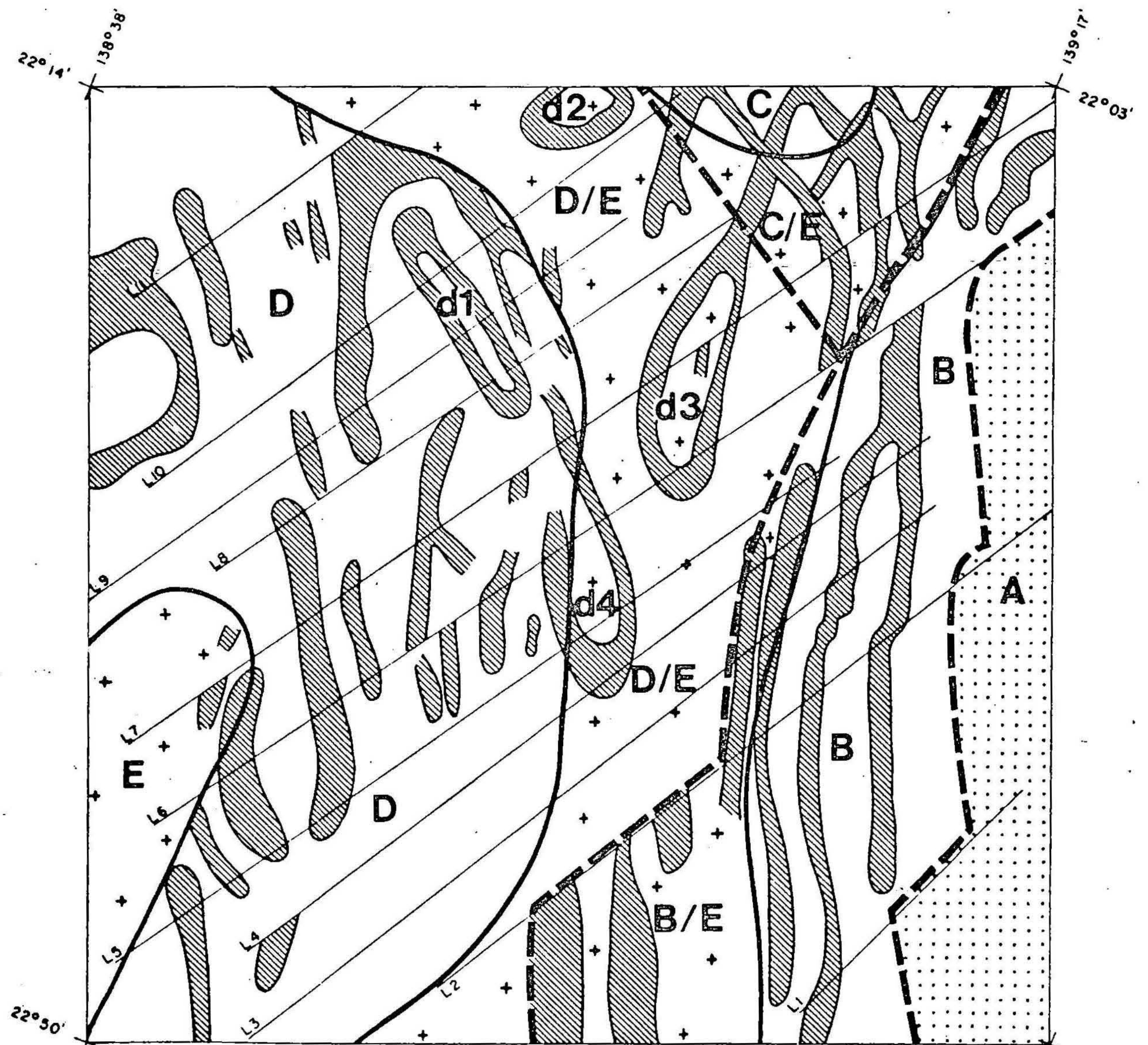
Magnetic basement depth interpretation

$22^{o}43$'S, $139^{0}15$'E. This ridge pitches to the south from less than 100 m below surface at the northern survey boundary to over 400 m below surface at the southern survey boundary. The thickest Palaeozoic sections occur in the southwest and southeast corners of the survey area where section thicknesses of 800 m and 700 m respectively are interpreted. The reliability of the latter estimate is not high owing to the complex character of large magnetic anomalies used for depth analysis.

The Proterozoic basement within the survey area has been subdivided into four principal rock units (Fig. MA 4). These are equated with a southerly extension of the Jayah Creek Metabasalt adjacent to the eastern survey boundary (basement type A); to the immediate west, a near-parallel belt which could constitute a southerly extension of Sulieman Gneiss or alternatively, and more likely, a rock unit showing some similarity to the Jayah Creek Metabasalt but with a lower metabasalt content (basement type B); a small zone which flanks the most southerly outcrop of Sybella Granite, and which has anomaly characteristics of cross-cutting metabasalt units (basement type C); and, finally, over the western half of the survey area, an extensive basement unit (D) which contains arcuate magnetic anomalies of a similar character to those occurring over the Saint Ronans Metamorphics exposed to the north. Sybella Granite (E) is interpreted to underlie the eastern extremity of the latter basement unit and parts of B and C type basement. Its distribution has been interpreted primarily from gravity data.

Results obtained place the western boundary of the Mount Isa Inlier to the west of the Georgina River, that is, beyond the western boundary of the survey area.

The most obvious basement structure evident in the magnetic data is a suite of lineaments oriented approximately 040^{o}. These lineaments are interpreted as faults, three of which show displacement of magnetic rock units up to 3 km in a dextral sense.



Magnetic rock unit with susceptibility mainly in the range 0·01 to 0·03 SI units

Complex magnetic rock unit with susceptibility mainly in the range 0·04 to 0·12 SI units

B Basement type classification

Basement type boundary

Boundary of granite interpreted from gravity data

Lineament interpreted from magnetic data

d Magnetic anomaly closure

0 10 20km

GLENORMISTON SPECIAL AIRBORNE SURVEY

Interpreted composition and structure of Proterozoic basement

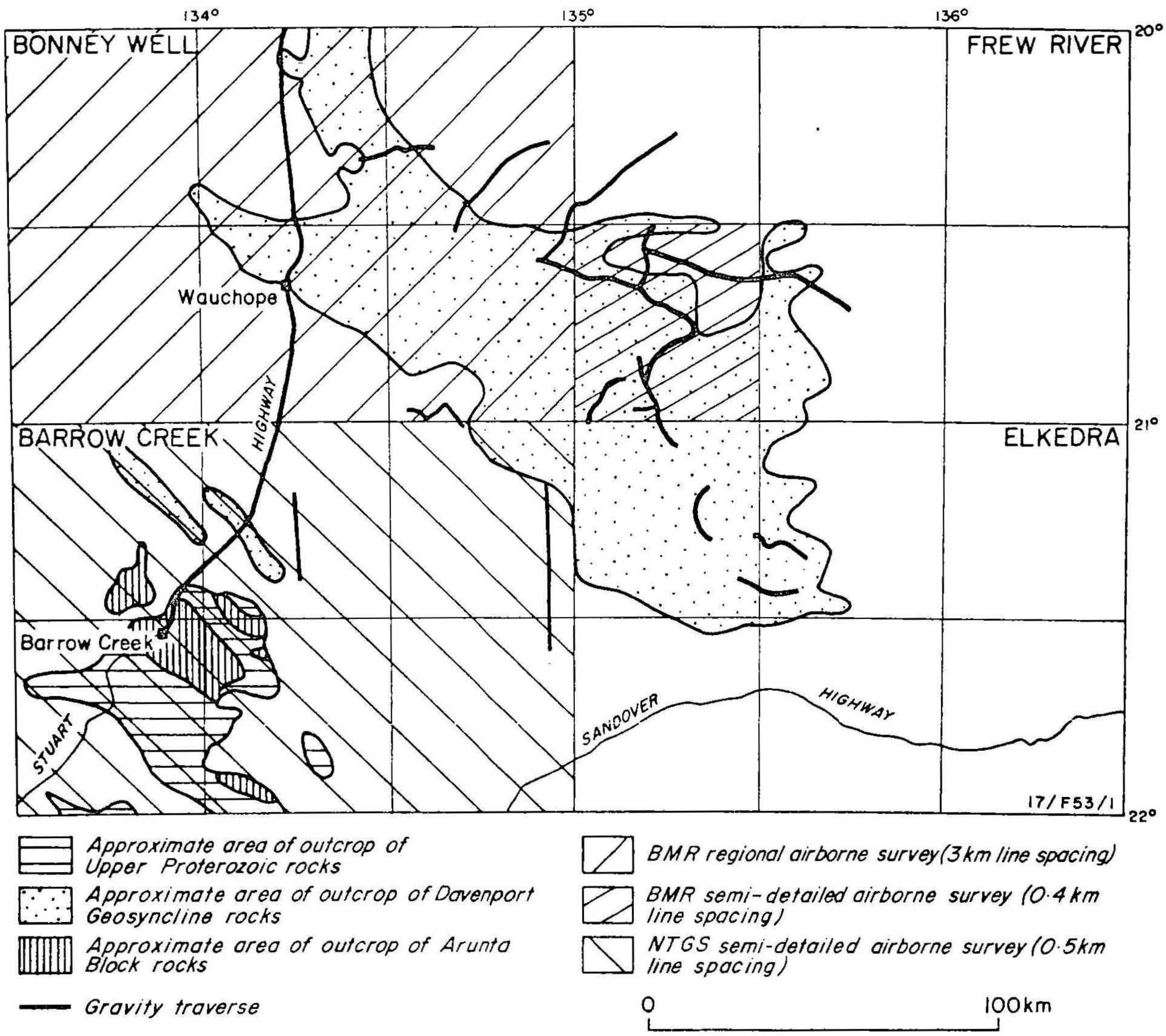


Fig. MA 5. Locality map Davenport Geosyncline geophysical study

Arcuate magnetic anomalies in the most westerly basement unit are interpreted as evidence for the presence of domed magnetic rock units. The contrast between this anomaly form and the prominent parallel linear anomalies over the eastern basement units may delineate a major fault which would appear to connect with the major fault mapped 9 km to the east of the Rufus Fault in southern Ardmore 1:100 000 Sheet area. The correlation of the interpreted eastern boundary of the Sybella Granite with this basement contact supports this hypothesis.

The interpretation referred to above should enable hypotheses to be developed to outline the more favourable areas for the possible formation of strata-bound Pb-Zn mineralisation, the final aim of the project. The intersections of interpreted faults striking 040° with the possible major fault marking the eastern boundary of Sybella Granite must attract consideration, particularly as these intersections lie along the interpreted Proterozoic basement high.

Davenport Geosyncline geophysical study (1415)

I.G. Hone, R.D. Shaw, R.A. Almond, P.M. Davies, V. Carberry, H. Reith

The aim of this project is to produce an integrated geological and geophysical interpretation of the Davenport Geosyncline as part of BMR's overall program of research into the regional geology and mineral potential of the continent.

This project forms part of a research program initiated by the Geological Branch, BMR, involving the collaboration of the Northern Territory Geological Survey.

Work commenced in 1981 with BMR flying a regional magnetic and radiometric survey of BONNEY WELL, and a more detailed survey of the Hatches 1:100 000 Sheet area. Similar semi-detailed surveys were flown over BARROW CREEK by contractors to the Northern Territory

Geological Survey. Figure MA 5 shows this airborne survey coverage with respect to outcropping rocks of the Davenport Geosyncline. Other work done in 1981 involved the collection of representative rock samples for physical property measurements, measurement of in-situ radioactivity of rock units, and a carborne magnetometer survey to identify the sources of aeromagnetic anomalies.

In the first half of 1982 the airborne survey data were processed and analysed, physical properties of samples were measured and analysed, and a gravity survey was carried out. Work on this project is expected to continue into 1983.

Airborne survey (R. Almond). Processing of magnetic and radiometric data was partly completed for the Hatches 1:100 000 Sheet area. Flight path, radiometric and total magnetic intensity profile maps were produced. All maps for Hatches and BONNEY WELL are expected to be released by late 1982 or early 1983.

Physical properties. (I.G. Hone, R.D. Shaw, V. Carberry, H. Reith). It is essential to establish a physical property framework to interpret regional geophysical data. Accordingly wet and dry densities, grain density, porosity, magnetic susceptibility and remanence determinations were made on samples in the laboratory.

The results show that the main sources of magnetic anomalies are basic and intermediate-to-acid volcanic rocks, and basic intrusives. Basalts and intermediate rocks of the Edmiringee Volcanics are the most magnetic rocks sampled. Other very magnetic rocks are basalts of the Alingabon Sandstone, mafic feldspar porphyry of the Arabulja Volcanics, gabbro, and granophyre. Basalts from the Kudinga Basalt and Treasure Volcanics are much less magnetic and can be distinguished easily from the Edmiringee Volcanics and Alingabon Sandstone by measurement of magnetic susceptibility. Sandstone units sampled are generally non-magnetic except for a quartzite from the Errolala Sandstone which yielded a susceptibility of 130 x 10^{-5} SI units. Except for one weakly magnetic sample from a granite in northwest BARROW CREEK, granites sampled are non-magnetic.

Basic volcanics and intrusives are the densest rocks sampled with densities in the range 2.75-2.95 t/m^3, and granites and granophyres generally have densities of less than 2.7 t/m^3.

Gravity survey (I.G. Hone, R.D. Shaw, P.M. Davies, V. Carberry, H. Reith). In May and June a gravity survey was conducted along key traverses selected following analysis of regional gravity, magnetic, and geological data. These traverses were chosen to provide information on gravity signatures of specific rock units, subsurface geometries of intrusives, and the nature of Proterozoic geology in areas of cover.

Most of the traverses were levelled to third-order accuracy by the Australian Survey Office (ASO) and are now included in the third-order network of Australia. Several other traverses were surveyed and barometrically levelled by BMR personnel. Gravity readings along these traverses were tied into the Australian network via ties to bases at Tennant Creek, Barrow Creek, and Ammaroo.

Electrical methods research

Work was concentrated on completing investigations into the applications for, and interpretation of, omni-directional downhole electromagnetic (EM) surveys. A small experimental magmetometric resistivity (MMR) survey using a SQUID detector was undertaken in February.

Downhole omni-directional EM probe (R. Cobcroft, D. Stuart, R. Curtis-Nuthall, J. Major). Further field surveys were undertaken with the BMR-constructed logging system which employs a surface transmitter loop and a three-component downhole sensor. Also, improvements were made to the methods of data reduction, presentation and interpretation.

Field surveys were conducted at test sites near Cooma and Michelago in NSW. At each of these sites drill holes passing through or near sulphide conductors were logged with different loop configurations and excitation frequencies. The results of these surveys were used to investigate the characteristics of the BMR system and to demonstrate the advantages of downhole, omni-directional EM surveys in base metal exploration.

Improvements to data reduction and interpretation include an algorithm for calculating rapidly the parameters of the polarisation ellipse, and some simple modelling to assist in the interpretation of the ellipse parameters. The principal parameter used in the interpretation of the data is the ratio of minor ellipse axis to major axis, which is invariant with probe-orientation changes and field curvature. Other useful parameters include the phase of the ellipse vector (invariant), the major and minor ellipse axes, and the phase and amplitude of the axial (downhole) component. Model considerations show that use of the ratio of ellipse axes greatly simplifies interpretation as all anomalies are positive, and permits increased sensitivity through the use of close-coupled small transmitter loops. Some of the attributes of the omnidirectional probe are illustrated in Figure MA 6.

Figure MA 6 (a) shows the effect of loop size on the response to a zone of mineralisation for the three-component system, and for an axial (Z) component system. For the large loop a similar ellipse axes ratio anomaly is recorded adjacent to the intersected mineralisation but the presence of offhole mineralisation is not clear. The Z axis data for the large loop are difficult to interpret but appear to respond to the intersected mineralisation. Using the closer-coupled 100 m x 100 m loop the ratio anomaly broadens as the system becomes more sensitive to offhole mineralisation. However, the Z axis phase data are uninterpretable with the small loop, owing to the 180^{o} phase reversal resulting from the high curvature of the primary field and scattering in the conductive ground.

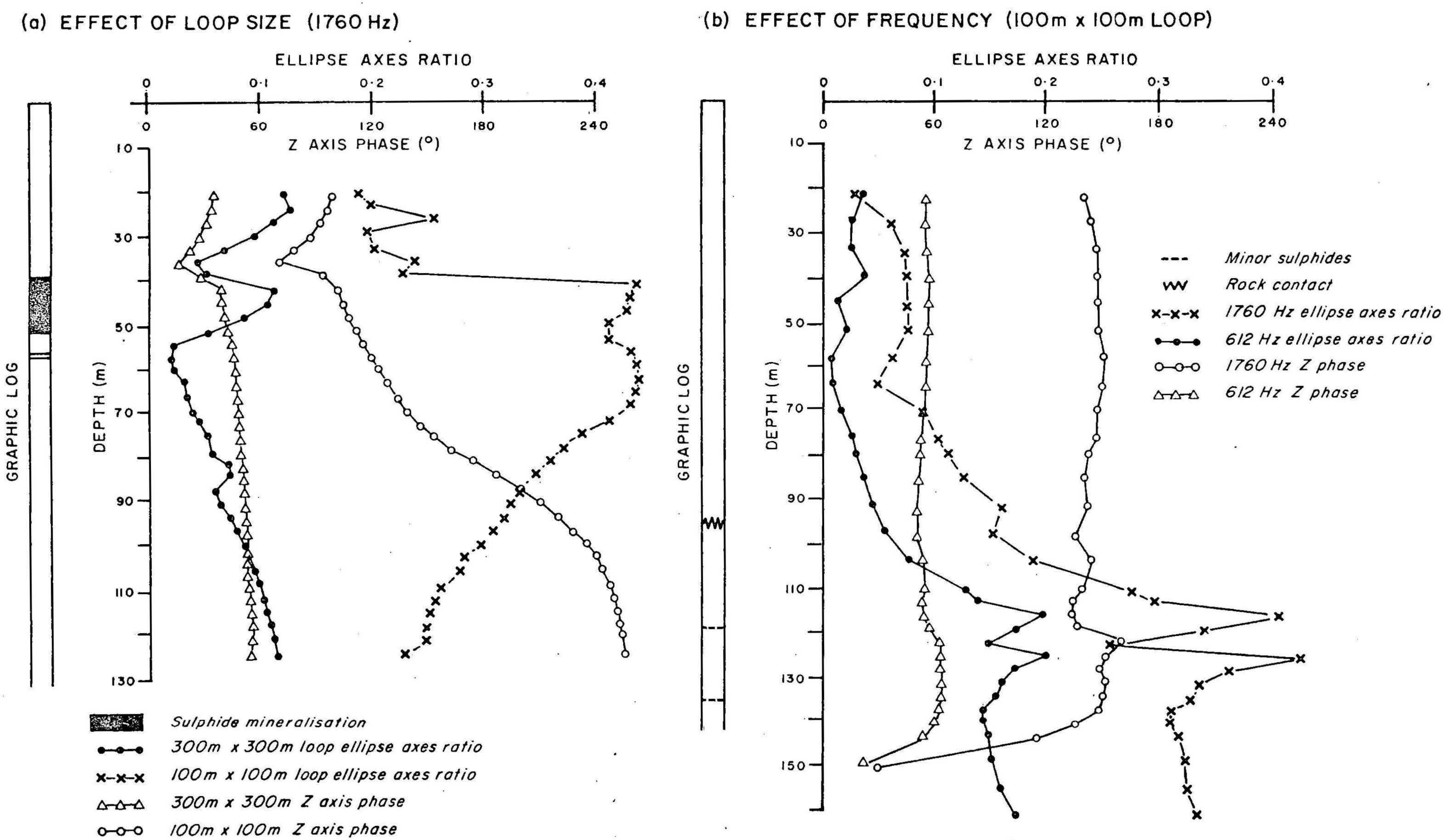


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Fig. MA6 Downhole EM probe response

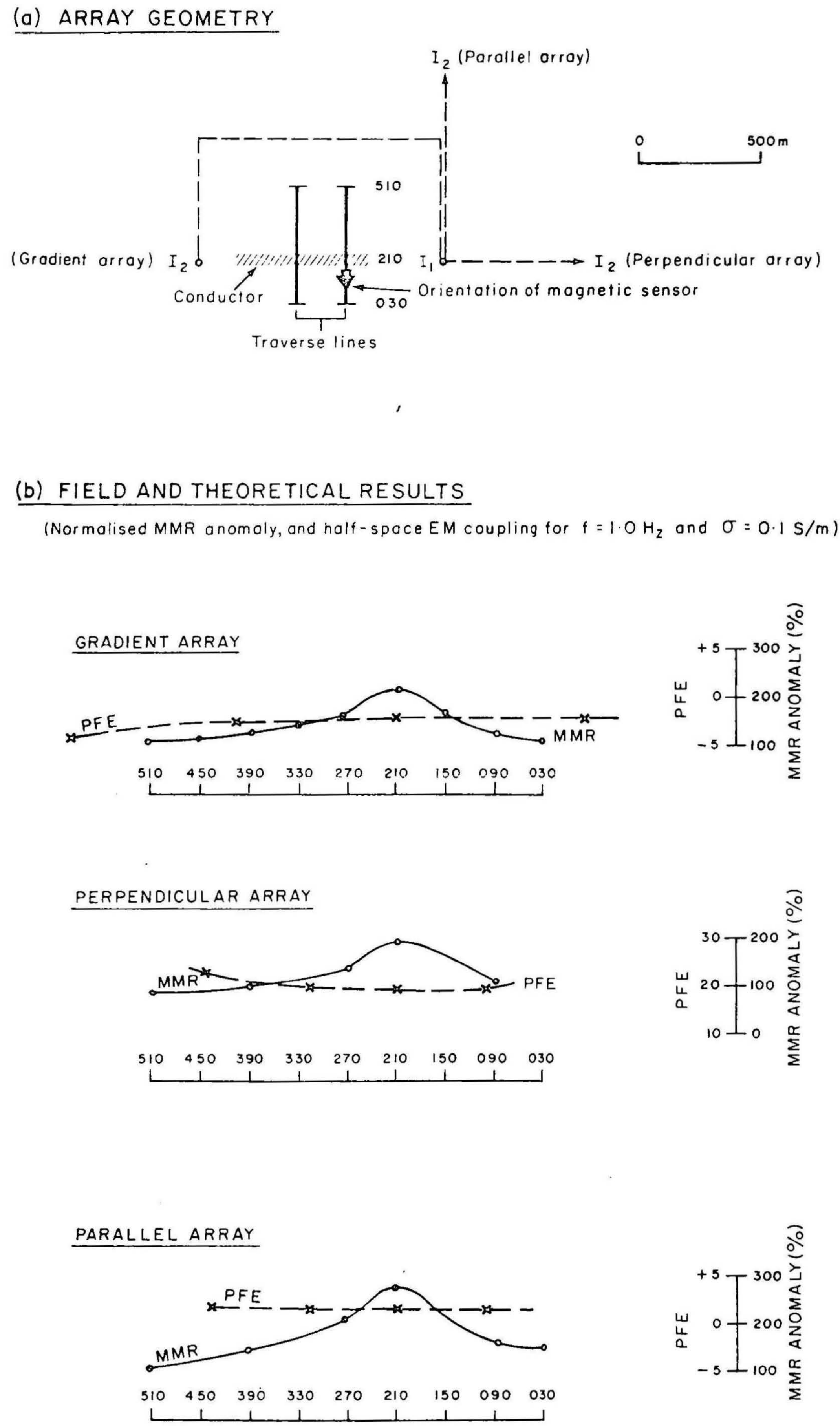

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Fig. MA7 Results of experimental MMR/SQUID survey

Figure MA 6 (b) also illustrates the superior ability of the three-component system to detect offhole mineralisation, and shows how the change in response with frequency discriminates between a good offhole conductor observed below 110 m and the effects of scattering in the ground observed above 110 m. In contrast to these results, the Z axis anomalies are weak and complicated by the 180^{o} phase reversal below 140 m.

Experimental MMR survey with SQUID magnetometer (D. Stuart, R. Curtis-Nuthall, P. Hopgood, A. Warnes, J. Silic (Aberfoyle Exploration P/L). During February 1982 an experimental magnetometric resistivity (MMR) survey using a SQUID (Superconducting Quantum Interference Device) magnetometer, was conducted with Aberfoyle Exploration P/L over a tin prospect near the abandoned Doradilla copper mine, 45 km southeast of Bourke, NSW.

The objectives of the survey were to evaluate the potential of MMR surveys to detect massive sulphide targets beneath a conductive overburden, and to establish how the high-sensitivity SQUID magnetometer could be utilised as a sensor in electrical exploration surveys. The field studies were supported by theoretical studies of the MMR response, and attention was paid to the problem of spurious responses arising from EM coupling.

The survey was conducted along two traverses where extensive prior geophysical surveys and drilling have established the presence, beneath a conductive overburden up to 100 m thick, of a large, highly conductive tin-bearing pyrrhotite body in a variably resistive bedrock.

Three different array geometries were employed at the test site and are shown in Figure MA 7(a). At each station along the traverses, measurements of the amplitude and phase of the horizontal magnetic field along the traverse were made over the frequency range 0.125 Hz to 500 Hz using a SQUID magnetometer, signal-averaging spectrum analyzer, and phase-reference link to the transmitter.

The SQUID magnetometer proved to be easy to use for MMR measurements. Only a few minutes per station were required for setting up, and the 25-litre liquid helium dewar permitted up to 21 days of field operations between refills. However, the SQUID's potential sensitivity of 1×10^{-4} nT could not be realised in practice owing to wind, microseismic and spheric noise. The practical accuracy proved to be around 50×10^{-4} nT and was too low for reliable measurements of induced polarisation effects.

MMR results obtained for each of the three arrays at a frequency of 1.0 Hz are shown in Figure MA 7(b) as normalised values relative to the predicted d.c. half-space response at each point of measurement. All arrays show a definite MMR anomaly over the sulphide zone and suggest current channelling in or around this conductor. Small changes in anomaly amplitude and shape for the three arrays presumably reflect different galvanic coupling between the transmitting array and the conductor.

Figure MA 7(b) also shows the theoretical IP effects arising from EM coupling between each of the arrays and a 0.1 S/m half-space at a frequncy of 1.0 Hz. Note that only the minimum-coupled parallel array is immune from substantial EM coupling effects and therefore spurious MIP anomalies arising from variations in the thickness and conductivity of the overburden. The close-coupled perpendicular array is shown to be extremely sensitive to EM coupling effects.

Radiometric methods research

Studies were undertaken of the migration of radon in soils, the use of statistical techniques for interpretation of gamma-ray spectrometer data, the sensitivity of various prospecting systems, and the radiometric equilibrium characteristics of rocks in the Pine Creek Geosyncline.

Migration of radon in soils (D. Stuart, J. Major). The ratio of late and early count-rates observed in emanometer surveys over buried concentrations of uranium at Austatom and elsewhere in the Pine Creek Geosyncline suggests that radon gas associated with buried uranium mineralisation may be relatively depleted in its alpha-particle emitting daughter product Po 218 compared with shallow sources of radon.

The observations might be explained by assuming that the source of radon is close to the collection chamber of the emanometer. However, it may also be possible that the longer half-life and chemical inertness of Rn 222 compared with Po 218 could lead to depletion of Po 218 from the soil gas over long transport distances. To investigate this hypothesis, the relative concentration of Po 218 and Rn 222 in soil gas was modelled using a numerical, one-dimensional system undergoing diffusion and radiometric decay.

The results of this modelling indicate that under practical boundary conditions where Po 218 and Rn 222 have different diffusion coefficients and decay constants, the steady-state ratio of Rn 222 to Po 218 will be equal to the inverse ratio of their decay constants over all distances except very close to the source of radon, unless one of the products is removed by chemical processes such as adsorption. Where Po 218 is removed from the system with a probability independent of transport distance, the steady state ratio of Rn 222 and Po 218 will be greater than the inverse ratio but constant over any length of transport. However, the observed ratio anomaly might still be explained if it could be established that the probability of adsorption of Po 218 increases with distance from the source of radon. This is an area worthy of future research.

Statistical techniques and interpretation (D. Stuart, A. Warnes). The possibility of using various statistical techniques to assist in the interpretation of gamma-ray spectrometer surveys was investigated by the analysis of high-resolution ground gamma-ray spectrometer data collected during 1980 in the Rum Jungle area of the Pine Creek Geosyncline.

As shown in Fig MA 8(a), high-resolution gamma-ray spectrometer data along traverses provide localised discrimination of subsurface rock types. Attempts were made to generalise the interpretation on the basis of specific radiometric and/or spatial signatures by the use of histograms, multivariate analyses and correlation techniques.

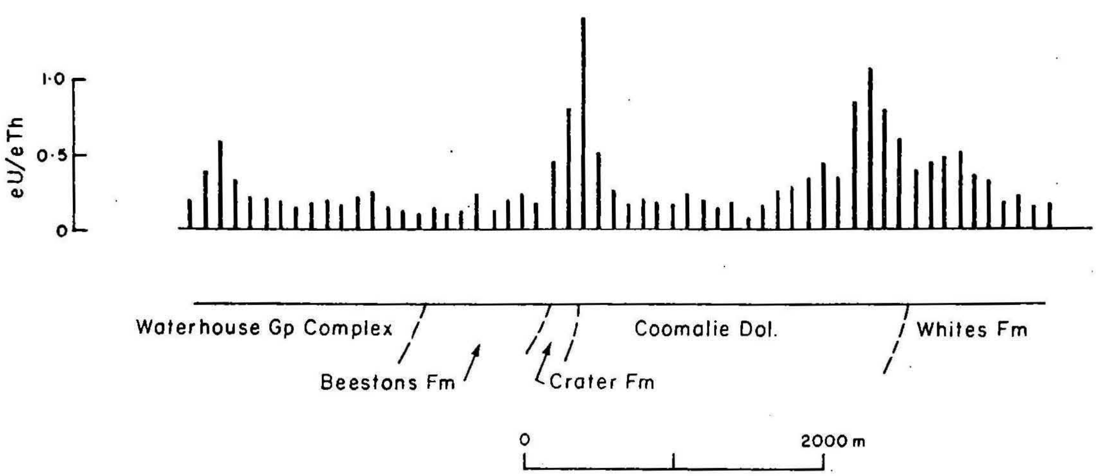
As shown in Fig MA 8(b), the discrimination of rock types solely on the basis of apparent radioelement concentration or mix is precluded by the wide and overlapping dispersion of values recorded over different rock types in different areas. Similar problems were encountered with the multivariate analyses techniques. However, current investigations using correlation techniques for comparison between traverses, or between traverses and nominated anomaly characteristics, appear to offer some scope for generalised and automatic interpretation.

<u>Detection capabilities of gamma-ray surveys</u> (D. Stuart). The resolution and detection capability of various gamma-ray prospecting instruments in the Pine Creek Geosyncline were established by a program of model studies based on the knowledge of the radiometric characteristics of rocks and soils in the area.

The results of investigations into the resolution of small targets by gamma-ray spectrometer surveys at different heights is summarised in Figure MA 9. Other areas of investigation included an assessment of minimum sized anomalies likely to be detected by various gamma-ray survey techniques, and a comparison of the relative capability of gamma-ray and radon techniques.

<u>Radiometric equilibrium of Pine Creek Geosyncline rocks</u> (D. Stuart). The equilibrium state of radioelements in surface and bedrock material was investigated by a comparison of 85 <u>in situ</u> surface or downhole gamma-ray spectrometer assays (collected in 1980) with X-ray fluorescence (XRF) analyses of uranium and thorium in samples collected from the sites of the gamma-ray assays.

(a) HIGH RESOLUTION GAMMA-SPECTROMETER TRAVERSE



(b) HISTOGRAM OF U/Th VALUES, RUM JUNGLE AREA

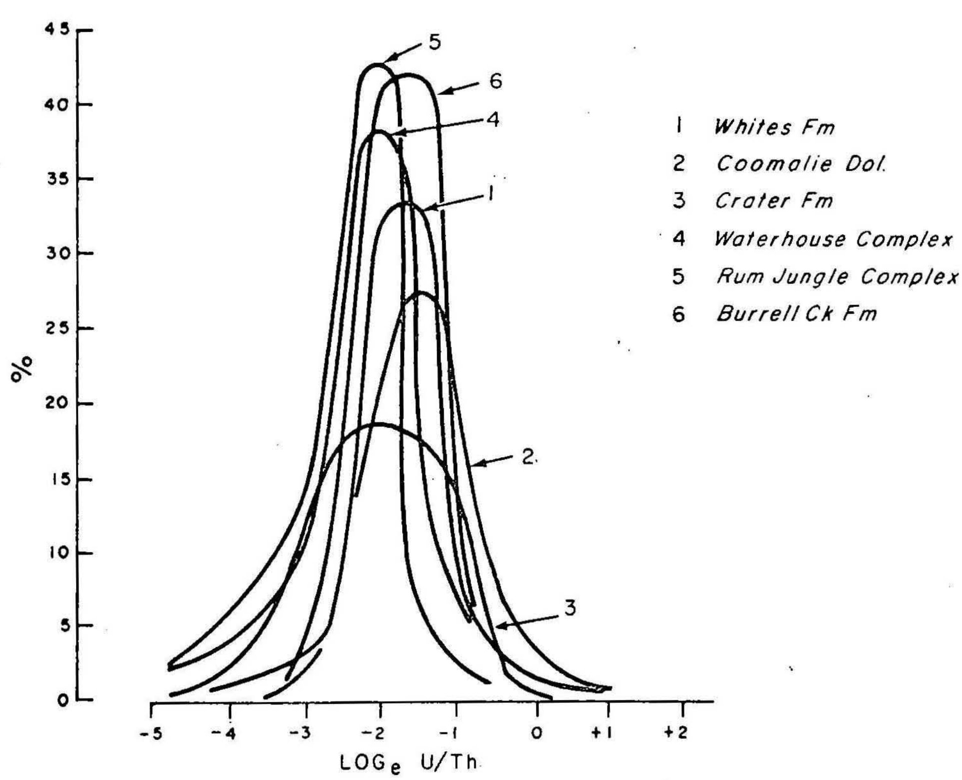


Fig. MA 8 Radio element characteristics of Rum Jungle area rocks 17/20

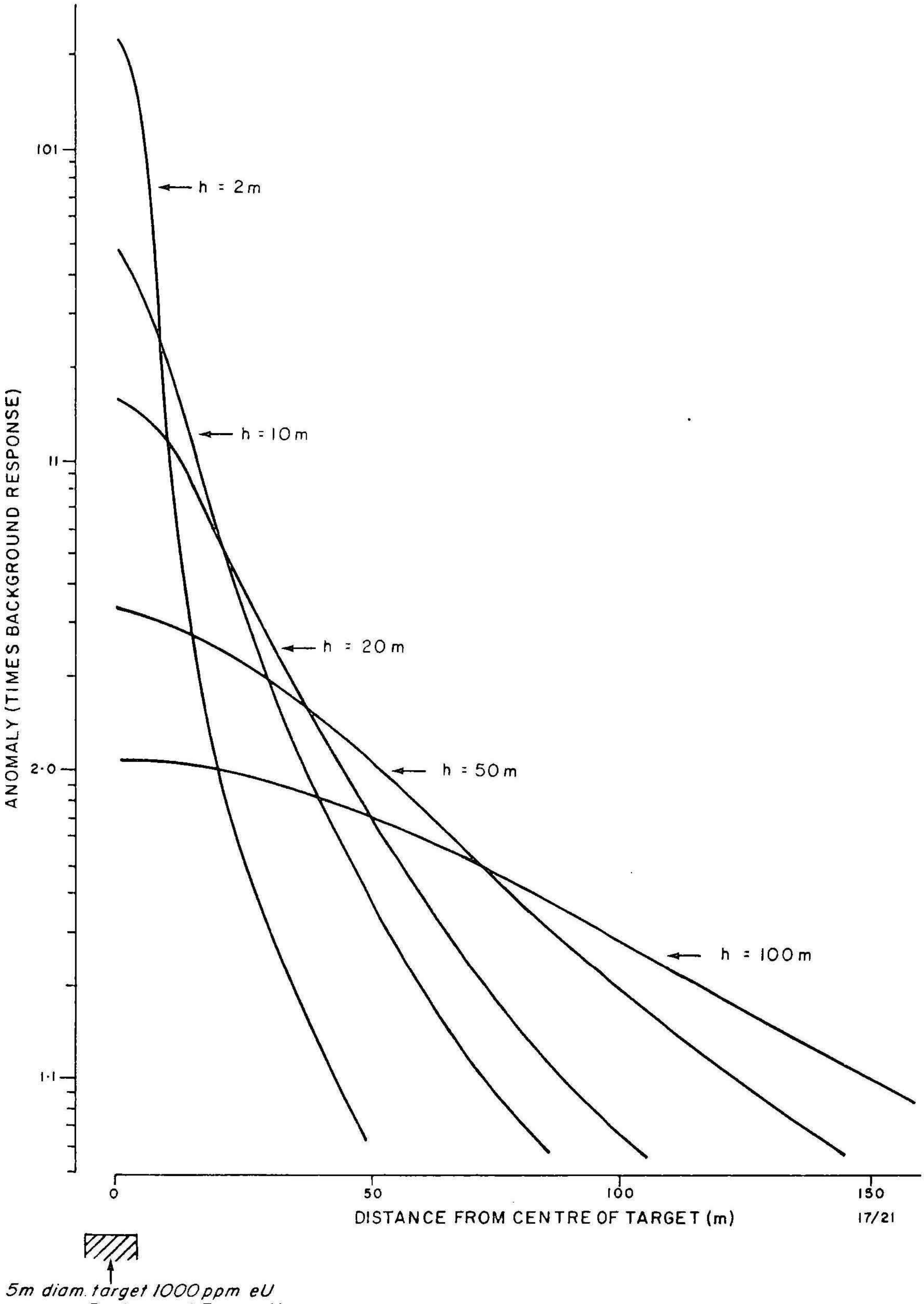


Fig. MA 9. Height attenuation/resolution characteristics of gamma-spectrometer systems

The results of this study for uranium are summarised in Table MA 1 as the ratio U-gamma to U-XRF (the equilibrium index) over different depths. Although the results from all depth intervals show a large dispersion, there is no evidence that surface rocks are grossly depleted or enriched in daughter products. However, the significant increase in the equilibrium index over the interval 2 m to 10 m might reflect a relative enrichment of daughter products above the watertable. Similarly the high mean value of the distribution suggests that most samples are relatively enriched in Bi 214.

TABLE MA 1

Uranium equilibrium index, surface and downhole samples, Pine Creek Geosyncline

Sample interval	0-30 m	0-2 m	2-10 m	10-30 m
No. of samples	85	34	26	25
Mode	1.0	1.0	1.8	1.4
Mean	1.9	1.6	2.0	2.3
Standard deviation	1.4	1.3	1.5	1.4

Magnetic methods research

Work was concentrated on the development and testing of software for the computer-controlled carborne magnetometer and gamma-ray spectrometer system. Other activities included tne analysis of carborne magnetic data from an experimental survey in the Eromanga Basin during 1981, and the development and documentation of filtering and modelling programs used in the Lachlan Fold Belt transect studies.

Vehicle-borne magnetometer and data acquisition system (R. Almond, R. Curtis-Nuthall). Programming and interfacing of the microprocesser-controlled acquisition system to magnetometer, intervalometer and four-channel gamma-ray spectrometer were completed and tested.

Data acquisition is controlled by terminal commands from the operator and is triggered on the basis of either an elapsed distance or a time interval. Data records are currently recorded on mini floppy-discs and comprise odometer value, time, total magnetic field, and four channels of gamma-ray spectrometer data.

Prior to a major program of field work in the Davenport Range area the system was successfully field tested at test sites near Dalgety and Dubbo in NSW.

Experimental survey, Eromanga Basin (P.M. Davies). Analysis of the results of the carborne magnetometer survey conducted during 1981 was completed. The survey was experimental and intended to establish whether high-resolution magnetic surveys could locate and map possible accumulations of magnetic minerals in shallow faults thought to act as hydrocarbon traps within the Eromanga Basin sequences.

A comparison of filtered magnetic data and seismic records suggests a weak but ambiguous association between zones of disturbed magnetic response and fault zones. However, the widespread occurrence of surficial magnetic material produces spurious anomalies that preclude the use of magnetic methods to identify or map shallow faults reliably.

Development of modelling and analysis methods (R. Almond). Improvements were made to programs used for filtering, analysing and modelling data. Work was concentrated on testing and improving the documentation and file handling capabilities of existing programs for use in the analyses of Lachlan Fold Belt transect data.

AIRBORNE SUBSECTION

D.N. Downie

Airborne surveys in the first six months of 1982 were restricted to the period May-June. Approximately 34 000 line-km were flown with the Twin Otter (VH-BMG) and the Aero Commander

(VH-BMR), both aircraft being assigned to the one project. Most of the Subsection's resources were allocated to data acquisition, data processing and training new staff. Data interpretation continued at a limited level.

On 1 March H.C. Sleigh Aviation was awarded a two-year contract to crew and maintain BMR's survey aircraft.

Officer Basin airborne geophysics (1526)

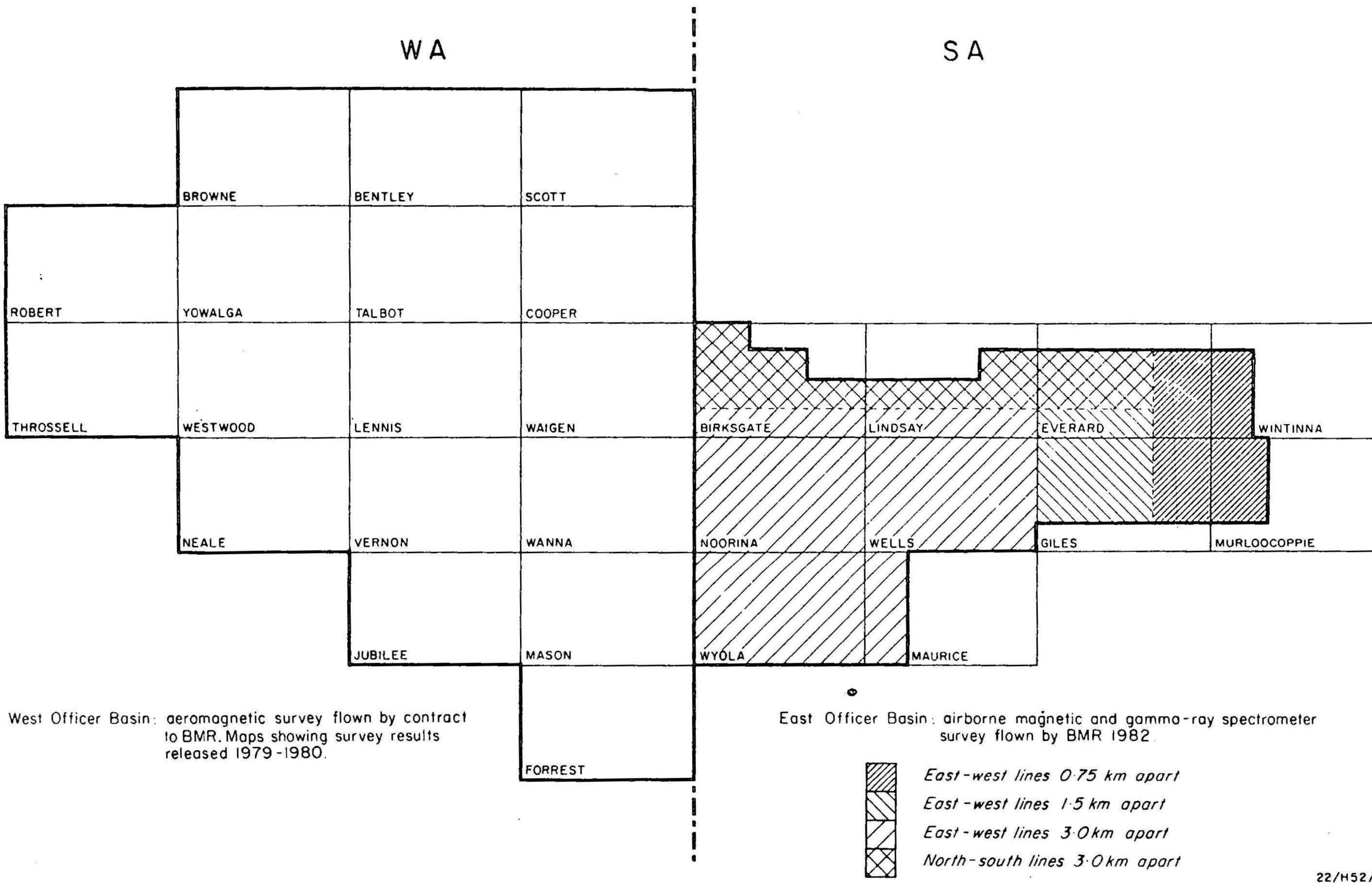
I. Zadoroznyj, N. Sampath

A program of airborne geophysics was commenced in 1975 to complete map coverage of the Officer Basin and the peripheries of provinces which bound it. Data obtained were to be used to determine the extent of the Officer Basin sediments and the distribution and depth of troughs within it, basement composition and structure, and the interrelations between the various provinces which bound the basin.

Figure MA 10 summarises the two phases of surveying which have been done as separate projects in West Officer Basin (WA) and East Officer Basin (SA).

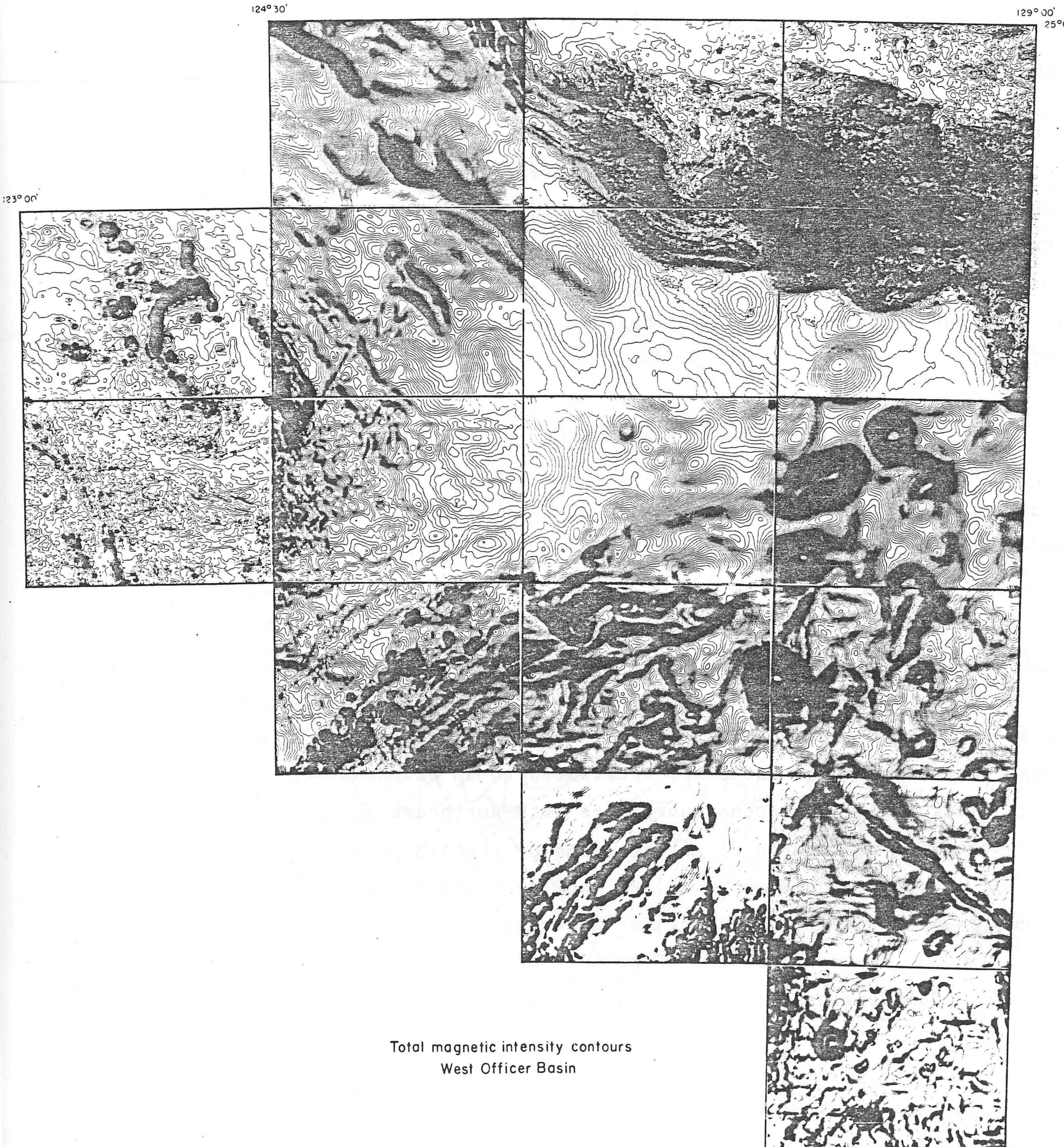
West Officer Basin, WA, aeromagnetic interpretation. In 1980 BMR completed the release of aeromagnetic maps of the West Officer Basin area, WA, from survey results obtained under contract in the period late 1975 to mid 1978. Figure MA 11 illustrates the full set of contour maps produced.

An interpretation of these data was carried out by Hunting Geology and Geophysics (Australia) Pty Limited in the period late 1981 to mid 1982 on behalf of Shell Development (Australia) Ltd. The objective was to produce a depth-to-magnetic-basement map of this region and a structural interpretation in order to assist hydrocarbon exploration. BMR contributed a copy of the magnetic data base to



WA
SA
BROWNE
BENTLEY
SCOTT
ROBERT
YOWALGA
TALBOT
COOPER
THROSSELL
WESTWOOD
LENNIS
WAIGEN
BIRKSGATE
LINDSAY
EVERARD
WINTINNA
NEALE
VERNON
WANNA
NOORINA
WELLS
GILES
MURLOOCOPPIE
JUBILEE
MASON
WYOLA
MAURICE
FORREST
West Officer Basin: aeromagnetic survey flown by contract to BMR. Maps showing survey results released 1979-1980.
East Officer Basin: airborne magnetic and gamma-ray spectrometer survey flown by BMR 1982
East-west lines 0·75 km apart
East-west lines 1·5 km apart
East-west lines 3·0 km apart
North-south lines 3·0 km apart
22/H52/2

Fig MA 11



Total magnetic intensity contours
West Officer Basin

22/H52/3

the project. Shell Development (Australia) Ltd made available for public release a copy of the interpretation report shortly after its completion. Figures MA 12 and MA 13, derived by reduction of figures contained in the Shell report, show contours of depths to magnetic basement, major magnetic zones, and faults.

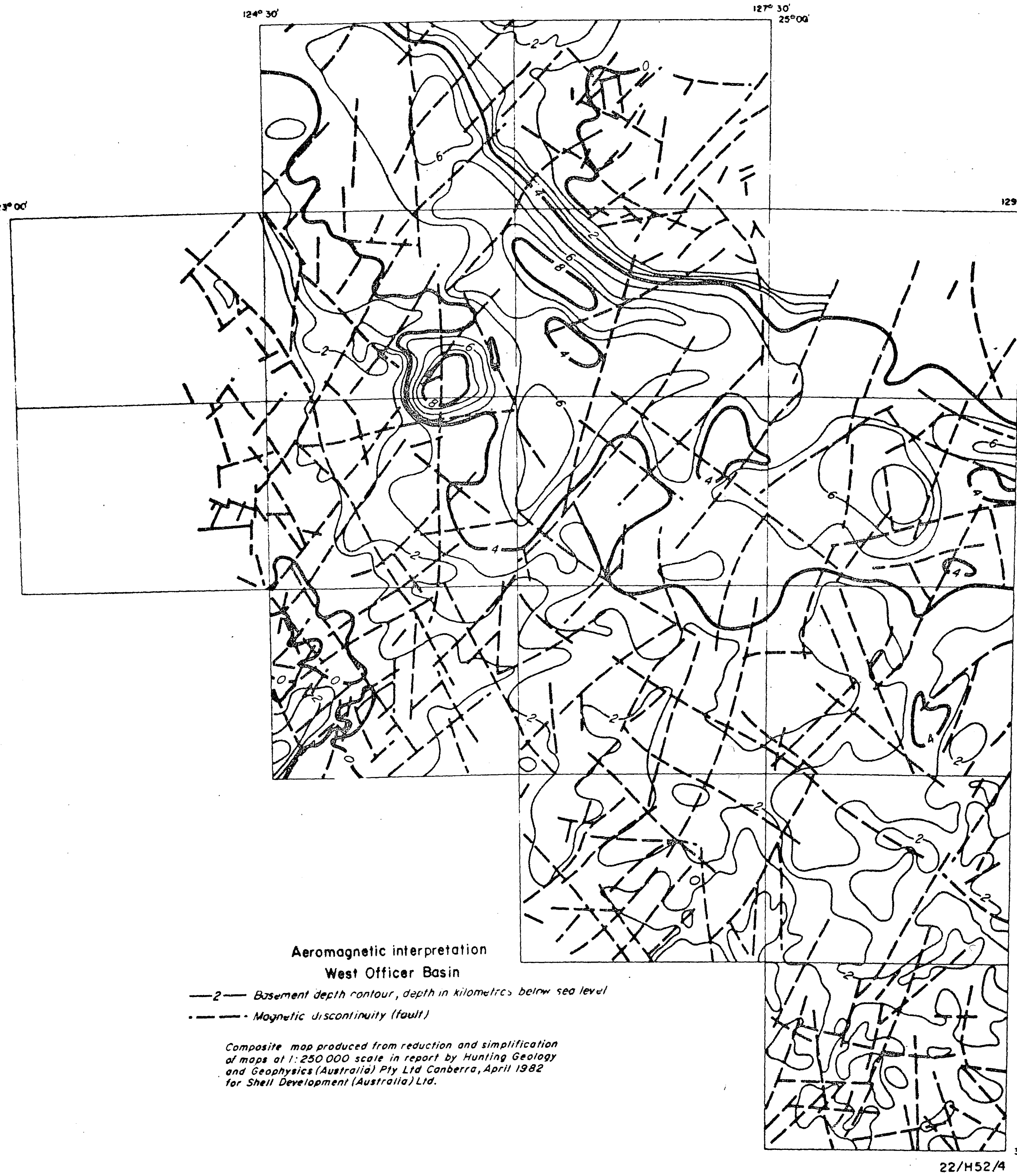
The depth contours show a major basement trough with sediment thickness in excess of 8 km in BROWNE, YOWALGA and TALBOT. Three further major basement depressions have been located in LENNIS, WAIGEN and YOWALGA. The Birksgate Trough of South Australia can be traced on to eastern WAIGEN. The northern, western and southern margins of the Officer Basin have been defined although in the northwest the thick sedimentary section continues on to HERBERT, MADLEY and WARRI.

Many intrasedimentary anomalies are evident in the basin, most of which have been attributed to Cambrian Table Hill lava flows and dyke feeders. On western NEALE and southern JUBILEE and MASON, some older dykes, possibly of Proterozoic age, have been identified.

The distinguishing features of the magnetic zones are the medium-amplitude anomalies with predominent northwest trends in the central part of the Officer Basin (Zone 1); a very intense elongated doublet anomaly to the southwest of the Musgrave Block (Zone 2); intense short-wavelength anomalies attributed to an extension of the Yilgarn Block (Zone 3); intense anomalies with northeast to east-northeast trends attributed to an extension of the Albany Fraser Province (Zone 4); a region with some anomalies showing similarities to those of Zones 2 and 4 but with distinctive large-amplitude, negative-polarity anomalies also included (Zone 5); and complex intense short-wavelength anomalies associated with the Musgrave Block (Zone 6).

The full report, accompanied by figures at 1:250 000 scale which illustrate the interpretation of the individual map sheets, is available from the Copy Service, Australian Government Printer (Production), Canberra. Total magnetic intensity contour maps at the same scale are available from the same source. The latter are not included in the interpretation report.

Fig MA 12



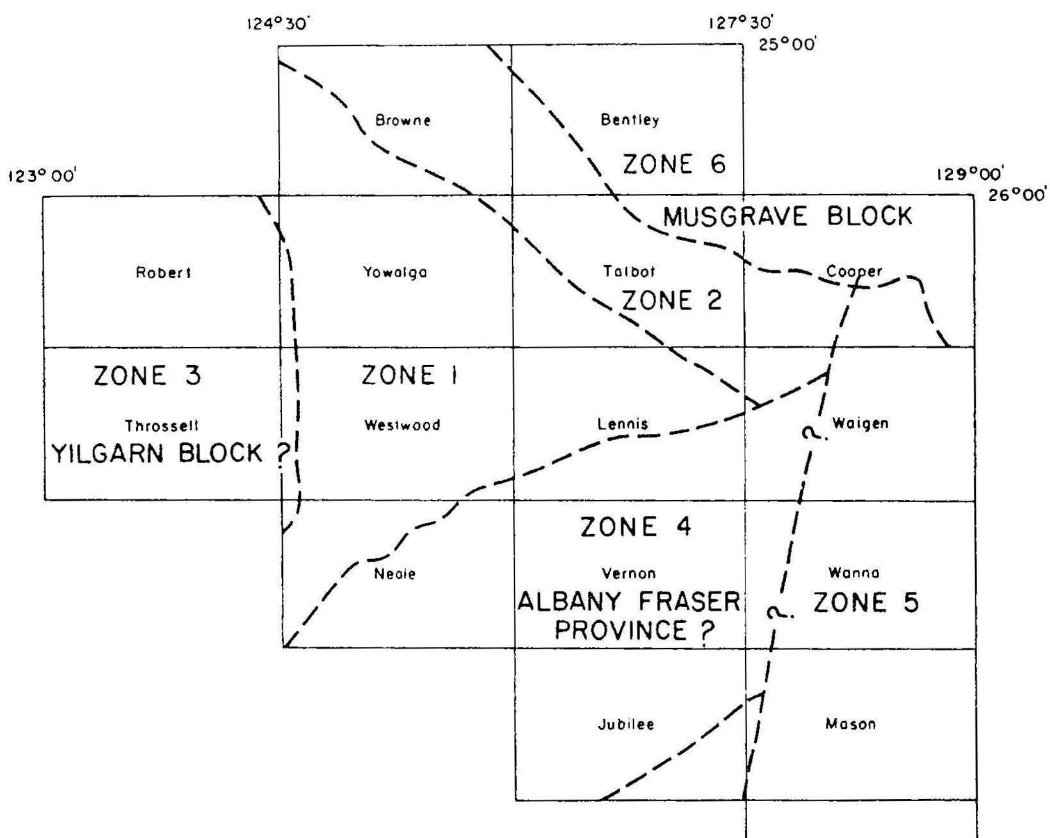
Aeromagnetic interpretation
West Officer Basin

—2— *Basement depth contour, depth in kilometres below sea level*

-·—·- *Magnetic discontinuity (fault)*

Composite map produced from reduction and simplification of maps at 1:250 000 scale in report by Hunting Geology and Geophysics (Australia) Pty Ltd Canberra, April 1982 for Shell Development (Australia) Ltd.

22/H52/4



Magnetic interpretation zones
West Officer Basin

Map reproduced from report by Hunting Geology and Geophysics (Australia) Pty Ltd Canberra, April 1982, for Shell Development (Australia) Ltd.

East Officer Basin, SA, airborne magnetic and radiometric survey. Both BMR survey aircraft were assigned to this project at the commencement of the survey year in 1982. Each aircraft was equipped with a magnetometer (resolution 0.25 nT or better), 4-channel gamma-ray spectrometer, doppler navigation system, and digital data acquisition system. The Twin Otter (VH-BMG) commenced survey operations in mid-May on WYOLA and MAURICE. The Aero Commander (VH-BMR) commenced survey operations in early May flying lines spaced at intervals of 3 km through NOORINA, WELLS, GILES and MURLOOCOPPIE. The overall survey design is shown in Figure MA 10. The South Australian Department of Mines and Energy provided funds to enable flight line spacing to be reduced to 0.75 km in the extreme east of the project area.

At the end of June 34 000 line-km of surveying had been completed out of 57 000 line-km required to complete the project. The remainder of the survey work was scheduled for completion by the end of July. Data processing is expected to commence in September 1982 with maps being released progressively through the Government Printer copy service in the first half of 1983. It is unlikely that interpretation of these results will commence before 1984.

East Canning Basin airborne geophysics (1106)

M. Bacchin, G. Young

This project was initiated at the request of the Petroleum Exploration Branch, BMR, to advance the geological understanding of the eastern periphery of the Canning Basin. It was expected that results obtained would assist petroleum exploration by providing regional information on basement geometry at the basin margin, and basement structure. It was also expected that the results would assist exploration for other minerals in areas of exposed or shallow basement.

Phase one of the project involved an airborne magnetic and radiometric survey which covered STANSMORE, LUCAS, BILLILUNA and the southern-half of GORDON DOWNS. This was completed in September 1980. Phase two was the production of maps presenting survey results. This was completed in early 1982 with the release of total magnetic intensity and total count radiometric contour maps (Fig. MA 14 to MA 21). Phase three of the project involves the interpretation of data obtained. This commenced in April 1982, and is expected to be completed in early 1983.

Interpretation commenced with a study of the characteristics and sources of magnetic anomalies in TANAMI and THE GRANITES to the east of the survey area. A geological understanding of such anomalies is needed in the interpretation of basement composition beneath the Canning Basin sediments. It appears that much of the magnetic pattern evident in TANAMI and THE GRANITES can be interpreted in terms of one or two magnetic marker horizons in the Mount Charles Beds. Anomaly complexity is in general interpreted as a function of structural distortion of these marker horizons.

Depth estimates to magnetic basement have been determined using manual and computer assisted methods. A preliminary depth-to-basement map produced from these results indicates thicknesses of non-magnetic strata up to 6000 m in STANSMORE and LUCAS. Grid surfaces used in the production of the radiometric and magnetic contour maps were adopted for use on the Hewlett Packard Comtal (colour video) display system. This facility assists the interpretation of structure. In this instance it highlighted a series of high-frequency, low-amplitude magnetic anomalies which trend north-south in BILLILUNA and LUCAS. The form of these anomalies suggests fault control of post-Permian age. Similar anomalies appear to be associated with basement in TANAMI and THE GRANITES.

Aircraft systems development

D. Downie

A significant enhancement of the capability of BMR's Aero Commander aircraft was achieved in the first half of 1982 with the installation of new navigation and gamma-ray spectrometer equipment. Airframe modifications associated with the doppler installation were completed in December 1981. Integration of doppler navigation into the BMR data acquisition system, followed by test flying of the complete system, was successfully completed in the April-May period. Operation of the system in the field has been satisfactory, but the navigation program requires a better heading reference than that provided by the C14 compass.

The Aero Commander's gamma-ray spectrometer was brought up to the same specification as the system in the Twin Otter with the installation of 16 780 cubic centimetres of detector crystal and a multi-channel gamma-ray spectrometer interfaced directly with the data acquisition computer.

Video flight-path recording equipment was introduced into both aircraft for the 1982 survey program. This equipment has performed well, proving to be exceptionally reliable and easy to operate. It is also cheaper to run than 35-mm cameras and has the additional advantage of allowing immediate review and/or plotting of the flight-path record.

A project was commenced to improve aircraft compensation to match the increased resolution of the magnetometer. The system will involve real-time corrections for aircraft attitude to be performed by the data acquisition computer. The first stage, involving heading reference, was implemented in 1982. Pitch and roll corrections will require the installation of a vertical gyro.

Airorne Reductions and Mapping Group

C. Leary, A. Luyendyk, J. Dale, D. Souter, R. Reitsma, E. Smilek, K. Horsfall, N. Sampath, F. Bagliani*, D. Conley*, R. Franklin*, M. Rudman*

This group is responsible for the entry of corrected airborne geophysical data, acquired by BMR, into comprehensive analogue and digital data bases, and the maintenance of these data bases. As new data are acquired, personnel are assigned to their processing with the objective of producing maps for release through the Australian Government Printer Copy Service. Basic data are made available, on request, to outside organisations. An extensive suite of computer programs has been developed for reduction-mapping and interpretation of these data. Recruits* to the Airborne Subsection commence their training in this group.

Airborne data processing. The status of data processing and mapping releases for the period covered by the report is shown in Table MA 2. Data from 12 previously processed 1:250 000 map areas were upgraded with revised maps being released where appropriate. Work commenced or continued on data sets from recent surveys covering 12 1:250 000 areas; 6 of these were processed to completion. Data processing was also carried out on two special purpose surveys, Glenormiston in Queensland and Hatches in the Northern Territory. Seventy-three geophysical maps were released through the Australian Government Printer Copy Service (see Table MA 2). Of these the total magnetic and total count contour maps reduced to 1:1 000 000 scale are shown in Figures MA 14 to MA 29.

Data sets for a further 20 1:250 000 areas await processing. It is envisaged that 16 of these, together with those for which processing has already commenced, will be completed within the next 12 months.

Supply of data to outside users. Over the period October 1981 to June 1982, 5 organisations have visited BMR to access the analogue data for 15 1:250 000 map areas. Seven areas were in SA, 5 in WA and 3 in NT. In addition microfilm copies of analogue data were obtained by 5 organisations involving 25 1:250 000 areas, 18 being in WA, 6 in NSW and 1 in Victoria.

For the same period, six organisations have obtained digital copies of data for 77 1:250 000 map areas. The requirement was for 40 areas in the NT, 28 in WA, 4 in SA, 3 in NSW and 2 in Qld.

Two maps (Fig. MA 30 and MA 31) show the availability of magnetic and radiometric digital data for Australia from BMR.

Airborne ADP system development. Excluding general maintenance and minor modifications, the following software developments were undertaken.

1. A new gridding program was completed and integrated with the existing contouring system. Benefits arising from the changes include:

(a) Greater flexibility in the acceptable distribution of (x,y) data.
(b) Reduced processing costs with quicker convergence to the final grid.
(c) Exact windowing of the (x,y) area to be contoured and automatic production of title panels.

Further work is planned to label contours and highs/lows automatically, which would eliminate all manual drafting in contour map production.

2. A program was written to combine all data retained on magnetic tape from the Magnetic Map of Australia Project (1976) and rationalise its digital format.

3. The Werner deconvolution depth-to-basement interpretation program was updated to allow separate plots to be produced from successive magnetic profiles.

4. The design of a program to compact and report on survey-data random-access work files was completed. This program will be developed in the next 12 months.

5. Improvements to the aircraft acquisition systems were reflected in modifications to the program that enters the field data into the Airborne data base. The improvements include the recording or pressure and temperature, the introduction of doppler navigation to VH-BMR and the upgrading of the fluxgate magnetometer to record at 1 nT or 0.1 nT.

TABLE MA 2

AIRBORNE DATA PROCESSING/MAPPING RELEASES

R - Maps and Data Released
C - Processing Completed

S - Data Stockpiled
P - Processing in Progress

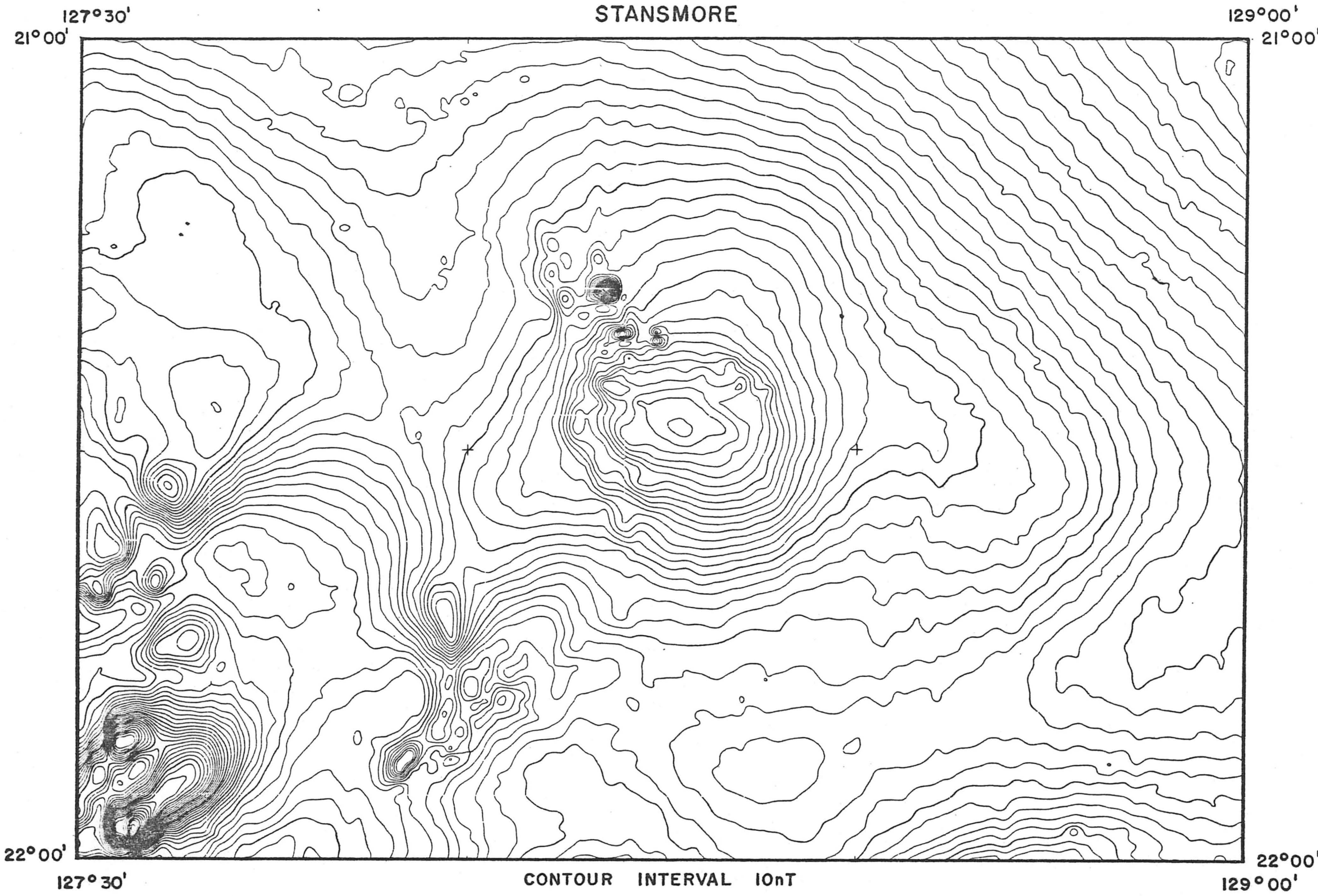
MI - Total Magnetic Intensity
TC - Total Count Radiometric

STATE	SHEETS	SURVEY CONFIGURATION				PROCESSING		MAPPING			COMMENT	
		MAG.	RAD.	SPACING KM	ALT. M	DATA STATUS	SCALE	NO. MAPS	CONTOURS	PROFILES		FIG.
NSW	Ana Branch	X	X	3.0	150	S	1:250 000	-				
	Booligal	X	X	3.0	150	S	1:250 000	-				
	Barnato	X	X	3.0	150	S	1:250 000	-				
	Cobham Lake	X	X	3.0	150	S	1:250 000	-				
	Ivanhoe	X	X	3.0	150	R	1:250 000	1		TMI		
								5		Radiometrics		
								1		Flight path		
	Louth	X	X	3.0	150	S	1:250 000	-				
	Manara	X	X	3.0	150	R	1:250 000	1	TMI			MA 22
								1		TMI		
								5		Radiometrics		
								1		Flight path		
	Menindee	X	X	3.0	150	R	1:250 000	1	TMI			MA 23
								1	TC			MA 24
								1		TMI		
								5		Radiometrics		
								1		Flight path		
								3		Ratios		
	Milparinka	X	X	3.0	150	S	1:250 000	-				
	Pooncarie	X	X	3.0	150	S	1:250 000	-				
	Urisino	X	X	3.0	150	S	1:250 000	-				
	White Cliffs	X	X	3.0	150	S	1:250 000	-				
	Wilcannia	X	X	3.0	150	P	1:250 000	-				
NSW/VIC	Balranald	X	X	3.0	150	S	1:250 000	-				
	Mildura	X	X	3.0	150	S	1:250 000	-				
VIC	Ouyen	X	X	3.0	150	S	1:250 000	-				
	Swan Hill	X	X	3.0	150	S	1:250 000	-				
	Glenormiston special	X	X	1.0	100	P	1:125 000	-				

STATE	SHEETS	SURVEY CONFIGURATION				PROCESSING			MAPPING		COMMENT	
		MAG.	RAD.	SPACING KM	ALT. M	DATA STATUS	SCALE	NO. MAPS	CONTOURS	PROFILES		FIG.
SA	Barton	X	X	1.6	150	R	1:250 000	1	TMI			MA 25
								1		TMI		
								1		Flight path		
	Birksgate	X	X	3.0	150	S	1:250 000	-			Western & Southern	
	Cook	X	X	1.6	150	R	1:250 000	1	TMI		halves	MA 26
								1		TMI		
								1		Flight path		
	Everard	X	X	0.75	150	S	1:250 000	-			Southern 2/3	
	Giles	X	X	0.75	150	S	1:250 000	-			Northern 2/3	
	Lindsay	X	X	3.0	150	S	1:250 000	-			Southern half	
	Maurice	X	X	3.0	150	S	1:250 000	-				
	Murloocoppie	X	X	0.75	150	S	1:250 000	-			W. quarter	
	Noorina	X	X	3.0	150	S	1:250 000	-				
	Ooldea	X	X	1.6	150	R	1:250 000	1	TMI			MA 27
								1		TMI		
								1		Flight path		
	Wells	X	X	3.0	150	S		-				
	Wintinna	X	X	0.75	150	S		-			W. quarter	
	Wyola	X	X	3.0	150	S		-				
WA	Balladonia	X	X	1.5	150	P	1:250 000	-				
	Belele	X	X	1.6	180	R	1:250 000	1		TMI	revised	
								1		Flight path	revised	
	Billiluna	X	X	1.5	150	R	1:250 000	1	TMI			MA 18
								1	TC			MA 19
								1		Flight path	revised	
	Byro	X	X	1.6	180	R	1:250 000	1		TMI	revised E. third	
								1		Flight path	revised E. third	
	Cue	X	X	1.6	180	R	1:250 000	1		TMI	revised	
								1		Flight path	revised	
	Esperance	X	X	1.5	150	P	1:250 000	-				
	Gordon Downs	X	X	1.5	150	R	1:250 000	1	TMI		S. half	MA 20
								1	TC		S. half	MA 21
								1		Flight path	revised	
	Kirkalocka	X	X	1.6	180	R	1:250 000	1		TMI	revised	
								1	TMI	Flight path	revised	
	Lucas	X	X	1.5	150	R	1:250 000	1	TMI			MA 16
								1	TC			MA 17
								1		Flight path	revised	
	Malcolm	X	X	1.5	150	P	1:250 000	-				
	Murgoo	X	X	1.6	180	R	1:250 000	1		TMI	revised E. third	
								1		Flight path	revised E. third	

STATE	SHEETS	SURVEY CONFIGURATION MAG.	RAD.	SPACING KM	ALT. M	PROCESSING DATA STATUS	SCALE	NO. MAPS	MAPPING CONTOURS	PROFILES	COMMENT	FIG.
	Ravensthorpe	X	X	1.5	150	R	1:250 000	1	TMI			MA 28
								1	TC			MA 29
								3		Ratios		
								1		TMI	revised	
								1		Flight path	revised	
	Sandstone	X	X	1.6	180	R	1:250 000	1		TMI	revised	
								1		Flight path	revised	
	Stansmore	X	X	1.5	150	R	1:250 000	1	TMI			MA 14
								1	TC			MA 15
								1		Flight path	revised	
	Yalgoo	X	X	1.6	180	R	1:250 000	1		TMI	revised E.third	
								1		Flight path	revised E.third	
	Youanmi	X	X	1.6	180	R	1:250 000	1		TMI	revised	
								1		Flight path		
	Zanthus	X	X	1.5	150	P	1:250 000	-				
NT	Alligator River	X	X	1.5	150	R	1:250 000	1		TMI	revised	
								1		Flight path	revised	
	Bonney Well	X	X	3.0	150	P	1:250 000	-				
	Hatches	X	X	0.5	100	P	1:100 000	-				

Fig MA 14



AIRBORNE SURVEY, STANSMORE, WA 1980

TOTAL MAGNETIC INTENSITY

SCALE 1:1000 000

10 0 10 20 30 40 50 km

LOCATION DIAGRAM

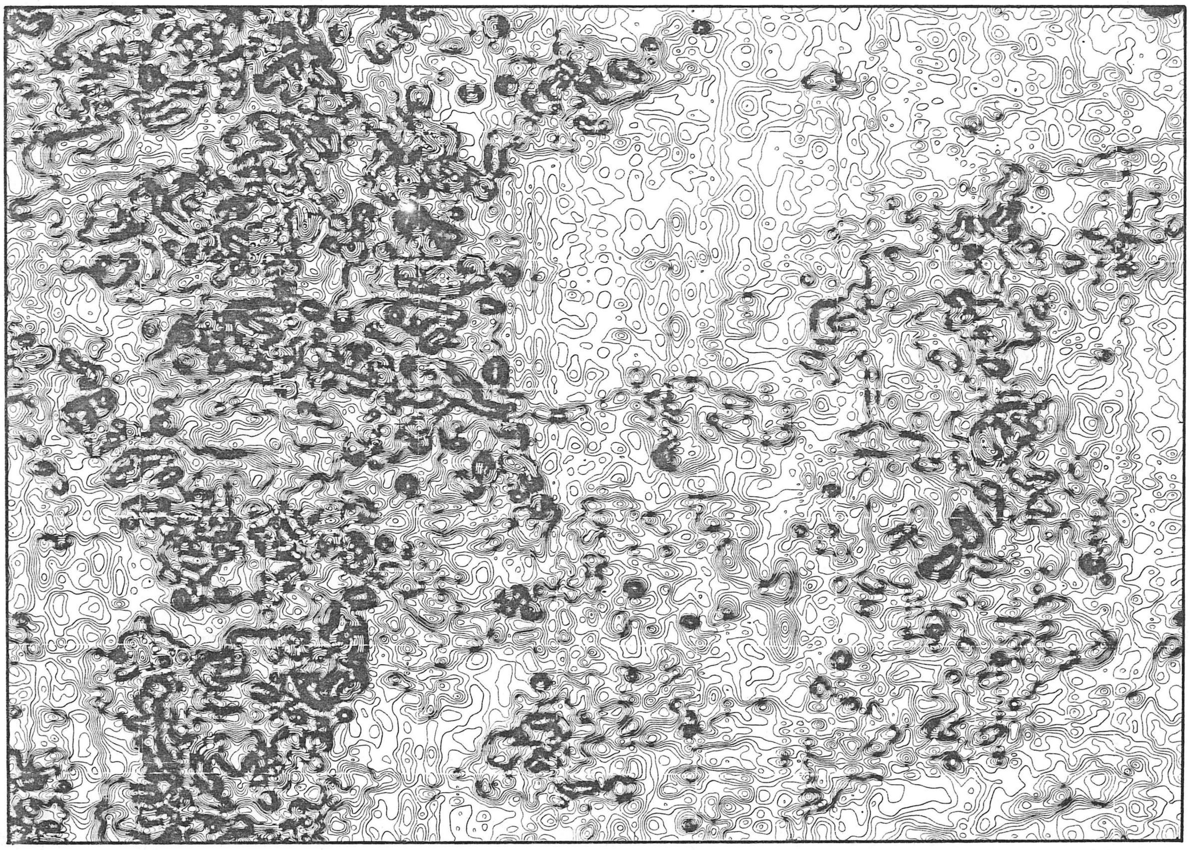
REFERENCE TO 1:250 000 MAP SERIES

CORNISH	LUCAS	THE GRANITES
HELENA	STANSMORE	HIGHLAND ROCKS
WILSON	WEBB	LAKE MACKAY

Fig MA 15

STANSMORE

127°30' 21°00' 129°00' 21°00'



22°00' 127°30' 22°00' 129°00'

CONTOUR INTERVAL 20 C/S

AIRBORNE SURVEY, STANSMORE, WA 1980

RADIOMETRIC CONTOURS
TOTAL COUNT

SCALE 1:1000 000

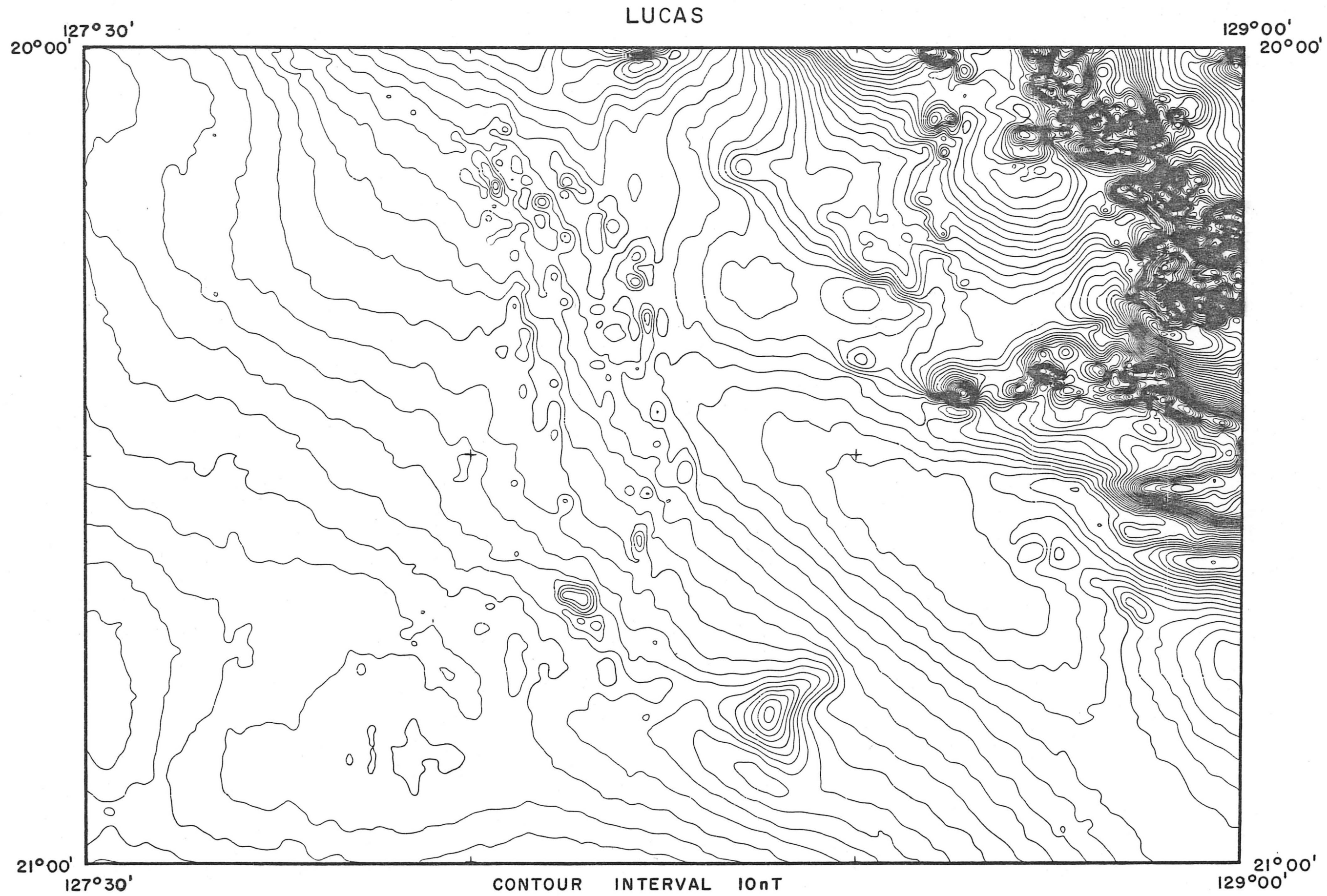
10 0 10 20 30 40 50 km

LOCATION DIAGRAM

REFERENCE TO 1:250 000 MAP SERIES

CORNISH	LUCAS	THE GRANITES
HELENA	STANSMORE	HIGHLAND ROCKS
WILSON	WEBB	LAKE MACKAY

Fig MA 16



AIRBORNE SURVEY, LUCAS, WA 1980

TOTAL MAGNETIC INTENSITY

SCALE 1:1000 000

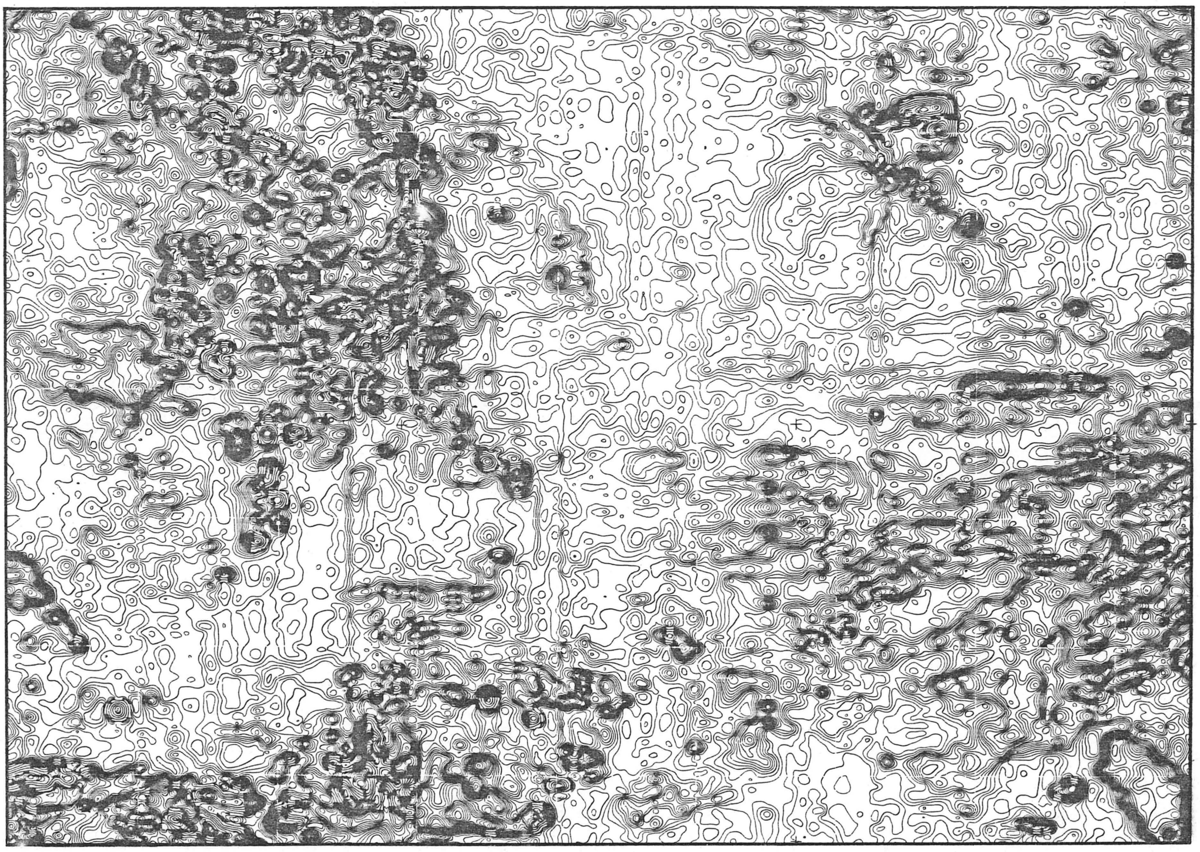
10 0 10 20 30 40 50 km

LOCATION DIAGRAM

REFERENCE TO 1:250 000 MAP SERIES

MOUNT BANNERMAN	BILLILUNA	TANAMI
CORNISH	LUCAS	THE GRANITES
HELENA	STANSMORE	HIGHLAND ROCKS

Fig. MA 17



CONTOUR INTERVAL 20C/S

AIRBORNE SURVEY, LUCAS, WA 1980

RADIOMETRIC CONTOURS
TOTAL COUNT

SCALE 1:1 000 000

10 0 10 20 30 40 50 km

LOCATION DIAGRAM

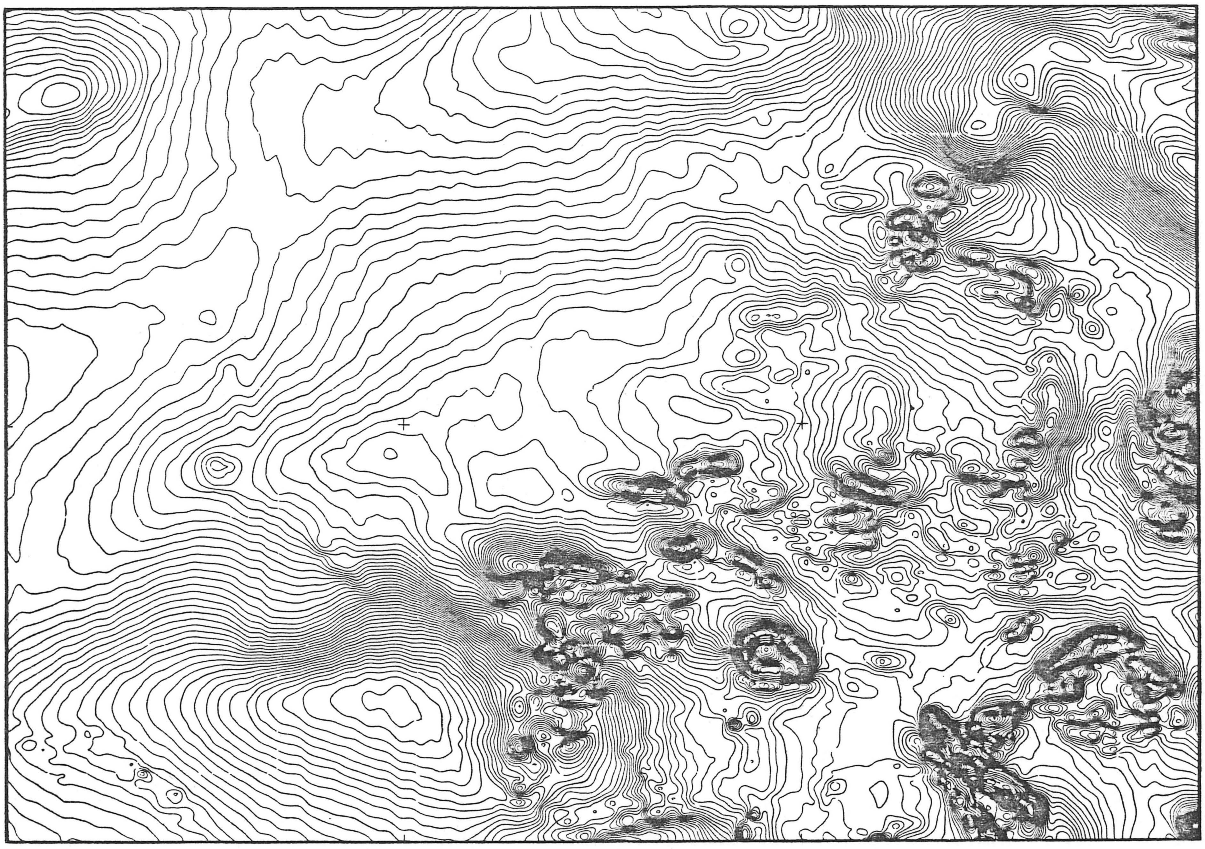
REFERENCE TO 1:250 000 MAP SERIES

MOUNT BANNERMAN	BILLILUNA	TANAMI
CORNISH	LUCAS	THE GRANITES
HELENA	STANSMORE	HIGHLAND ROCKS

Fig MA 18

127°30' BILLILUNA 129° 00'

19°00' 19°00'



20° 00' 20°00'

127°30' CONTOUR INTERVAL 10nT 129°00'

AIRBORNE SURVEY, BILLILUNA, WA 1980

TOTAL MAGNETIC INTENSITY

SCALE 1:1 000 000

10 0 10 20 30 40 50 km

LOCATION DIAGRAM

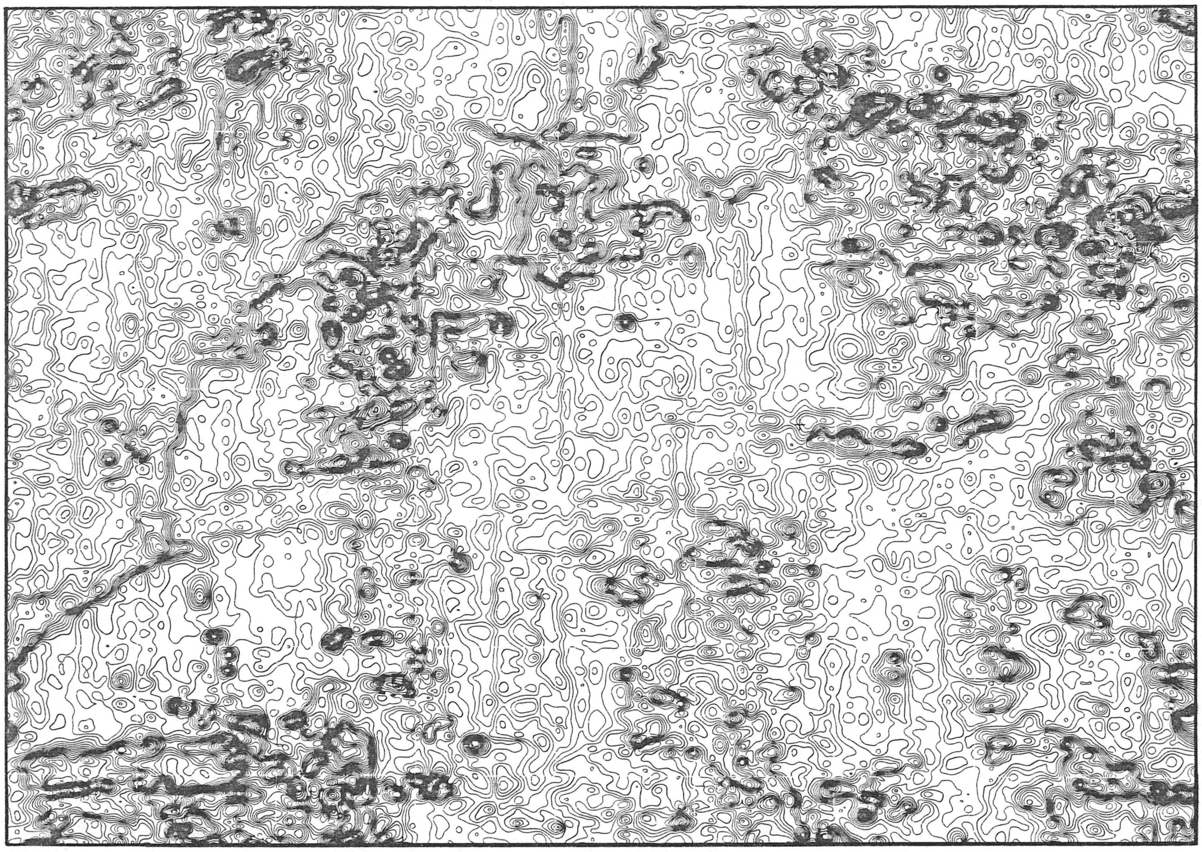
REFERENCE TO 1:250 000 MAP SERIES

MOUNT RAMSAY	GORDON DOWNS	BIRRINDUDU
MOUNT BANNERMAN	BILLILUNA	TANAMI
CORNISH	LUCAS	THE GRANITES

Fig MA 19

BILLILUNA

127°30' 19°00' 129°00' 19°00'



20°00' 127°30' 20°00' 129°00'

CONTOUR INTERVAL 20C/S

AIRBORNE SURVEY, BILLILUNA, WA 1980

RADIOMETRIC CONTOURS
TOTAL COUNT

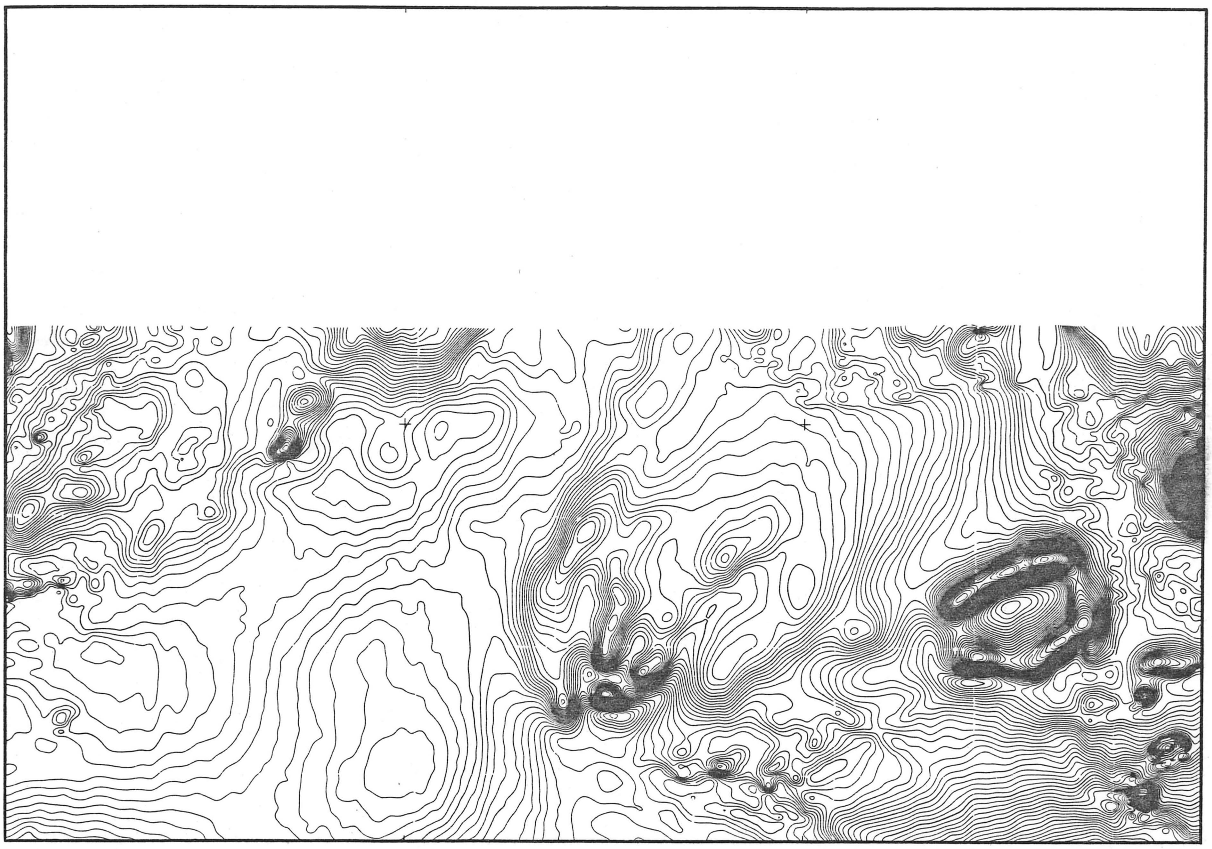
SCALE 1:1 000 000

10 0 10 20 30 40 50 km

LOCATION DIAGRAM

REFERENCE TO 1:250 000 MAP SERIES

MOUNT RAMSAY	GORDON DOWNS	BIRRINDUDU
MOUNT BANNERMAN	BILLILUNA	TANAMI
CORNISH	LUCAS	THE GRANITES



CONTOUR INTERVAL 10nT

AIRBORNE SURVEY, GORDON DOWNS, WA 1980

TOTAL MAGNETIC INTENSITY

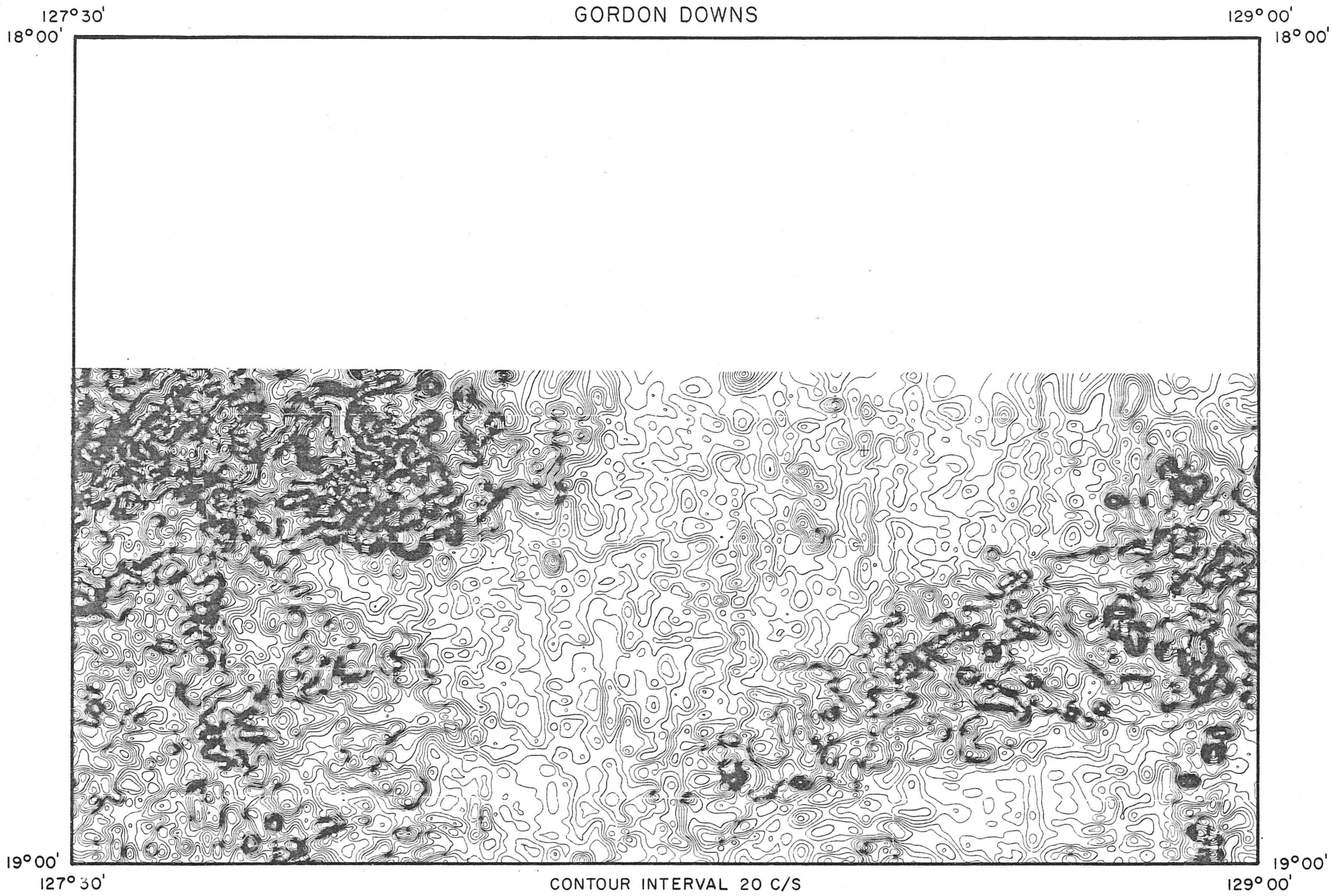
SCALE 1:1 000 000

10 0 10 20 30 40 50 km

LOCATION DIAGRAM

REFERENCE TO 1:250 000 MAP SERIES

LANSDOWNE	DIXON RANGE	LIMBUNYA
MOUNT RAMSAY	GORDON DOWNS	BIRRINDUDU
MOUNT BANNERMAN	BILLILUNA	TANAMI



AIRBORNE SURVEY, GORDON DOWNS, WA 1980

RADIOMETRIC CONTOURS

TOTAL COUNT

SCALE 1:1 000 000

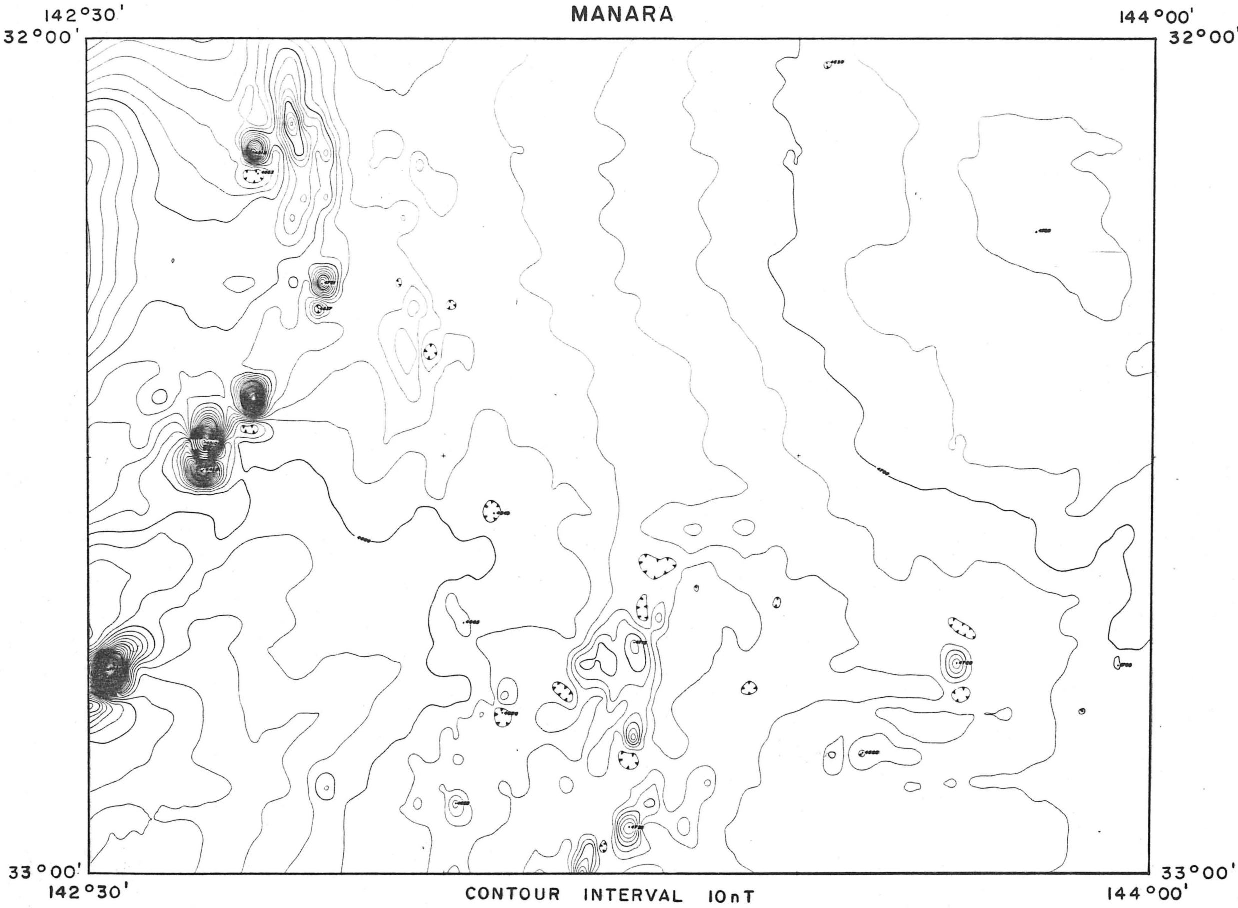
10 0 10 20 30 40 50 km

LOCATION DIAGRAM

REFERENCE TO 1:250 000 MAP SERIES

LANSDOWNE	DIXON RANGE	LIMBUNYA
MOUNT RAMSAY	GORDON DOWNS	BIRRINDUDU
MOUNT BANNERMAN	BILLILUNA	TANAMI

Fig MA 22



CONTOUR INTERVAL 10nT

AIRBORNE SURVEY, MANARA, NSW 1981

TOTAL MAGNETIC INTENSITY

SCALE 1:1 000 000

10 0 10 20 30 40 50 km

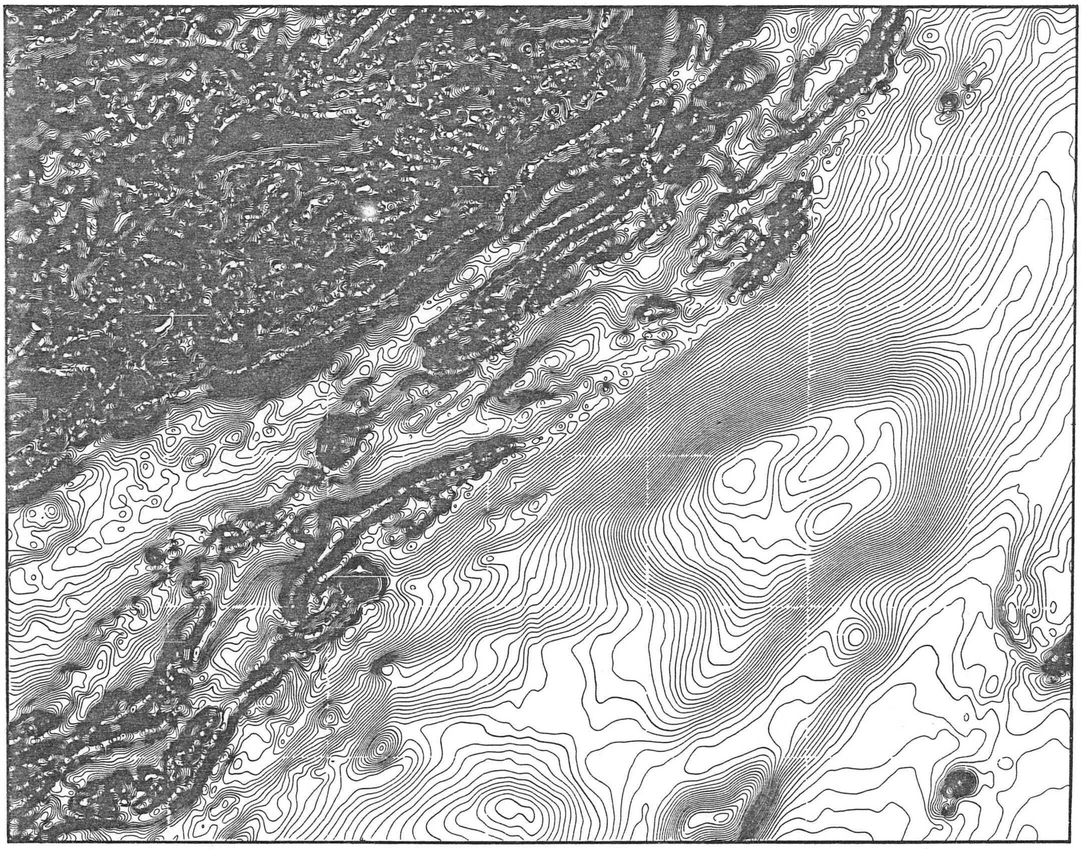
LOCATION DIAGRAM

REFERENCE TO 1:250 000 MAP SERIES

BROKEN HILL	WILCANNIA	BARNATO
MENINDEE	MANARA	IVANHOE
ANA BRANCH	POONCARIE	BOOLIGAL

141°00' MENINDEE 142°30'

32°00' 32°00'



33°00' 33°00'

141°00' CONTOUR INTERVAL 10nT 142°30'

AIRBORNE SURVEY, MENINDEE, NSW 1980

TOTAL MAGNETIC INTENSITY

SCALE 1:1000 000

10 0 10 20 30 40 50 km

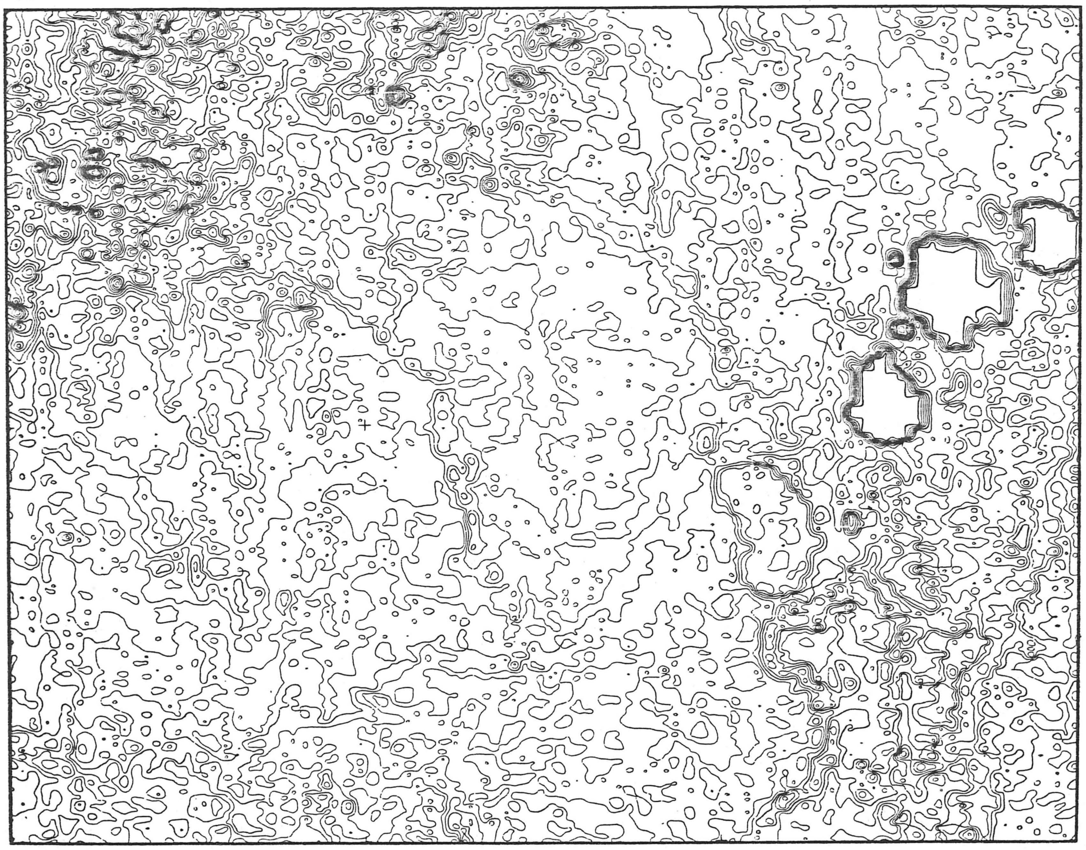
LOCATION DIAGRAM

REFERENCE TO 1:250 000 MAP SERIES

CURNAMONA	BROKEN HILL	WILCANNIA
OLARY	MENINDEE	MANARA
CHOWILLA	ANA BRANCH	POONCARIE

MENINDEE

141°00' 142°30'
32°00' 32°00'



33°00' 33°00'
141°00' 142°30'

CONTOUR INTERVAL 40 COUNTS/S

AIRBORNE SURVEY, MENINDEE, NSW 1980

RADIOMETRIC CONTOURS
TOTAL COUNT

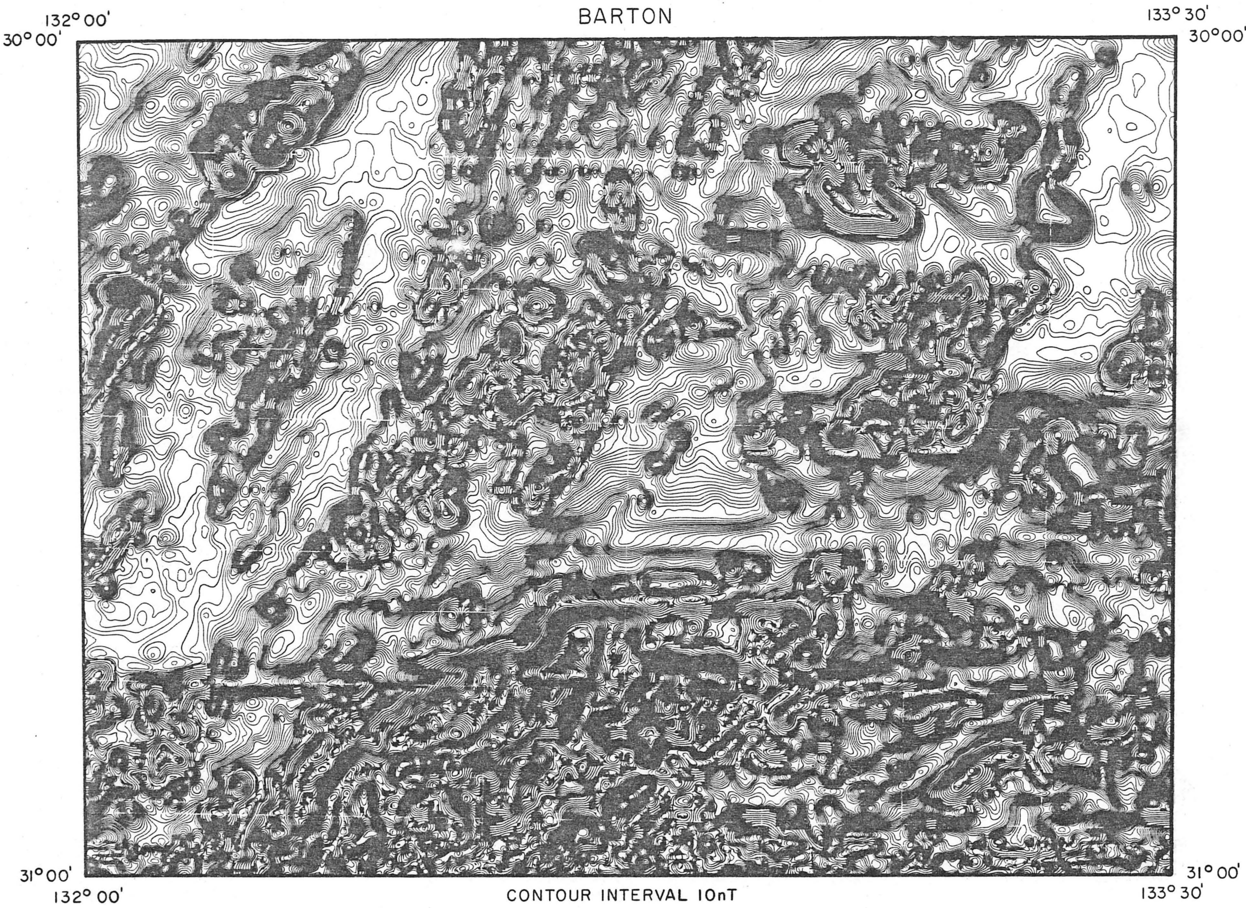
SCALE 1:1 000 0.00

10 0 10 20 30 40 50 km

LOCATION DIAGRAM

REFERENCE TO 1:250 000 MAP SERIES

CURNAMONA	BROKEN HILL	WILCANNIA
OLARY	MENINDEE	MANARA
CHOWILLA	ANA BRANCH	POONCARIE



CONTOUR INTERVAL 10nT

AIRBORNE SURVEY, BARTON, SA 1970

TOTAL MAGNETIC INTENSITY

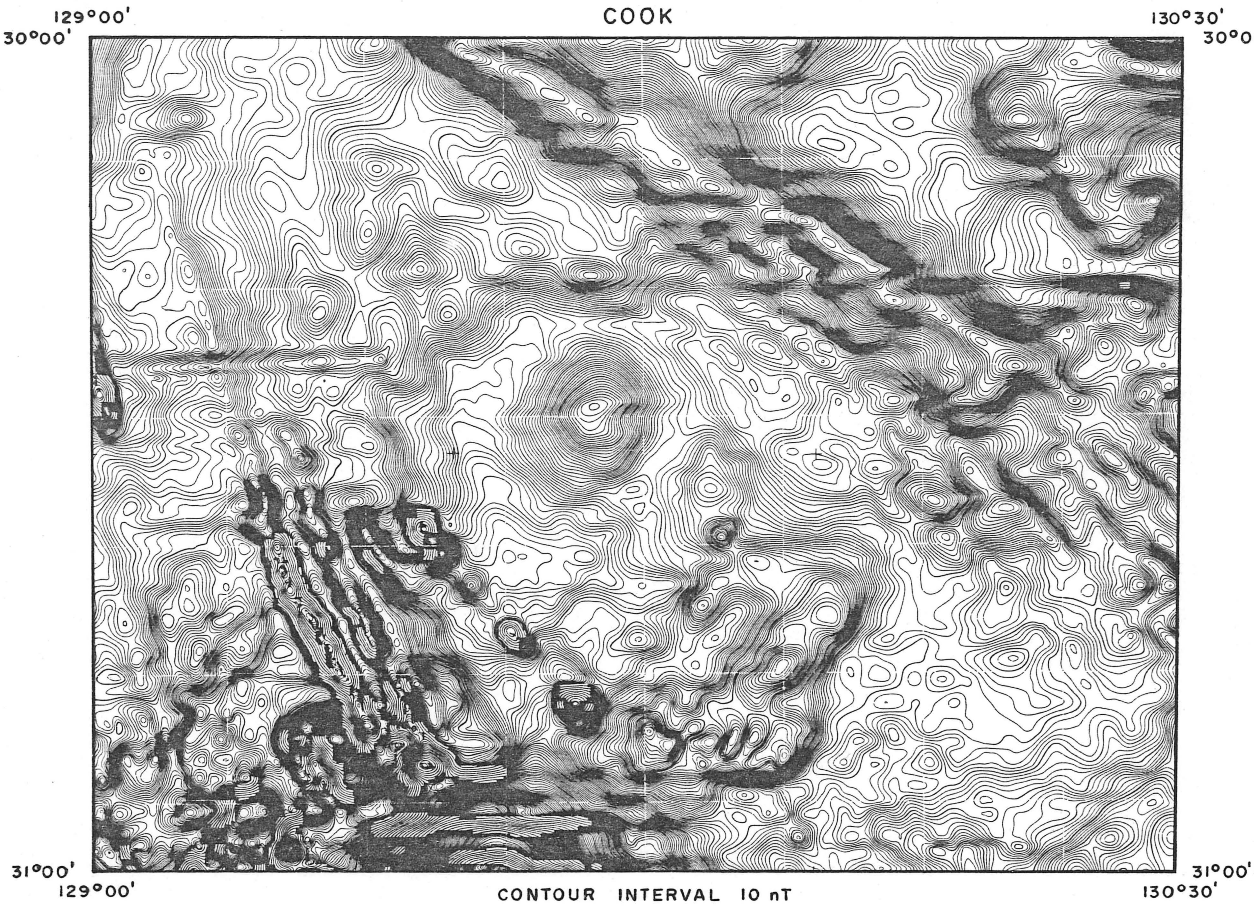
SCALE 1:1 000 000

10 0 10 20 30 40 50 km

LOCATION DIAGRAM

REFERENCE TO 1:250 000 MAP SERIES

MAURICE	TALLARINGA	COOBER PEDY
OOLDEA	BARTON	TARCOOLA
NULLARBOR	FOWLER	CHILDARA



AIRBORNE SURVEY, COOK, S.A 1970

TOTAL MAGNETIC INTENSITY

SCALE 1:1 000 000

10 0 10 20 30 40 50 km

LOCATION DIAGRAM

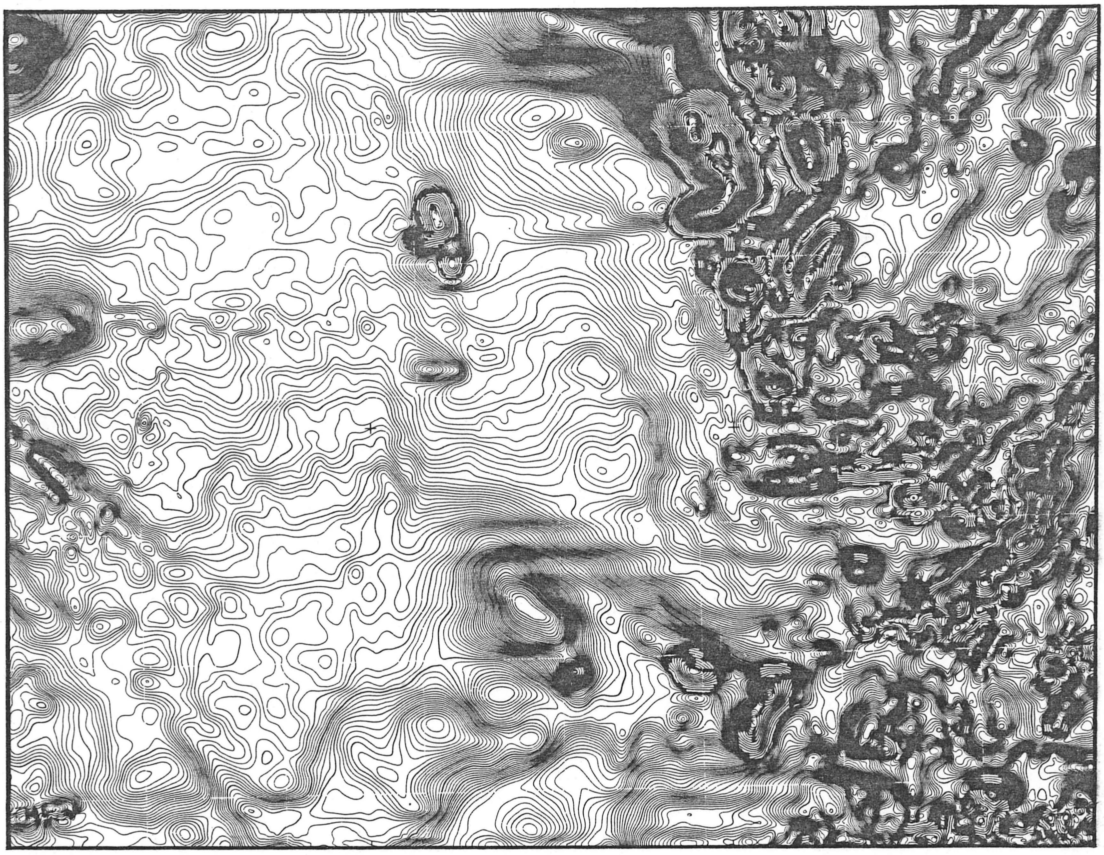
REFERENCE TO 1:250 000 MAP SERIES

MASON	WYOLA	MAURICE
FORREST	COOK	OOLDEA
EUCLA	COOMPANA	NULLARBOR

Fig MA 27

130°30' OOLDEA 132°00'

30°00' 30°00'



31°00' 31°00'

130°30' CONTOUR INTERVAL 10 nT 132°00'

AIRBORNE SURVEY, OOLDEA, SA 1970

TOTAL MAGNETIC INTENSITY

SCALE 1:1 000 000

10 0 10 20 30 40 50 km

LOCATION DIAGRAM

REFERENCE TO 1:250 000 MAP SERIES

WYOLA	MAURICE	TALLARINGA
COOK	OOLDEA	BARTON
COOMPANA	NULLARBOR	FOWLER

RAVENSTHORPE

CONTOUR INTERVAL 20 nT

AIRBORNE SURVEY, RAVENSTHORPE, WA 1980/81

TOTAL MAGNETIC INTENSITY

SCALE 1:1 000 000

10 0 10 20 30 40 50 km

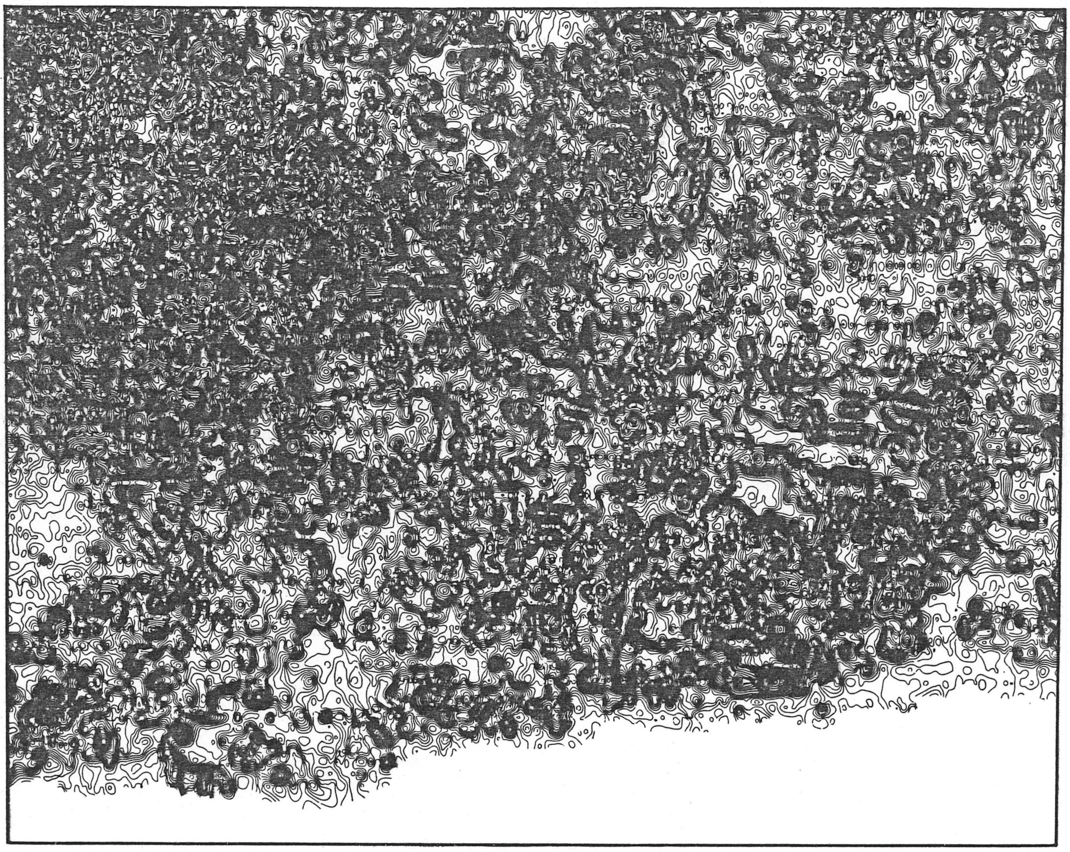
LOCATION DIAGRAM

REFERENCE TO 1:250 000 MAP SERIES

HYDEN	LAKE JOHNSTON	NORSEMAN
NEWDEGATE	RAVENS-THORPE	ESPERANCE
BREMER BAY		MONDRAIN ISLAND

RAVENSTHORPE

120°00' 33°00' — 121°30' 33°00'



34°00' 120°00' — 34°00' 121°30'

CONTOUR INTERVAL 20 C/S

AIRBORNE SURVEY, RAVENSTHORPE, WA 1980/81

RADIOMETRIC CONTOURS
TOTAL COUNT

SCALE 1:1 000 000

10 0 10 20 30 40 50 km

LOCATION DIAGRAM

REFERENCE TO 1:250 000 MAP SERIES

HYDEN	LAKE JOHNSTON	NORSEMAN
NEWDEGATE	RAVENS-THORPE	ESPERANCE
BREMER BAY		MONDRAIN ISLAND

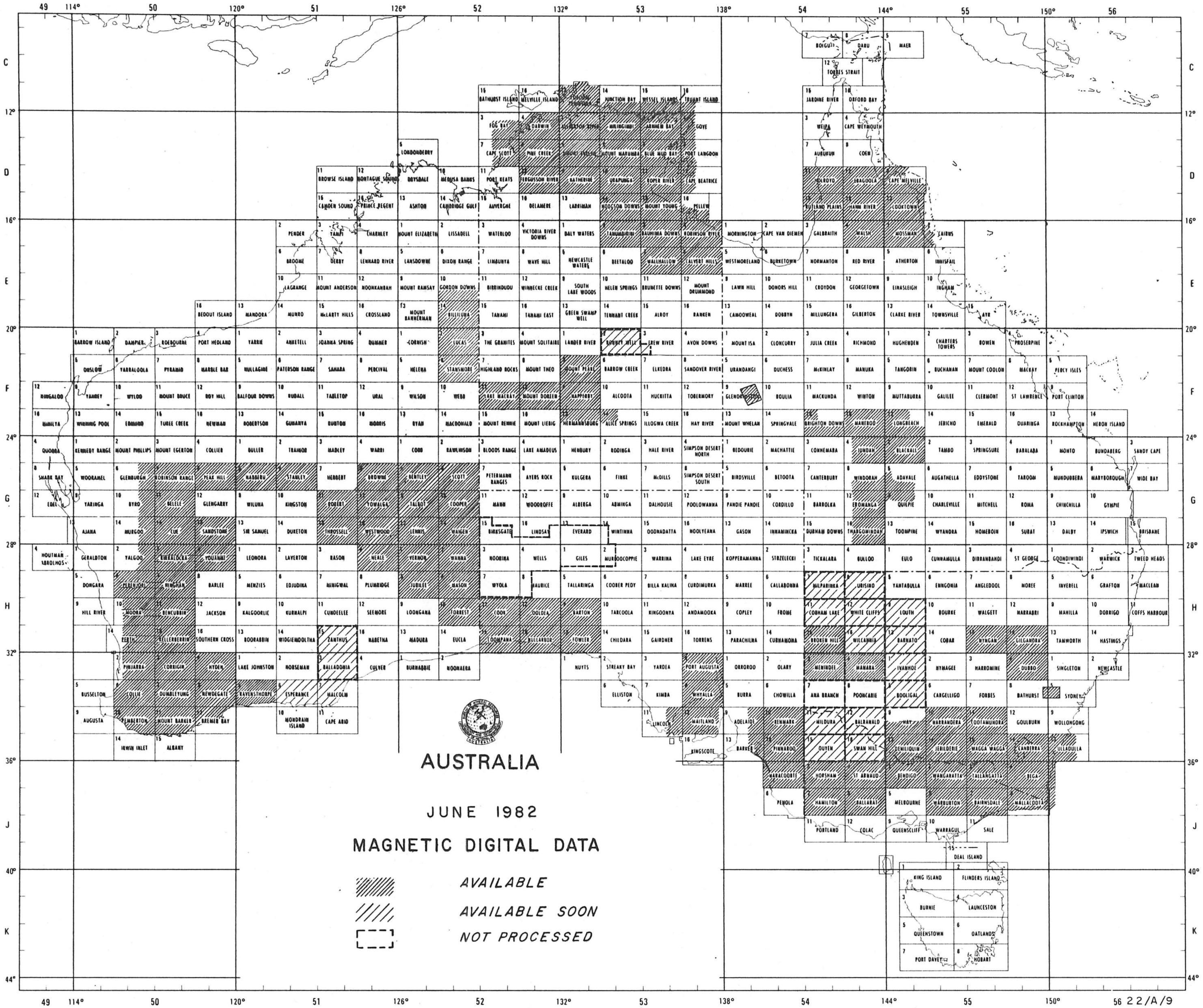

AUSTRALIA
JUNE 1982
MAGNETIC DIGITAL DATA
AVAILABLE
AVAILABLE SOON
NOT PROCESSED
22/A/9

Fig. MA 30

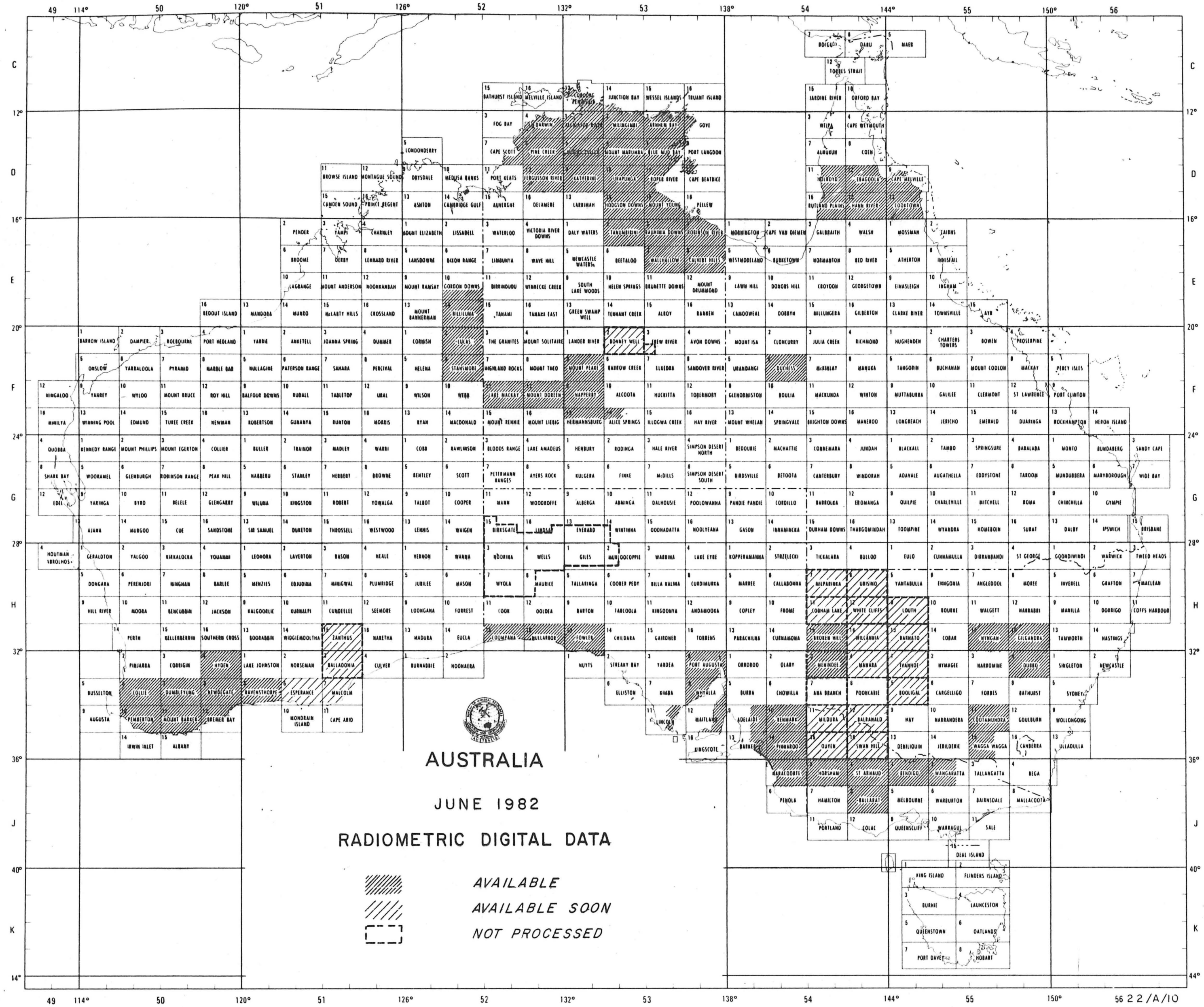


Fig. MA 31

Record No. 1983/6

2. SEISMIC, GRAVITY AND MARINE SECTION

A. Turpie

SEISMIC AND GRAVITY SURVEYS

F.J. Moss

The areas covered in the work of the Seismic and Gravity groups are shown in Figure SGM 1.

Central Eromanga Basin seismic and gravity surveys

F.J. Moss, S.P. Mathur, F.J. Taylor, O. Dixon (GSQ), M.J. Sexton, K.D. Wake-Dyster, W. Anfiloff, J.K.C. Grace, D. Gardner, G. Price, R.D.E. Cherry, L.A. Rickardsson, D.K. McIntyre, A.C. Takken, J.A. Somerville, W. Cox, D.W. Johnstone, S. Howard, G. Jennings

Seismic reflection surveys, 1980-1982 (1334). The broad objectives of the central Eromanga Basin project are to define the regional structural and depositional history of the central part of the Eromanga Basin and the underlying Cooper, Galilee and Adavale Basins in southwestern Queensland (Fig. SGM 2). The new information will be available for studies of the petroleum potential of the area. The field program in 1981, which was completed in October, was designed to obtain 6-fold CDP coverage, and gravity measurements at 0.5 km intervals, on a number of regional traverses with the following objectives:

(1) To complete investigations in the area west of the Canaway Ridge over the eastern margin of the Cooper Basin, the Thomson Syncline and underlying Barcoo Trough, and the Canaway Ridge.

(2) To extend the investigation of the Eromanga Basin sequence to the Warbreccan area.

(3) To commence work east of the Canaway Ridge to investigate the Quilpie Trough.

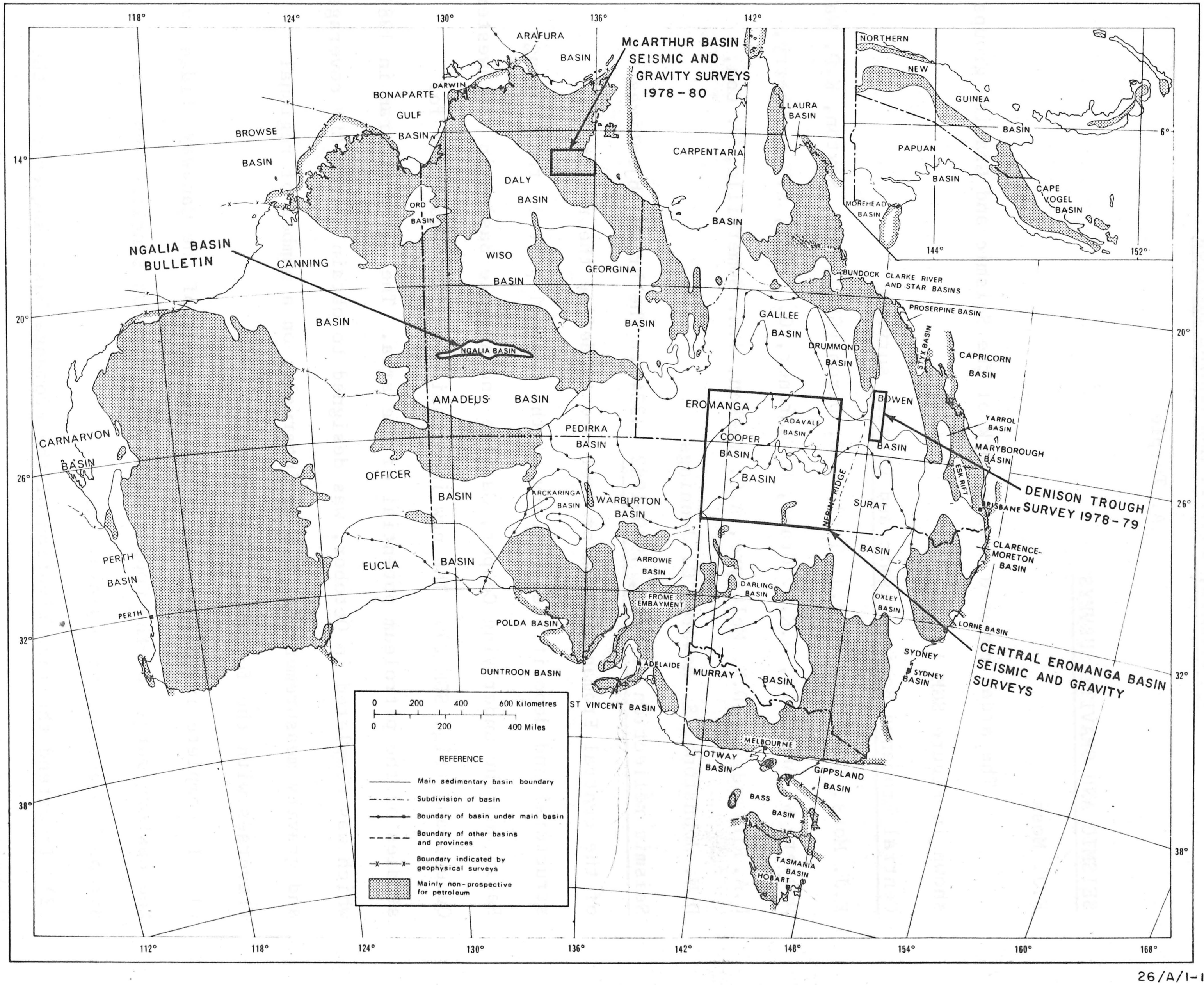


Fig. SGM 1. Areas covered by seismic and gravity reviews, reports and surveys

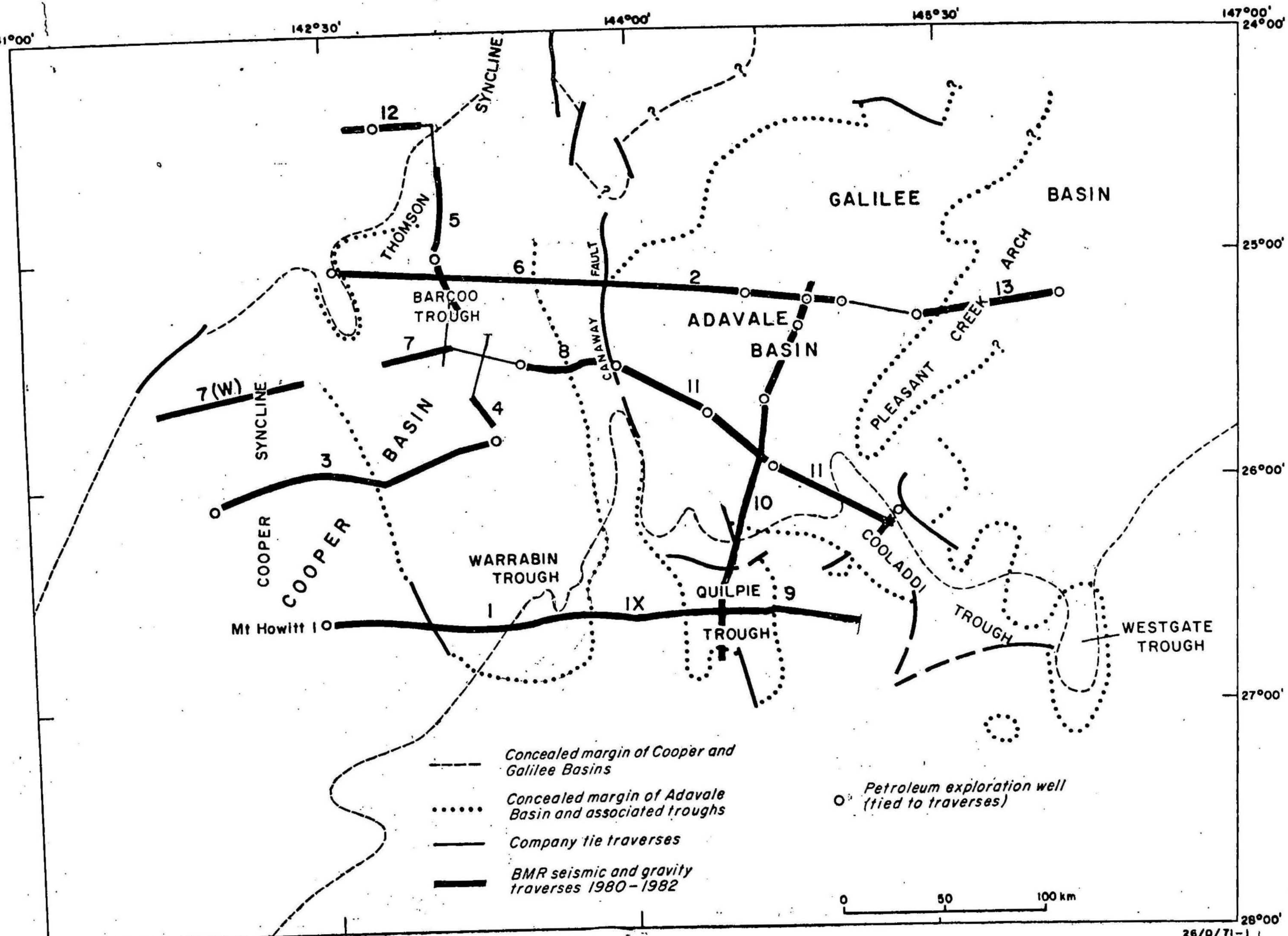


Fig. SGM 2 Central Eromanga Basin Project — seismic and gravity traverses

The 1982 survey program was planned to commence in late June to early July to continue the investigations of the Quilpie Trough and investigate the Adavale Basin.

The field activities in 1981 were reported in the 1981 Geophysical Branch Summary of Activities (Report 238). The period October 1981 to June 1982 was taken up with processing the 1981 data and interpreting the 1980 and 1981 data together with other siesmic data, some of which were reprocessed after analogue-to-digital conversion. The transcribed data were from the Barcoo, Bulgroo, Quilpie, Gumbardo, Leopardwood, Adavale and Jundah-Yaraka-Blackwater-Lenglo subsidised seismic surveys. Approximately 1650 analogue tapes transcribed into digital format require processing during 1983.

The extension of Traverse 6 westward to Galway 1 petroleum exploration well (Fig. SGM 3) indicated clearly the major unconformity associated with the top of the Devonian sequence elsewhere in the region. Together with a northerly extension of Traverse 5 through Barcoo Junction 1 petroleum exploration well, the Barcoo Trough, a remnant of a formerly widespread Devonian sequence of the Adavale Basin, could be defined better. Earlier interpretations considered the Devonian sequence of the Barcoo Trough to be Permo-Triassic sediments of the Cooper Basin. With the aid of synthetic seismograms, seismic data were reinterpreted to produce depth contour and structural maps for major seismic reflection horizons within the Eromanga Basin sequence of the Thomson Syncline and Devonian sequence of the Barcoo Trough.

The Barcoo Trough contains up to 1450 m of Devonian sediments, with a north-trending structural axis and a smaller sub-basin on its western flank abutting the Windorah Anticline. The axis of the Thomson Syncline, determined

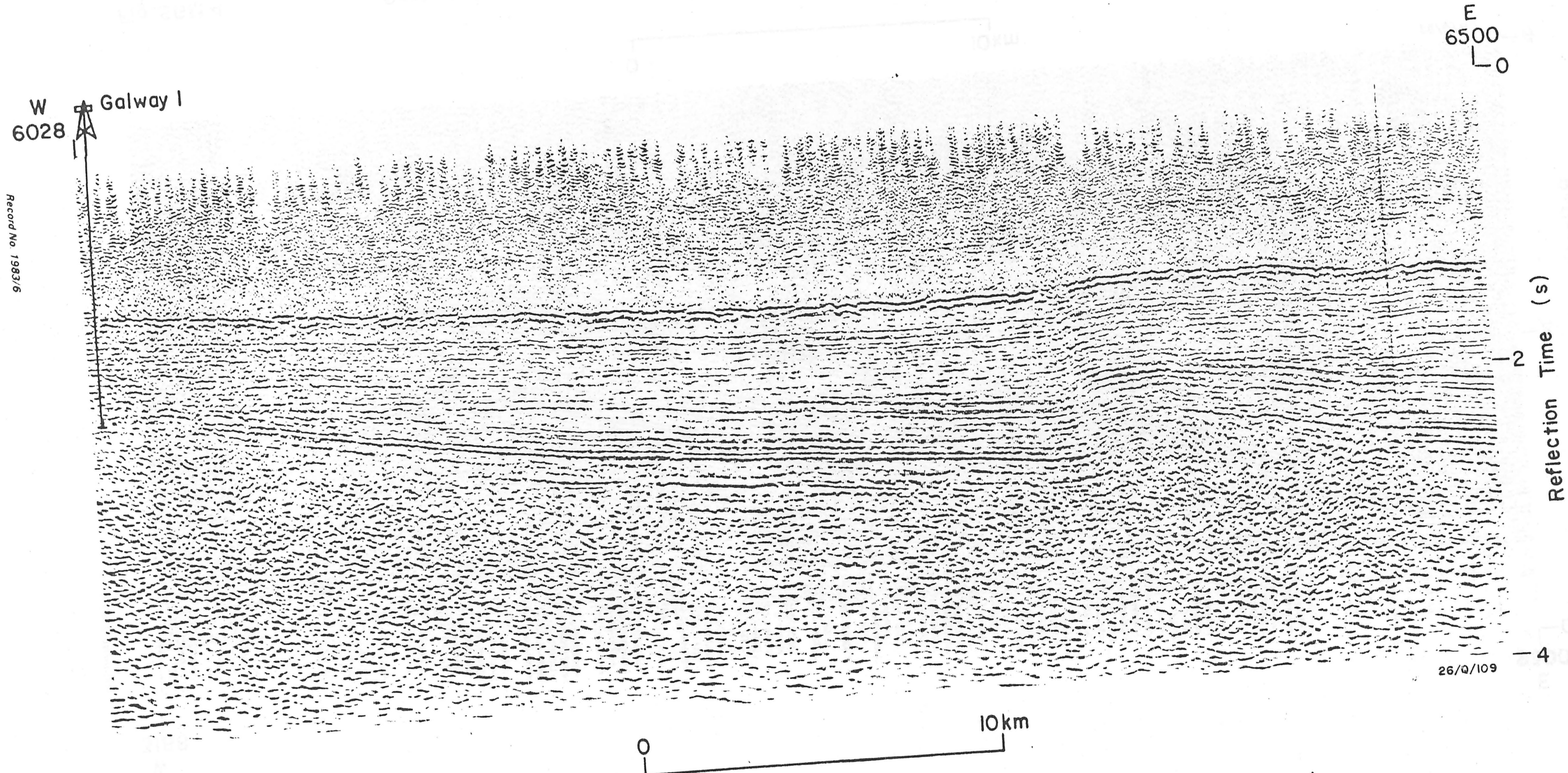


Fig. SGM 3

Central Eromanga Basin, Traverse 6, seismic section over western end Barcoo Trough

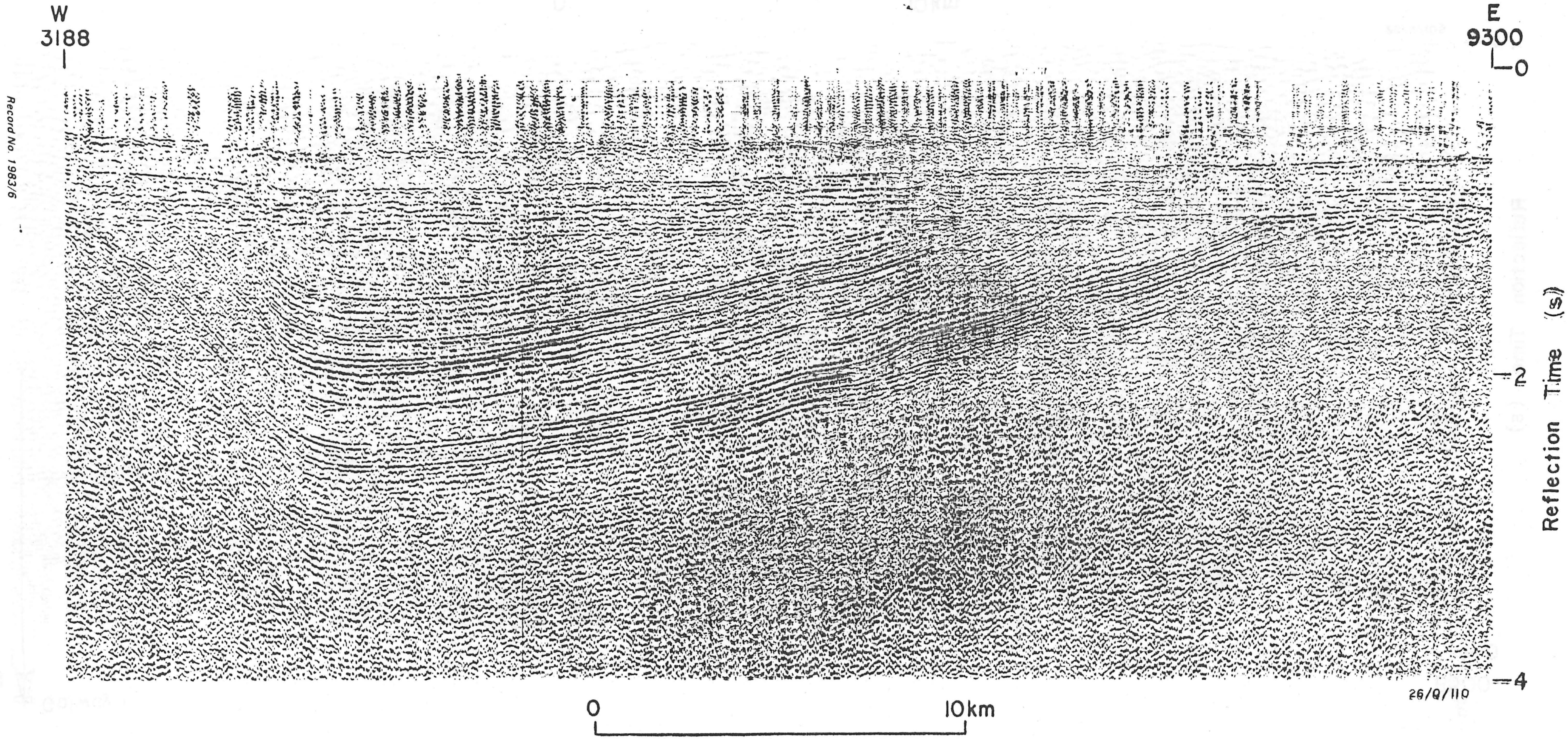


Fig. SGM 4 Central Eromanga Basin, Traverse IX and 9, seismic section across Quilpie Trough from surface mapping to be coincident with the Thomson River, lies west of the axis of the Barcoo Trough. During its formation the Barcoo Trough has been structurally controlled by uplift of the Canaway Ridge and other associated basement highs. The structure of the overlying Eromanga Basin sequence has been controlled by rejuvenation of faults within the Barcoo Trough producing low-amplitude folds. The investigation of the Devonian sequence in the Barcoo Trough suggests that the trough is connected to the Warrabin Trough by a thin sequence of Devonian sediments.

Traverse 9, an easterly extension of Traverse 1 (Fig. SGM 4), recorded in 1980, and Traverse 10, a north-south cross traverse, provided good quality seismic data, which together with older fair quality seismic data, were interpreted to enable the margins and structural history of the Quilpie Trough to be defined better. The Devonian sequence in the Quilpie Trough was found to be of equivalent thickness to that of the Warrabin Trough west of the Canaway Ridge. The trough is fault-bounded on the western and northern margins and structurally controlled on the eastern and southern margins by basement highs. The overlying Eromanga Basin sequence is gently folded compared with that over the Warrabin Trough, with a lesser amount of deformation within the Quilpie Trough.

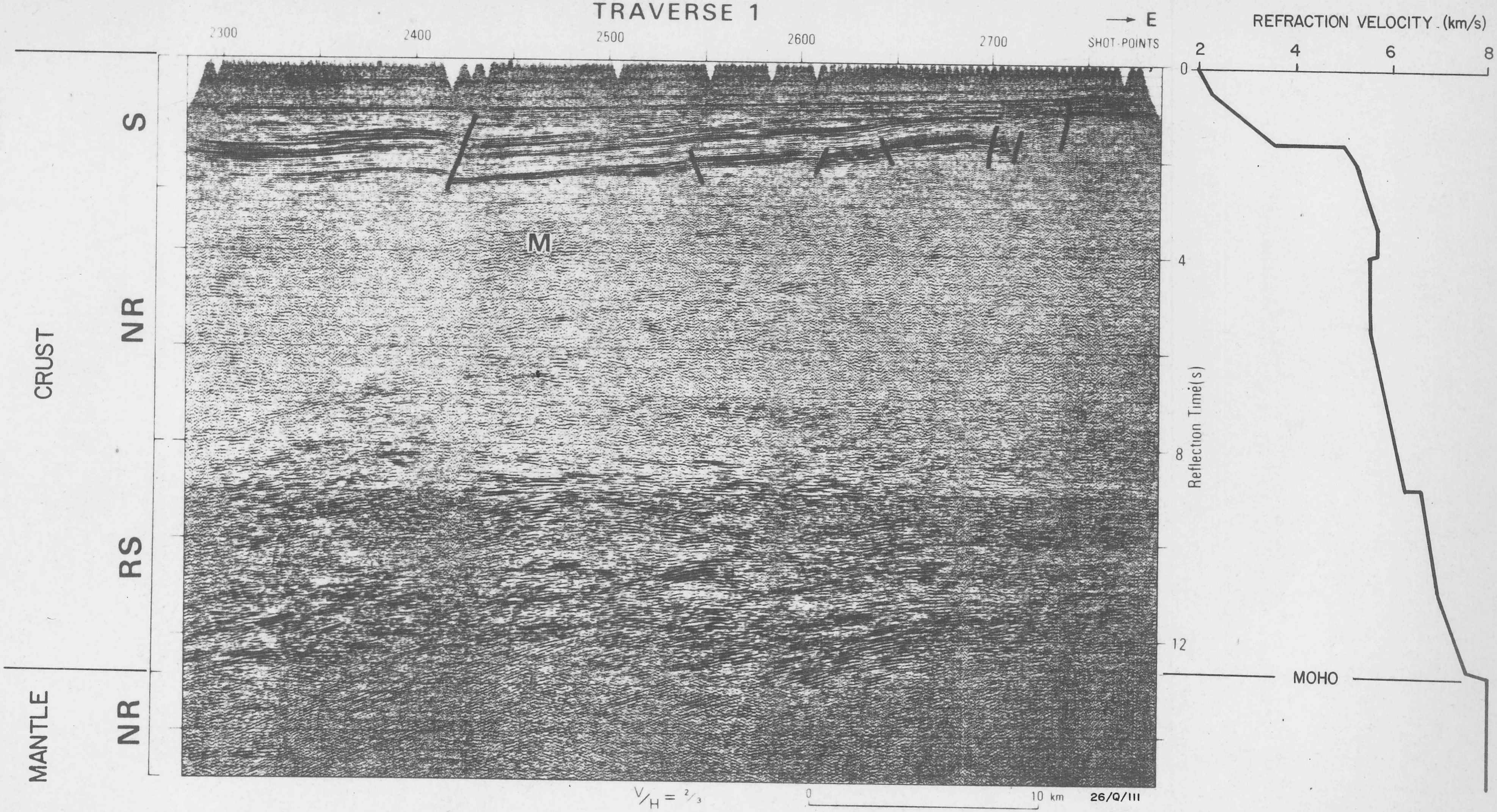
An investigation into the Canaway Fault was completed, defining it as a 250-km long north-trending normal fault within the Eromanga Basin, separating the Cooper Basin from the Galilee Basin. The Canaway Fault is nearly vertical and is in places associated with granitic intrusions. During the Early Devonian a palaeo-ridge at the Canaway Fault cut across the Adavale Basin, but later Devonian deposition was continuous across this ridge. The Canaway Fault began with large movements in the Carboniferous, followed by a long period of erosion and then the deposition of the Cooper and Galilee Basins. During the deposition of the Eromanga Basin sequence, movement was almost continuous along the Canaway Fault and continued after deposition ceased, ending in the Late Tertiary. The Canaway Fault is unlikely to have acted as a total barrier to the migration of hydrocarbons as it is a rounded, monoclinal, shallow structure, suggesting sedimentary sequences are not terminated abruptly. If hydrocarbons have migrated into the fault region the Jurassic rocks to the east of the fault may be almost as prospective as those to the west.

Preparations for the 1982 central Eromanga Basin seismic survey were made with a reconnaissance visit to the Adavale Basin area to investigate rough terrain problems, accessibility, and water availability for camp use and drilling. The region in the vicinity of Grey Range required detailed aerial photograph interpretation to determine suitable positioning of seismic traverses. Further analogue-to-digital tape transcription was made for seismic survey in the Adavale Basin area. Synthetic seismograms for exploration wells Grey Range, Leopardwood, Gumbardo, Gilmore, Quilberry and Buckabie were generated as an aid to interpretation.

Central Eromanga Basin deep crustal reflections (1204) (S.P. Mathur). Attempts made by the seismic data processing contractor to process and display the deep reflection data were not satisfactory. Consequently no processing of data recorded in 1981 survey could be carried out. Collaboration with Prof. J. Costain of Virginia Polytecnic Institute (VPI) in further processing and migration of the 1980 data is continuing. Copies of field tapes for Traverse 3 were sent to VPI for the reporocessing.

Record No. 1983/6

EROMANGA BASIN



S = sedimentary reflections RS = reflection segments, NR = no reflections, M = Multiple

Note: Reflection time (s) x 3 = approx. depth (km)

Fig. SGM 5 Central Eromanga Basin - deep reflection section across Warrabin Trough.

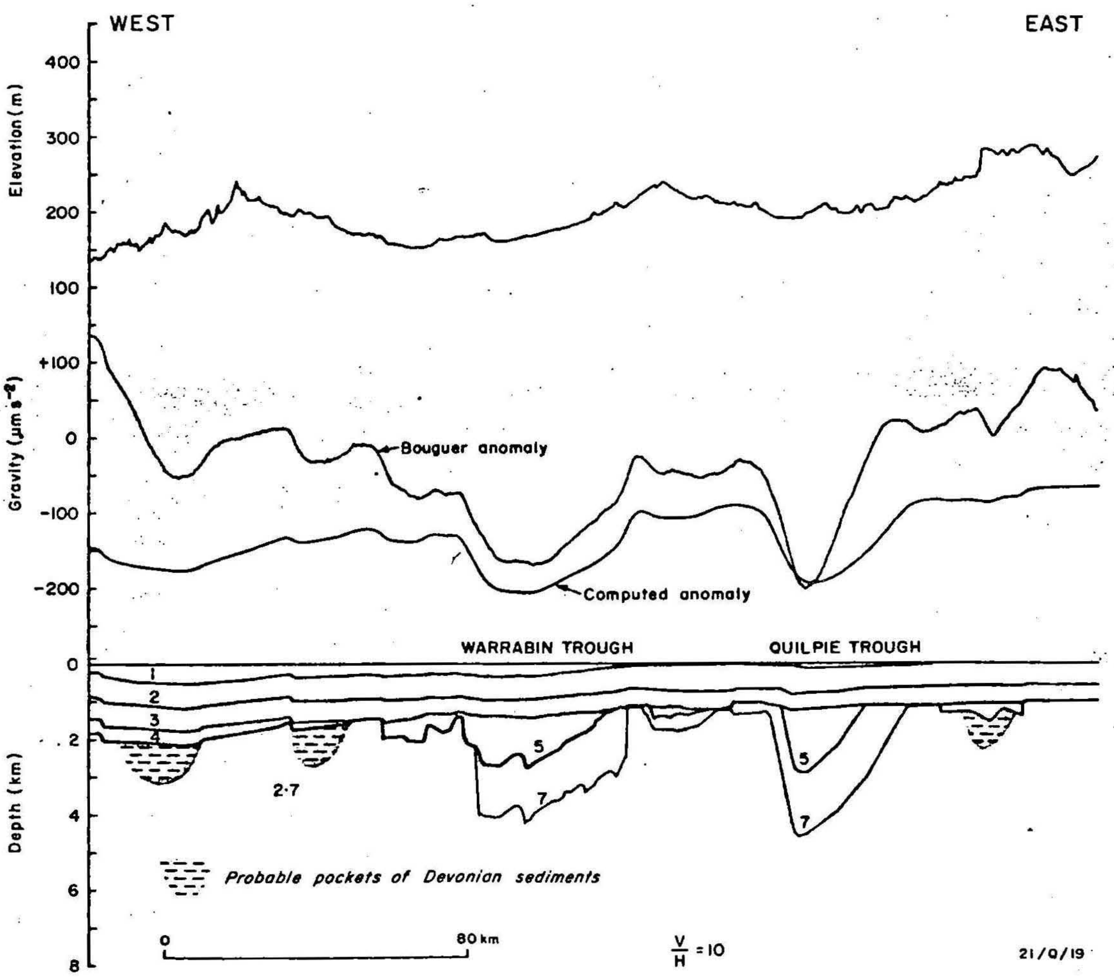
Most of the processed deep reflection sections recorded in 1980 show reflection events with varying continuity, strength and spatial distribution. Based on the reflection characteristics, the sections can be divided into four zones as shown in Figure SGM 5. The top zone of long, continuous and coherent reflections is related to sediments of the Eromanga Basin, and the underlying Cooper and Adavale (Warrabin Trough) Basins. The next zone, between 2.5 and 7 s, shows few events, most of which are considered to be multiples. The top part of this zone corresponds to the steeply dipping Ordovician shales that were intersected in exploration wells in this area, and which underly the basin sediments. The zone between 7 and 12.5 s shows numerous events which are of two types: 1 to 3-km long, subhorizontal, discontinuous reflections; and longer, hyperbolic events which continue down to the end of the section and are considered to be diffractions. The base of this zone correlates with a sharp increase in refraction velocity to upper mantle velocity of 8.15 km/s as modelled by Lock and Finalyson (see refraction studies). The zone of no reflections below 12.5 s therefore corresponds to the upper mantle.

Gravity interpretation (1336). During 1982, an extensive analysis of combined seismic and gravity data was carried out over a large part of the central Eromanga Basin extending from the Cork Fault region in the northwest to the Quilpie region in the southeast. The analysis involved detailed seismic and gravity data from a previous BMR survey in 1975 in the Lovelle Depression of the Galilee Basin and from the 1980 and 1981 surveys, and gravity data from about 33 000 reconnaissance gravity stations. The analysis involved the following stages:

(1) Preparation of 1:1 000 000 scale maps of elevation, free-air anomaly and Bouguer anomaly contours. An attempt to apply a high-degree orthogonal polynomial surface to the gravity contours to enhance trends failed owing to the large number of grid elements involved.

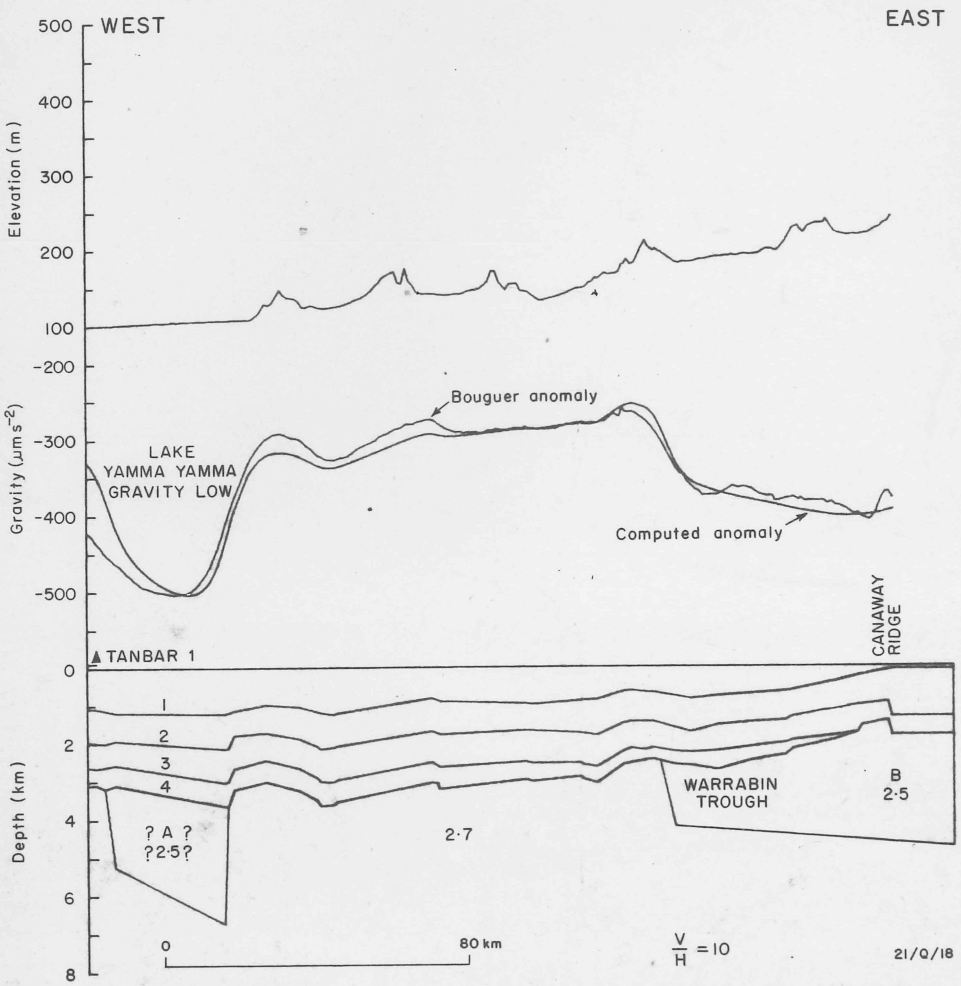
(2) Gravity modelling along seismic traverses. Seismic time-horizons and stacking velocities were digitized, and processed to produce depth-sections and gravity models. Comparison of the actual and computed gravity profiles shows where hidden or deep structures may occur. It was found that deep pockets of Devonian sediments can be missing from seismic sections in areas where Permian coal seams prevent seismic penetration (Fig. SGM 6). There appears to be a major trough of Devonian sediments which has not been recognised previously (Fig. SGM 7) near the Tanbar 1 well. Modelling has also revealed thick Devonian sediments adjacent to the Canaway Fault, and an elongate granitic intrusion along the length of the Canaway Ridge. In the Quilpie Trough, modelling shows that the lower part of the Devonian sediments is as dense as underlying basement.

A rectilinear pattern of elongate gravity lows and fault anomalies extends across the Eromanga Basin and into adjacent areas. The pattern frequently displays orthogonality and appears to represent a system of crustal sutures which extends across the eastern Australian region. This evidence suggests that the Eromanga Basin is underlain by Proterozoic basement which is contiguous with the main part of the continent, in which case the Eromanga Basin would have been produced by crustal subsidence. The elongate negative gravity features may represent sedimentary troughs which developed when rigid crustal blocks were displaced by forces acting



BMR Traverse 1-9 seismic section converted directly to a gravity model gives good agreement over the Warrabin Trough. In the Quilpie Trough, Cooladie sediments (7) do not contribute to the gravity low. Gravity suggests pockets of Devonian sediments occur under the Permian sequence. (Seismic layers defined in Figure 6). Model densities are: 1=2.4, 2=2.5, 3=2.5, 4=2.5, 5=2.6, 7=2.6, basements=2.7 t/m3

Fig. SGM 6



BMR-SSL Traverse 3. Bodies A & B have been added to the seismic depth section to produce a gravity model. A thick pocket of Devonian is indicated under the Lake Yamma Yamma Gravity Low. (Seismic layers defined in Figure 6). Model Densities are: 1=2.4, 2=2.5, 3=2.5, 4=2.5, A=2.5, B=2.5, basement=2.7 t/m3

Fig. SGM 7

horizontally through the crust. Major isostatic imbalances in the area, and ample evidence for differential passive subsidence, also imply that horizontal forces have been operating.

Ngalia Basin, NT (1346)

F.J. Moss, A.T. Wells (Geol. Branch)

A number of editorial matters relating to BMR Bulletin 212 on the structure and stratigraphy of the Ngalia Basin were attended to. Gravity profiles and seismic cross-sections were drafted for illustrations.

Further discussions were held with petroleum lease holders on interpretation of previous seismic information.

Denison Trough seismic surveys, Qld, 1978-79 (1052)

F.J. Moss, O. Dixon (GSQ), J.A. Bauer (AAR)

Seismic data from the Denison Trough surveys were provided for AAR, Brisbane, the petroleum lease holders, for reprocessing by Digital Exploration Limited, Brisbane. This further processing has given significantly improved data quality, particularly in the Upper Permian section in areas where the company is conducting an active petroleum exploration program near the Merivale Fault, and elsewhere in the Denison Trough.

A paper on the results of the seismic traverse across the Denison Trough in the Rolleston area was published in the Queensland Mining Journal.

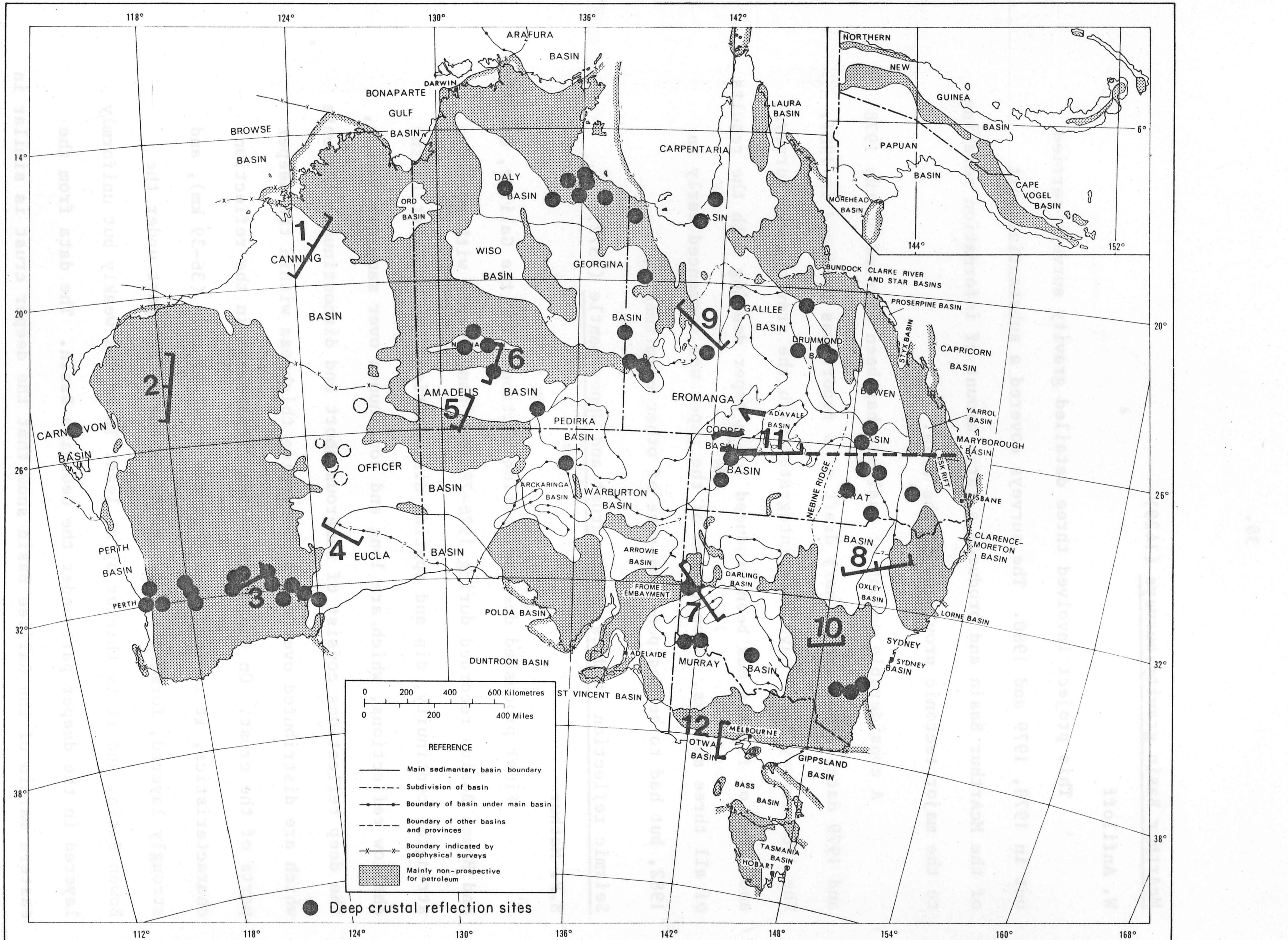


Fig.SGM 8 Deep seismic reflection sites and BMR preliminary proposals for ACORP traverses.

25/A/44

McArthur Basin gravity surveys (1429)

W. Anfiloff

This project involved three detailed gravity surveys carried out in 1978, 1979 and 1980. The surveys covered a substantial part of the McArthur Basin and produced a large amount of information relating to the major tectonic provinces in the area.

A considerable amount of analysis has been carried on the 1978 and 1979 data, and a preliminary draft of a report was produced in 1981. The 1980 survey data have been integrated with the previous two surveys, and a set of figures has been produced for a paper dealing with the results of all three surveys. Preparation of the paper was commenced early in 1982, but had to be postponed because of other commitments.

Seismic reflection studies of the crust and upper mantle (1372)

S.P. Mathur

Final processed deep reflection sections from the Galilee, Georgina and Bowen Basins recorded during 1976-78 show many events with variable strength, continuity, dip and spatial distribution. In contrast to the shallow reflections, which are long and continuous over many kilometres, the deep reflections consist of numerous short and discontinuous segments which are distributed over zones of varying thickness within the deeper parts of the crust. On the basis of the differences in the reflection characteristics, it is suggested that the crust is thin (36-39 km), and strongly layered, forming several bands in the deeper part under the Bowen Basin, and it is thicker by at least 10 km and weakly but uniformly layered in the deeper part under the Georgina Basin. The data from the eastern margin of the Galilee Basin show that the deeper crust is similar in reflection characteristics to that under the Georgina Basin.

Australian Continental Reflection Profiling (ACORP) program

F.J. Moss, S.P. Mathur, R.D. Shaw (Geol. Branch), B.R. Goleby

Over 50 representatives from BMR, CSIRO, State Geological Surveys, academic institutions and petroleum and mineral exploration companies attended an ACORP Workshop held at the Research School of Earth Sciences, Australian National University, Canberra, from 18-20 May. Financial support for the Workshop was provided by the Australian Academy of Science from the John Conrad Jaeger Fund and by industry through the Australian Academy of Technological Sciences.

Professor S. Kaufman of Cornell University, USA, the Executive Director of the Consortium for Continental Reflection Profiling (COCORP) in the USA, gave the principal address to the Workshop. Professor Kaufman reviewed the organisation and activities of COCORP, indicating the possible problems ACORP could have in initiating programs, and he commented on the significant amount of new information on the structure of the crust which has been provided by the COCORP work. He indicated that COCORP now had substantial backing from the mineral and petroleum exploration companies in the USA.

Other speakers reviewed the results of deep seismic reflection work in Australia and discussed the techniques for recording and processing the data. They stressed the need for other studies in association with the reflection work to provide constraints on interpretation.

A major part of the Workshop program was taken up with discussion of proposals for deep seismic reflection traverses in all States of Australia (Fig. SGM 8). BMR presented a proposal for a major study of crustal structure in central Australia based on a deep seismic profiling traverse over the Amadeus Basin and Arunta Block (Fig. SGM 8). Studies across major geosutures at the boundaries of tectonic provinces are likely to be of particular interest in the ACORP program, but studies of some structures within the tectonic provinces will also be of high priority, especially where they are relevant to metallogenesis or petroleum occurrences.

BMR was requested to undertake the acquisition of data on behalf of ACORP for a period of 5 years as part of a collaborative effort by BMR and other research organisations. BMR has considerable experience in this field, having already made deep seismic reflection recordings in a large number of areas. Many recordings have been made to about 20 s in a number of isolated locations, and systematic surveys have been made in the Mildura-Broken Hill area, West Australian Shield, Lachlan Geosyncline, and in the Amadeus, Bowen, Georgina, McArthur, Ngalia and central Eromanga Basins. The University of Sydney has also conducted a short deep seismic reflection survey in the central Eromanga Basin. Whereas earlier work was mainly single coverage, BMR's central Eromanga Basin work will have produced by the end of 1982 approximately 1400 km of 6-fold CDP data, recorded to 20 s by letting the normal sedimentary basin records run on. These data are good quality and are being analysed together with seismic refraction, gravity, magnetotelluric and other data to provide information on the properties and structure of the deep crust and its relation to the structure and depositional history of the sedimentary basins.

An ACORP Management Committee was set up to look after the logistics and planning of the proposed seismic program. A Technical Committee was appointed to investigate the options available for processing ACORP data. Detailed proposals for program are to be prepared by State and Territory Working Groups for Lithosphere Transect Studies of the Australian Continent (LITSAC). The proceedings of the Workshop are being prepared for publication.

Shotpoint and well location compilation

D. Pfister, M.J. Sexton

Digitization of shotpoint locations from previous subsidised company and BMR surveys, checking for errors, and production of maps at different scales continued. Information provided by active exploration programs was incorporated in the maps. New maps were produced for the Quilpie and Adavale areas for the 1982 seismic survey.

Crusader Oil carried out a detailed airborne survey to check the locations of seismic traverses in their area of interest southeast of Windorah. Their results highlighted errors in the BMR-compiled maps, which have been based on company information with poor surveying.

Seismic technical services (1403)

J.K.C. Grace, D. Gardner, G.S. Jennings, D. Pfister, G. Price, R.D.E. Cherry, L.A. Rickardsson, A. Takken, D.K. McIntyre, D.W. Johnstone, S. Howard.

The field team was involved in the seismic reflection survey and in shotfiring for the refraction field work until November 1981. Maintenance and repairs were carried out on the DFSIV digital seismic recording system, geophones, cables and other ancillary equipment in preparation for the 1982 survey. Modifications were made to the cable vehicles. A new control panel was made for the 40 kVA generator, and the new 12.5 kVA generator was acceptance-tested.

The DFSIV field system continued to be used together with the PMR20 and MSH2 analogue tape transports for A-D conversion of seismic tapes from previous central Eromanga Basin surveys.

Well logging

G.S. Jennings, J.W. Whatman, G. Price

Wireline logging was carried out on ten stratigraphic holes drilled in the Northern Territory and Queensland for the NERDDC Oil Shale Methodology Project investigating the Toolebuc Limestone. Gamma-ray logs were run in the holes, as the gamma-ray anomaly associated with the Toolebuc Formation is an important diagnostic feature. Neutron, electric, potential and resistivity logs were also run in two holes.

Gamma-ray, neutron, resistivity, potential and caliper logs were run in seven holes to assist the ACT groundwater investigations at Tharwa.

A major maintenance program was carried out on the 300-m logging equipment. All tools, uphole electronic equipment, depth and speed measuring equipment were calibrated and the power plant was overhauled. A new dual-density tool was tested on receipt, found to be unsatisfactory and returned to the manufacturer for replacement of components that did not reach temperature specifications.

MARINE SURVEYS

Please refer to the Preface.

3. GEOMAGNETISM, SEISMOLOGY AND REGIONAL GEOPHYSICS SECTION

D. Denham

REGIONAL GEOPHYSICS SUBSECTION

D.M. Finlayson

Eromanga Basin seismic refraction studies (1334)

J. Lock, D.M. Finlayson

In 1980 and 1981 BMR conducted seismic surveys in the central Eromanga Basin, which included continuous seismic reflection and coincident refraction recording along a line extending from Mount Howitt No. 1 well in the west to Cheepie in the east (Fig. GSR 1).

Refraction stations were spaced at 1.875 km intervals out to distances of 75 km to study the velocity structure of the Eromanga sequences, underlying basins and basement. A representative velocity model from first arrival data is simple but allows several conclusions to be drawn about basin and basement structure with depth. No strong primary reflection branches are observed at short distances (less than 20 km), therefore the velocity of the basin sequence is interpreted as increasing continuously from 2.3 km/s at the surface to 5.0 km/s at 2.4 km depth. Arrivals between 8 and 20 km have a lower apparent velocity than those recorded at greater distances. This indicates that the low-grade Ordovician meta-sediments encountered in Mount Howitt No. 1 well may extend to the east under the Eromanga Basin, possibly as far as the Canaway Ridge. Arrivals from beyond 20 km are from basement, where velocity increases relatively rapidly to 5.9 km/s at 8 km depth. Clear impulsive first arrivals persist with appreciable amplitudes out to 100 km. At greater distances amplitudes are greatly reduced, arrivals become emergent and their nature changes. This implies structure where basement velocity reduces from 5.9 km/s at 8 km depth to 5.6 km/s at 8.5 km depth.

A feature of these seismic refraction data is a sequence of clear later arrivals which, in general, consist of an energy packet of the same shape as the initial onset but often of larger amplitudes. There are at least three such arrivals identifiable on any record section. These later arrivals are observed beyond 10 km to at least 40 km. Unambiguous identification of these arrivals at distances greater than 40 km is difficult. Their amplitude and arrival time characteristics indicate they

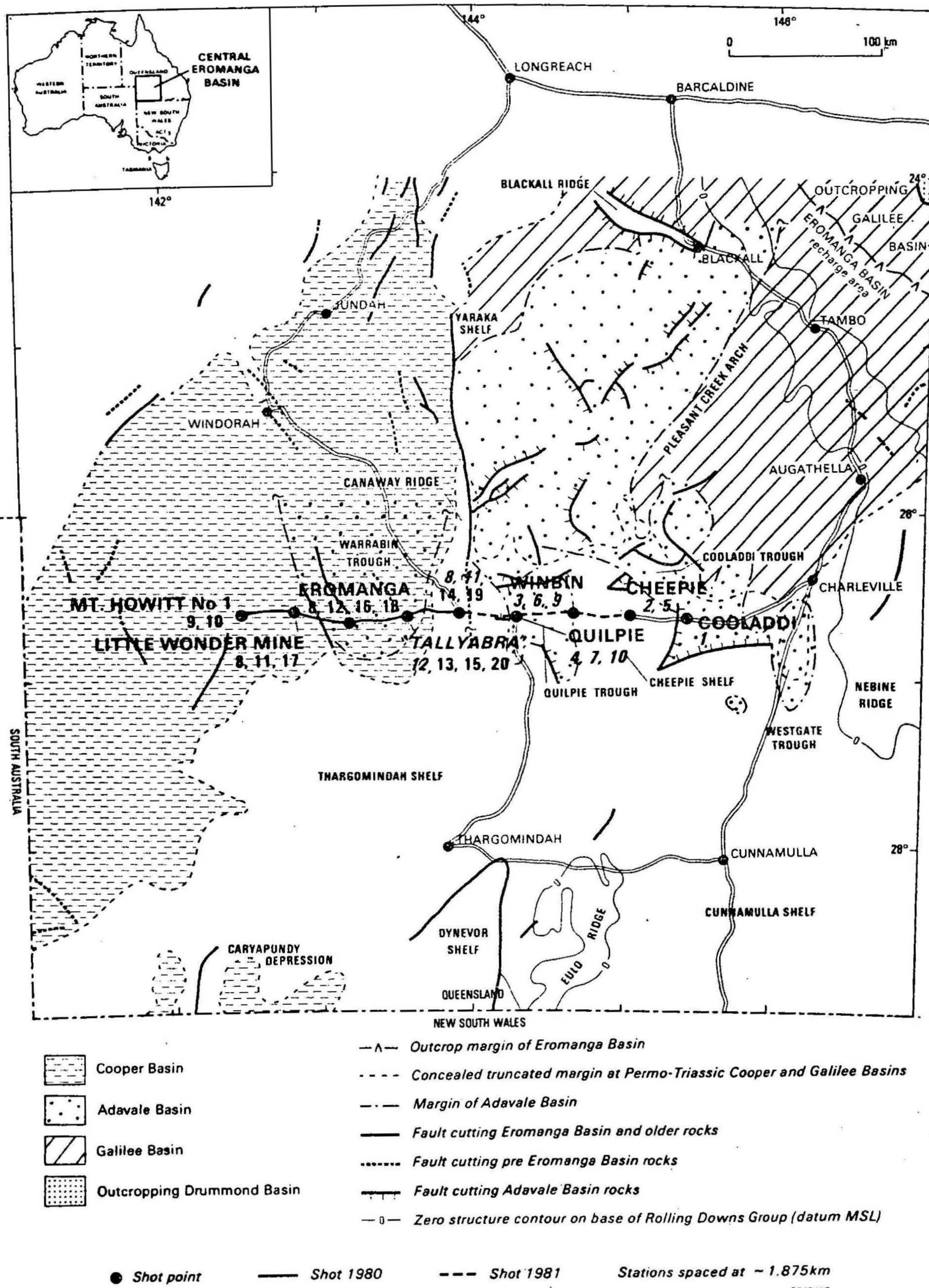


Fig. GSR I 1980-81 Seismic refraction lines at shot station spacing

Record No. 1983/6

are not multiple reflections from the basin/basement interface. Theoretical travel times for refracted arrivals multiply reflected at the surface are too early. They possibly represent refracted arrivals multiply reflected at the top or the base of the Gidgealpa Group (coal sequence). Ray tracing is being carried out to determine whether this type of velocity model can explain these arrivals. These arrivals can constrain further the velocity variation with depth in the uppermost crust.

Refraction stations were spaced at 7.5 km intervals from Mount Howitt No. 1 well to Cheepie (Fig. GSR 1), a distance of 300 km, to study the velocity structure of the crust and upper mantle under the central Eromanga Basin.

The crustal structure of the central Eromanga Basin, revealed by coincident seismic reflection and refraction shooting, contrasts with some neighbouring regions of the continent. The depth to the crust/mantle boundary (Moho) of 36-41 km is much less than that under the North Australian Craton to the northwest (50-55 km) and the Lachlan Fold Belt to the southeast (43-51 km), but is similar to that under the Drummond and Bowen Basins to the east. The seismic velocity boundaries within the crust are sharp compared with the transitional nature of the boundaries under the North Australian and Lachlan provinces. In particular, there is a sharp velocity increase at mid-crustal depths (19-26 km) which has not been observed with such clarity elsewhere in Australia (the Conrad discontinuity?). Velocity decreases in the upper crust may be interpreted in terms of the effects of temperature gradients on quartz-bearing upper crustal rocks.

In the lower crust, the many discontinuous sub-horizontal reflections are in marked contrast to lack of reflection horizons in the upper crust, further emphasising the differences between the upper and lower crust. The Moho is characterised by a relatively sharp increase in velocity from 7.1-7.7 km/s to 8.15-8.4 km/s. The depth to the Moho under the Canaway Ridge, a prominent basement high, is shallower by between 2 and 7 km than the regional Moho depth; there is no mid-crustal horizon under the Canaway Ridge but there is a very sharp velocity increase at the Moho depth of 34 km. The Canaway Ridge could be interpreted as a major horst structure extending to at least Moho depths but it could also have a different intra-crustal structure from the surrounding area.

The sub-crustal lithosphere has features which have been interpreted from limited data as being caused by a strong velocity gradient at 50-60 km depth, possibly with a low velocity zone above it.

Because of the contrasting crustal thicknesses and velocity gradients, the lithosphere of the central Eromanga Basin cannot be considered as an extension of the exposed Lachlan Fold Belt or the North Australian Craton. Resistivity values suggest tightly folded meta-sedimentary and meta-volcanic rocks in the crust rather than extensive high-resistivity plutonic or basic rocks. The lack of seismic reflections from the upper crust indicates no coherent acoustic impedance pattern at wavelengths greater than 100 m. The crustal structure is consistent with a pericratonic or arc/backarc basin being cratonised in an episode of convergent tectonics in the Late Proterozoic-Early Palaeozoic. The seismic reflections from the lower crust indicate that it could have developed in a different tectonic environment.

Seismic structure of the north Australian lithosphere (1114)
D.M. Finlayson, C.D.N. Collins, B.J. Drummond, J. Whatman

The objective of this project is to determine the fine P-wave velocity structure to depths of about 600 km under a stable continent as a contribution towards world-wide studies of the continental lithosphere. The project is being conducted in cooperation with the Australian National University and the Royal Australian Navy. Seismic recordings are planned from a variety of sources at stations located between Darwin and Alice Springs with station spacing of about 10 km or less. The sources are land shots at four locations between Darwin and Daly Waters, large marine shots fired by the Royal Australian Navy off Melville Island, and Banda Sea earthquakes. These three sources should enable detailed seismic record sections to be compiled out to distances of 2000 km.

Discussions have been held with the Royal Australian Navy on the number and size of the marine shots which could be deployed from the hydrographic ship HMAS Moresby. Both BMR and ANU were proceeding with equipment development programs to increase the number of automatic seismic tape recorders which will be available for the survey. Discussions have been held with staff of the NT Dept of Mines and BMR staff in Darwin regarding the sites to be used for land shots. Planning was proceeding aimed at a survey field program in September-October 1982.

Structure of the Australian continental lithosphere (1192)

D.M. Finlayson

This project is designed to synthesise seismic knowledge of the Australian continental lithosphere from all sources, and to provide constraints on such questions as the thickness of the continental lithosphere and lateral variations in its structure. The compilation of some results was completed in early 1982 with the publication of some of the geophysical differences in the lithosphere between Phanerozoic and Precambrian Australia (Tectonophysics, 84, 287-312). Some results of this research were documented in the 1981 Geophysical Branch Summary of Activities (BMR Report 238).

Seismic investigations of the lithosphere in the Pilbara region (1192)

B.J. Drummond

The seismic velocities in the crust of the Pilbara Craton imply that the upper crust of the craton is of granitic composition. At 10-15 km depth, it is metamorphosed to felsic granulite. Below this depth, the amount of garnet increases, causing an increase in the seismic velocity. The mafic content also increases, causing a further increase in the amount of garnet, until the lower crust of the craton is of dioritic composition. The crust/mantle boundary under the craton must be a chemical discontinuity. The lower crust of the Pilbara Craton is much less mafic than the lower crust in younger regions of Australia, implying that different tectonic processes were active in the Archaean.

The Pn seismic velocity under the Pilbara Craton is anisotropic, with the direction of maximum velocity at right angles to the axis of the Hamersley Basin along the azimuth 030°. The anisotropy is probably due to realignment of olivine crystals in the upper mantle by syntectonic recrystallisation and/or creep in the tensional environment caused at the base of the lithosphere by flexure during loading by the Hamersley Basin rocks. Another seismic boundary occurs 15 km below the crust/mantle boundary throughout the region. It exhibits topography, being shallower under the Pilbara Craton than under the Yilgarn Craton to the south, and the velocity under it is anisotropic, with the apparent direction of maximum velocity between north and 40° west of north. This direction correlates loosely with, or is at right angles to, trends of geological features in the Hamersley Basin, which overlies the southern part of the

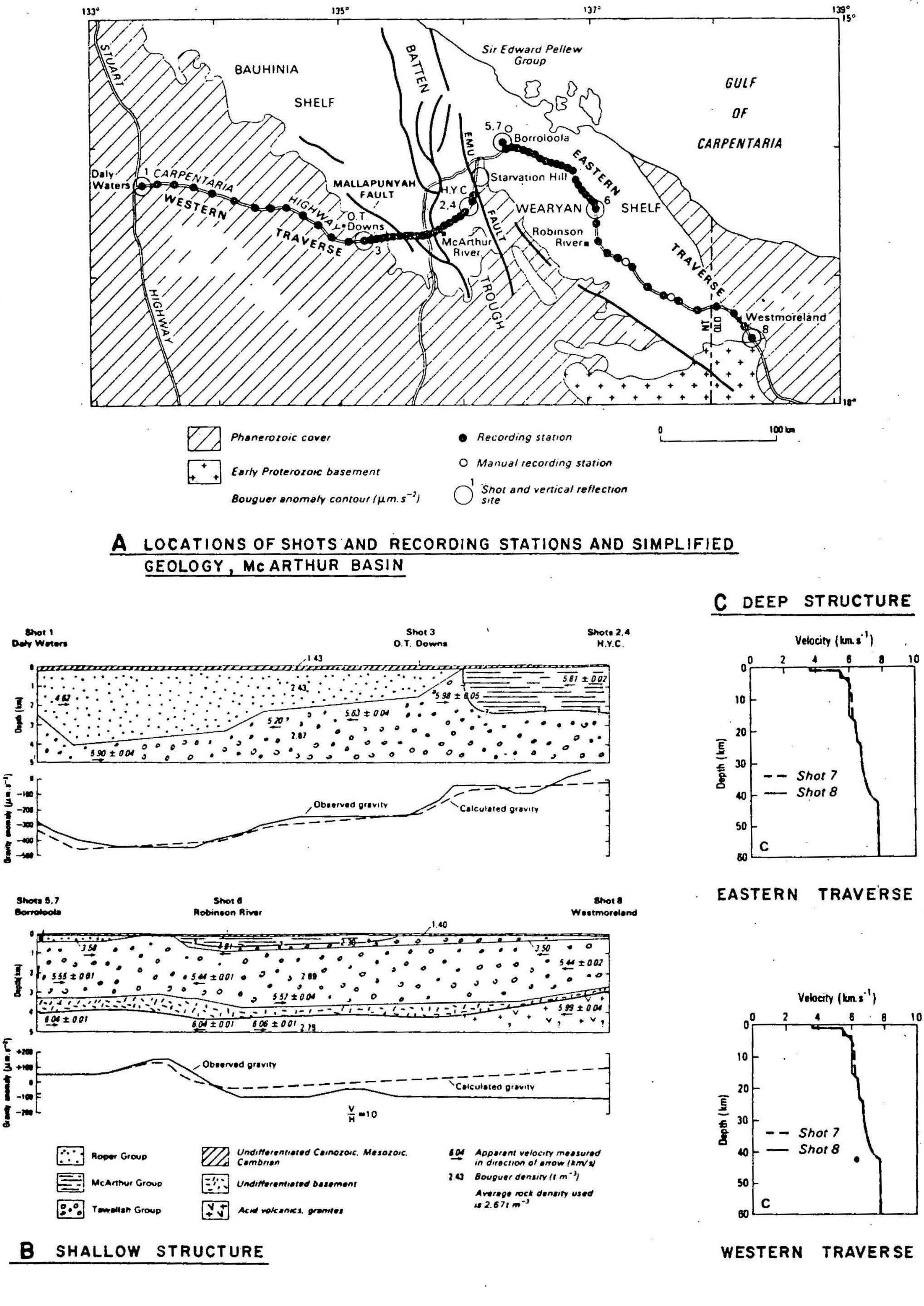
Pilbara Craton, and in the younger Capricorn Orogenic Belt, which lies between the Pilbara and Yilgarn Cratons, suggesting that the anisotropy below the sub-Moho boundary is a younger feature than that immediately below the crust/mantle boundary. This is consistent with the notion that the lithosphere was thinner in the Precambrian and implies that the sub-Moho boundary, now at 45 km depth under the Pilbara Craton, was the base of the Archaean lithosphere. The current base of the lithosphere in the region may be below 200 km depth.

The seismic models limit the types of evolutionary processes that can be proposed for the formation of the Hamersley Basin. The most likely are: compression and folding of a thin lithosphere by a compressive stress, causing the basin to form out of isostatic equilibrium, or isostatic adjustment of an initial depression gradually filled with sediments. The initial depression may have been formed by any one of a number of processes, but the seismic models, when considered with the known geology and thermal history of the region, limit the likely processes to any or all of (1) thermal uplift followed by erosion and then cooling and contraction, (2) a thermal event causing a metamorphic change within the crust to a denser, less voluminous phase, and (3) a mass transfer process in which volcanic rocks were taken from the upper mantle and deposited on the land surface.

McArthur Basin crustal seismic studies (1192)

C.D.N. Collins

Deep seismic refraction and vertical reflection recordings were made in the southern McArthur Basin, between Daly Waters and the H.Y.C. mineral deposit, and between Borroloola and Westmoreland (Fig. GSR 2). These recording lines crossed the Bauhinia Shelf, Batten Trough, and the Wearyan Shelf. The Basin contains a number of mineral deposits, and the search for new deposits requires an understanding of its present structure and structural history. The H.Y.C. deposit is associated with the Emu Fault, the boundary between the Batten Trough and Wearyan Shelf, and one objective of the seismic survey was to define any differences in crustal structure on either side of the Emu Fault. Other objectives were to delineate the basement of the McArthur Basin, to derive velocities and structures beneath younger cover rocks, and to determine deep crustal and upper mantle velocities and depths within the North Australian Craton.



A LOCATIONS OF SHOTS AND RECORDING STATIONS AND SIMPLIFIED GEOLOGY, McARTHUR BASIN

B SHALLOW STRUCTURE

C DEEP STRUCTURE

EASTERN TRAVERSE

WESTERN TRAVERSE

Fig. GSR 2 McArthur Basin crustal seismic studies

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In the western McArthur Basin, over the Bauhinia Shelf, Cainozoic, Mesozoic and perhaps Cambrian sediments 100-200 m thick overlie ?Roper Group sediments (with a P-wave velocity of V = 4.6 km/s). These sediments are 2.4 km thick at Daly Waters, but increase rapidly to 4.1 km 20 km to the east, and then thin gradually to wedge out about 20 km east of O.T. Downs. Below this layer are probably Tawallah Group rocks (V = 5.8-5.9 km/s). Magnetotelluric measurements define a resistivity contrast, possibly basement, at 6 to 9 km depth but this was not recorded seismically. Within the Batten Trough, the average velocity of McArthur Group rocks is 5.8 km/s, but their thickness could not be determined.

In the eastern McArthur Basin, on the Wearyan Shelf at Borroloola, 370 m of Roper Group rocks (V = 3.58 km/s) overlie 2.9 km of Tawallah Group rocks (V = 5.55 km/s). At Robinson River, 650 m of Cainozoic sediments, thin McArthur Group and perhaps upper units of Tawallah Group (V = 4.81 km/s) were detected. Tawallah Group rocks (V = 5.44 km/s) crop out northwest of Robinson River and are about 2.8 km thick. A basement velocity of 6.04 km/s was determined. The presence of McArthur Group rocks between Borroloola and Robinson River could not be established. Between Robinson River and Westmoreland, basement depths are in the range 3.5-2.7 km. At Westmoreland the McArthur Basin sequence thins against the Murphy Ridge. A layer 260 m thick (V = 3.50 km/s) lies on top of a 2.4 km thick layer (V = 5.44 km/s), and the basement velocity of 5.99 km/s increases to 6.06 km/s towards Robinson River. Near Westmoreland, the basement may be granites or acid volcanics. On both the Bauhinia and Wearyan Shelves, magnetotelluric and gravity data support the seismic interpretation.

At mid-crustal depths, between 4.3 and 26 km below the Bauhinia Shelf, and between 3.5 and 24 km below the Wearyan Shelf, velocities are in the range 5.9-6.9 km/s, with velocities under the Wearyan Shelf tending to be the greater. In the lower crust, to depths of 43 km in the west and 40 km in the east, the velocities are in the range 6.8-7.5 km/s. Below this, a velocity gradient is interpreted until upper mantle velocities are reached between 43 and 53 km depth in the west (V = 7.5-8.4 km/s) and 44 km in the east (V = 7.9 km/s). These upper mantle velocities are not well determined.

The velocities and depths interpreted east and west of the Emu Fault are different. Whether these differences occur abruptly at the Emu Fault or are gradual could not be determined, except for the top few kilometres. The shallow structure under the H.Y.C. deposit on the western side of the Emu Fault is markedly different from the nearby structure under Borroloola to the east, supporting geological and magneto-telluric evidence for differences across the Emu Fault. North of the survey area, near Darwin, similar mid-crustal velocities have been observed to depths of 22 km, with lower velocities between 22 and 44 km. Upper mantle velocities of 7.95-8.18 km/s were reached at 44-45 km, similar to the McArthur Basin. South of the survey area, between Tennant Creek and Mount Isa, velocities are higher in the upper crust, above 16-20 km, but are lower in the lower crust. Generally, the crustal structure of the North Australian Craton is characterised by high lower-crustal velocities, broad velocity gradients, and thick crust, which probably evolved during Proterozoic tectonism from an Archaean continental crust.

<u>Seismic investigations of the North Australian Craton between Tennant Creek and Mount Isa</u> (1192)
D.M. Finlayson, C.D.N. Collins, J. Williams

The seismic investigation between Tennant Creek and Mount Isa was undertaken in 1979 as part of a program aimed at determining the basic velocity features of the lithosphere in the major tectonic provinces of continental Australia. The survey was undertaken in cooperation with the Australian National University. The interpretation of results was completed in 1981 and reported in the 1981 Geophysical Branch Summary of Activities (BMR Report 238). In 1982 these results were prepared for publication in the Journal of Geophysical Research.

<u>Seismic crustal studies - instrumentation and computer programs</u> (1192)
B.J. Drummond, C.D.N. Collins, D.M. Finlayson, J. Whatman, B. Liu

<u>Instrumentation</u>. Work proceeded on the construction of 12 new light-weight portable tape-recording field seismographs, and three of the exist-ing 4-channel Akai recorders were modified to use low-power d.c. motors and new NCE-3 digital clocks. Field tests were conducted on the modified recorders during the 1981 field season in the Eromanga Basin, and some

further modifications will be necessary to reduce noise generated in the tape transport mechanism.

Computer program development. Some of the data processing programs were improved, and rewriting of the record section programs was begun. This will make them easier to use, and more versatile. Work is progressing as time permits.

Two ray-tracing programs, one for models with lateral homogeneity and the other for models with lateral inhomogeneity, were converted from the CSIRO CYBER 76 computer to the in-house Hewlett Packard system. The in-house computer gives a faster turn around of plots, as well as having no external cost to BMR.

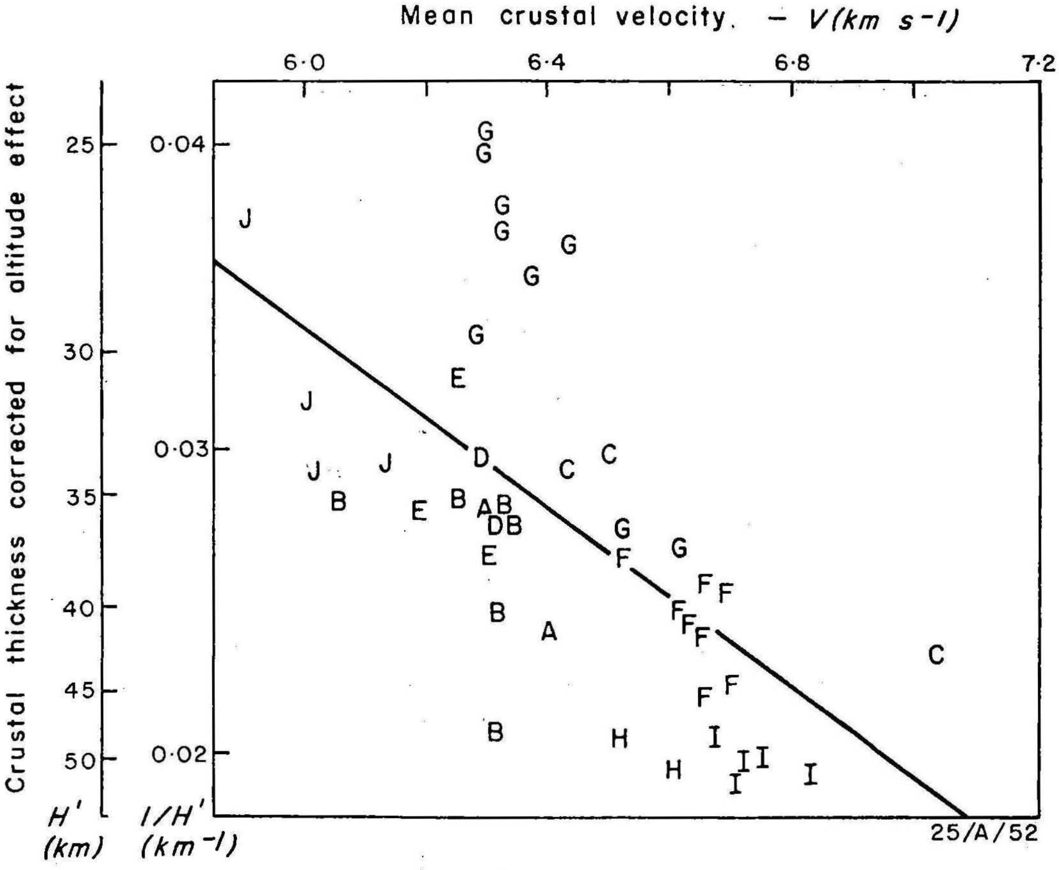
The synthetic seismogram program REFLEX was updated and improved with a faster routine for calculating reflectivities implemented, and more use made of LCM for storing the reflectivity array. The changes reduce greatly the run time of jobs, with a subsequent cost saving.

Australian regional gravity interpretation (1551)
P. Wellman

The objective of this project is to interpret the available information alone, or with other data, to provide a knowledge of the regional crustal structure for oil and mineral search and Australian tectonics.

Seismic refraction results and isostasy. A paper was written using the seismic refraction results from Australia to confirm that crustal isostatic effects are a major (40%) cause of variation of crustal thickness even in a continent of little surface relief. However, there is an equally important regional variation in crustal thickness unrelated to crustal isostasy; this is thought to be due to density variation in the lower lithosphere (Fig. GSR 3).

Continental structure from trends and trend offsets. An expanded abstract on this topic was written for the Society of Exploration Geophysicists 1982 annual meeting in Dallas, Texas. The abstract reviewed the mapping of basement blocks using the gravity trend pattern, and discussed the future use of gravity and magnetic data to map cross-cutting fractures in the basement.



Relation between crustal thickness corrected for altitude effect and mean crustal velocity. Letters give seismic refraction results from various areas in Australia. The line gives the least squares correlation, which is the relation expected for isostasy.

Fig. GSR 3

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Australian gravity maps and gravity surveying control (1556)

A.S. Murray, J.W. Williams, R.M. Tracey, E.H. Smilek

The aim of this project is to maintain a central repository of gravity data for Australia, produce maps at scales of 1:250 000 and 1:1 000 000 for the whole continent and provide data and technical assistance on gravity to other organisations.

Gravity data bank. The data base was augmented by the addition of West Australian Petroleum (WAPET) surveys in the Canning Basin area. Work commenced on the assimilation of a large volume of WAPET marine surveys into the data base. These surveys need extensive reformatting and re-numbering of stations before they can be added to the data base. Systematic checking of the data base for errors continued as time permitted. Updated data for South Australia were received from the South Australian Department of Mines.

Gravity maps. The Sydney 1:1 000 000 area maps were released, and processing was completed for the Armidale 1:1 000 000 area. The Tasmania 1:1 000 000 area maps were delayed by several problems in the data. Checking of data for the Broome 1:1 000 000 area was commenced.

The final plotter files for the Canberra, Sydney and Hamersley Range areas were rearranged and archived on magnetic tape.

Requests for gravity data. Four copies of the gravity data base were provided to exploration companies. Tidal gravity correction listings were provided at a rate of one per week to various organisations. Data listings, tapes and maps were provided for regional areas to several other organisations and to other Sections of BMR. Descriptions of gravity stations and data values and access to BMR aerial photographs of gravity stations were made available to exploration companies.

Computer programs. A program was written to rearrange and concatenate plotter files to allow more efficient plotting at BMR and to remove unwanted annotation from the maps. A program to produce plotter files for drawing maxima and minima signs on the final gravity maps was written and tested successfully.

Copies of the BMR data base programs were made available to the Victorian Department of Minerals and Energy.

Gravity base network and equipment. The data from the 1980 base network survey were processed by the Canadian Earth Physics Branch, Department of Mines and Energy, and the results were returned for analysis.

Temperature testing of the LaCoste and Romberg gravity meters was completed and a report on the results was written. A Worden gravity meter was lent to the University of Queensland and LaCoste meter G518 was returned to the manufacturer for repairs.

Subglacial structure of Antarctica (1005)

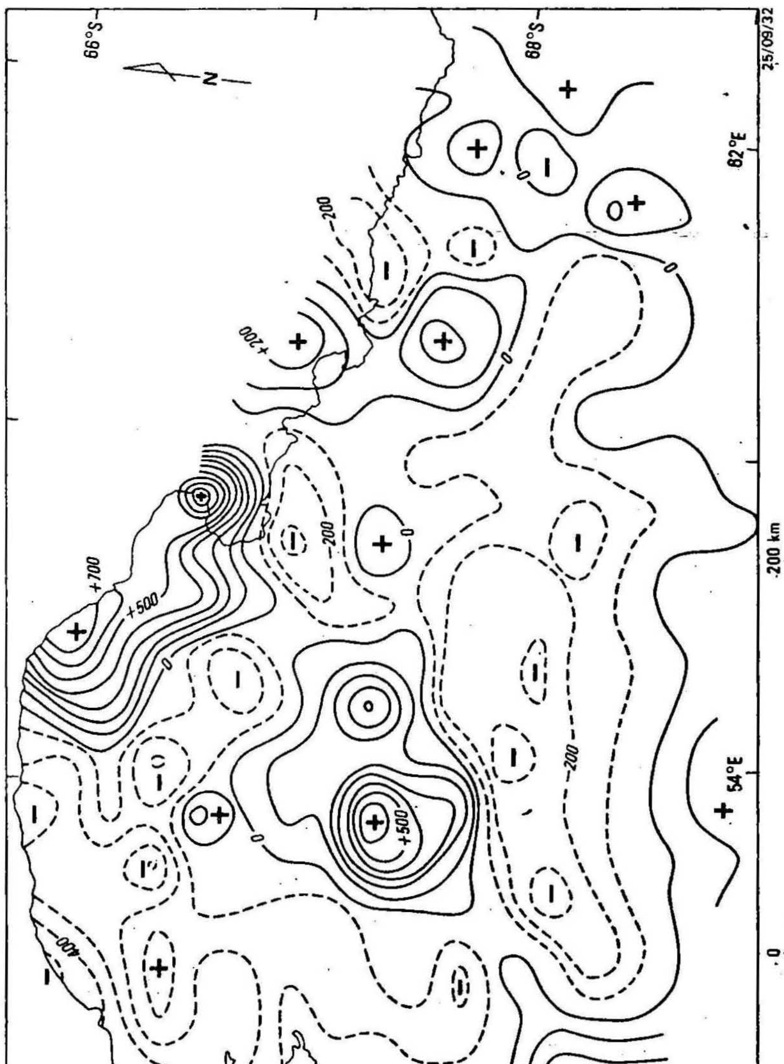
P. Wellman, J. Williams

The objective is to obtain aeromagnetic, ice-radar and gravity measurements over Australian East Antarctica and interpret them in terms of regional geology and crustal structure.

Gravity maps. P. Wellman compiled the available data and prepared computer-drawn maps of the Prince Charles Mountains area at 1:2 000 000 scale, and of the Mawson-Molodezhnaya area at 1:1 000 000 scale. The information was released through the copy service of the Government Printer as 33 maps and sections of ice-surface altitude, rock-surface altitude, aeromagnetic anomaly and gravity anomaly. A BMR Record describing the map production was produced.

Aeromagnetic survey of Mawson-Molodezhnaya area. A paper was written for the Fourth International Symposium on Antarctic Earth Sciences. Using aeromagnetic anomaly magnitude (Fig. GSR 4), the boundary of the Napier and Rayner Complexes was delineated. The boundary is marked by a zone of abnormally high apparent susceptibility over a zone of partial remetamorphism. Gravity anomalies correlate with topography. This is interpreted to be due to regional and deep isostatic compensation in an area of relatively uniform crustal density. No sedimentary basins were detected.

Rock topography of the Mawson-Molodezhnaya area. A start was made in interpreting this information in terms of erosional and uplift history.



Total magnetic intensity anomalies of the Mawson-Molodezhnaya area of Antarctica.

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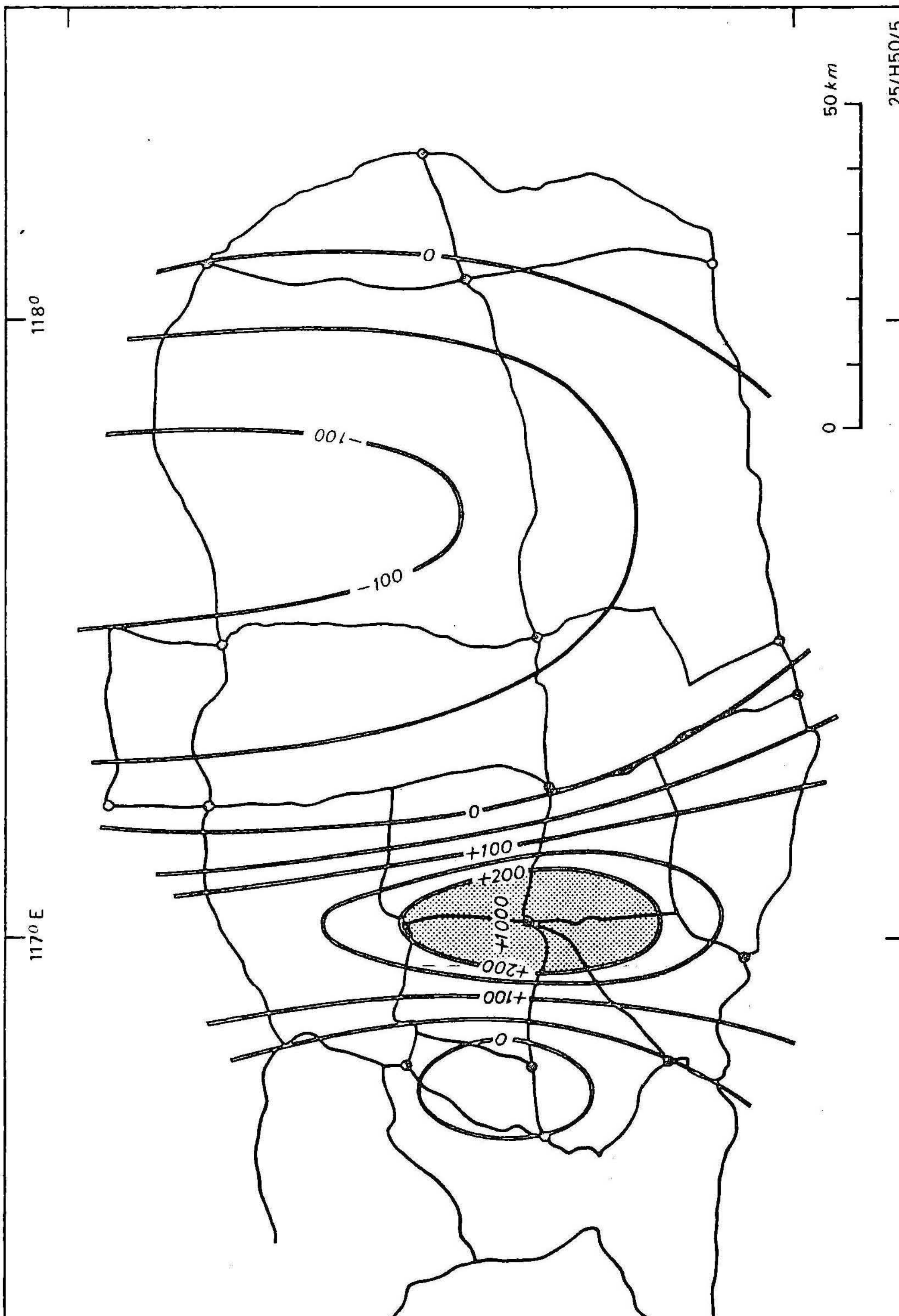
Fig. GSR 4



Meckering earthquake area of the southwest seismic zone. Vertical ground movement thought to have occurred at the approximate time of the earthquake. The contour interval is 50mm except in the shaded area.

31°S

32°

Fig. GSR 5

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Equipment for surveys. Preparations were made by J. Williams for BMR to construct an ice-thickness radar set for use in Antarctica. Gravity meters and associated equipment were prepared for a gravity survey of Northern Victoria Land by R.J. Tingey.

Crustal strain measurements (1115)

P. Wellman, R.J. Tingey

The objective is to measure rates of present day crustal movement on the Australian Continent, and define Cainozoic tectonics, recurrence interval for damaging earthquakes, and, together with stress measurements, define areas with abnormally high short-term earthquake risk.

Relevelling program in southwest seismic zone. The Australian Survey Office program of relevelling continued. The first set of results was analysed by R. Tracey, and a BMR Record written (Fig. GSR 5). In the process a HP9825A computer program was written to reduce the results.

Simpson Desert area. A map of the deformed pre-desert surface was drawn from gravity-survey altitudes. The relationship of the deformation to the earthquakes was studied.

Southeast Australia. The Division of National Mapping program to remeasure the triangulation network between Lake George and Sydney started with the measurement of several distances.

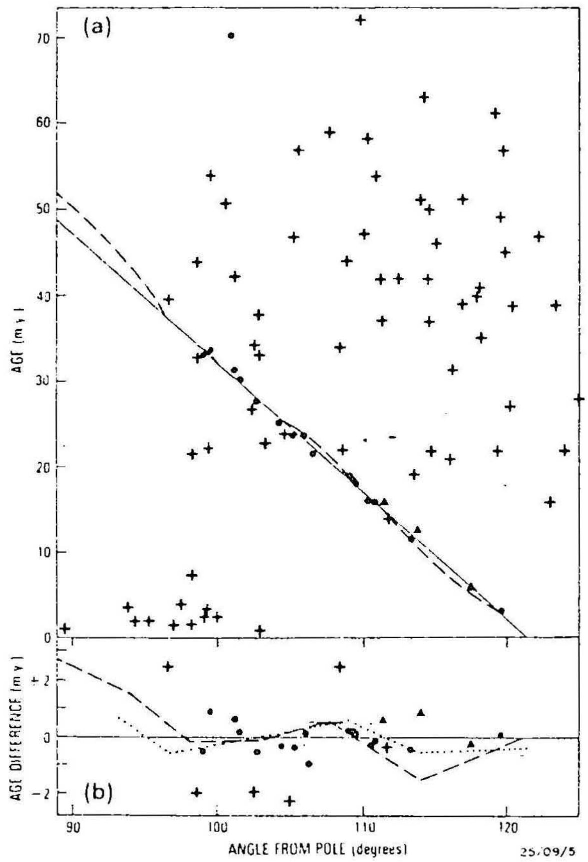
Talks. Lectures on the strain results were given at the Geodesy Seminars at the University of NSW, and at a general meeting of the International Association of Geodesy (IUGG) in Tokyo. Extensive information on overseas research on crustal movement and precise gravity surveys was gained by attendance at the Tokyo meeting.

Volcanology of eastern Australia - associated gravity anomalies and crustal deformation (1032)

P. Wellman

The objective is to contribute a geophysical framework for petrological studies of eastern Australian volcanology by studying intrusions and their deformation, and geophysical lithospherical models.

Workshop on Cainozoic volcanology. A talk on geophysics was given at this workshop.



Caiñozoic volcanic provinces of eastern Australia. Relation between age of province and azimuth of province from pole of rotation of Australian plate and hot-spot reference frame. Crosses are lava field provinces, dots are central volcano provinces, and triangles are high potassium provinces. In (b) age differences are from a linear rotation model of (a) above. Dashed line is the Duncan (1981) hot-spot model, dotted line is this model updated using Stock & Molnar (1981).

Fig GSR 6

Hot-spot models. A paper was written re-analysing K-Ar dating information in terms of empirical models of hot-spot migration, and making estimates of associated uplift. Both eastern Australian and New Zealand-Cambell Plateau Cainozoic hot-spot volcanoes are consistent with being caused by a segment of a stationary great circle through the pole of rotation of the lithosphere relative to the 'hot-spot' reference frame (Fig. GSR 6). About 100 m of temporary uplift is associated. Mid-Mesozoic volcanism appears consistent with this model.

K-Ar dating. A paper was started with Dr L. Sutherland of the Australian Museum on documenting unpublished K-Ar work by BMR and the Museum, and discussing the results in terms of volcanic history, petrology and erosional history.

Antarctic palaeomagnetism (1410)

M. Idnurm, J.W. Giddings, J. Salib, P. Wellman

This project determines Proterozoic pole positions of eastern Antarctica as constraints on the reconstruction of Gondwanaland.

Vestfold Hills mafic dykes. A reconnaissance study of the Vestfold Hills region was concluded. Thermal and AF demagnetization measurements were made on one pilot specimen from each of 143 hand samples collected in the summer 1980/81. A preliminary analysis of the data suggests three groups of remanence directions which resemble those of the Amundsen Dykes of Enderby Land. A more detailed analysis of the data is in progress.

Based on the results of the reconnaissance, a proposal was submitted to the Antarctic Research Policy Advisory Committee to carry out a comprehensive sampling of the mafic dykes in the Vestfold Hills region. The proposal was successful and J. Salib is being trained to collect samples in 1982/83.

Enderby Land mafic dykes. Pilot demagnetization measurements were completed on 86 samples collected from Enderby Land in 1979/80. This collection supplements earlier sampling which yielded one well defined and two poorly defined groups of remanence directions. All three directional groups have been consolidated by the new data.

Data from the original Enderby Land sample collection have been transferred from thermal printouts on to punched cards and thence on to the data base in readiness for an orthogonal projection analysis of remanence components.

Cenozoic weathered profiles (1060)
M. Idnurm

This project aims to determine the chronology of chemical weathering in Australia in order to improve our understanding of the processes of weathering, and to study its implications on past climates, tectonism and other related phenomena.

Cenozoic polar-wander path. Errors and uncertainties in the existing Cenozoic pole path severely limit palaeomagnetism as a dating technique. The emphasis in the project has shifted therefore from measurements on weathered profiles to a redetermination of the pole path. Sedimentary rock sequences of the Otway Basin in southwest Victoria were sampled earlier in 1981 for this purpose. The samples have now been measured and the data analysed, yielding three new palaeomagnetic pole positions. Southwest Victoria was revisited briefly in 1982 to collect supplementary samples for consolidating the three pole positions and for determining a fourth pole position.

Petroleum exploration drill cores of the BMR Core and Cuttings Laboratory were examined to find material that may be suitable for additional Cenozoic pole determinations. Reconnaissance measurements were carried out on a number of different drill cores, and comprehensive measurements were made on North Rankin No. 1, yielding an early Tertiary pole position.

Central and northern Australian weathered profiles. A 1981 collection of 500 samples from weathered profiles at various localities in central and northern Australia has been prepared ready for measurements, and a data base has been created. Measurements have been completed from the Hale Basin part of the collection and pilot thermal demagnetization measurements have been made on samples from "Inverway" on the western border of the Northern Territory. Both localities give early Tertiary remanence directions.

M. Idnurm took over from B. Senior the convenorship of the Palaeomagnetic Dating Subgroup of International Geological Correlation

Project 129 (Lateritization Processes). A symposium/workshop is being considered on palaeomagnetic dating of laterites, to be held, possibly in Canberra, in 1984.

McArthur Basin palaeomagnetic studies (1430)
M. Idnurm, J.W. Giddings, J. Salib

This project studies the feasibility of magnetostratigraphy in Carpentarian rock sequences, determines the Carpentarian apparent pole path segment and applies palaeomagnetic techniques to improve our understanding of the geologic history of the McArthur Basin.

Eastern McArthur Basin. Specimens have been prepared from 160 drill core and hand samples collected from the Kilgour and McArthur Rivers region in 1981. A data base has been created for the samples and the initial remanences (NRMs) have been measured.

Western McArthur Basin. 600 specimens were prepared from all remaining drill core samples of the Kombolgie Formation. NRM measurements on these were completed and the data added to the data base. The process of adding all pre-data base measurements of the Kombolgie Formation to the data base was finalised.

Palaeomagnetism of Proterozoic igneous rocks of Australia (1029)
J. Giddings, J. Salib

This project is designed to improve the first-order apparent polar wander path for Australia for the period 750 Ma-1800 Ma by establishing well-defined, well-dated palaeomagnetic poles.

Specimen preparation was completed for the remaining 200 samples of Edith River Volcanics, Campbell Sandstone, Morawa Lavas and Neereno Sandstone. NRM measurements on the 500 new specimens and 17-step thermal demagnetization measurements on a supplementary set of 120 pilot specimens were completed. The 3100 measurements were added to the data base; detailed analysis of these data in terms of the various components of magnetization recorded by the rocks awaits implementation of the interactive graphics analysis package in the coming year. However, a cursory analysis of the remanence based on the original set of pilot specimens was reported last year; changes to the accepted apparent polar wander path for Australia for the period 2500 Ma-750 Ma required to incorporate those preliminary results are briefly considered elsewhere in this report.

Development of a comprehensive palaeomagnetic data-processing system (1029)

J. Giddings

A comprehensive palaeomagnetic data-processing system is being developed which will automate, as far as possible, the collection and analysis of palaeomagnetic measurements. The system is designed around two elements:

(1) A 10-Mbyte data base PALMAG for systematic storage of measurements and results, and a suite of accession, maintenance and analysis programs.

(2) A minicomputer-based facility at the Black Mountain Palaeomagnetic Laboratory for recording measurements.

Effort was concentrated on the data base and service programs aspect of the system. The final three interactive programs of the suite for accessing data were completed. These comprise two programs which enable paper-tape recorded data from the Digico spinner magnetometers to be processed and stored on the data base, and a program which reformats, for the data base addition program, raw measurement data files which have been prepared from hard-copy only records.

A start was made on the suite of 5 programs that will facilitate maintenance of the integrity of the data stored on the data base. One program was completed; it permits changes to be made to susceptibility data already stored, or subsequent additions of such data. The remaining 4 programs should be completed in 1982.

The structure of the data base was changed to allow inclusion of 3 new detail sets and the expansion of others. The function of the new sets is to provide a more direct relation between a particular formation and its localities/sites/samples than existed in the old structure; as a consequence, considerable savings of processing time are expected when the suite of analysis programs is operational.

All remanence measurements now made are added to the data base routinely. The process of clearing the backlog of measurements from the pre-data base period and adding them to the data base was finalised except for data from the Antarctic dykes project; disc files of these data, however, are now ready for addition. To date, there are about 20 000 measurements on the data base from 40 formations in Australia and Indonesia.

Apparent polar wander with respect to Australia for the period 2500 Ma-750 Ma (1029)
J. Giddings

This project considers the preliminary results obtained from two other projects, McArthur Basin magnetostratigraphy, and palaeomagnetism of Proterozoic igneous rocks of Australia, in the context of apparent polar wander (apw) path with respect to Australia for the period 2500 Ma-750 Ma. It describes the main changes to that path that will be necessary to incorporate the final results.

14 preliminary results are available; their ages range from 1720 Ma to 900 Ma and they are derived from the following units:

- Edith River Volcanics, Pine Creek Geosyncline, about 1730 Ma.
- Lower part of the Kombolgie Formation of the Katherine River Group, western McArthur Basin, 1700 Ma-1650 Ma.
- Hobblechain Rhyolite through to the Emmerugga Dolomite of the Upper Tawallah and Lower McArthur Groups, eastern McArthur Basin, about 1700 Ma.
- Morawa Lavas, the underlying Neereno Sandstone, and the overlying Campbell Sandstone, Yilgarn Block, about 1350 Ma.
- Stuart Dykes, Arunta Block, about 900 Ma.

Main features of the results are:

- The Edith River Volcanics pole is some 25° away from the result established over 20 years ago.
- A polar shift can be identified in the Lower Kombolgie Formation from the western McArthur Basin which is in the same sense as, and superposes the first part of, the polar shift found in the eastern McArthur Basin rocks, suggesting, at this preliminary stage, that the two sequences are equivalent in age. Tradition-

ally, the Kombolgie Formation has been regarded as equivalent in age to the lower, not the upper, part of the Tawallah Group.

- The Morawa Lavas pole is about 40° away from the published result. Along with results from the underlying and overlying sediments, a 35° path segment is defined which establishes that the sense of polar motion through the Morawa Lavas pole is opposite to that shown on the existing apw path.
- The Stuart Dykes pole lies about 35° away from younger poles and assists in defining an older part of the Late Precambrian section of the apw path.

Most of the results, which represent about a 50% increase in the pole data set for the period 2500 Ma-750 Ma, do not fall on the existing path; however, the data refer to periods for which the old apw path was poorly defined. The re-defined path differs from the old in the following respects:

(1) The loop connecting poles younger than 1500 Ma is opposite in sense.

(2) The antipole sequence of poles defining the 1660 Ma-1470 Ma path segment, based mainly on Gawler Craton poles, is more appropriate.

(3) The unambiguous polar shift defined by McArthur Basin rocks shows that the sense of polar motion in the 1760 Ma-1660 Ma interval is opposite.

(4) The antipole sequence of poles from rocks older than 1800 Ma is more appropriate for minimising apw when making a connection with younger poles.

<u>McArthur Basin magnetotelluric profiles</u> (1205)

J.P. Cull

Magnetotelluric profiles have been used to investigate the nature of major structural trends in the McArthur Basin. Sites were occupied during 1978 and 1979 on two traverses of 350 km across the Wearyan Shelf, the Batten Fault Zone and the Bauhinia Shelf.

Resistivity contrasts appear to be sufficient to characterise the McArthur Group to the west of the Emu Fault, and the Tawallah Group both to the east and west of the Emu Fault.

Interpretations based on estimates of rotated tensor apparent resistivities reveal marked differences in structure across the Emu Fault. Orthogonal components of apparent resistivity are highly divergent and lateral variations can be detected. This feature is emphasised using 2-D models for data reduction. Major changes in resistivity are suggested deep within the crust. However the actual resistivities for all stratigraphic units are not completely resolved because of anisotropy related to the structure in the vicinity of the Emu Fault.

The distinctiveness of the Tawallah Group seemingly makes it impossible that any appreciable thickness of McArthur Group can be present east of the Emu Fault. These results support geological models based on the assumption that the Batten Trough formed as a syndepositional graben, with rapid changes in depositional thickness at the boundary faults.

Isotropic data for the Wearyan Shelf were inverted in a 1-D analysis revealing a well-defined basement with resistivity of about 3000 ohm-m. This is covered by a layer which is attributed to the Tawallah Group. It is commonly 5000 m thick with consistently low resistivities of about 300 ohm-m. At the surface there is a layer with a resistivity of about 20 ohm-m consistent with Roper Group sediments ranging in thickness to 300 m.

<u>Magnetotelluric systems development</u> (1205)

J.P. Cull

All software has been converted to the RTE IV environment of a 1000 E series CPU. Many revisions were implemented during this process. In particular unnecessary options were removed from the standard processing stream. A single stream has been adopted through the FFT stage to the calculation of tensor elements. Separate plotting programs have been combined for presentation of individual data sets. The same data format has been adopted for pseudosections generated using existing contour routines.

Most estimates of apparent resistivity contain considerable scatter. Some of this noise can be attributed to variations in tensor rotation when calculating a strike direction. In some cases a giant scatter is generated when the normal 90 degree ambiguity results in an inconsistent mixing of orthogonal components. This problem has been eliminated by specifying a regional strike from the average of the individual rotations.

Geothermal studies (1118)

J.P. Cull

Holes near Lancefield (Vic.) and Bombala (NSW) were logged, and measurements were made in the Mount Isa Mine to determine thermal gradients beneath the current mine-workings.

All available estimates of heat flow in Australia have been assessed for quality. Sources of error have been suggested and levels of accuracy have been assigned. Regional trends are preserved in the revised data but extreme values in the southeast have been eliminated. New data have now been obtained in these critical areas. However climatic corrections are required for observations in shallow boreholes.

Variations in mean surface temperature can be identified from curvature of the geothermal gradient. Data obtained near Lancefield, Victoria, confirm previous observations that temperatures have been relatively stable since glacier retreat in the Snowy Mountains commencing at about 14000 BP. However, one major event has been identified, corresponding to a rapid removal of vegetation at about 50 years BP. Increased levels of insolation appear to cause a surface warming of about 0.6°C, consistent with data from other areas of Australia. The climatic consequences are difficult to predict, but land clearance may produce effects comparable in magnitude with those from atmospheric pollution.

GEOMAGNETISM AND SEISMOLOGY SUBSECTION

P.M. McGregor

The five groups comprising the Subsection and their personnel were:

Antarctic and Special Projects: I.B. Everingham (to Nov. 1981), A.J. McEwin (from Nov. 1981), B.A. Gaull (to Nov. 1981); at Macquarie Island - W. Williams (to Oct 1981), G.H.Y. Thomas (Nov 1981 - Jan 1982), I. Ferguson (Feb-Oct 1982); at Mawson - A. Marks to Mar 1982), R.P. Silberstein (Mar 1982-Mar 1983).

Canberra Observatory Group: R.S. Smith, M.W. McMullan (to Jan 1982), P.A. Hopgood (from Mar 1982).

Mundaring Observatory Group: P.J. Gregson, E.P. Paull, B.A. Gaull (from Nov 1981), M.A. Bousfield.

Surveys, Data and Reductions Group: G.R. Small, A.J. McEwin (to Nov 1981), V.F. Dent

Technical Support Group: J. Vahala, M.K. Douch, J. Salib (to Dec 1981), N. Ashmore (Darwin); outposted from IES Branch - W.K. Greenwood (Canberra); G. Woad, B.J. Page (Mundaring).

In addition, I.D. Ripper was on secondment to the PNG Geological Survey (Port Moresby Geophysical Observatory).

In broad terms, observatory operations within Australia are shared by the groups as follows: Canberra group - Canberra and Toolangi magnetic observatories and the eastern seismograph network; Mundaring group - Gnangara magnetic observatory and the western seismograph network; Reductions and Technical groups - final data processing and distribution, and engineering support.

During the report period I.B. Everingham (Science 3) retired after 30 years in BMR, mostly spent at observatories; M.W. McMullan (Science 2, 10 years) transferred to the Ionospheric Prediction Service; and J. Salib (TA/2) transferred to the Palaeomagnetism group. Although P. Hopgood replaced McMullan, the other vacancies caused severe setbacks, and considerable backlogs once again accrued, mainly in the reduction and reporting of magnetic surveys, production of 1980 magnetic charts, and the reduction of observatory mean hourly values.

Subsection officers were represented on various committees at national and international levels, namely:

P.J. Gregson - Geophysics Advisory Committee, Western Australian Institute of Technology; Seismological data base subcommittee of the Accreditation Technical Experts Natural Disasters.

P.M. McGregor - AAS Subcommittee for Geomagnetism & Aeronomy (Chairman); AAS Subcommittee for Seismology & Physics of the Earth's Interior; ANCAR Subcommittee for Geomagnetism & Upper Atmospheric Physics; IAGA Working Groups V-5 (Magnetic Surveys & Charts, Chairman), V-10 (Ground Measurements for Satellite Surveys).

G.R. Small - IAGA Working Group V-1 (Observatories and Instruments)

R.S. Smith - IASPEI Commission on Practice

Geomagnetism (2010, 2011)

The objectives are to obtain and publish information on the Earth's magnetic field in Australia and its territories and offshore regions; particular emphasis is given to the internal fields - the main and crustal fields - and to secular variation. Basic data are obtained by the operation of magnetic observatories (Project 2010); and by conducting first-order (repeat) surveys for secular variation, and third-order surveys to chart the spatial changes (Project 2011).

Observatories. Three-component, normal-run (20 mm/hr) magnetographs were operated continuously at Canberra, Gnangara (WA), Macquarie Island, Mawson (Antarctica), and Toolangi (Vic.); absolute observations were made regularly at all places except Toolangi, and at Casey and Davis by members of the Australian National Antarctic Research Expeditions.

In addition a digital magnetograph (BMR-modified Elsec 6920) was operated at Canberra and demonstrated its advantages in reliability (0.4% record loss), timeliness, and versatility. The other magnetographs worked very well, the total record loss being 2.4%. Unfortunately lack of staff allowed little progress on modifying and proving a second AMO for Gnangara.

Encouraging progress was made by IES Branch in the development of the 'photo-electronic magnetograph' (PEM), a nulling device for application to classical magnet-fibre variometers. PEMs will replace analogue D and H variometers at all existing observatories, to produce visible and digital records. A significant design change was the replacement of La Cour variometers by QHMs as the sensors, to provide standardisation and portability. Promising analogue test records were obtained from a prototype.

With the cessation of results-reporting from Toolangi an historic era in Australian geomagnetism ended on 31 December 1981. Canberra replaced it as the regional reference observatory, but Toolangi will be retained indefinitely as a variations observatory and first-order station; with its predecessors at Melbourne it provides almost continuous records since 1858.

Observatory results were reported nationally and internationally according to IAGA recommendations on monthly and other schedules, and in BMR's monthly 'Geophysical Observatory Report'. Significant delays occurred in production of the Report and in the reduction of mean hourly values, but elimination of the backlogs was well in hand at the time of writing. Data reported comprise: indices of disturbance, magnetic storms, solar flare effects, sudden commencements and monthly mean values (to 150 recipients); and magnetogram copies and mean hourly values to World Data Centre A. Numerous <u>ad hoc</u> requests were received, for magnetograms or numerical results, from government agencies, university researchers, companies and individuals. Table GSR 1 gives the values of the magnetic elements and the annual change at 1981.0.

<u>Magnetic surveys</u>. Field work comprised:

A third-order survey of Yorke Peninsula; 28 stations were occupied in February 1982 and the results were reduced and reported. This completed the coverage of southern Australia.

First-order observations at Mallacoota, Vic. (a new station), in June.

Calibration of ship-swinging sites on Sydney Harbour in June for the RAN Trials and Assessment Unit.

As steps towards improving the efficiency of first-order surveying, a slide-on recorder caravan was modified and fitted out; some stations were improved (by the Division of National Mapping and the Australian Survey Office) - more permanent markers were laid, auxiliary stations established, and azimuths of fixed reference marks determined; and a D/I fluxgate theodolite (by EDA) was purchased and evaluated.

No progress was made on the reduction of 1981 surveys in Irian Jaya, PNG and Melanesia, and on the backlog of earlier surveys. This work has high priority for completion.

An address presented to a workshop on MAGSAT (August 1981) was prepared for publication later in 1982.

Magnetic charts 1980.0. The chart of total intensity (F) was completed and published; F and its secular variation were expressed as fourth-degree polynomials for computer-drawing (Fig. GSR 7).

Only slight progress was made on the chart for horizontal intensity (H) - the third of the basic charts - mainly because recent H standards have not been determined (see later).

The 1980.0 F and D models were used to make a more comprehensive assessment of candidates for the International Geomagnetic Reference Field IGRF 1980 than was possible in 1981. This was published in collaboration with Prof. D.F. Winch, University of Sydney (McGregor, Winch & McEwin).

Australian magnetic standards. Work was resumed on adopting H standards since 1976. This entails the collation and analysis of many inter-comparisons made between Australian and IAGA magnetometers, including the recently introduced proton vector magnetometers (PVM).

For D, procedures were detailed for the de-torsioning of declinometer fibres and for preserving azimuths of reference marks - two auxiliary marks were established at Gnangara for this purpose.

The increased demand for more accurate models of the field and secular variation, and the realisation that sharp changes in secular acceleration do occur, highlight the need for a properly based set of magnetic standards. Regrettably, insufficient attention has been given to this matter in recent years.

Co-operative and miscellaneous studies. In co-operation with the bodies noted, programs were carried out on:

Ionospheric soundings - at Mundaring, with the Ionospheric Prediction Service; BMR staff maintain the IPS/4B ionosonde and derive some basic F2-layer parameters daily.

Pulsations recording - at Mundaring, for Dr B.J. Fraser, University of Newcastle; recorder maintained.

Re-occupation of the Rossbank (Hobart) Observatory site - with Major F. Bond, Antarctic Division; a review of this historic observatory and its re-occupation was begun.

TOTAL MAGNETIC INTENSITY
EPOCH 1980.0

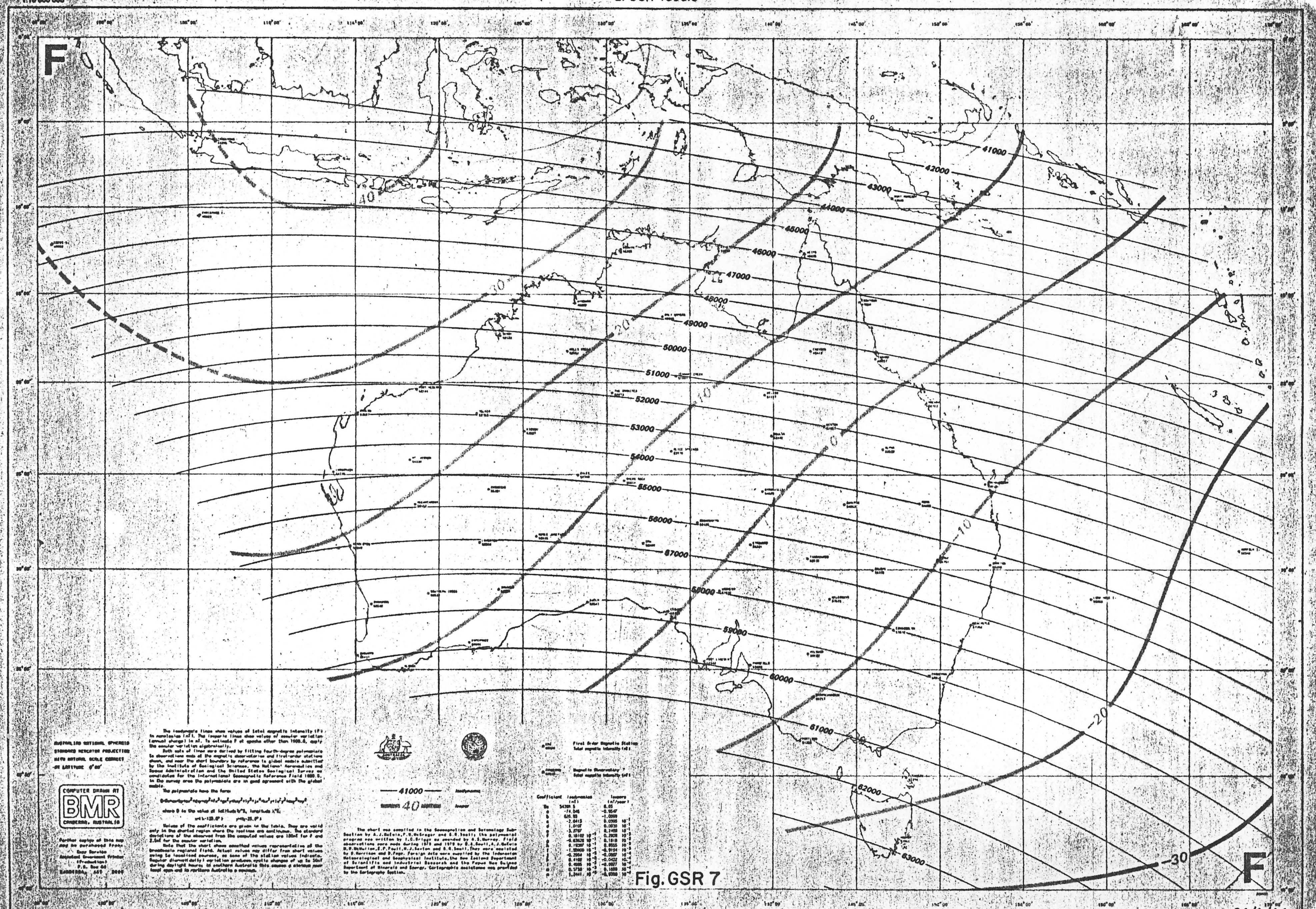


Fig. GSR 7

Record No. 1983/6

Establishment of a magnetic observatory at Charters Towers - agreement was reached with the University of Queensland, and contracts were let (by Dept of Transport and Construction) for erection of a recorder-room and magnetometer shelter at the seismograph station. An EDA three-component fluxgate magnetograph was test-run at Canberra Observatory.

Absolute observations - at Casey and Davis, with Antarctic Division.

Magnetic mean hourly values - at Port Moresby, with PNG Geological Survey.

Calibration of a fluxgate variograph - at Canberra Observatory, for Dr W.D. Parkinson, University of Tasmania.

Calibration of reference compasses - at Canberra Observatory, for the Army, the Australian Survey Office, and a private company.

Secular motion of the south magnetic pole - an address was prepared for the Fourth Antarctic Symposium on Earth Sciences (August). Positions of the pole since 1600 were derived and those since 1905 were compared with cells of the non-dipole field (Fig. GSR 8 and Fig. GSR 9).

Seismology (2000 - 2003)

The objectives of the seismological programs are to provide and publish information on seismic waves from near and distant earthquakes and explosions as a contribution to global seismology; to study the tectonic implications of earthquakes, particularly those in the Australian region, and to assess earthquake risk throughout Australia.

Basic data are obtained from BMR's Australian Regional Seismograph Network (ARSN), and more specialised networks operated by others (Project 2000); from sets of accelerographs in seismically active areas (Project 2001); and from direct measurements of crustal stress (Project 1117).

Seismograph stations. The ARSN comprises three sets of stations:

BMR's eastern network - operated by the Canberra Observatory Group; the stations (with the number of components) are: Alice Springs (6), Bellfield (1), Canberra (1, monitor only), Cooney

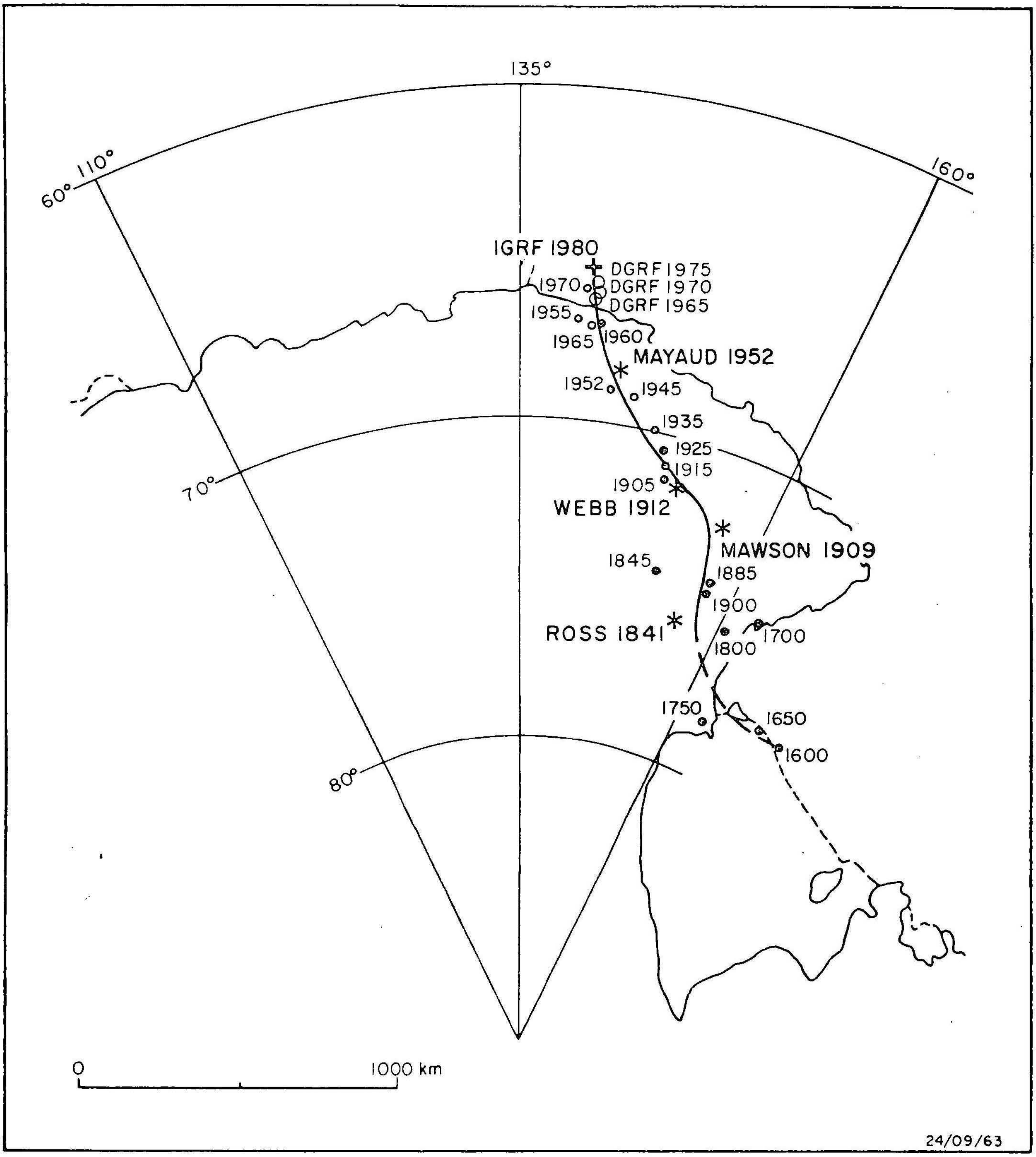


Fig. GSR 8 Path of the south magnetic pole 1600 – 1980

Record No 1983/6

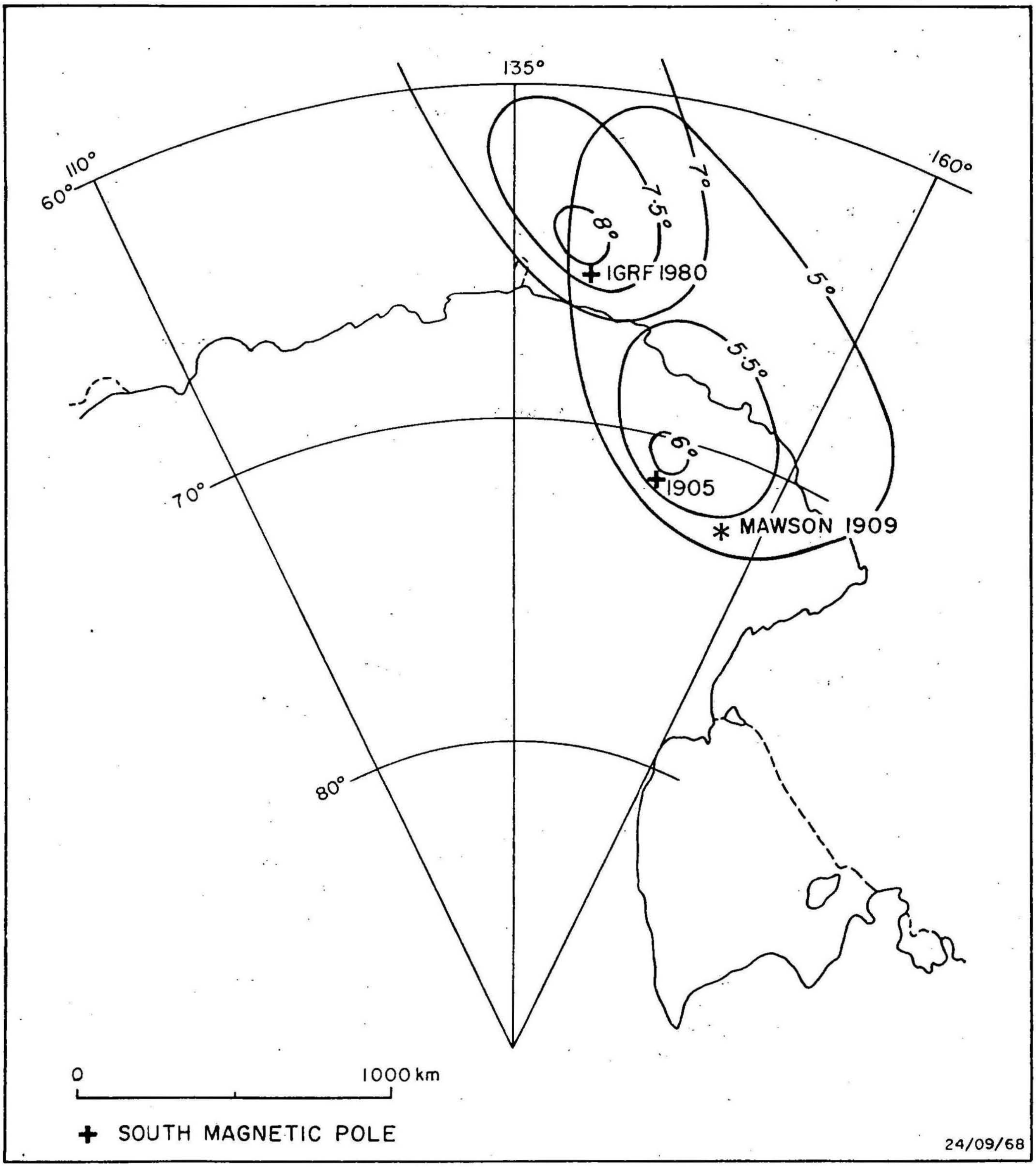


Fig. GSR 9 Non-dipole fields near the magnetic poles 1905 – 1980

Record No. 1983/6

(1), Manton (3), Mount Isa (1), Stephens Creek (1), Toolangi (6).

BMR's western network - operated by the Mundaring Observatory Group; the stations are: Kalgoorlie (1), Kellerberrin (1), Kununurra (3), Marble Bar (1), Meekatharra (1), Mundaring (WWSSN), Nanutarra (1), Narrogin (SRO), Warburton (1).

Contract stations: Adelaide (WWSSN, University of Adelaide), Charters Towers (ASRO, WWSSN, University of Queensland), Hobart (DWWSSN, University of Tasmania), Riverview (WWSSN, Riverview College).

Stations of the (Digital) Worldwide Standard Seismograph Network are abbreviated (D)WWSSN and (Abbreviated) Seismic Research Observatories (A)SRO.

Two other BMR stations, Macquarie Island (1) and Mawson (4), are outside the ARSN and were staffed full-time by geophysicists from the Antarctic Group. For the contract stations all seismograms were analysed by the contractors except those for Riverview, which were handled by the Canberra Group; N. Ashmore at Darwin made preliminary analyses for Alice Springs and Manton.

No new stations were commissioned but a photo-drum recorder modified for hot-stylus writing was installed at Macquarie Island (January). Most stations operated satisfactorily, the average up-time being 92%; all except Cooney were visited at least once for maintenance and calibration.

Data production and distribution. Regular seismological bulletins comprised:

Monthly preliminary bulletins (30 recipients). These are microfiche lists of current BMR data and included a time-sorted bulletin (from November), and regional epicentres (from April).

Final bulletins (10 recipients). Microfiche lists of phase and epicentre data, distributed about 2 years after the event.

Magnetic tapes for the International Seismological Centre (ISC); collated lists from all agencies of final parameters, and epicentres of earthquakes only with magnitudes 3 and over; this new limitation (since July) reduced the monthly number from about 80 to 10.

The Earthquake Data File was brought up to the end of 1981 and minor corrections were made to it. Lists and computer plots were made from it in response to requests from insurance companies, engineering consultants, research groups and individuals.

Figure GSR 10 shows the numbers of P-phases reported from each BMR station, and the percentage losses of short-period vertical records (= 'downtime').

Accelerographs. Two accelerographs were maintained in the Dalton/Gunning district and one was triggered twice; maximum accelerations were about $0.8\ m/s^2$ and $0.5\ m/s^2$ but they could not be associated with specific earthquakes.

An accelerograph at Kununurra was not triggered, but 19 earthquakes triggered one or other of three in the southwest seismic zone (these have been modified to trigger at lower thresholds). Ten of the earthquakes were felt in the very near vicinity but the peak acceleration was only $7.7\ m/s^2$ at 2 km.

Australian seismicity. Significant earthquakes which occurred during the period reported are given in Table GSR 2, and earthquakes for 1981 with ML greater than 2.9 which were added to the earthquake data file are shown in Figure GSR 11. As in previous years most of the seismicity was in Western Australia: of the 55 WA earthquakes, one was greater than ML 5.0, 19 occurred in the southwest seismic zone and 17 near Cadoux.

In the east the main Appin earthquake produced surface waves large enough at Alice Springs for determination of the seismic moment (1.37×10^{15} Nm); a fault-plane solution suggested reverse dip-slip motion, due to east-west horizontal compression.

Isoseismal maps and atlas. Maps were drawn for the earthquakes of 15 November 1981 (Appin), 30 November 1981 (Suggan Buggan), 24 January 1982 (Cadoux), 6 February 1982 (Cadoux), 9 March 1982 (Corryong), and 20 May 1982 (West Wyalong). The first two were included in the Atlas of Isoseismal Maps of Australian Earthquakes (Bulletin 214), and the others are shown in Figures GSR 12-16.

Detection seismology. P.M. McGregor attended the thirteenth (March 1982) session of the Geneva Group of Scientific Experts (on the detection and identification of seismic events); in this capacity he was a member of the Australian delegation to the Committee on Disarmament. He chaired Study Group 3 - on the use of the Global Telecommunications System (GTS) - and conducted a workshop on the large-scale data-exchange experiment conducted in November-December 1981 (designated GTS/2).

The subsection contributed to GTS/2 by forwarding daily messages from Canberra and Mundaring to the Australian GTS centre in Melbourne for global distribution. Twenty-two countries in the GSE took part; the experiment was considered an important development in the Geneva proceedings because of its practical value and because of the participation of socialist bloc countries.

Department of Foreign Affairs provided funds for the Geneva travel and for engaging a seismogram reader during GTS/2. The Bureau of Meteorology provided connections to the GTS and copies of incoming messages.

Table GSR 1

Annual mean values and secular change of the magnetic elements 1981.0

OBSERVATORY	D ° '	I ° '	H nT	X nT	Y nT	Z nT	F nT
PORT MORESBY	06 30.2	33 21.2	35962	35731	4073	-23671	43053
	+1.7	-2.2	-9	-11	17	-28	+8
GNANGARA	-03 19.1	-66 28.9	23364	23325	- 1352	-53685	58549
	-1.3	-3.2	-45	-45	-7	-33	+7
CANBERRA	12 11.2	-66 08.6	23779	23243	5020	-53770	58793
	+2.4	-1.8	-34	-37	9	0	-15
MACQUARIE ISLAND	28 37.5	-78 44.5	12687	11136	6078	-63735	64985
	+8.7	-1.5	-36	-47	11	+33	-40
MAWSON	-63 14.6	-68 27.1	18443	8303	-16468	-46705	50215
	-8.8	+2.7	+11	-37	-32	+79	-69
DAVIS	-76 18.0	-72 29.4	16587	3928	-16115	-52576	55130
	-	-	-	-	-	-	-
CASEY	-88 02.1	-81 32.0	9540	327	- 9534	-64083	64789
	-	-	-	-	-	-	-

TABLE GSR 2

SIGNIFICANT EARTHQUAKES IN THE AUSTRALIAN REGION

1 October 1981 - 30 June 1982

Date	Locality	Magnitude ML	Remarks
1981			
Oct 05	95km NE Carnarvon	3.2	
11	30km E Dairy Ck Stn	3.5	
13	600km WNW Carnarvon	4.1	
14	800km S Albany	4.3	
17	600km NNW Darwin	6.1	Felt
Nov 01	100km WSW Meekatharra	3.2	
09	50km NW Landor	3.4	
14	260km WNW Kalgoorlie	3.6	
15	Appin NSW	4.6	Felt MMV
19	Appin NSW	3.3	Aftershock
30	27km N Suggan Buggan	3.7	Felt MMIV
Dec 06	60km SSE Learmonth	4.5	Felt MMV
06	116km S Kununurra	3.0	Felt MMIV
08	135km NE Kununurra	4.8	
14	480km N Broome	4.1	
15	105km SW Christmas Ck	3.7	
1982			
Jan 02	Rowley Shoals	4.7	
09	45km Marble Bar	4.0	
17	360km S Esperance	3.2	
22	18km S Cadoux	3.8	Felt MMV
24	15km S Cadoux	4.3	Felt MMV
25	16km S Cadoux	4.4	Felt MMV
27	145km SW Warburton	3.6	
Feb 05	13km S Cadoux	3.1	
05	12km S Cadoux	3.2	
06	12km SSE Cadoux	4.9	Felt MMVI
06	12km S Cadoux	4.6	Felt MMV
07	13km S Cadoux	4.1	
07	14km S Cadoux	3.4	
08	Rowley Shoals	3.1	
08	13km S Cadoux	4.1	
08	20km W Cartier Is	3.6	
08	12km S Cadoux	3.9	
09	12km S Cadoux	3.4	
13	50km E Tobin Lake	5.3	
14	50km E Tobin Lake	3.3	
19	135km SE Broome	4.3	
19	160km N Port Hedland	3.4	
19	20km W Learmonth	3.6	
20	10km E Neckering	3.5	Felt MMIV
26	50km NE Broome	3.8	

Date	Locality	Magnitude ML	Remarks
Feb 27	120km WSW Broome	3.3	
Mar 04	270km NW Broome	3.9	
04	20km SW Inverell NSW	4.5	
08	5km NNE Cadoux	3.5	
09	Corryong, Vic	3.4	Felt MMIV
11	260km NW Broome	4.2	
13	75km NW Mundiwindi	3.0	
17	90km NW Wyndham	3.6	
20	12km S Cadoux	3.7	
27	25km SSW Learmonth	4.0	
28	60km W Erong Station	3.0	
Apr 15	13km S Cadoux	3.9	Felt MMIV
20	10km SSW Cadoux	3.4	
22	260km NW Broome	3.5	
28	430km NW Geraldton	3.3	
May 20	West Wyalong NSW	3.6	Felt MMIV
26	150km SE Marble Bar	3.4	
Jun 06	37km SSE Norseman	4.1	
16	60km S Rowley Shoals	4.5	
22	560km NW Darwin	6.5 (MB)	Felt MMII
23	50km E Tobin Lake	3.3	
30	4km NW Cadoux	3.1	

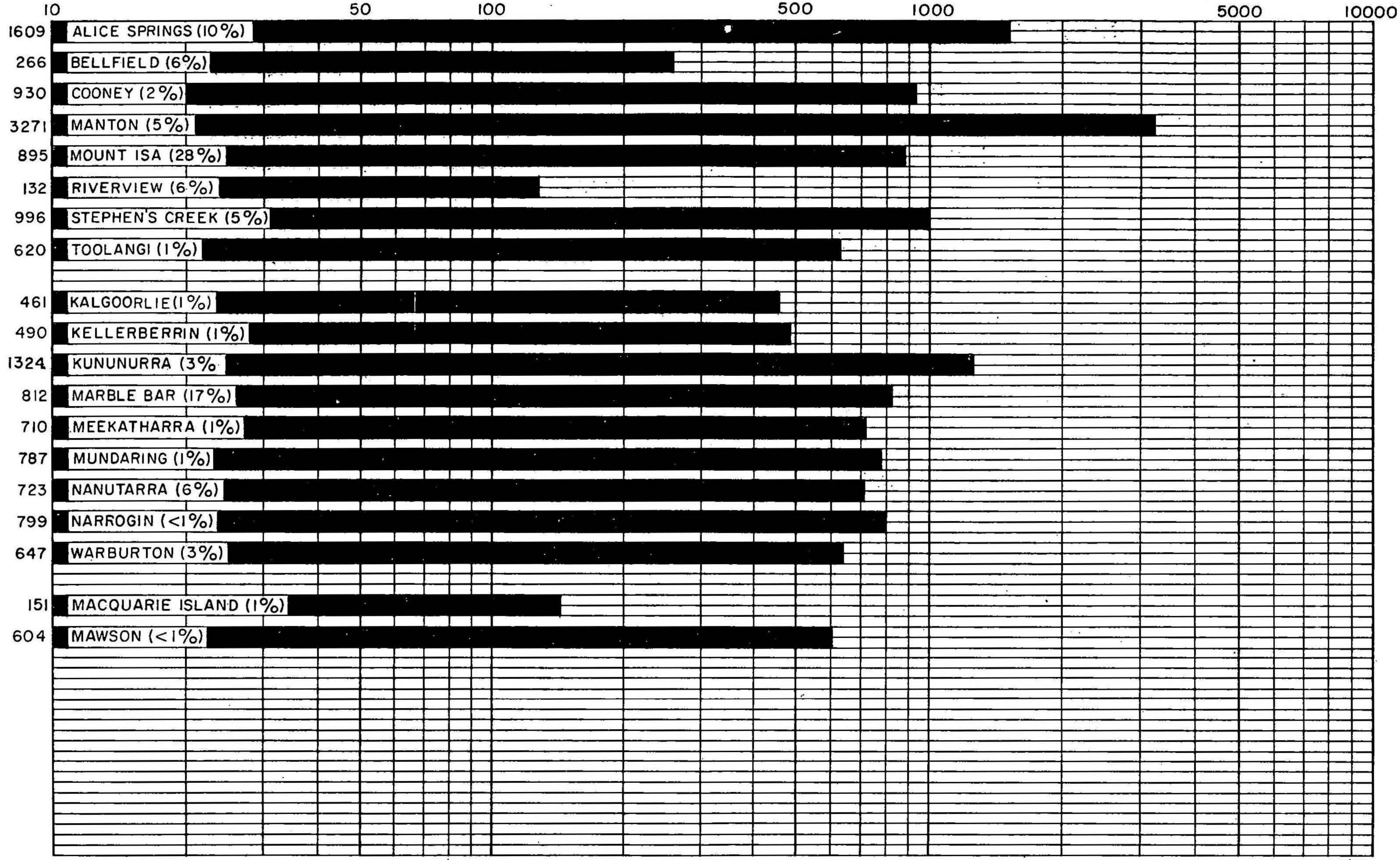
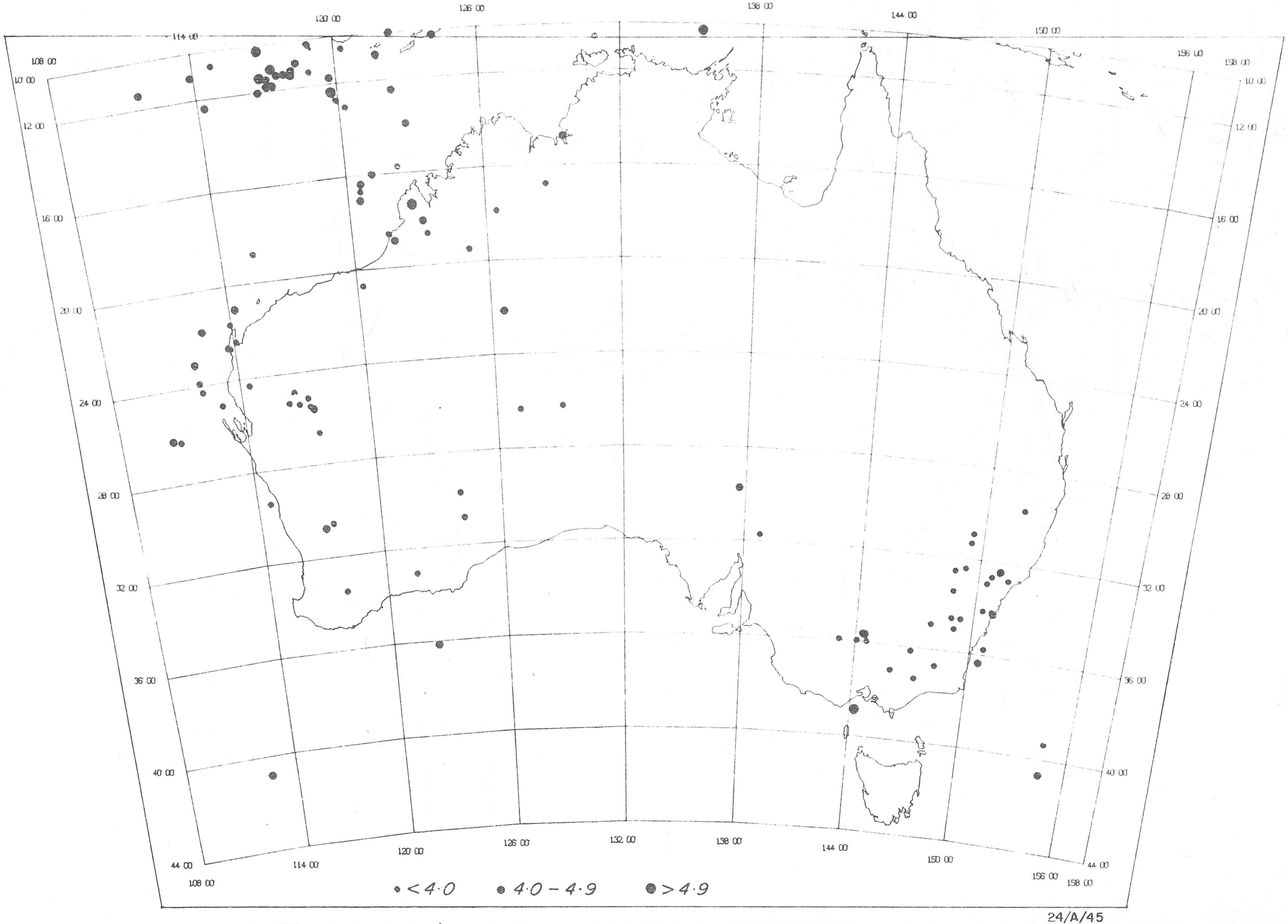


Fig. GSR 10 P – Wave arrivals and downtimes BMR stations Oct. 1981 – Jun. 1982

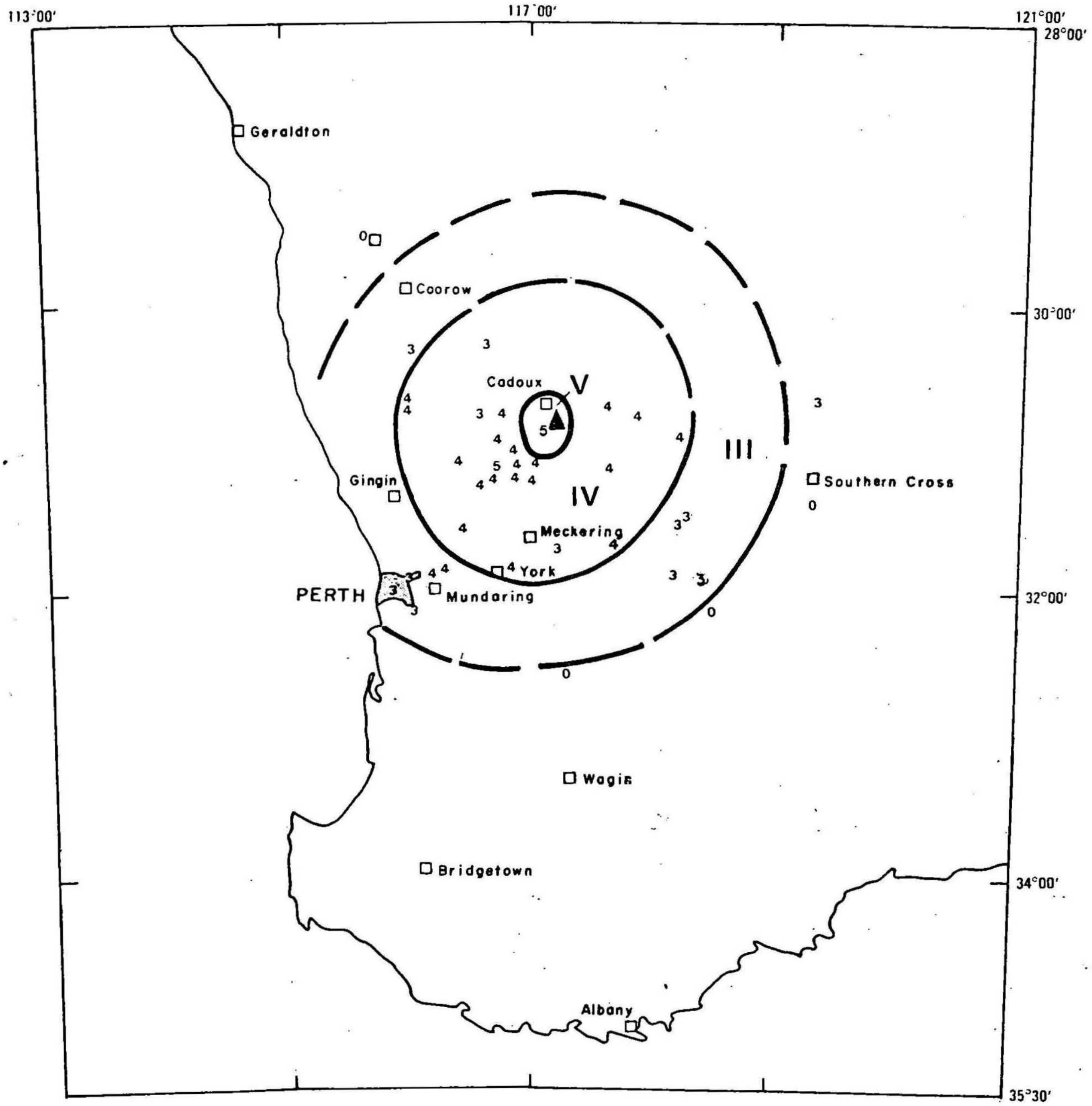
Record No. 1983/6

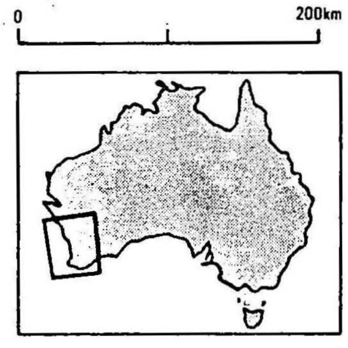


NOTE— Australian seismograph network detection capability M>3·9
Location capability M>4.5

Fig. GSR II. Seismicity of Australia 1981

ISOSEISMAL MAP OF CADOUX EARTHQUAKE, WESTERN AUSTRALIA
6 FEBRUARY 1982





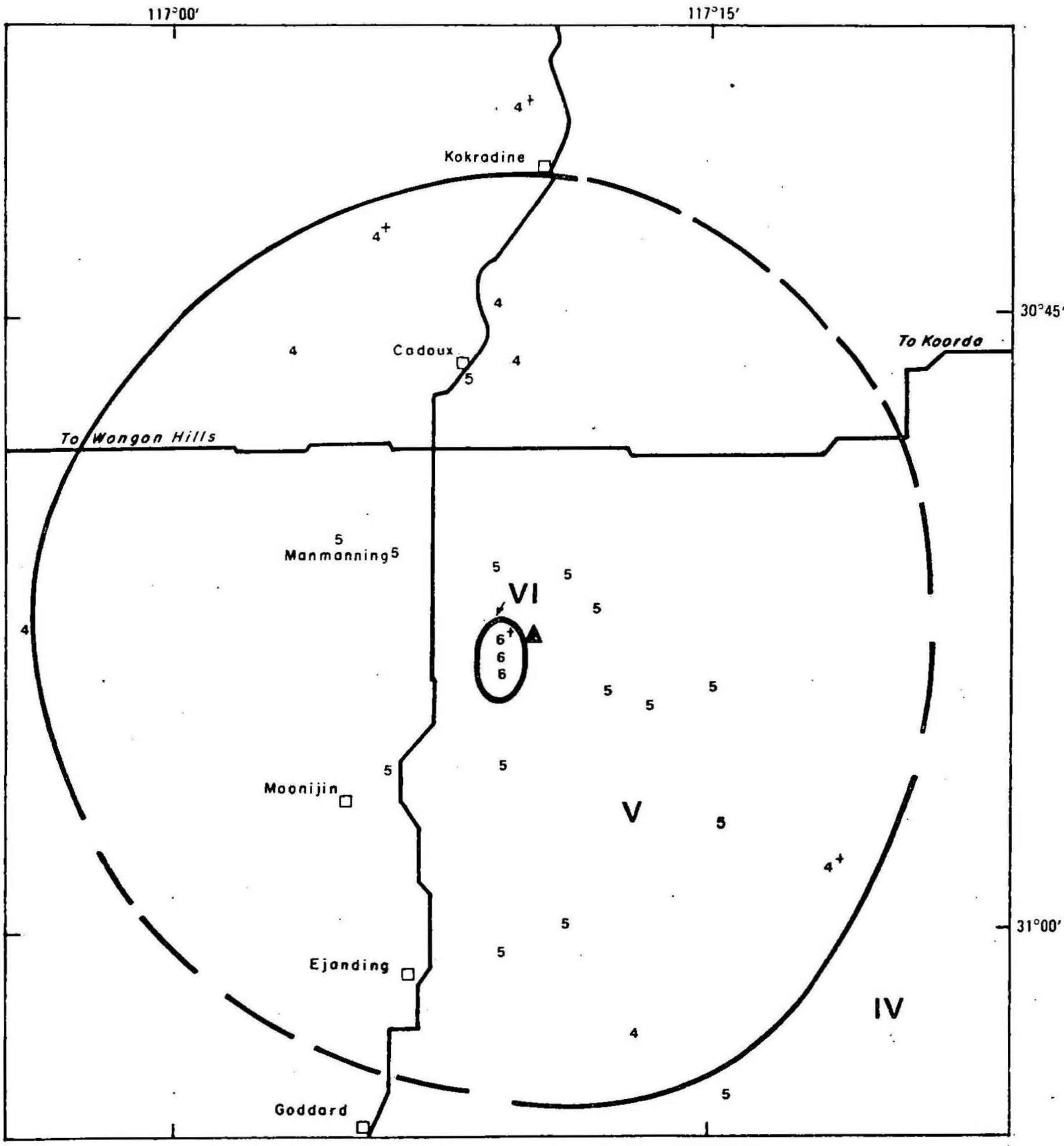
DATE : 6 FEBRUARY 1982
TIME : 15:24:38·4
MAGNITUDE : 4·9 ML (MUN)
EPICENTRE : 30·87°S 117·16°E
DEPTH : 7km

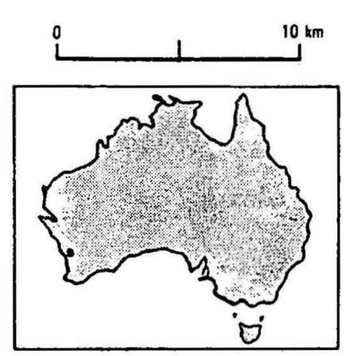
▲ EPICENTRE
IV ZONE INTENSITY DESIGNATION (MM)
4 EARTHQUAKE FELT (MM)
o EARTHQUAKE NOT FELT

Based on 24/1 *Record No. 1983/6* 24/H50/7

Fig. GSR 12

ISOSEISMAL MAP OF CADOUX EARTHQUAKE, WESTERN AUSTRALIA NEAR EPICENTRE, 6 FEBRUARY 1982





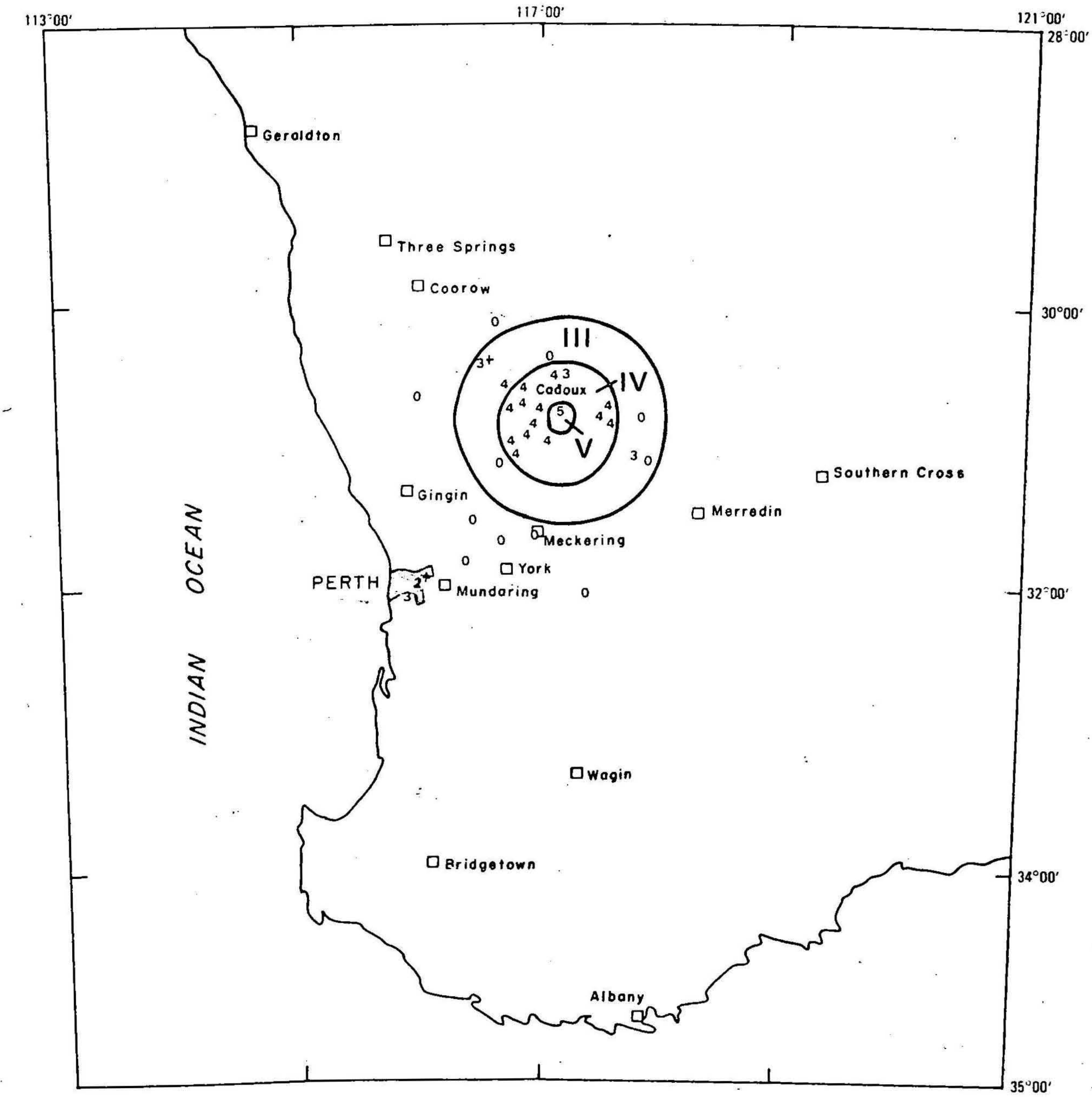
DATE : 6 FEBRUARY 1982
TIME : 15:24:38·4 UT
MAGNITUDE : 4·9 ML(MUN)
EPICENTRE : 30·87°S 117·16°E
DEPTH : 7 km

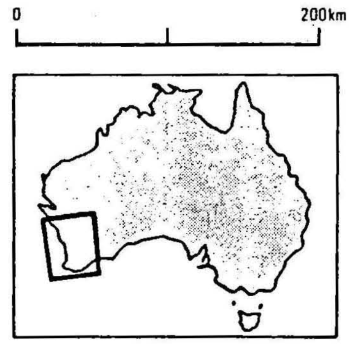
▲ EPICENTRE
IV ZONE INTENSITY DESIGNATION (MM)
4 EARTHQUAKE FELT (MM)
o EARTHQUAKE NOT FELT

Based on 24/1 Record No. 1983/6 24/H50/8

Fig. GSR 13

ISOSEISMAL MAP OF CADOUX EARTHQUAKE, WESTERN AUSTRALIA
24 JANUARY 1982





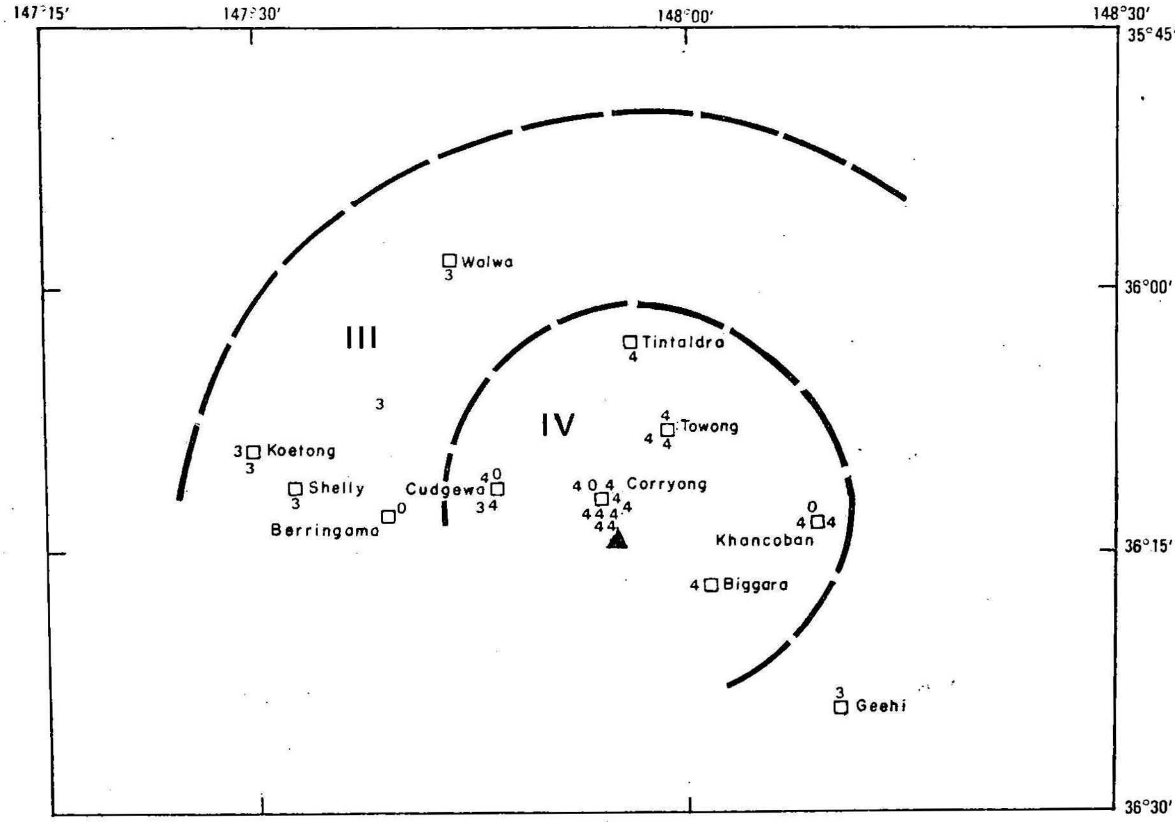
DATE : 24 JANUARY 1982
TIME : 04:06:19 UT
MAGNITUDE : 4·4 ML
EPICENTRE : 30·90°S 117·12°E
DEPTH : 5km

▲ EPICENTRE
IV ZONE INTENSITY DESIGNATION (MM)
4 EARTHQUAKE FELT (MM)
o EARTHQUAKE NOT FELT

Based on 24/1 — *Record No. 1983/6* — 24/H50/9

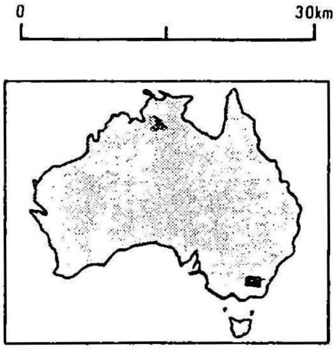
Fig. GSR 14

ISOSEISMAL MAP OF CORRYONG EARTHQUAKE, NEW SOUTH WALES
9 MARCH 1982



DATE : 9 MARCH 1982
TIME : 00:09:26·5 UT
MAGNITUDE : 3·4 ML (BMR), 3·2 ML (TOO)
EPICENTRE : 36·24° S 147·92° E
DEPTH : 13 km

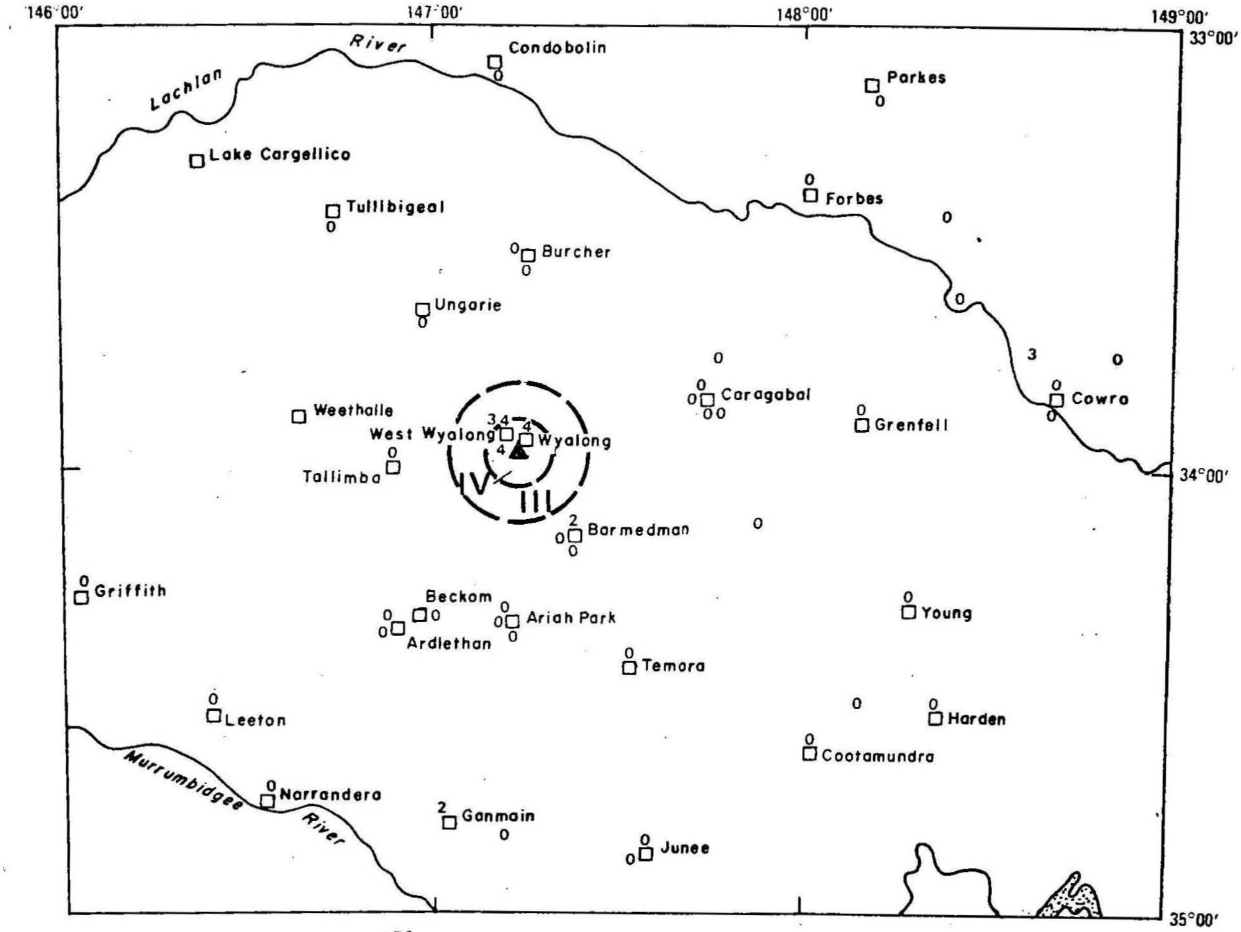
▲ EPICENTRE
IV ZONE INTENSITY DESIGNATION (MM)
4 EARTHQUAKE FELT (MM)
o EARTHQUAKE NOT FELT

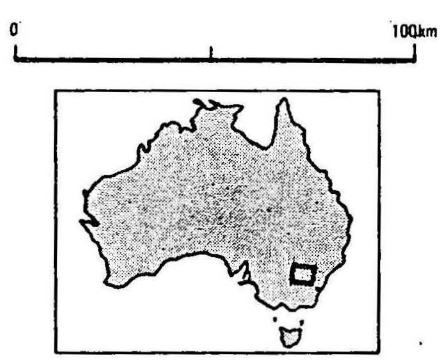


Based on 24/1 *Record No. 1983/6* 24/J55/15

Fig. GSR 15

ISOSEISMAL MAP OF WEST WYALONG EARTHQUAKE, NEW SOUTH WALES
20 MAY 1982





DATE : 20 MAY 1982
TIME : 07:36:18 UT
MAGNITUDE : 3·6 ML (BMR)
EPICENTRE : 33·96°S 147·24°E
DEPTH : 2km

▲ EPICENTRE
IV ZONE INTENSITY DESIGNATION (MM)
4 EARTHQUAKE FELT (MM)
o EARTHQUAKE NOT FELT

Based on 24/1

Record No. 1983/6

24/I55/4

Fig. GSR 16

4. PUBLICATIONS, LECTURES, CONFERENCES, OVERSEAS VISITS, COURSES

EXTERNAL PUBLICATIONS

x Indicates non-BMR author

ANFILOFF, V., & xFLAVELLE, A.J., 1982 - Formal gravity interpretation over the 800-m Darai escarpment in New Guinea. Geophysics, 47 (in press).

xDIXON, O., & BAUER, J., 1982 - Southern Denison Trough - Interpretation of seismic data from the Rolleston area. Queensland Government Mining Journal, 83 (965), 122-131.

DOOLEY, J.C., & McGREGOR, P.M., 1982 - Correlative geophysical data in the Australian region for use in the MAGSAT project. Australian Society of Exploration Geophysicists Bulletin 13 (in press).

FINLAYSON, D.M., 1982 - Geophysical differences in the lithosphere between Phanerozoic and Precambrian Australia. Tectonophysics, 84, 287-312.

FINDLAYSON, D.M., 1982 - Seismic structure of the Proterozoic North Australian Craton between Tennant Creek and Mount Isa. Journal of Geophysical Research, 87 (in press).

MATHUR, S.P., in press - Improvements in seismic reflection techniques for studying the lithosphere in Australia. Tectonophysics.

MATHUR, S.P., in press - Deep reflection experiments in northeastern Australia, 1976-78 Geophysics.

MATHUR, S.P., & SHAW, R.D., in press - Australian orogenic belts: evidence for evolving plate tectonics? Earth Evolution Sciences.

McGREGOR, P.M., xWINCH, D.E., & McEWIN, A.J., 1982 - A preliminary assessment of International Geomagnetic Reference Field Models for Australia. Journal of Geomagnetism and Geo-electricity.

PINCHIN, J., & SENIOR, B.R., 1982. The Warrabin Trough, western Adavale Basin, Queensland. Journal of the Geological Society of Australia, 29(4), 413-424.

SPENCE, A.G., & FINLAYSON, D.M., 1982 - Resistivity structure of the crust and upper mantle in the central Eromanga Basin, Queensland, using magnetotelluric techniques. Journal of the Geological Society of Australia, (in press).

WELLMAN, P., 1981 - Crustal movement determined by repeat surveying - results from southeastern and southwestern Australia. Journal of the Geological Society of Australia, 28, 311-321.

WELLMAN, P., 1982 - The southeastern highlands: a geological and environmental history from 100 million years ago to present. Victorian Naturalist, 99, 110-120.

WELLMAN, P., 1982 - Surging of the Fisher Glacier, eastern Antarctica: evidence from geomorphology. Journal of Glaciology, 28, 23-28.

WELLMAN, P., & TINGEY, R.J., 1982 - A gravity survey of Enderby and Kemp Lands, Antarctica. In CRADDOCK, C. (editor), ANTARCTIC GEOSCIENCE, University of Wisconsin Press, Madison, 937-940.

YEATES, A.N., WYATT, B.W., & TUCKER, D.H., 1982 - Application of gamma-ray spectrometer to prospecting for tin and tungsten granites, particularly within the Lachlan Fold Belt, New South Wales. Economic Geology, 77, (in press).

BMR PUBLICATIONS

Contributions to the BMR Journal

ANFILOFF, V., 1982 - Elevation and gravity profiles across Australia: some implications for tectonism. BMR Journal of Australian Geology and Geophysics, 7, 47-54.

CULL, J.P., 1982 - An appraisal of Australian heat-flow data. BMR Journal of Australian Geology and Geophysics, 7, 11-21.

DOOLEY, J.C., 1981 - Some lesser-known aspects of BMR geophysical research. In Tenth BMR Symposium Abstracts. BMR Journal of Australian Geology and Geophysics, 6, 279.

KARNER, G.D., 1982 - Spectral representation of isostatic models. BMR Journal of Australian Geology and Geophysics, 7, 55-62.

MOSS, F.J., PINCHIN, J., & SENIOR, B.R., 1981 - Regional geology, geophysics, and petroleum potential of the central Eromanga Basin area. In Tenth BMR Symposium Abstracts. BMR Journal of Australian Geology and Geophysics, 6, 279-80.

STUART, D.C., 1982 - Design and interpretation of gamma-spectrometer and radon surveys for mapping and exploraion in the Pine Creek Geosyncline. In Abstracts - 11th BMR Symposium. BMR Journal of Australian Geology and Geophysics, 7(2), 142.

WELLMAN, P., 1982 - Australian seismic refraction results, isostasy, and altitude anomalies. In Abstracts - 11th BMR Symposium. BMR Journal of Australian Geology and Geophysics, 7(2), 144.

BMR Bulletins and Reports issued or in preparation

Bulletin 214. EVERINGHAM, I.B., McEWIN, A.J., & DENHAM, D. - Atlas of isoseismal maps of Australian earthquakes.

Report 245. HONE, I.G. - Physical property measurements on mineralised and unmineralised samples from the Cleveland mine, Tasmania.

Report 238. GEOPHYSICAL BRANCH - Geophysical Branch summary of activities 1981.

Bulletin 212. WELLS, A.T., & MOSS, F.J. - The Ngalia Basin, Northern Territory. Stratigraphy and structure.

Report 244. WYATT, B.W., YEATES, D.H., TUCKER, D.H., & [x]VETTER, U.W.K. - A rock-property data base for the Lachlan Fold Belt, New South Wales.

BMR Records (an unpublished series) issued

1981/1. CULL, J.P., SPENCE, A.G., MAJOR, J.A., KERR, D.W. & PLUMB, K.A. - The 1978 McArthur Basin magnetotelluric survey.

1981/64. CULL, J.P., SPENCE, A.G., & PLUMB, K.A. - The 1979 McArthur Basin magnetotelluric survey.

1981/57. GEOPHYSICAL BRANCH - Geophysical Branch summary of activities 1981.

1982/9. GREGSON, P.J. - Mundaring Geophysical Observatory annual report 1980.

1982/28. MARKS, A.S. - Mawson Geophysical Observatory annual report 1981.

1982/10. McEWIN, A.J. - Third-order magnetic survey of Yorke Peninsula, SA, February 1982.

1981/77. SILIC, J. - Electrical properties of the Flying Doctor prospect, Broken Hill, NSW.

1981/66. SPIES, B.R. - Electrical geophysics in the USSR.

1982/5. STUART, D.C., & WARNES, A.T. - Investigation of the source of a radon anomaly east of Batchelor, Rum Jungle, Northern Territory.

1982/36. THOMAS, G.H.Y. - Macquarie Island Geophysical Observatory report October 1981 - January 1982.

1982/20 WELLMAN, P. - Geophysical maps of parts of Enderby, Kemp and MacRobertson Lands, Antarctica, 45 to 82°E.

1981/59. WILLIAMS, J.W. - Geophysical and surveying work along the Ingrid Christensen Coast near Davis Base, Antarctica, 1980/1981 summer.

1982/27. WILLIAMS, W.H. - Macquarie Island Geophysical Observatory annual report 1981.

BMR Records in an advanced stage of preparation

1982/15. BLADON, G.M., & DAVIES, P.M. - Ground magnetic survey and drilling (BMR Ayers Rock Nos. 1 and 2) of a shallow magnetic-anomaly source in the southern Amadeus Basin, Northern Territory.

DAVIES, P.M. - Macquarie Island Geophysical Observatory annual report 1980.

GREGSON, P.J. - Mundaring Geophysical Observatory annual report 1981.

1982/34. SPENCE, A. - Central Eromanga Basin magnetotelluric survey 1980: operational report.

1982/35. SPENCE, A., & KERR, D.W. - BMR magnetotelluric system software 1980.

Maps, profiles and sections issued

Total Magnetic Intensity, Epoch 1980.0.

Airborne maps and profiles - see Table MA 2.

Bouguer gravity anomaly maps, 1:1 000 000 : Sydney

Bouguer gravity anomaly maps, 1:250 000 : Singleton, Newcastle, Sydney, Woolongong, Ulladulla.

Seismic shotpoint-location maps, 1:250 000 : Jundah, Quilpie.

Seismic cross-sections, BMR surveys:

Central Eromanga Basin 1980, traverses 5, 6A.

Central Eromanga Basin 1981, traverses 1x, 5, 6, 7, 7W, 10, 12.

Seismic cross-sections, subsidised surveys:

Barcoo 1965, lines 25B, 26B.

Bulgroo 1963, lines 7, 10, 11, 13, 14.

Gumbardo 1962, line 441/426

Quilpie-Adavale-JYBL, lines 26-27-320-322-323, 326, 308-320-454.

Mawson-Molodezhnaya area, Antarctica, 1:1 000 000 maps and sections (28 sheets):

Ice-surface altitude, rock altitude, Bouguer gravity anomaly, Faye gravity correction, Faye gravity anomaly, magnetic anomaly map, compilation of rock-surface profiles east-west and north-south, flight paths 1980, flight paths 1977, ice-thickness profiles, aeromagnetic profiles.

Prince Charles Mountains area, Antarctica, 1:2 000 000 maps (5 sheets):

Ice-surface altitude, rock altitude, Bouguer gravity anomaly, Faye gravity correction, Faye gravity anomaly.

ADDRESSES TO MEETINGS AND CONFERENCES

DOOLEY, J.C.	Comparative regional geophysical studies. Workshop on MAGSAT, Macquarie University Centre for Geophysical Exploration Research, 18 March 1982.
DOOLEY, J.C.	An approach to mapping the lithosphere of a continent. Australian Continental Reflection Profiling (ACORP) Workshop, Canberra, 18-20 May 1982.
FINLAYSON, D.M.	COCORP results and a strategy for Australian seismic reflection/refraction investigations. Australian Continental Reflection Profiling (ACORP) Workshop, Canberra, 18-20 May 1982.
xJACKSON, I.N.S. xARCULUS, R.J., & DRUMMOND, B.J.	Velocity measurements on lower crustal nodules and their relevance to the interpretation of deep crustal reflection/refraction data. Australian Continental Reflection Profiling (ACORP) Workshop, Canberra, 18-20 May 1982.

MOSS, F.J., & MATHUR, S.P.	Deep seismic reflection profiling by BMR in Australia. Australian Continental Reflection Profiling (ACORP) Workshop, Canberra, 18-20 May 1982.
SHAW, R.D., & MATHUR, S.P.	A proposal for deep seismic reflection profiling of major structural elements in central Australia. Australian Continental Reflection Profiling (ACORP) Workshop, Canberra, 18-20 May 1982.
STUART, D.C.	Design and interpretation of gamma-spectrometer and radon surveys for mapping and exploration in the Pine Creek Geosyncline. 11th BMR Symposium, Canberra, 4-5 May 1982.
WELLMAN, P.	Report - B MR activities in crustal motion. Geodesy Research Seminar, University of New South Wales, 3-4 November 1981.
WELLMAN, P.	Geophysics and geodesy. Cainozoic volcanism of eastern Australia: reviews and future programs. BMR, 9 December 1981.
WELLMAN, P.	Australian seismic refraction results, isostasy, and altitude anomalies. 11th BMR Symposium, Canberra, 4-5 May 1982.
WELLMAN, P.	Recent crustal movements determined from repeat surveying - results from southeastern and southwestern Australia. International Association of Geodesy, Tokyo, 7-20 May 1982.
WELLMAN, P.	Australian national base station net: 1980 remeasurement. International Association of Geodesy, Tokyo, 7-20 May 1982.

OVERSEAS VISITS AND CONFERENCES

McGREGOR, P.M.	Thirteenth Session, Group of Scientific Experts (on the detection and identification of seismic events), Geneva, 24 February-16 March 1982.
WAKE-DYSTER, K.D. (private visit)	44th meeting, European Association of Exploration Geophysicists, Cannes, 8-11 June 1982.
WELLMAN, P.	International Association of Geodesy, Tokyo, 7-20 May 1982, and institutions in Japan.

LOCAL CONFERENCES

COLLINS, C.D.N., DENHAM, D., DOOLEY, J.C., DRUMMOND, B.J., FINLAYSON, D.M., GOLEBY, B.R., LOCK, J., MATHUR, S.P., & MOSS, F.J.	Australian Continental Reflection (ACORP) Workshop, Canberra, 18-20 May 1982.
DOOLEY, J.C., MURRAY, A.S., & WELLMAN, P.	Workshop on MAGSAT: data processing, preliminary results, and interpretation, Macquarie University Centre for Geophysical Exploration Research, 18 March 1982.

TRAINING COURSES

PAGE, B.J.	Introduction to micro-processors, Telecom, Perth, 15-19 February 1982.
WAKE-DYSTER, K.D. (private visit)	Static corrections, European Association of Exploration Geophysicists, Cannes, 6 June 1982.