DEPARTMENT OF
MINERALS AND ENERGY

BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS

Record 1975/161

GEOPHYSICAL BRANCH SUMMARY OF ACTIVITIES, 1975

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SUMMARY

1. Metalliferous and Airborne Section

The locations of the activities of the Section during 1975 are shown in Figure MA1.

The Metalliferous Subsection continued the program of investigation of down-hole geophysical techniques utilizing drill-holes made available by companies at Woodlawn and Tumut, NSW. The Scintrex DHP-4 down-hole electromagnetic system was subjected to a series of tests designed to provide information regarding the equipment's response to sulphide bodies of various sizes. Further experimentation was carried out in the use of down-hole induced polarization measurements. This primarily involved tests to assess the performance of a multi-electrode logging cable.

A magnetic induced polarization survey was made at Woodlawn as part of the continuing company, government, and university studies of geophysical responses produced by the orebody. Results obtained were basically similar to those given by the electrical polarization method, and there was no distinct advantage in applying the magnetic induced polarization method.

Technical support was given to the Department of Housing and Construction with respect to the search for metallic objects buried in the Holsworthy weapons range, NSW. Field trials were carried out which demonstrated the potential of the transient electromagnetic tool for this work. As such, BMR plans to develop equipment designed specifically for this task.

Geological Branch staff were helped to obtain gravity data in part of the WESTMORELAND 1:250 000 Sheet area during the course of a helicopter-borne geochemical survey. Subsection personnel also assisted with field tests of an electromagnetic depth-sounding technique in the Rum Jungle area.

Major ground survey activities were concentrated in northern Australia near Georgetown, Cloncurry, and the Alligator Rivers.

At Georgetown, a number of detailed surveys were made to determine geophysical responses associated with known mineralization or untested geochemical anomalies. Drill-holes have been recommended to establish the sources of the most

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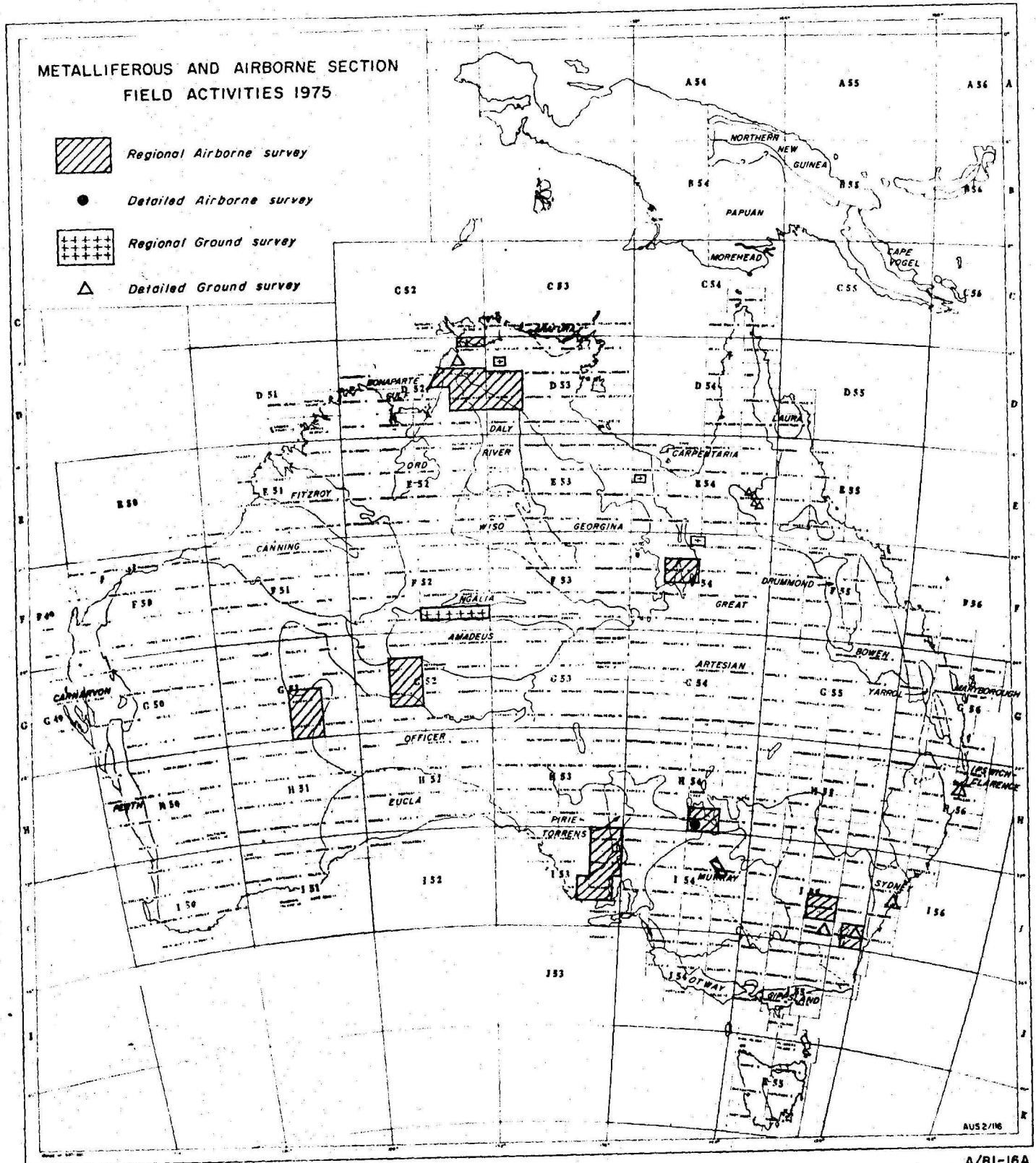

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interesting geophysical anomalies recorded; the only hole so drilled by November intersected several metres of lead-zinc mineralization.

Work at Cloncurry was of a more regional nature designed to provide information on Precambrian rock geology in a region where Mesozoic and younger sediments constitute a thin veneer which effectively blankets the older basement rocks. Magnetic and gravity methods were used extensively in this survey.

In the Alligator Rivers area, work was confined to the KAPALGA 1:100 000 Sheet area. Electromagnetic and magnetic methods were used to trace Koolpin-equivalent rocks in a region of very sparse outcrop. The former method proved to be quite successful.

A survey was made over heavy-mineral deposits which occur in beach sands at Jerusalem Creek, NSW. Magnetic, gamma-ray spectrometer, and induced polarization methods were employed of which the last proved to be particularly useful. It appears that this results from polarization effects associated with the magnetic fraction of the heavy-mineral assemblage.

Ground magnetic, radiometric, and geological observations were made in the northern parts of the MOUNT RENNIE and MOUNT LIEBIG Sheet areas to examine the correlation between existing geological mapping and the airborne geophysical results obtained in 1965. The survey was designed specifically to assist with the planning of further airborne surveys to be flown over the Arunta Complex.

After Cyclone Tracy (Christmas 1974), most Darwin Uranium Group geophysical staff were transferred to Canberra. Those who remained in Darwin operated the Manton seismograph station and made preliminary analyses of the results, and assisted with the geophysical survey in the Alligator Rivers region.

The Bureau's Twin Otter and Aero Commander aircraft operated successfully for much of the year surveying more than 150 000 km in the course of routine magnetic and gamma-ray spectrometer mapping of 1:250 000 map Sheet areas. A further 20 000 km of magnetic data are expected to be recorded during November and December in the form of long line traverses to support the Observatory Group's magnetic secular variation project. In addition to obtaining primary aeromagnetic data, the Aero Commander will be used on this project to transport Observatory Group ground recording equipment between First-Order sites around Australia.

Prior to aircraft and equipment overhaul, before Easter, the surveying of the CANBERRA 1:250 000 Sheet area was completed by the Twin Otter.

The 1975 airborne field season commenced in late March with a survey in the Spencer Gulf region, in which both aircraft were used. Doppler navigation installed in the Twin Otter was essential for the survey of the WHYALLA, PORT LINCOLN (Pt) and MAITLAND (Pt) 1:250 000 Sheet areas which involved considerable work over water. The Aero Commander was used in the survey of the PORT AUGUSTA Sheet. Approximately 40 000 km were flown on this project, both aircraft having similar geophysical equipment configurations involving fluxgate magnetometer, gamma-ray spectrometer and digital data recording facilities.

In the September-October period both aircraft again combined to undertake a survey of the Darwin/Pine Creek area involving the DARWIN, CAPE SCOTT (Pt), PINE CREEK, FERGUSSON RIVER, KATHERINE and MOUNT EVELYN (Pt) 1:250 000 Sheet areas. Approximately 49 000 km were flown on this project.

During the remainder of the field season the Twin Otter completed a regional survey of the BROKEN HILL 1:250 000 Sheet together with a detailed survey of the regional immediately north of Broken Hill. In addition this aircraft completed a regional survey of the DUCHESS 1:250 000 Sheet area.

Similar work was done by the Aero Commander in the COOTAMUNDRA 1:250 000 Sheet area.

A contract was let in July for a major aeromagnetic survey of the Western Australian portion of the Officer Basin covering sixteen 1:250 000 Sheet areas. Work is expected to commence in November with the surveying of the ROBERT and THROSSELL Sheet areas.

The Airborne Reductions and Contracts Group continued to supervise the production of the continental component of the Magnetic Map of Australia with the expectation of completing this work by the end of the year. The group was most successful throughout the year in processing airborne data to preliminary mapping stage available for public release. The results of work flown this year in the CANBERRA, WHYALLA, LINCOLN, MAITLAND, and BROKEN HILL Sheet areas are expected to be available from the Australian Government Printer by December.

2. Seismic, Gravity, and Marine Section

A seismic survey in central Queensland from July to November has shown that Permo-Triassic Galilee Basin sedimentation in the Lovelle Depression beneath the northern Eromanga Basin is more widespread than previously estimated. The possibility exists of a link with the Permian sediments of the Cooper Basin but further surveying will be required to answer this question.

In a continuing review of previous knowledge of older sediments beneath the northern Eromanga Basin, information and basic data from well logs, and seismic, gravity, and aeromagnetic surveys have been indexed and compiled, and some seismic data have been reprocessed in attempts to improve the quality of the seismic information.

A short review was made of the geophysical information in the northwest Eromanga and underlying basins as a contribution to a Bulletin being prepared in Geological Branch, and reviews were started of geophysical information in the Georgina and Wiso Basins where geological mapping projects by BMR are currently being done.

A small amount of further work was done by the Seismic Group on interpretation of Gosses Bluff and deep crust and upper mantle studies.

Gravity was measured in Melbourne and adjacent areas on a 1.6 km grid with the purpose of assisting groundwater and engineering geological studies. Some geological deductions have been made from the more detailed regional gravity configuration. Otherwise the Gravity Group was occupied on the completion of interpretation and reporting of previous work which comprised the helicopter reconnaissance of New South Wales, Victoria, and Tasmania, 1973-74, the overall regional reconnaissance of Australia, the Kalgoorlie and Arltunga Nappe detailed surveys and other older work. Also data including those from marine surveys, were compiled, plotted, and checked for the 1:5 million scale coloured Gravity Map of Australia.

The Marine Group was again occupied on the assessment and processing of data, and interpretation and reporting of results from the Continental Margin Survey, 1970-1973. The assessment projects on various aspects of the navigation, gravity, and magnetic data were mainly continuing from 1974. During the year the emphasis moved to production processing, and preparations were made for the latest stages of processing and presentation of the data.

Much of the interpretation of seismic lines across the Exmouth Plateau had been done in 1974, and 1975 was spent preparing reports covering various aspects of the study. Also maps in terms of depths and thicknesses were prepared making use of velocity measurements from wells on the adjacent shelf and from refraction studies.

The study of the Queensland Plateau was continued and a geological history has been suggested. A Bulletin has been prepared.

The magnetic survey in association with the bathymetric survey on the northwest shelf by the Division of National Mapping was continued, but only a small amount of data was gathered in 1975.

Preparations are being made for participation in Lamont-Doherty Geological Observatory marine surveys in the Australian region later in 1975 and early in 1976.

A compilation has been made of all ships' tracks on which geophysical measurements have been made over the Lord Howe Rise and Norfolk Ridge. The available data have been reviewed and the findings reported. A similar review is under way over areas around the Australian island territories outside the Australian continental margin.

Preparations were started for the next marine geophysical survey. A. Turpie was a member of a Marine Committee that made recommendations to the Director on future marine program and resources required for it.

Studies of a geomagnetic reference field suitable for the Australian region were continued in the Marine Group and the results and recommendations arising out of this study were presented by R. Whitworth at the Zmuda Memorial Conference in Colorado Springs in May. Because of the divergences in the area from the IGRF and because of the lack of corrective action by the world body it seems that it will be necessary for some purposes in Australia to adopt an Australian Geomagnetic Reference Field.

R. Whitworth and A.R. Fraser went on overseas visits to study marine and gravity topics respectively.

3. Observatories and Regional Section

The Section comprises two Subsections - Observatories, with Groups at Headquarters, Mundaring, Port Moresby and Toolangi; and Regional, subdivided into Gravity and Structural Survey Groups.

Good progress was made with scaling the backlog of magnetograms from the five magnetic observatories, and the program for computation of mean hourly values was converted to Cyber 76; however, production of final results has to be deferred because of budget cuts. Automatic magnetic recording continued at Kowen Forest (near Canberra) preparatory to moving Toolangi Observatory to ACT.

Four additional seismographs were installed during the year, at Purari and Madang in PNG, and at Swan View and Narrogin in WA; the latter will be replaced by the US Geological Survey borehole seismograph late in 1975. This makes a total of 31 seismograph stations. Manton Dam seismograph resumed recording in February following the cyclone damage, but resumption of telemetry awaits repairs to the Darwin office.

Strong-motion recording continued at 27 sites, mostly in PNG, and several records were analyzed. Maps of Australia showing zones of earthquake risk were prepared, and preparation of an atlas of isoseismals for major Australian earthquakes was in progress. A report was prepared on the seismological effects of an earthquake of magnitude 7.2 in Bougainville.

Travel-time residuals were compiled for seismograph stations, and the effectiveness of various crustal models for improving earthquake locations was studied.

A major regional magnetic survey was conducted using helicopters in the inaccessible areas of the continent; this almost completes the third-order coverage.

Application of regional magnetic corrections to airborne and marine surveys has shown that our knowledge of secular variation is inadequate, and a reoccupation of first-order stations is in progress to improve this, using one of BMR's aircraft for transport. Long magnetic profiles will be flown between airports during this survey.

Magnetic declination maps were prepared for epoch 1975 for Australia and Enderby Land (Antarctica). A few regional magnetic observations were obtained in Enderby Land, but aircraft accidents prevented the full program being achieved.

The Regional Gravity Group was mostly preoccupied with recomputation of old surveys and incorporating them into the data bank, and using this to produce a coloured gravity map of Australia at 1:5 million, to be printed in 1976. A black and white gravity map of Melanesia will also be produced.

Gravity values at Isogal network stations were readjusted to new base data. Further measurements were made on the crustal movement survey markers in PNG, on stations of the Australian Calibration Line, and on local calibration ranges. A tilting table on loan from USSR was used to calibrate quartz-movement gravity meters from many Australian institutions and companies.

Gravity measurements in Enderby Land were fewer than expected, because of aircraft unserviceability. Australian gravity measurements in Antarctica, and of ties between Antarctica and Australia, were compiled.

The results from the earth-tide tilt measurements at Cooney are anomalous; it appears that the anomaly is probably due to local conditions rather than regional structure. Four gravity meters on loan from Belgium were used for earth-tide measurements at 5 sites during the year, and measurements have begun at 2 more sites.

The Regional Structural Survey Group continued analysis of seismic, gravity, and magnetic results from the East Papua Crustal Survey, and several papers were prepared. Computer programs from overseas were adapted and used in the interpretation, as well as programs developed in BMR. Further interpretation of Bismarck Sea magnetic, gravity, and seismic profiling anomalies was undertaken.

A prototype of the improved field seismograph unit was constructed and tested, and conversion of all units was started. A playback unit for the tape output was constructed, but a time decoder is still required. Plans are in hand to enable digitization of the tapes, so as to facilitate more comprehensive analysis.

Preparations were begun for recording of large quarry blasts in southeast Australia early in 1976.

Sites were selected for rock stress measurements in southwest WA, but drilling and field work have been postponed until February 1976.

J.P. Cull is expected to return to Australia shortly after completing his studies of heat flow measurements at Oxford, and will develop a program in that field.

J.C. Dooley and B.C. Barlow attended the IUGG General Assembly at Grenoble, France. An invitation to hold the next General Assembly in Australia in 1979 was accepted by the Council. Dooley also visited institutions in USSR, Sweden, and UK.

4. Geophysical Services Section

The Section comprises three Subsections: Electronics, Mechanical, and Services. The Electronics and Mechanical Subsections are concerned primarily with equipment development, construction, and maintenance; the Services Subsection covers procurement and utilization of equipment, measurements of physical properties of rocks, engineering geophysics, and geophysical drafting.

The Electronics Subsection constructed a ruggedized version of their MFS-7 fluxgate airborne magnetometer, and both BMR aircraft are now equipped with these instruments. Work continued on a playback system for regional structural surveys and data acquisition systems for magnetic observatory use. Various items of equipment were developed for airborne and marine installations, and work commenced on improvements to transient electromagnetic survey equipment. Equipment and instruments were repaired and serviced for field and office use.

The Mechanical Subsection completed a 12 tonne hydraulic rock splitter, carried out extensive modifications on a 20 kVA motor alternator, and supported many electronic and other projects by manufacture of bins, panels, and other mechanical components. A trailer-mounted borewater flow test unit was designed and theoretical investigations and experiments were carried out on the reasons for the failure of a 9-element spark array intended for high-resolution seismic profiling. Many instruments and items of equipment were repaired and serviced for field and office use.

In the Services Subsection the Engineering Geophysics Group carried out extensive seismic surveys in the ACT to determine depth of weathering, and locations of faults and geological boundaries. The major sites investigated were the Ginninderra sewer tunnel line, Gungahlin and Belconnen town centres, and the West Murrumbidgee development area. In the Albury/Wodonga centre deep weathering was found at Thurgoona and Middle Creek town sites, and resistivity techniques were used to map sand and gravel reserves in the Murray flood plains at Wodonga. Fifty non-flowing water bores in the Great Artesian Basin in NSW and 47 flowing bores in western Queensland were logged. Good magneto-telluric data were obtained at 8 sites occupied (in co-operation with Macquarie University) on a traverse 80 km long across the Wentworth Trough gravity low in southwestern NSW. Interpretative modelling is still being done.

The Rock Measurements Group installed a uniaxial compression test machine. About 850 rock and sediment samples were measured, the principal measurements being compressive strength, elastic moduli, Shore hardness, magnetic remanence and susceptibility, electrical conductivity, and induced polarization. Palaeomagnetic techniques were used on a survey to assist in determining the age of weathering in southwestern Queensland.

The Geophysical Drafting Office produced 851 plates in support of geophysical survey Records and Reports, 487 miscellaneous drawings, prepared 315 slides and overhead projector films, and amended or finalized for publication 969 drawings. Three hundred and four labels, captions, and name tags were done on the Varityper. Nine aeromagnetic maps and 56 gravity maps were printed. In addition 33 preliminary airborne survey results were released. Work continued on the Magnetic Map of Australia and the Gravity Map of Australia. The Automated Cartographic Group produced 288 maps, contours, profiles, and other plots on the flat-bed plotter and 5097 plots on the drum-plotter.

1. METALLIFEROUS AND AIRBORNE SECTION

(G.A. Young)

METALLIFEROUS SUBSECTION (E.C.E. Sedmik, J.E. Gardener, D. Stuart)

Down-hole electromagnetic investigations NSW (R. Almond, N. Sampath, D. Robson, J. Williams, H. Reith)

During the period January to March 1975 the Scintrex DHP-4 down-hole electromagnetic prospecting system was used in a survey of drill-holes which passed through or near bodies of sulphide mineralization at Woodlawn and Tumut in south-eastern NSW.

The aim of the surveys was to evaluate the prospecting capabilities of the DHP-4 system; 15 drill-holes were surveyed and a variety of transmitter/receiver configurations was employed. Few of the resultant logs exhibit responses that are clearly due to the presence of sulphide conductors, and definitive anomalies were recorded only in drill-holes that intersected the sulphide orebody at Woodlawn.

The results indicate that the system has a limited range of detection and that the most diagnostic prospecting parameter is the phase measurement.

Down-hole induced polarization investigations, Woodlawn, NSW (D. Wilson, H. Allison, D. Hunter)

A 15-electrode, 500-m induced polarization logging cable was field tested in the ACT and at Woodlawn during the period January to April 1975. The cable was used with both time and frequency domain equipment in a variety of down-hole and surface arrays to investigate the logging and prospecting capabilities of the system.

In the logging mode the system proved suitable for identifying lithologies and sulphide distribution, but constraints on the current-carrying capacity of the cable, as well as coupling effects at large electrode separations, limited the use of the system in the prospecting mode. The use of different electrode spacings and configurations assisted the interpretation of results.

Magnetic induced polarization survey, Woodlawn, NSW (D. Robson, H. Allison).

During March and April 1975 a magnetic induced polarization (MIP) survey was made over the Woodlawn orebody using equipment which records data related to polarization and conductivity. The aim of the survey was to compare MIP results with those obtained previously by the geophysical methods. The survey involved traverses over the orebody and the surrounding country rocks and included some tests with unconventional electrode configurations.

A number of anomalies were recorded on most traverses. The probable sources of these are the orebody, black pyritic shales, and weakly mineralized dolerite. MIP data show that the orebody is distinguished from the other sources by its high conductivity. Polarization measurements did not clearly distinguish the orebody from the other sources.

A comparison of the results with those obtained from earlier geophysical surveys shows that the MIP method responds to the same sources as conventional electrical induced polarization surveys and that the responses are similar.

Metal detector investigations, Holsworthy, NSW (B. Spies, J. Williams).

After receiving a request for technical support from the Department of Housing and Construction, the Metalliferous Subsection and the Geophysical Services Section assisted in the search for metallic objects buried in the Holsworthy Weapons Range, NSW.

At Holsworthy maghemite is widespread and precludes the use of conventional metal-detecting equipment. In an attempt to overcome this problem and to develop an improved metal-detecting system, the MPPO1 transient electromagnetic prospecting system was modified to a metal-detecting mode and field tests were carried out.

Initial tests with the modified equipment were made in Canberra, and in June feasibility trials were made in conjunction with the Department of Housing and Construction at Mascot and Holsworthy, NSW.

The feasibility trials proved successful and further equipment development and field trials are planned for 1976.

Westmoreland gravity survey, Qld. (J. Major)

J. Major was attached to the Westmoreland geochemical party during August to train Geological Branch staff in gravity survey techniques. A series of gravity readings were made in conjunction with the program of helicopter-borne geochemical sampling, with the aim of establishing the feasibility of routinely carrying out such work

The combined gravity and geochemical survey covered the southwestern part of the WESTMORELAND area. About 190 gravity readings were made by the survey personnel; J. Major reduced the gravity and elevation data to national datums.

The production and accuracy maintained in obtaining the geochemical samples and gravity data respectively was satisfactory.

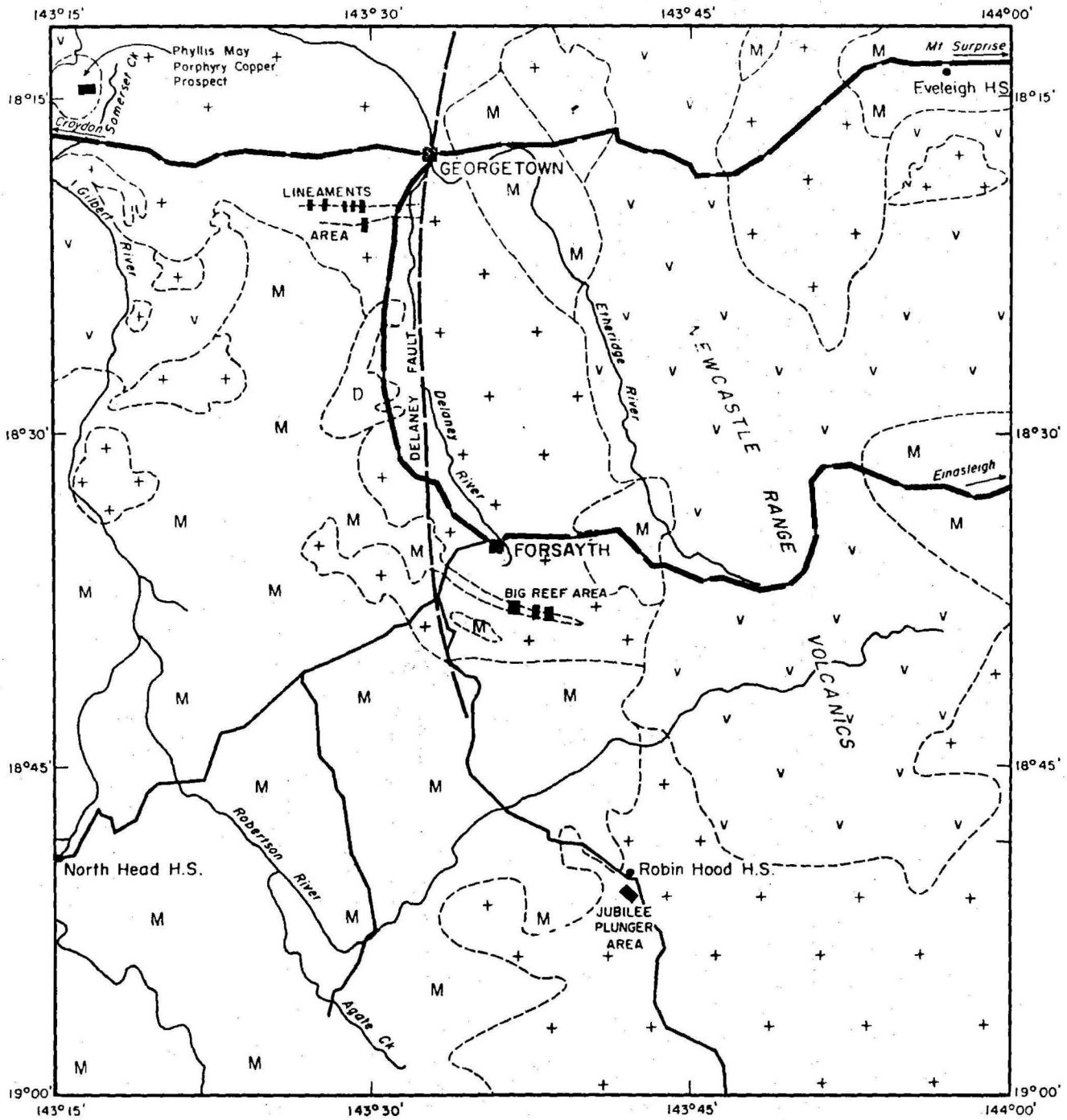
Electromagnetic depth sounding investigations, Rum Jungle, NT

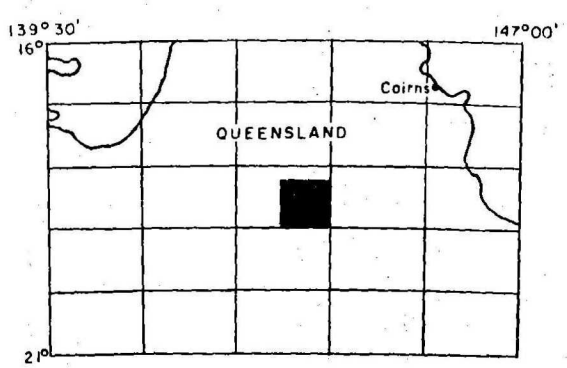
The Metalliferous Subsection provided field and office support to assist Dr K. Duckworth, University of Calgary, to field-test a depth-sounding technique he has developed through theoretical and model studies. The technique involves varying the orientation of a fixed-frequency source with respect to a conductor and measuring the resultant changes in the tilt-angle of the polarization ellipse with a receiver which is maintained at a fixed separation from the source throughout the sounding. Experiments were made in the Mount Minza and Woodcutters area from 5 to 18 August and in the Mount Bundey area from 19 August to 12 September. Assistance in the field was provided by personnel from the Alligator River geophysical party.

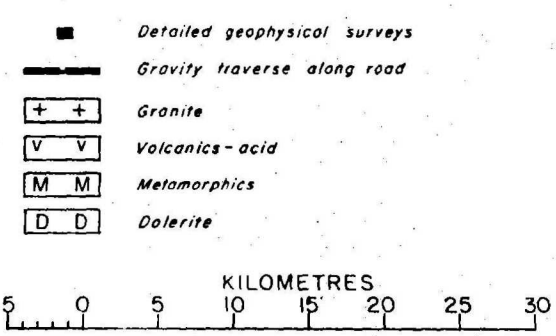
Georgetown area survey, Qld (D. Wilson, H. Allison)

Ground geophysical surveys were conducted in the GEORGETOWN area from June to August 1975 to assist Geological Branch investigations. In general, surveys were

MA 2







GEORGETOWN AREA GEOPHYSICAL SURVEY

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designed to determine geophysical responses to known mineralization, and the sources of untested geochemical anomalies. A semi-regional gravity survey was also made over the Newcastle Range Volcanics to assist structural investigations. The positions of the detailed surveys and the gravity traverses are shown in Figure MA2.

Magnetic, induced polarization, and various electromagnetic methods were used in each of the detailed surveys. Results obtained are presented below:

Phyllis May area. Induced polarization proved a most effective tool for outlining the mineralization associated with the Phyllis May porphyry copper prospect. The results indicate that sulphide mineralization is widespread.

The Lineaments area. Minor gold mineralization is known to be associated with a lineament evident on aerial photographs. The lineament was located on the ground by VLF and resistivity methods. Survey results indicate that the lineament reflects a shear zone in granite.

Big Reef area. The line of a worked-out gold lode at Big Reef was identified by characteristic VLF, magnetic, and resistivity responses. Large induced polarization anomalies were recorded over metamorphic rocks associated with the reef structure. The source of these anomalies will be investigated by drilling.

Jubilee Plunger area. Investigations were directed towards complementing BMR geochemical studies in an area of old gold workings. An induced polarization anomaly of limited strike extent was detected in a region of high lead and zinc values. A drill-hole sited as a result of the geophysical work intersected galena, sphalerite, and chalcopyrite mineralization over an interval of 10 m.

Cloncurry area survey, Qld (R. Almond, A. Mutton, R. Hill, H. Reith).

A ground geophysical survey was made from May to mid-August in an area of 1700 km^2 situated 50 km north east of Cloncurry as shown in Figure MA3. The area is to the east of the Precambrian Mount Isa belt and is almost entirely covered with alluvium and Mesozoic sediments. Aeromagnetic data (Fig. MA4) indicate that these sediments are only a thin veneer on the Precambrian rocks.

The object of the ground survey was to produce a map of Precambrian basement showing major lithological boundaries, structure, and depth to basement. The significance

of regional magnetic and gravity anomalies was investigated and an attempt was made to establish characteristic responses of formations and rock types present in the basement. Magnetic gravity, and resistivity methods were used. The magnetic and gravity methods proved to be the most useful. High surface conductivities severely limit the application of resistivity methods.

Magnetic readings were taken at 25-m intervals along tracks and surveyed lines.

Preliminary results show that some metamorphic rock units can be identified by characteristic magnetic responses. The most intense aeromagnetic anomalies were shown to be associated with outcrops or floats of magnetite.

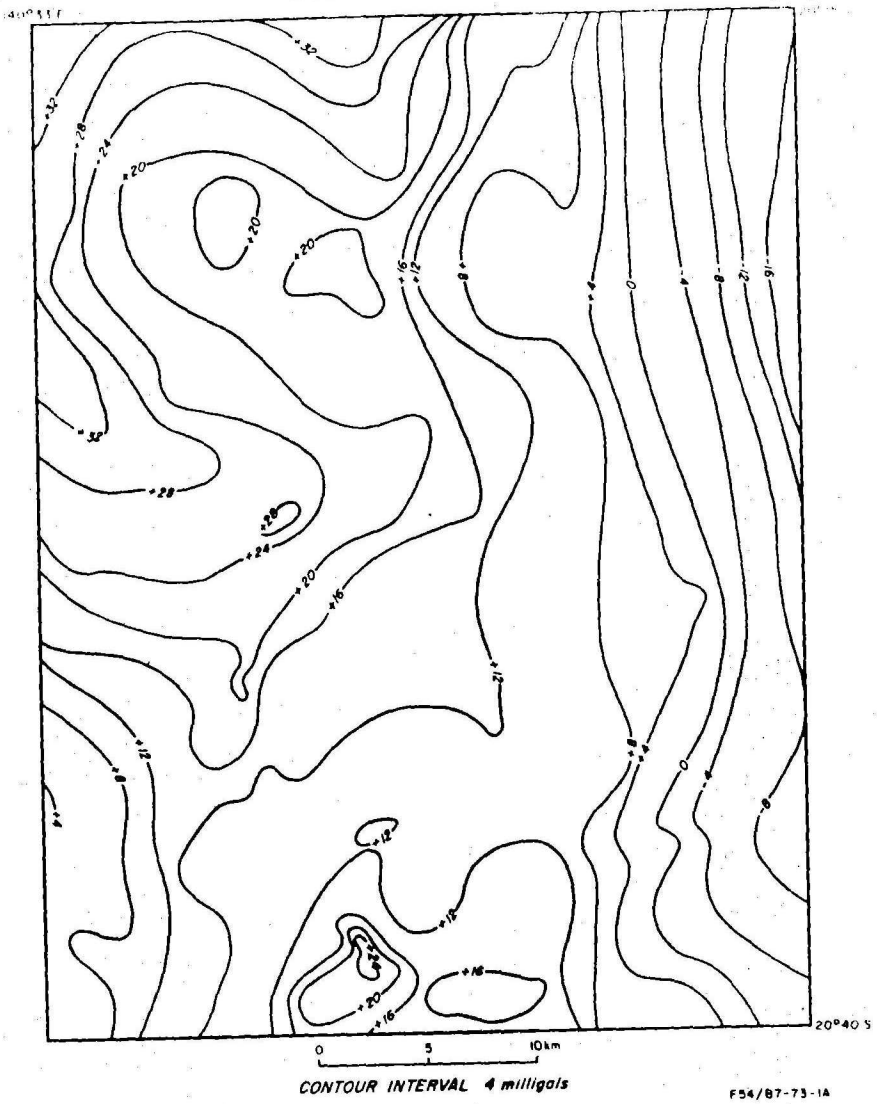
Gravity readings were made along accurately surveyed lines at 50-m intervals, or along track and compass traverses at 500-m or 1000-m intervals using micro-barometers for elevation control. The results of this work are shown in the preliminary Bouguer anomaly contour map in Figure MA3. The gravity data proved effective for delineating the boundaries of granitic rocks but are considered to be only of limited use for tracing contacts within the Precambrian metamorphic basement.

Alligator River area survey, NT (B. Spies, D. Robson, N. Ashmore)

During the period early July to October a ground geophysical survey was made in the eastern part of the KAPALGA 1:100 000 Sheet area to assist geological mapping of the Koolpin Formation. Magnetic and electrical methods were used to trace magnetic and conductive rock units in areas where there is little outcrop and alluvium is up to 100 m thick.

Only limited use was made of the magnetic method as lateritic sources produced anomalies which masked the effects of magnetic rocks. In the main, the transient electromagnetic (TEM) methowasused, but it was supplemented by resistivity depth soundings to investigate the source of TEM anomalies. An area of 60 km^2 was covered with TEM stations on 0.5-km or 1-km grids, and regional traverses were made to map extensions of anomalous zones over the remainder of the survey area. Figure MA5 shows the survey area and the location of the TEM grids and traverses.

CLONCURRY GRAVITY SURVEY
BOUGUER ANOMALIES



CONTOUR INTERVAL 4 milligals

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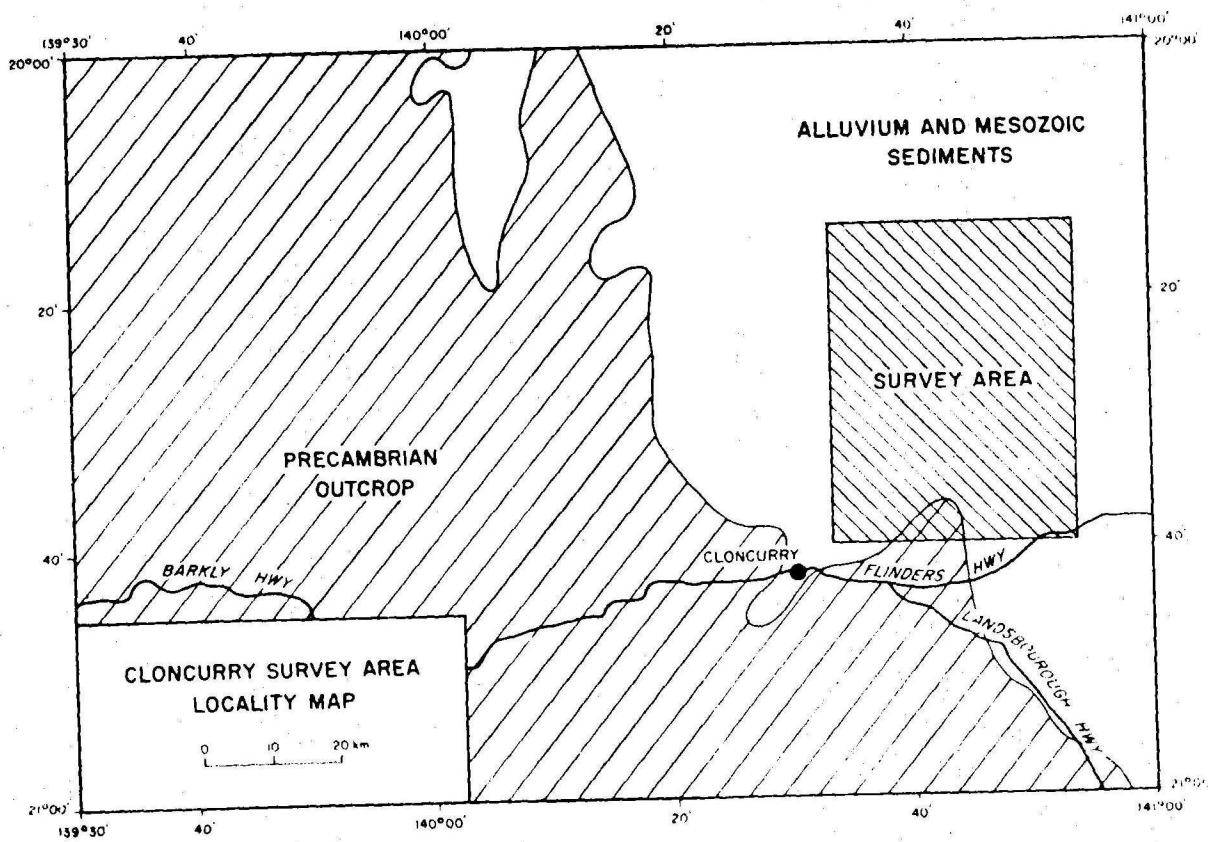

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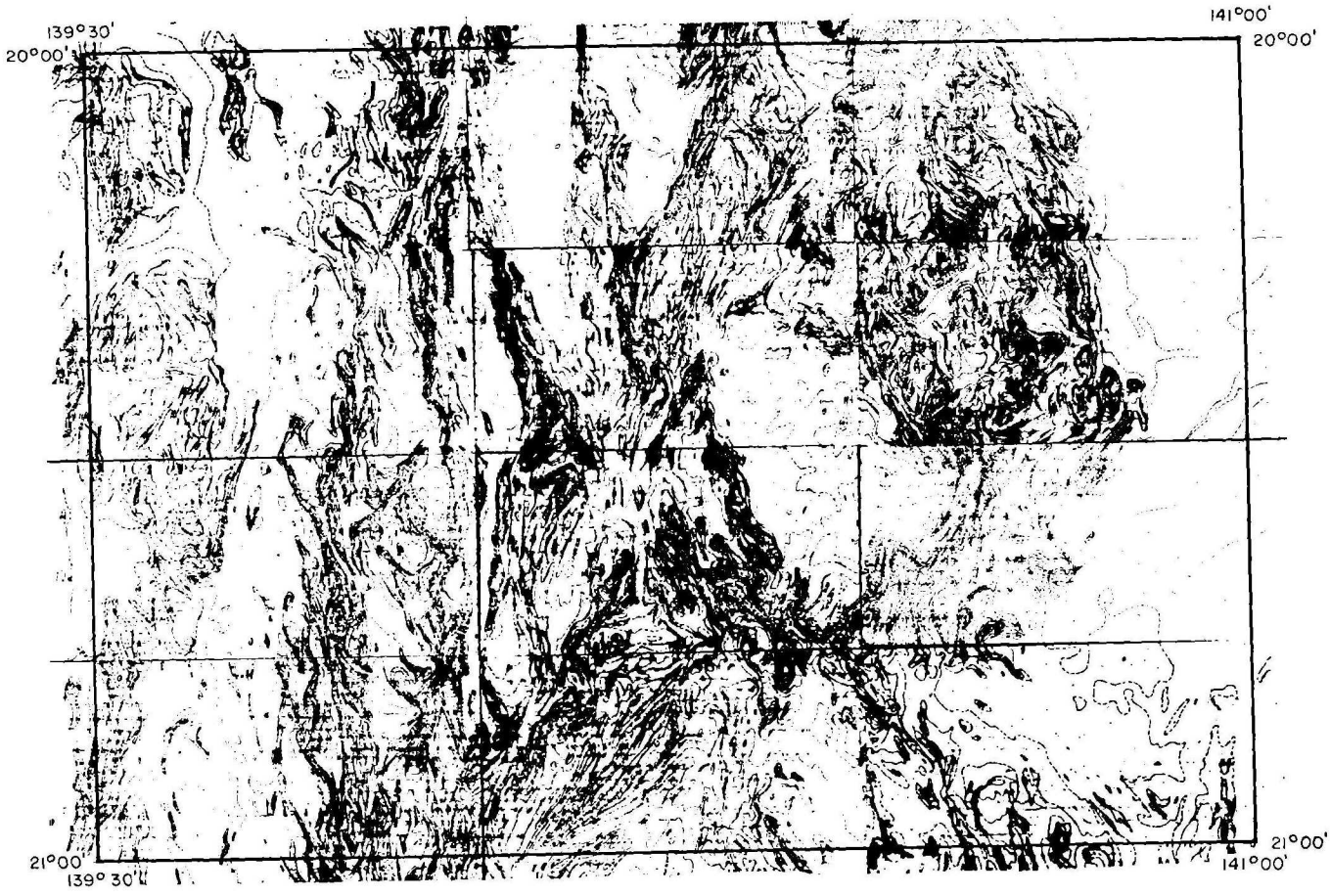
CLONCURRY



AIRBORNE SURVEY, CLONCURRY, QLD 1973

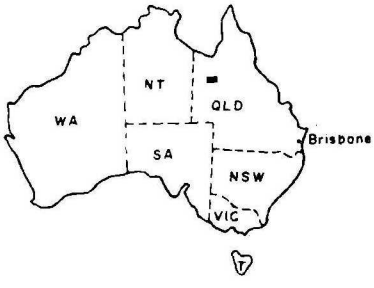
TOTAL MAGNETIC INTENSITY

SCALE

10 0 10 20 30 40 50 60 70 80 90 KILOMETRES

CONTOUR INTERVAL 50nT

LOCALITY DIAGRAM



REFERENCE TO 1:250000 MAP SERIES

CAMOOWEAL	DOBBYN	MILLUNGERA
MOUNT ISA	CLONCURRY	JULIA CREEK
URANDANGI	DUCHESS	McKINLAY

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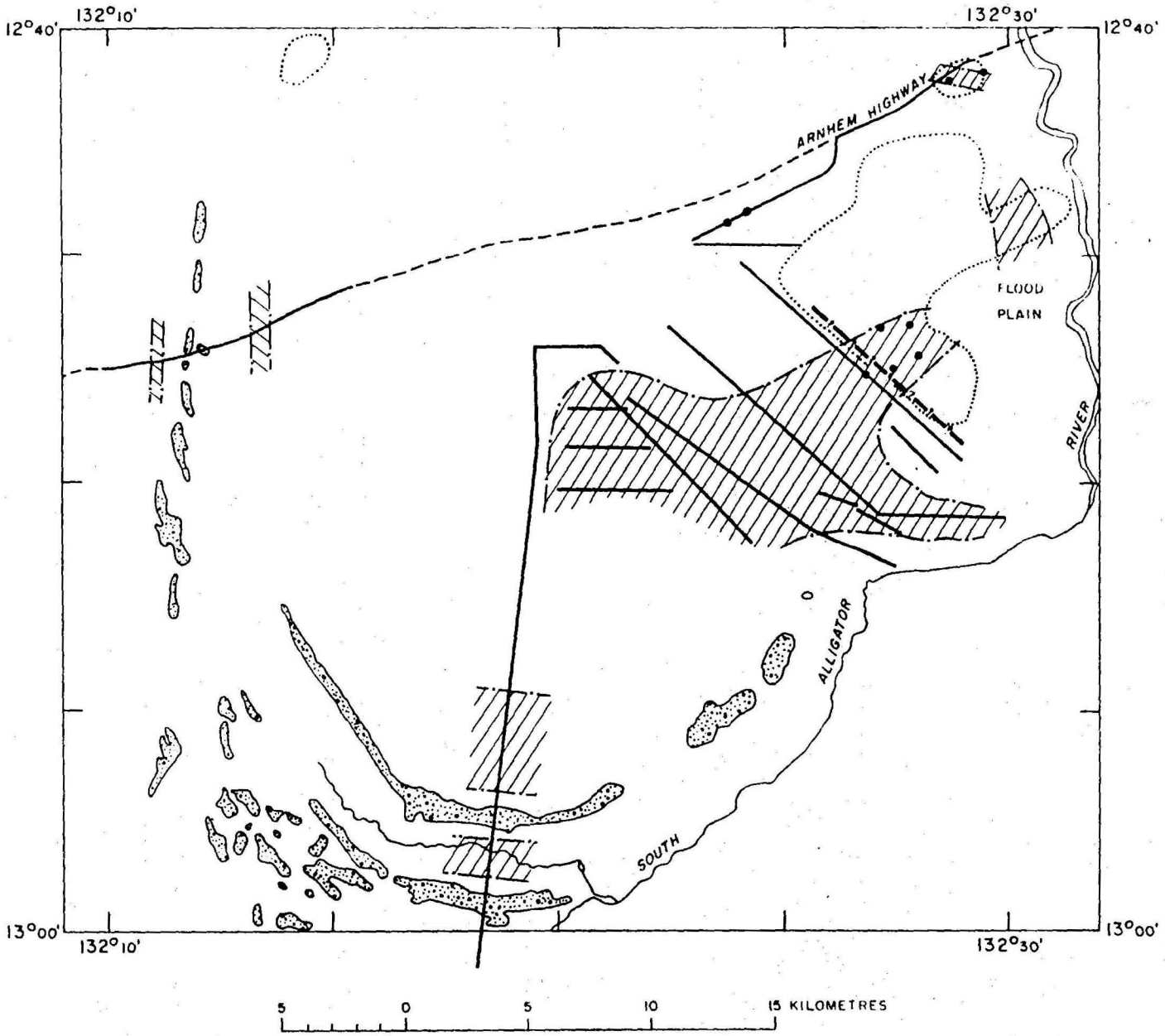
MA 5



LEGEND

- *Area surveyed with TEM on ½ or 1 km grid*
- *TEM traverse*
- *Anomalous TEM zone*
- *Resistivity depth sounding site*
- *Fault (inferred)*
- *Koolpin Formation*

ALLIGATOR RIVER AREA NT, 1975 GEOPHYSICAL SURVEY

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TEM anomalies observed over known carbonaceous shales in the south of the main gridded area could be traced to the northeast and southwest. However, the continuity of the zone to the northeast could not be established owing to the masking effects of the conductive soils of the Alligator River flood plain; to the southwest the zone becomes very wide.

Holes drilled to examine the source of the TEM zone away from the known carbonaceous shales intersected carbonaceous shales to the northeast and southwest of the main gridded area. On the basis of the drilling results it is postulated that the TEM zone reflects continuous conductive rock units which can be used to assist in mapping the Koolpin Formation. The change in the character of the TEM zone south of the main gridded area is thought to be due to an extension of the Jim Jim fault.

Jerusalem Creek survey, NSW (N. Sampath, I. Hone, D. Robson, D. Hunter)

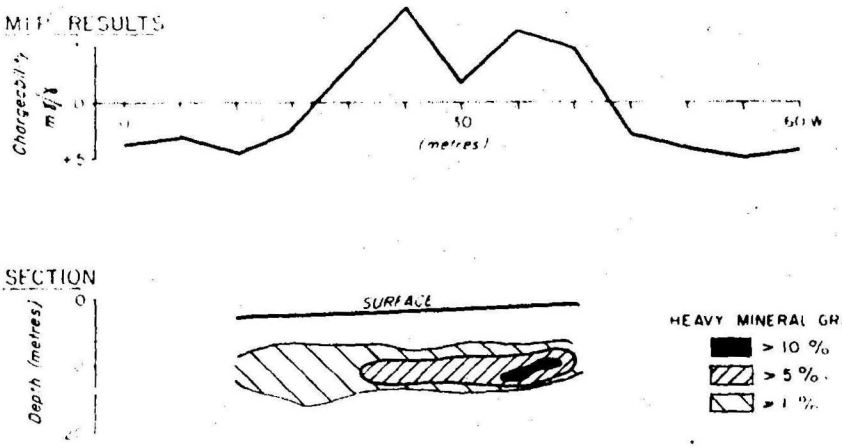
In June, July, and September 1975 ground geophysical surveys were made over heavy-mineral deposits occurring in beach sands at Jerusalem Creek. To complement this work a short airborne magnetic and gamma-ray spectrometer survey is planned to be flown over the area in November. The aim of the surveys was to investigate the use of geophysical methods to detect such heavy-mineral concentrations.

The heavy-mineral deposits at Jerusalem Creek consist mainly of rutile, zircon, and ilmenite and occur in several grades and forms. To investigate the geophysical response from a range of deposit types, ground surveys were conducted in two separate areas. The first area surveyed included a single body of high-grade mineralization 2 m thick lying beneath 4 m of overburden. The second area covered a number of zones having disseminated mineralization close to the surface. The geophysical methods used in the ground surveys were magnetic, radiometric, and induced polarization. Measurements of susceptibility, gamma spectra, and polarization were made on samples collected from the survey areas to assist the analysis of field data.

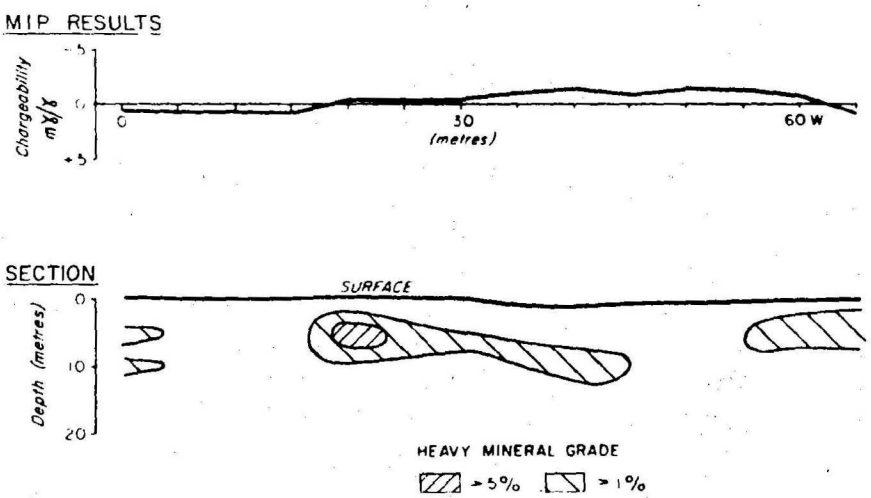
The magnetic surveys were carried out to an accuracy of 1 nT and used a proton-precession magnetometer with the sensor 1 m above the ground. Small anomalies were recorded in the survey areas but it was not possible to correlate them with the heavy-mineral concentrations.

MA6

(a) TRAVERSE OVER HIGH-GRADE HEAVY MINERAL DEPOSIT

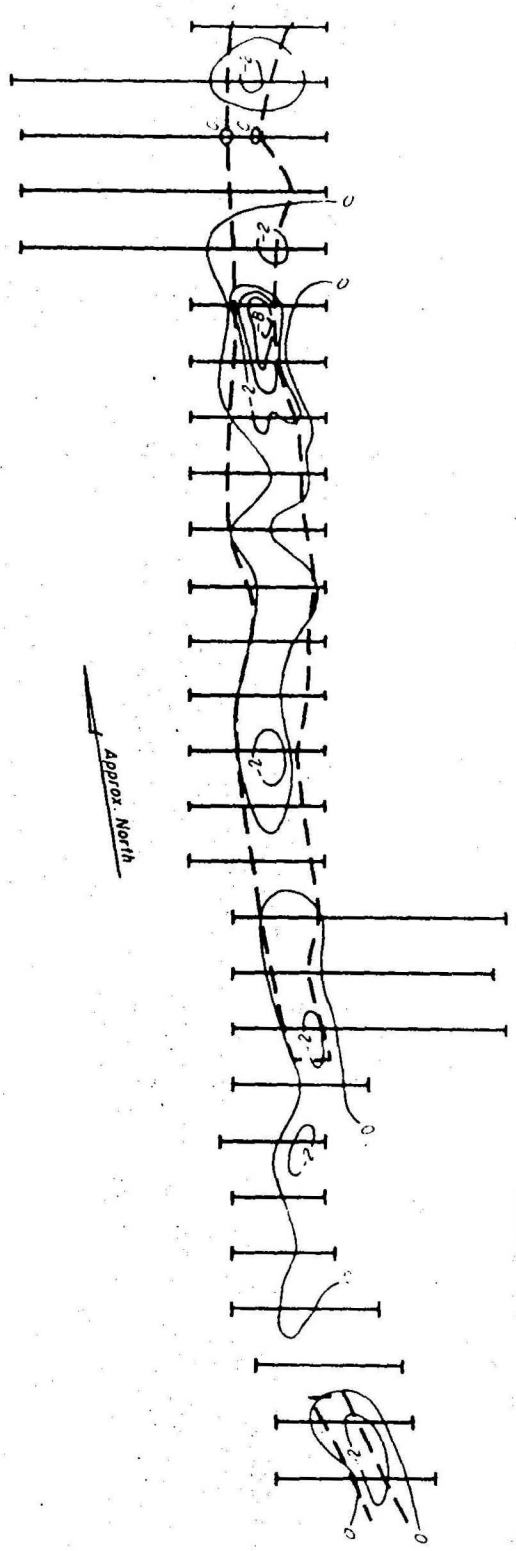


(b) TRAVERSE OVER DISSEMINATED HEAVY MINERAL DEPOSIT



MIP RESULTS, JERUSALEM CREEK AREA, N.S.W.

CROSS-SECTIONS



MIP RESULTS, JERUSALEM CREEK AREA, N.S.W.

CONTOUR PLAN

The radiometric surveys were made with a four-channel differential gamma-ray spectrometer; anomalies attributed to thorium sources were found to correlate with heavy minerals in the top metre of sand. There was no correlation between the radiometric results and heavy-mineral concentrations masked by several metres of overburden.

The induced polarization surveys employed both magnetic (MIP) and electrical (EIP) techniques in the time-domain mode. Small MIP anomalies were recorded in both survey areas and the anomalies correlated clearly with the heavy-mineral concentrations as shown in Figure MA6. EIP field surveys and laboratory sample tests show that the source of the MIP anomalies is the magnetic fraction of the heavy-mineral assemblage.

The results of the induced polarization surveys show that this method may have applications in the search for and development of heavy-mineral deposits, and further investigations are planned for 1976.

Arunta geophysical and geological survey, NT (P. Wilkes, R. Shaw, A. Mutton, H. Allison)

A combined geophysical and geological survey was made between 11 April and 9 May 1975 in the northern parts of the MOUNT RENNIE and MOUNT LIEBIG areas west of Alice Springs.

The main objective was to relate rock type to magnetic and radiometric response in areas where the main rock types of the Southern Arunta Block are exposed. In particular it was hoped to resolve discrepancies between the existing geological mapping and airborne geophysical results from the BMR Amadeus Basin survey of 1965, e.g. to explain the anomalously high magnetic response over extensive areas mapped as granite.

Additional objectives were to investigate the importance of remanent magnetism, the use of a gamma-ray spectrometer to determine radio-element content in situ, and to check the adequacy of the design of the 1965 airborne survey as related to future airborne surveys of the Arunta Complex.

Magnetic work comprised total magnetic intensity measurements along traverses, in situ susceptibility measurements, and the collection of orientated samples for laboratory determination of remanence. Radiometric work comprised the measurements of radioactivity in standard units, and the

determination of radio-element content using a four-channel differential gamma-ray spectrometer with a 7.6 x 7.6 cm detector. Rock samples were collected from about 200 localities for subsequent laboratory work including thin section work, geochemical analysis, and the measurement of density and magnetic properties.

Some of the more important results from this survey are:

(1) The field work showed that granites crop out extensively but probably not as extensively as previously mapped. The granites are highly variable in type and this is reflected in their magnetic and radiometric response. The composition of many of the granites is granodioritic or tonalitic rather than granitic in the strict sense.

(2) In the Ehrenberg Ranges some of the rocks previously mapped as granite are now believed to by hypersthene dacites. These are possibly extrusive acid differentiates of highly magnetic norites which were found about 15 km NE of Sandy Blight Junction. Gabbros and amphibolites found in this latter area were much less magnetic than the norites.

(3) Remanent magnetism is an important component of the magnetism of many of the rock types. Samples were collected from 24 localities. There appears to be no direct relation between remanence and metamorphic grade (as determined in the field), and the distribution of high remanent intensities is fairly random throughout the rock types.

(4) The radiometric contour maps from the 1965 airborne survey were generally unreliable, probably because of the flight pattern (lines 3.2 km apart and 250 m above the ground) and the lack of height correction. These maps emphasize topographic ridges which are parallel to and close to the east-west flight-lines and indicate continuity of radioactivity levels which were not confirmed by ground work. Some of the most radioactive features on the ground were not seen in the airborne data, either because of their limited areal extent or their distance from the nearest flight-line.

AIRBORNE SUBSECTION (J.H. Quilty, D. Downie, R. Wells)

Aero Commander VH-BMR: Equipment testing and performance (D. Downie, R. Curtis-Nuthall, S. Wilcox)

A tail boom was installed on VH-BMR by late February, and test flying of the basic magnetometer installation commenced immediately using the existing MFS7 fluxgate

magnetometers. Satisfactory results were soon obtained and work then proceeded on compensating the aircraft, testing the new third MFS7 magnetometer, and installing the gamma-ray detection and digital data acquisition equipment. Final testing of the complete aircraft system started in April, and productive surveying started in mid-May.

The equipment operated satisfactorily for the duration of the Aero Commander's survey commitment. The only serious problem was the failure of a digital voltmeter causing an interruption of four weeks while a replacement instrument was fitted. No major equipment development will be necessary for VH-BMR during 1976.

Twin Otter VH-BMG: Equipment testing and performance
(D. Downie)

Test flying prior to the 1975 survey program commenced in February. No significant changes had been made to the airborne equipment during the 1974-75 interfield season and consequently the testing program was kept as short as possible. Productive survey flying commenced in March.

During the year the Doppler computer and the radio-altimeters were the only equipment that failed and caused significant loss of production. The lack of adequate servicing facilities in Australia for the radio-altimeter led to a four-week delay in the Broken Hill survey. An 'in-house' maintenance and testing facility is being developed by BMR to cope with this problem.

A significant improvement to the Doppler navigation system was implemented in June when the airborne digital computer took over the function previously performed by the Doppler computer. The new system is more accurate and more reliable than the mechanical system it replaced.

Survey operations in 1975 again demonstrated the necessity for adequate spares and continuous, high-calibre technical support for the complex airborne equipment. Shortages of Technical Officers greatly increased the workload for the available staff, but successful recruitment to vacancies late in the year and a gradual improvement in stocks of spares should alleviate this situation in 1976. Major development of equipment will not be necessary for VH-BMG, but system documentation, and the training of both professional and technical officers, will be major tasks.

Spencer Gulf region airborne survey SA (VH-BMG, VH-BMR) (D. Hsu, K. Horsfall, K. Mort, R. Curtis-Nuthall, S. Wilcox, G. Green, C. Kieltyka, L. Miller)

A regional magnetic and radiometric survey of the PORT AUGUSTA, WHYALLA, PORT LINCOLN (part), and MAITLAND (part) areas (Fig. MA7) was flown during the period March to July 1975, at the request of the SA Department of Mines. The aim of the survey was to achieve aeromagnetic coverage over Spencer Gulf and the surrounding area, which has some economic potential, in order to provide a basis for more detailed studies.

The Twin Otter aircraft VH-BMG and the Aero Commander VH-BMR were both engaged in the project; VH-BMR surveyed the PORT AUGUSTA area and VH-BMG the remainder. Both the aircraft were fitted with a fluxgate magnetometer and a 4-channel gamma-ray spectrometer. All data were recorded digitally on magnetic tape.

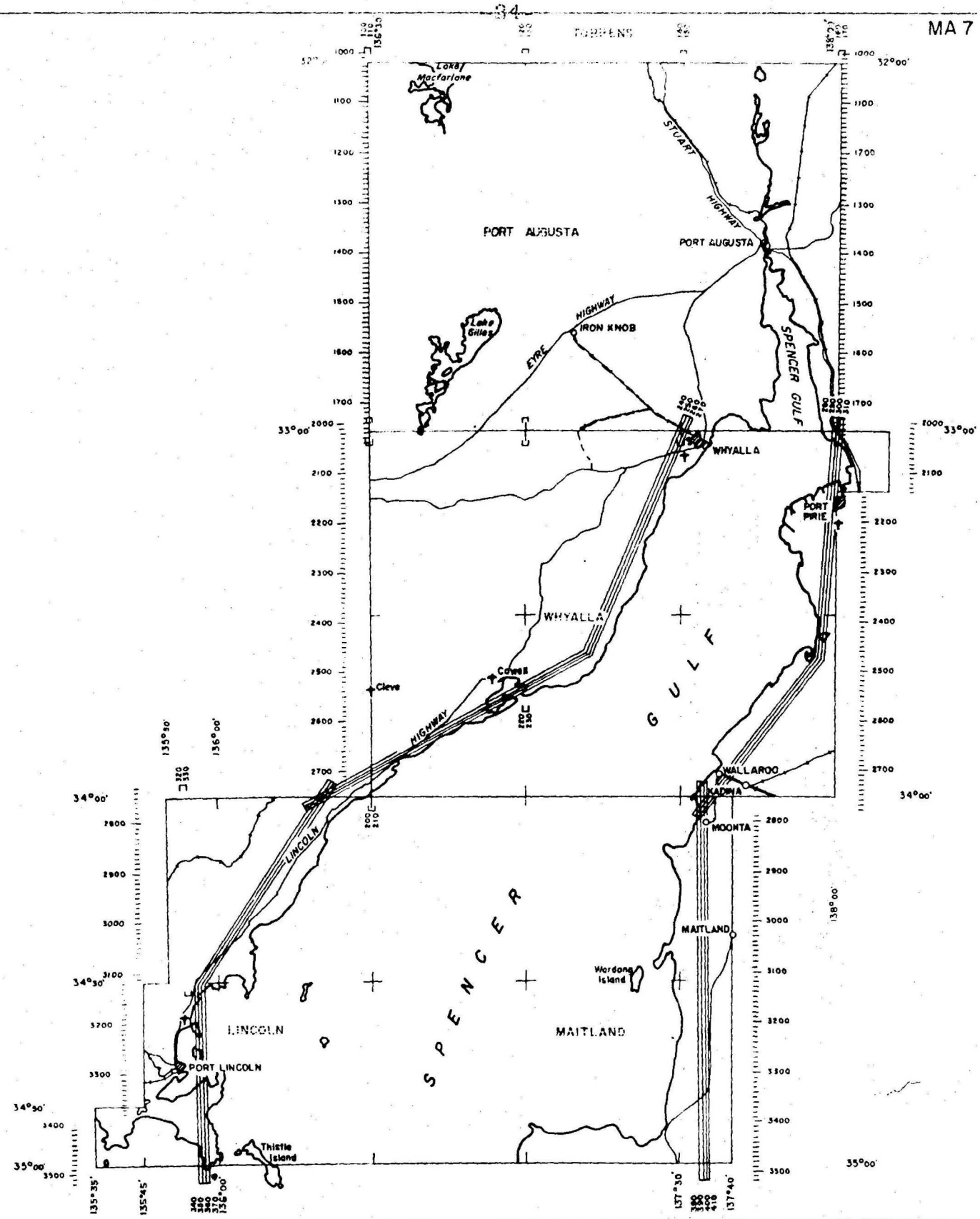
The flight-lines were flown at 150 m above ground level, orientated east-west and spaced 1.5 km apart; a set of north-south tie-lines was flown. Doppler navigation was used in the offshore area and resulted in a satisfactory flight path recovery despite sea drift variations across Spencer Gulf.

The data will not be processed completely until early 1976, but preliminary magnetic contours of the WHYLLA area have been produced (Fig. MA8). Intense magnetic anomalies of up to 5000 nT which trend northeast and north across the southeast corner of the Sheet area appear to be associated with the Torrens Hinge Zone which delineates the transition zone between Precambrian rocks of the Gawler Craton and the sediments of the Adelaide Geosyncline. On the western side of the Gulf in the central north of the area intense magnetic anomalies of up to 7000 nT correlate with magnetite-rich rocks of the Middleback Ranges.

Broken Hill airborne surveys, NSW(VH-BMG) (B.W. Wyatt, G. Green, K.A. Mort, C. Kieltyka, L. Miller)

A regional airborne magnetic and radiometric survey of the BROKEN HILL area was completed between 26 June and 31 July. An additional area, immediately north of Broken Hill city, was flown at reduced line spacing between 29 July and 29 August (Fig. MA9).

MA 7



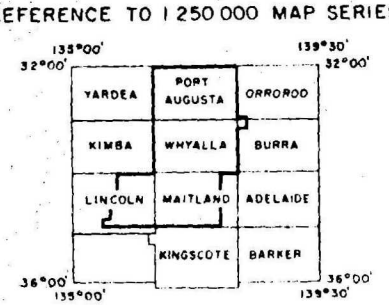
LOCATION DIAGRAM

FLIGHT – LINE SYSTEM

GAWLER BLOCK SA, 1975

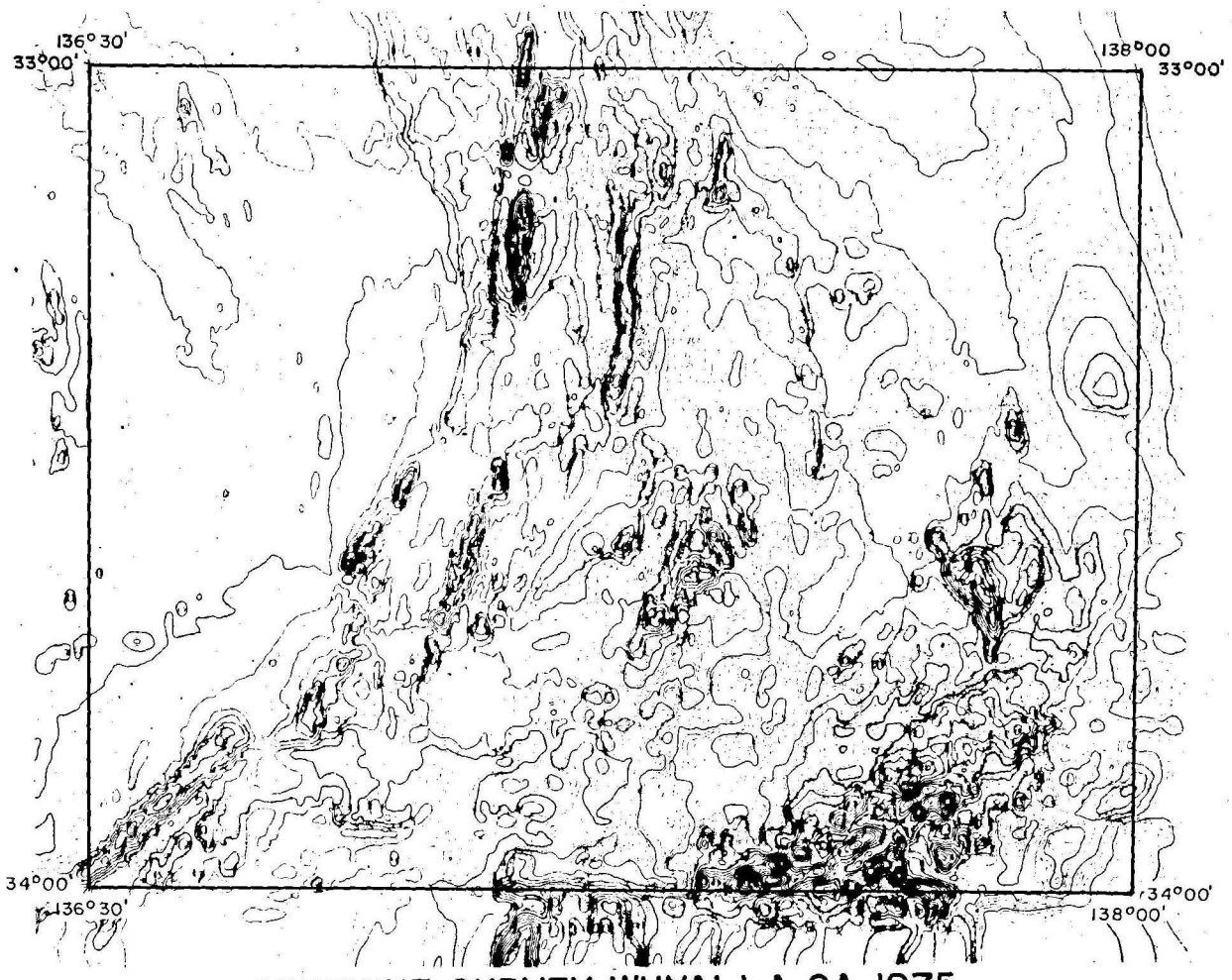
10 0 10 20 30 40 50 60 KILOMETRES

REFERENCE TO 1 250 000 MAP SERIES



Record No 1975/161

I53/BI-24AR



AIRBORNE SURVEY WHYALLA, SA 1975

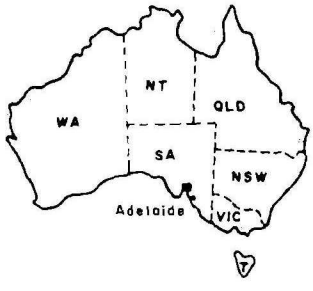
TOTAL MAGNETIC INTENSITY

SCALE

10 0 10 20 30 40 50 60 70 80 90 KILOMETRES

CONTOUR INTERVAL 50nT

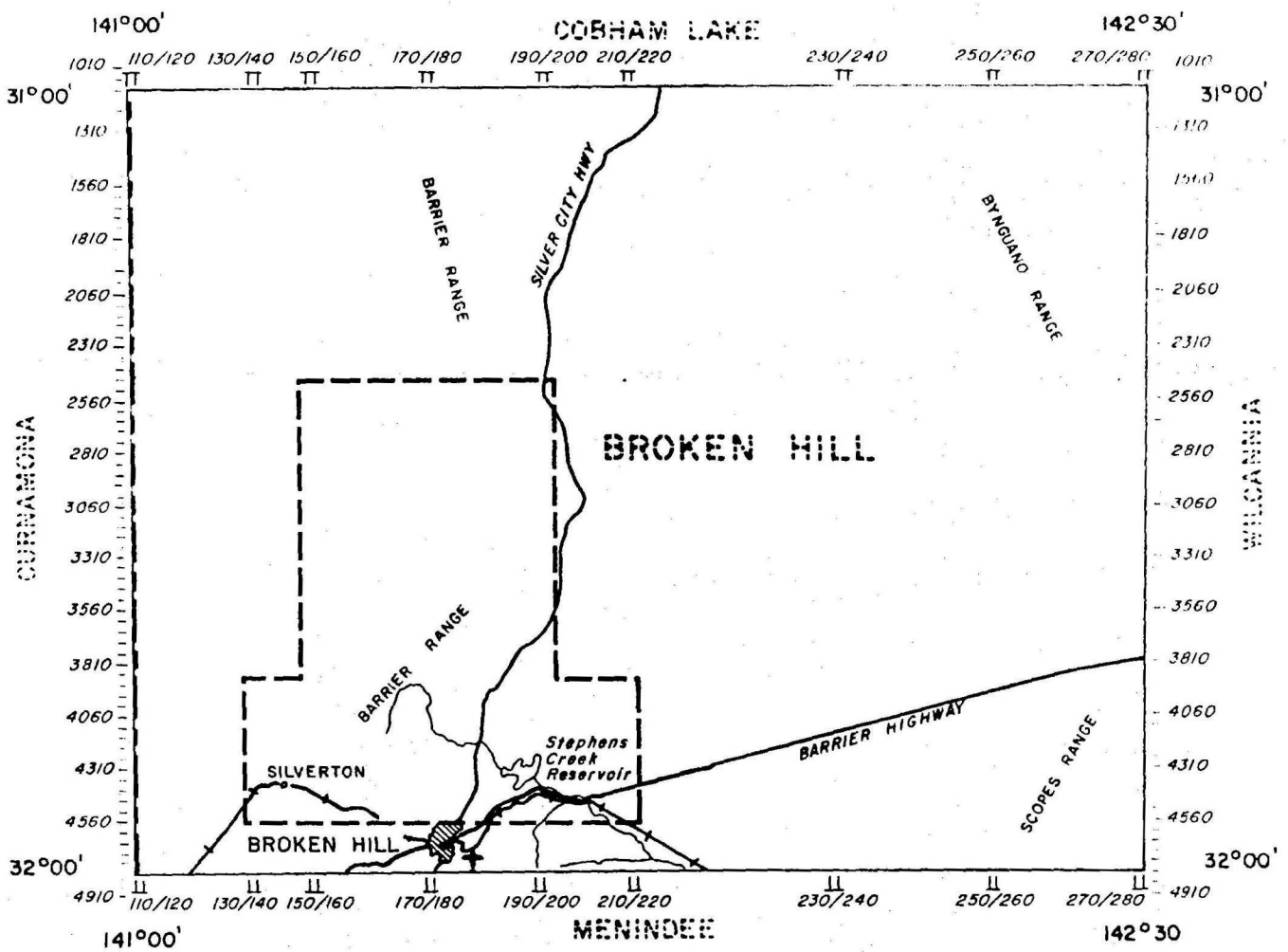
LOCALITY DIAGRAM



REFERENCE TO 1:250 000 MAP SERIES

YARDEA	PORT AUGUSTA	ORROROO
KIMBA	WHYALLA	BURRA
LINCOLN	MAITLAND	ADELAIDE

MA 9



— — Detailed survey boundary

— 1010 Flight-line

⊥ 110 Tie-line

AIRBORNE SURVEY, BROKEN HILL, NSW 1975

LOCALITY MAP AND FLIGHT-LINE SYSTEM

KILOMETRES

10 0 10 20 30 40 50 60 70 80

The purpose of the surveys was to obtain magnetic and gamma-ray spectrometer data to assist geological mapping and mineral exploration carried out in the Broken Hill area by the Geological Survey of NSW and mining companies respectively.

Both surveys were flown using the Twin Otter aircraft, VH-BMG, equipped with MFS-7 fluxgate magnetometer, 4-channel gamma-ray spectrometer, Doppler navigation system, radio-altimeter, camera, and digital recording system. The surveys were flown at an average ground clearance of 100 m and a groundspeed of 100 knots along east-west lines. The regional survey was flown at a line spacing of 1.5 km with photographic recovery every 50 km, and the detailed survey was flown at a line spacing of 300 m with photographic recovery every 0.2 seconds, altimeter and spectrometer values every second, and Doppler co-ordinates every 10 seconds. Tie-lines were flown north-south.

It is expected that processing of the data will be completed early in 1976. The current arrangement is for BMR to interpret the regional survey and for the Geological Survey of NSW to interpret the detailed survey.

Cootamundra airborne survey, NSW (VH-BMR) (S.S. Lambourn, S. Willcox, C. Kieltyka).

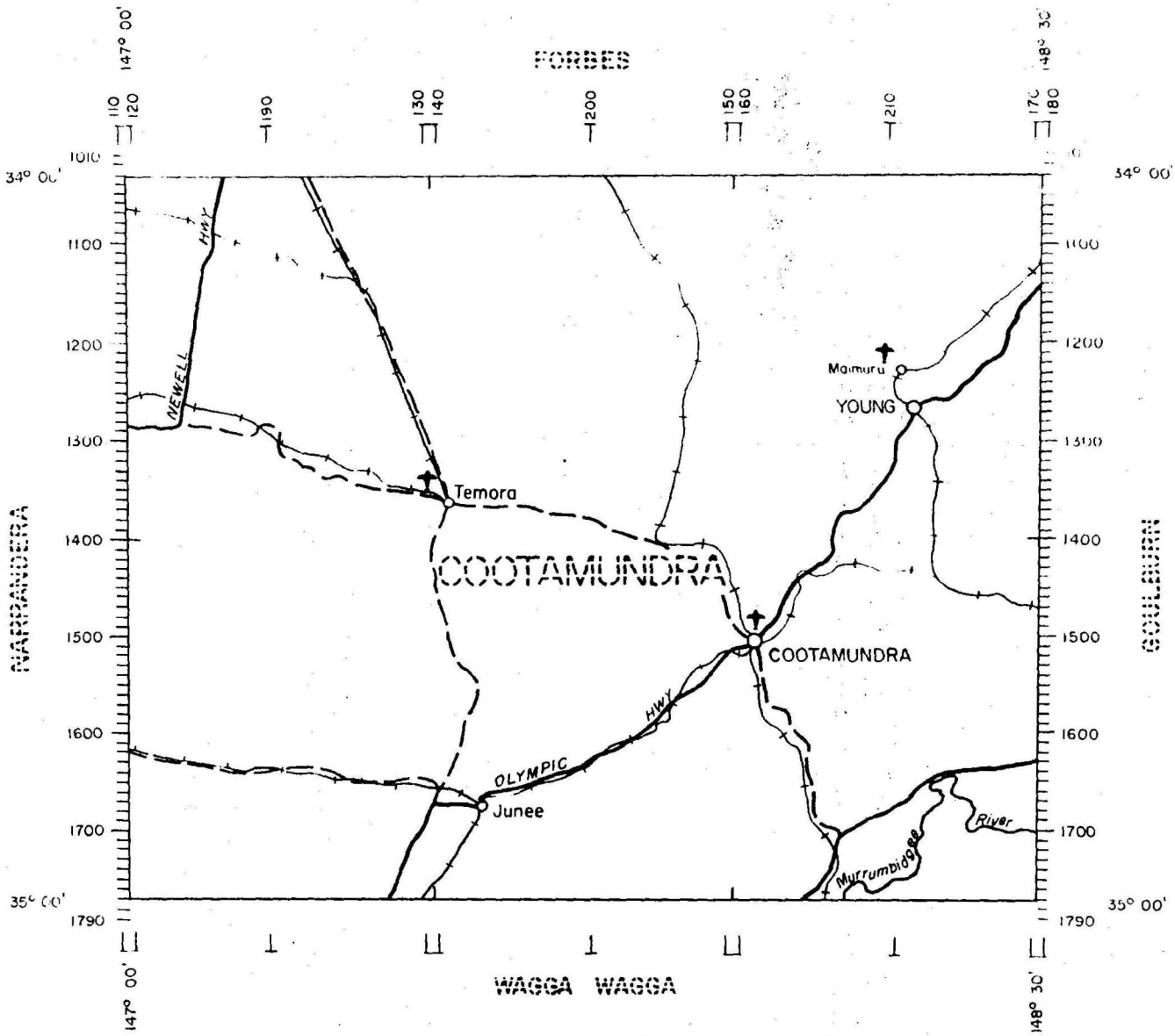
An airborne magnetic and radiometric survey of the COOTAMUNDRA area (Fig. MA10) was flown by BMR in August. The Aero Commander aircraft VH-BMR was used for the survey, and was equipped with a fluxgate magnetometer and a 4-channel gamma-ray spectrometer.

The survey was made along east-west lines spaced 1.5 km apart at an altitude of 150 m above ground level. The data were recorded digitally, and processing will be completed early in 1976.

The magnetic data show a disturbed area in central COOTAMUNDRA, extending from north to south, containing numerous intense, north-trending anomalies with amplitudes up to 4000 nT. To the east and west of this central area the magnetic field is much less disturbed with anomaly amplitudes less than 100 nT. The intense anomalies recorded in the central area suggest that previously mapped isolated occurrences of basic and ultrabasic intrusives in fact extend from north to south throughout COOTAMUNDRA, but are discontinuous in the central region.

The radiometric data show uniform count rates throughout with no identifiable anomalies recorded in the 'Uranium' or 'Thorium' channels. Numerous small anomalies were recorded in the 'Potassium' channel, the more intense of which occurred over sparse outcrops of Devonian granites in east and west COOTAMUNDRA. 'Total Count' channel

MA10



LOCATION DIAGRAM

REFERENCE TO 1:250 000 MAP SERIES

145° 30' 150° 00'
33° 00' 36° 00'

CARGELLIGO	FORBES	BATHURST
NARRANDERA	COOTA-MUNDRA	GOULBURN
JERILDERIE	WAGGA WAGGA	CANBERRA

AIRBORNE SURVEY
COOTAMUNDRA, N S W 1975

LOCALITY MAP

AND

FLIGHT-LINE SYSTEM

10 0 10 20 30 40 50 60 KILOMETRES

Record No 1975/161

I55/B1-93A

anomalies reflect the 'Potassium' channel response, with maximum count rates not greater than 1½ times background count rate.

Pooncarie airborne survey NSW, (VH-BMG) (B.W. Wyatt)

On 28 August, the Twin Otter aircraft made an aeromagnetic survey of a 30 km by 100 km rectangle centred on Pooncarie and aligned in a northwest direction (Fig. MA11). Nine lines and ten ties were flown at 600 m above sea level and 130 knots groundspeed.

The survey was designed to support magnetotelluric, gravity, and resistivity investigations of the structure of the Wentworth Trough. Accordingly, interpretation of the magnetic data will be included in the report on the magnetotelluric survey.

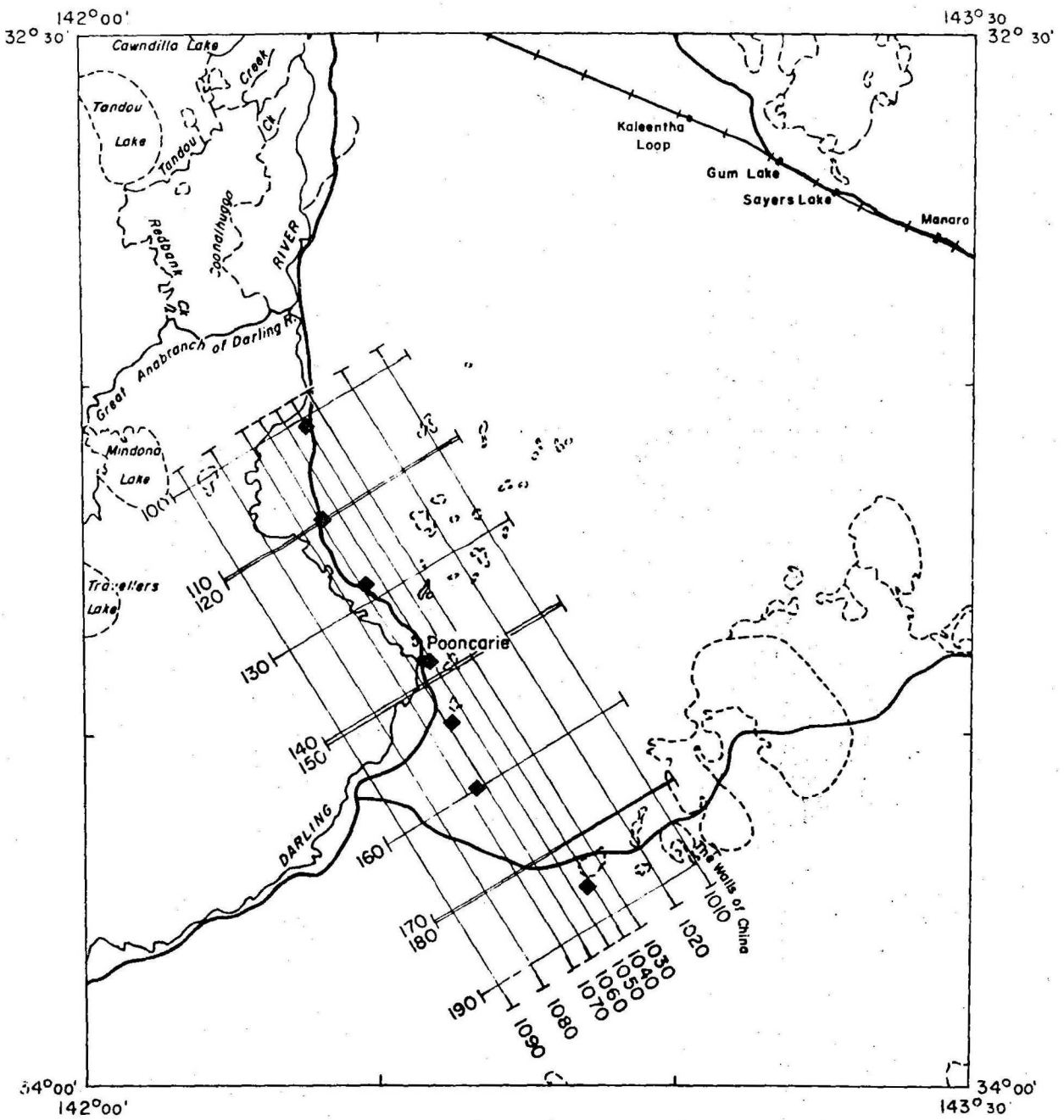
Darwin/Katherine region airborne survey, NT (VH-BMG, VH-BMR) (K. Horsfall, P. Wilkes, A. Mutton, J. Giddings, G. Green, S. Willcox, K. Mort, L. Miller)

Between 1 September and 16 October 1975, a regional magnetic and radiometric survey was flown over the DARWIN, CAPE SCOTT, PINE CREEK, FERGUSSON RIVER, KATHERINE, and MOUNT EVELYN (southern half) areas (Fig. MA12). This work completed the Darwin/Katherine survey which was commenced in late 1974. The Twin Otter aircraft VH-BMG and the Aero Commander VH-BMR were both engaged in the project; VH-BMR surveyed the KATHERINE and MOUNT EVELYN (southern half) areas and VH-BMG the remainder. Both aircraft were fitted with a fluxgate magnetometer and a 4-channel gamma-ray spectrometer. All data were recorded digitally on magnetic tape.

About 49 000 km was flown in the 6½ week period of survey operations. Flight-lines were flown at 150 m above ground level, orientated predominantly east-west, and spaced 1.5 km apart. The survey objectives were to provide radiometric and magnetic data to assist geological mapping and mineral exploration in the Pine Creek Geosyncline and adjacent areas.

Preliminary interpretation confined to PINE CREEK and FERGUSSON RIVER shows that in the eastern part of the former sheet very strong magnetic anomalies were recorded over the Masson Formation which is known to contain some iron-rich horizons in this area. The boundary between the Masson Formation and the Cullen Granite is clearly seen from the magnetic data. The Burrell Creek Formation appears to be moderately magnetic; accordingly the magnetic data should prove useful in tracing its extent.

MAII



AIRBORNE SURVEY, POONCARIE, NSW 1975

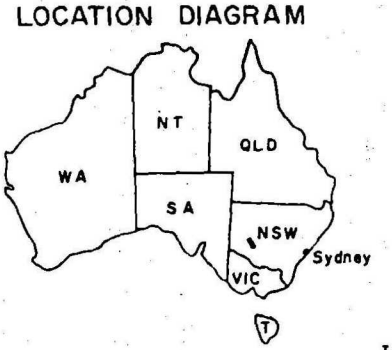
FLIGHT-LINE SYSTEM

SCALE 1:1 000 000

20 0 20 40 60 80 KILOMETRES

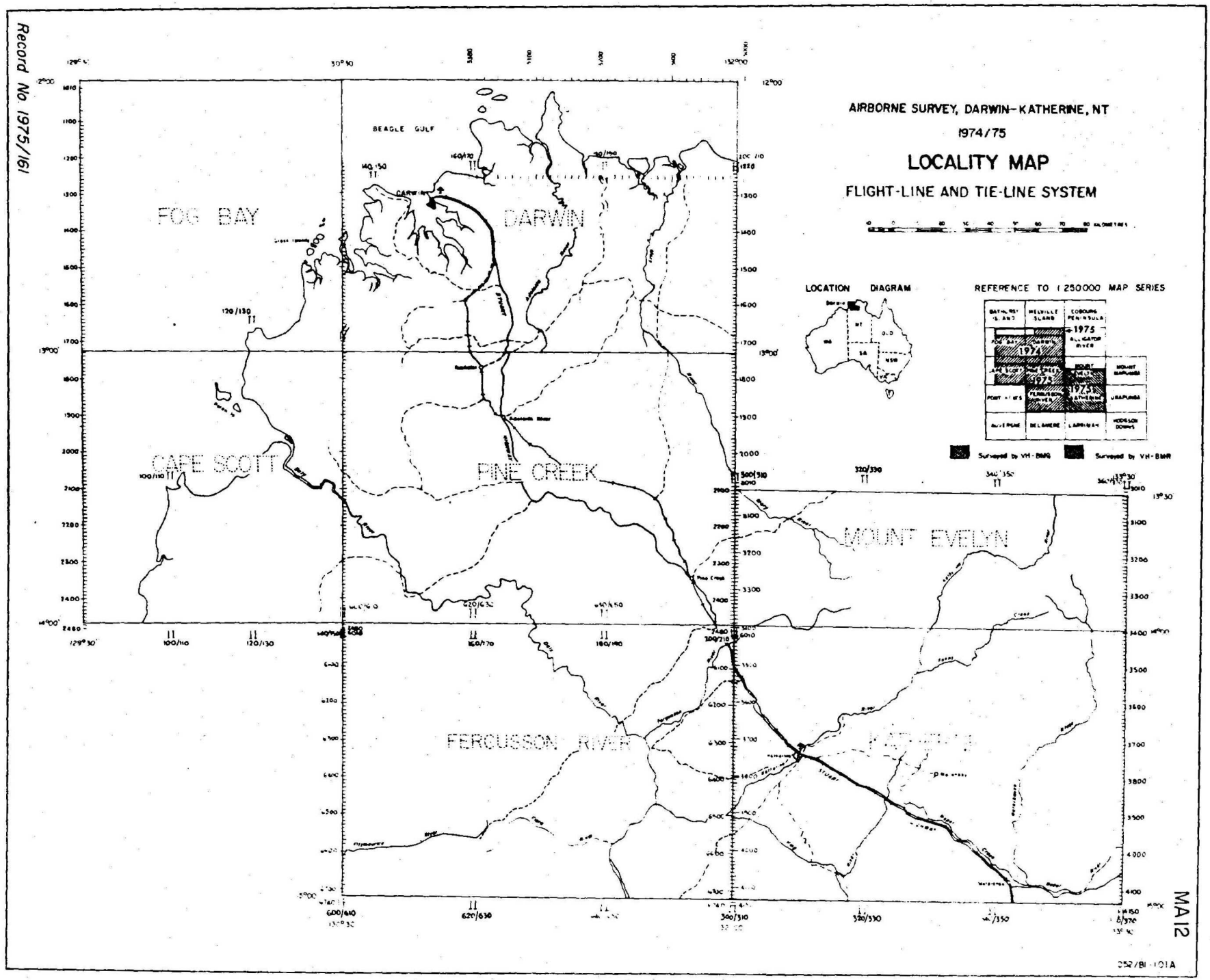
◆ ___ MAGNETOTELLURIC SITES

LOCATION DIAGRAM



Record No. 1975/161

I54/BI-24A


AIRBORNE SURVEY, DARWIN–KATHERINE, NT
1974/75
LOCALITY MAP
FLIGHT-LINE AND TIE-LINE SYSTEM
LOCATION DIAGRAM
REFERENCE TO 1:250000 MAP SERIES
1975
1974
1973
Surveyed by VH-BMG
Surveyed by VH-BMR
FOG BAY
DARWIN
CAPE SCOTT
PINE CREEK
MOUNT EVELYN
FERGUSSON RIVER
BEAGLE GULF
MA12
052/81-101A

In FERGUSSON RIVER very strong anomalies, with amplitudes up to 1000 nT, occur over Zamu Complex rocks (probably dolerite) in the northwestern part of the area. The Edith River Volcanics appear to have a characteristic magnetic response with anomalies up to 50 nT. In the Daly Basin it appears that the magnetic data show the boundary between the Oolloo Limestone and the Jinduckin Formation. Radioactive springs immediately southwest of Katherine exhibit a strong 'uranium channel' response.

DUCHESS airborne survey, Qld (VH-BMG)
(A. Mutton, J. Giddings, G. Green, K. Mort, L. Miller).

Between 21 October and 6 November 1975 a regional magnetic and radiometric survey was flown over the DUCHESS Sheet area. Flight-lines were flown at 150 m above ground level, orientated east-west and spaced 1.5 km apart. The survey objectives were to provide magnetic and radiometric data to assist geological mapping and mineral exploration in this area.

An initial inspection of data recorded indicates that a large portion of the area is highly anomalous both magnetically and radiometrically. The most magnetic units occur within Precambrian rock sequences. The Corella and Argylla Formations appear to produce moderate to strong magnetic anomalies, particularly where they are intruded by metadolerite sills and dykes to the south and southeast of Malbon. Some anomalies up to 5000 nT amplitude were detected over iron deposits associated with the lower Proterozoic Staveley Formation about 50 km south of Malbon. Weaker magnetic responses were recorded over the Soldiers Cap Formation on the eastern edge of the sheet, and the Marraba Volcanics near Malbon.

High radiometric responses were recorded over broad areas, generally coinciding with granite outcrop. The Wimberu and Williams Granites, outcropping over large areas south and east of Malbon respectively, are particularly anomolous.

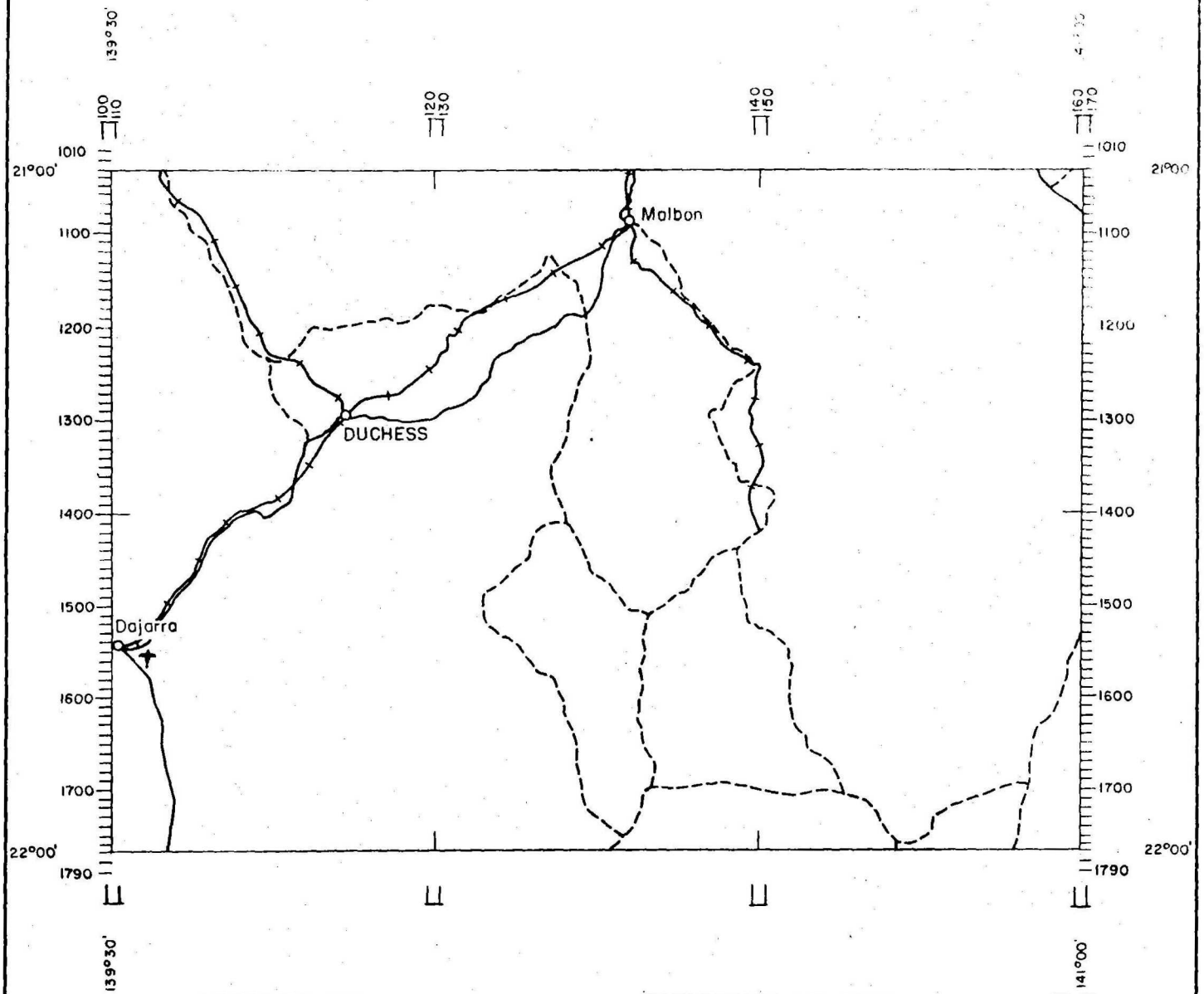
BAIRNSDALE airborne survey, Vic (VH-BMG)

This survey was requested by the Victorian Mines Department and is programmed to commence at the end of the Duchess survey.

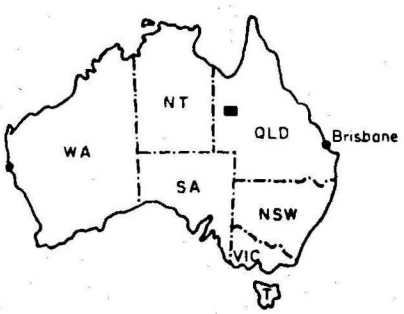
ST ARNAUD airborne survey, Vic (VH-BMG) (J.E. Olsen, K. Mort, C. Kieltyka)

A regional airborne magnetic and radiometric survey of the ST ARNAUD 1:250 000 Sheet area was made at the request

MA13



LOCATION DIAGRAM



REFERENCE TO 1:250 000 MAP SERIES

138° 00'
142° 30'
20° 00'
23° 00'

MOUNT ISA	CLONCURRY	JULIA CREEK
URANDANGI	DUCHESS	McKINLAY
GLENORMISTON	BOULIA	MACKUNDA

AIRBORNE SURVEY DUCHESS, QLD 1975

LOCALITY MAP

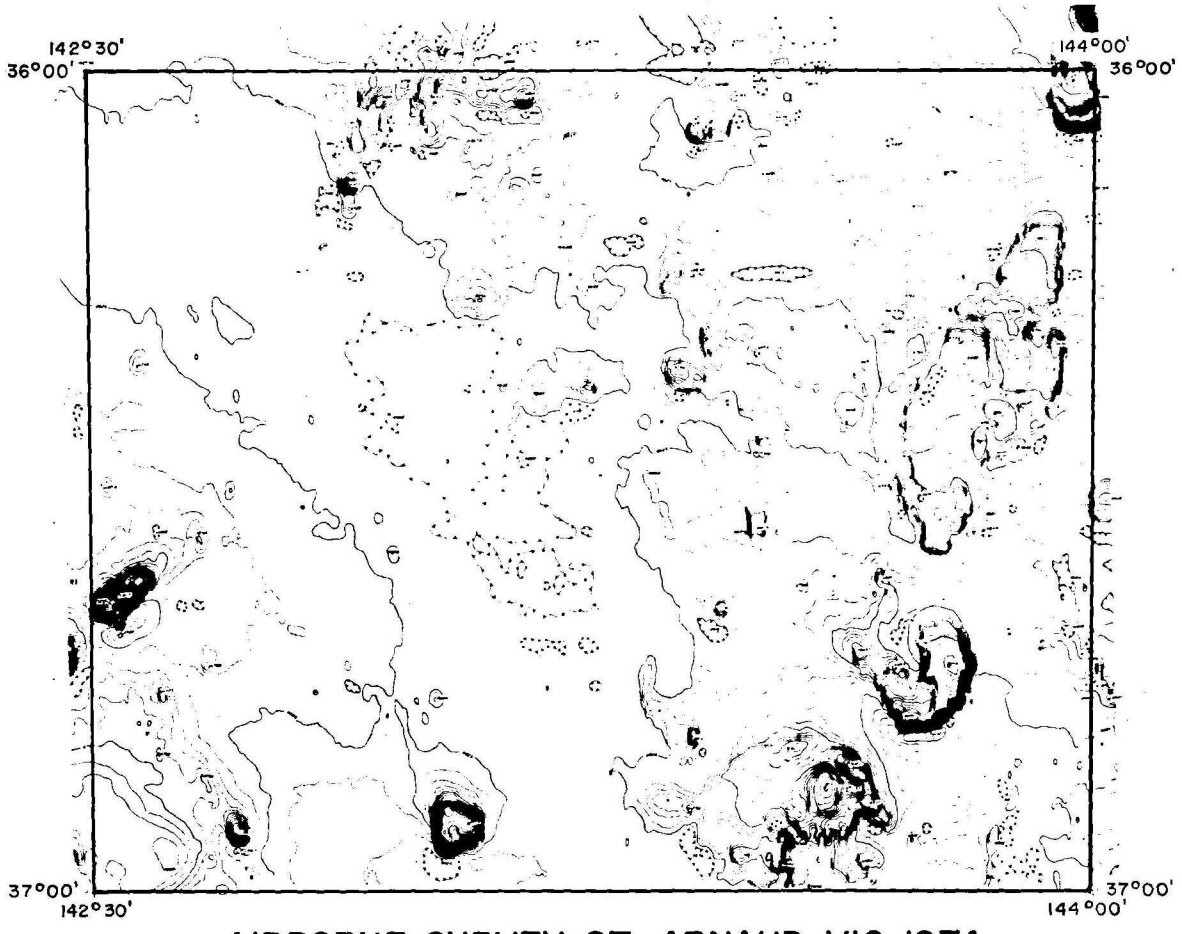
AND

FLIGHT – LINE SYSTEM

KILOMETRES 10 0 10 20 30 40 50 60 KILOMETRES

Record No. 1975/161

F54/B1 – 117A



AIRBORNE SURVEY ST ARNAUD, VIC. 1974

TOTAL MAGNETIC INTENSITY

SCALE

10 0 10 20 30 40 50 60 70 80 90 KILOMETRES

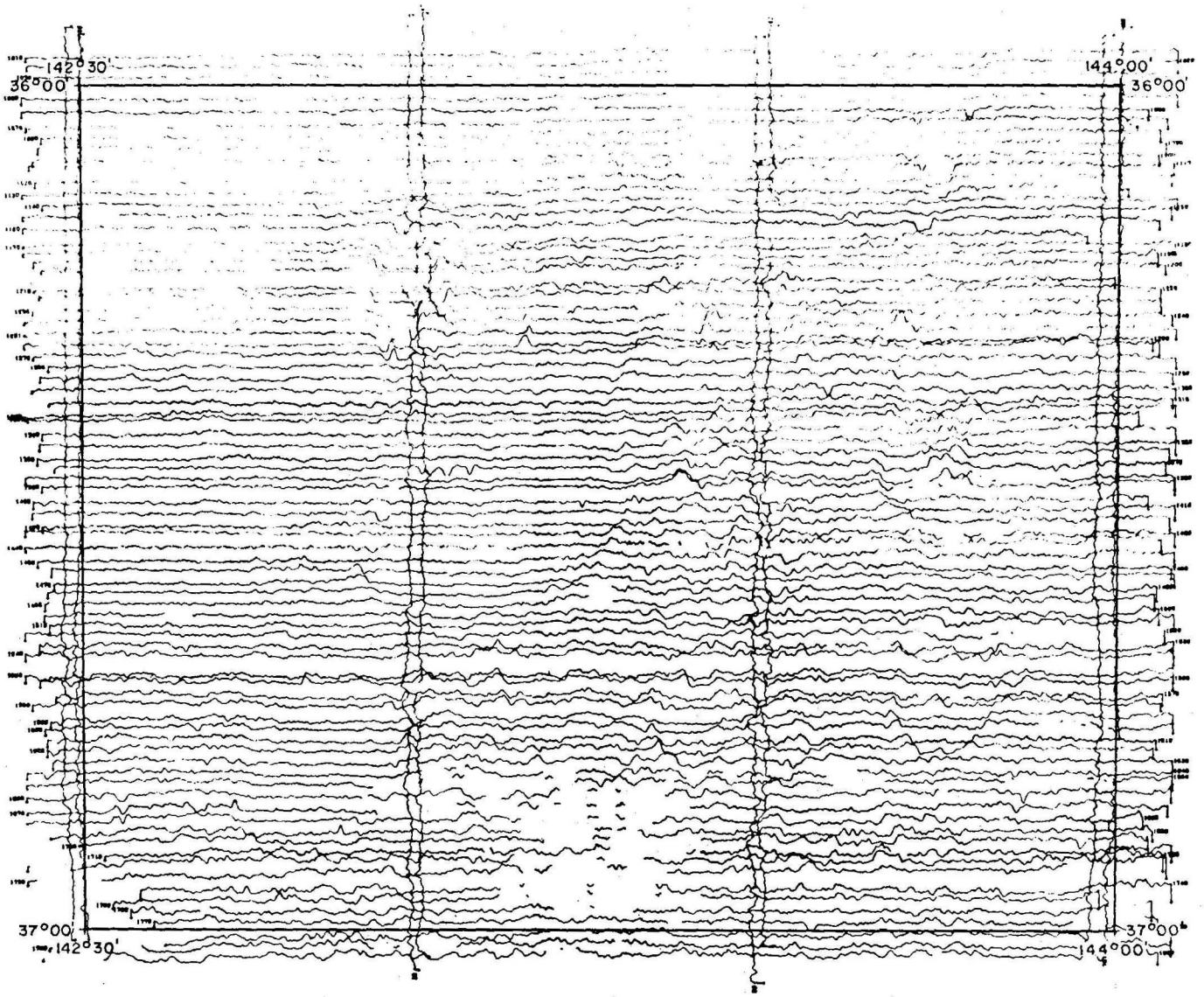
CONTOUR INTERVAL 25nT

LOCALITY DIAGRAM

REFERENCE TO 1:250000 MAP SERIES

OUYEN	SWAN HILL	DENILIQUIN
HORSHAM	ST ARNAUD	BENDIGO
HAMILTON	BALLARAT	MELBOURNE

Record No. 1975/161



AIRBORNE SURVEY ST ARNAUD, VIC. 1974

RADIOMETRIC PROFILES

TOTAL COUNT

SCALE

10 0 10 20 30 40 50 60 70 80 KILOMETRES

LOCALITY DIAGRAM

REFERENCE TO 1:250000 MAP SERIES

OUYEN	SWAN HILL	DENILIQUIN
HORSHAM	ST ARNAUD	BENDIGO
HAMILTON	BALLARAT	MELBOURNE

of the Victorian Mines Department in December 1974. The Twin Otter aircraft VH-BMG, equipped with a fluxgate magnetometer and a 4-channel gamma-ray spectrometer, was used for the survey. The aircraft was flown at an average ground clearance of 150 m along east-west lines spaced 1.5 km apart. The data were recorded digitally.

The magnetic contours resulting from the survey are displayed in Figure MA14. Cambrian and Ordovician sediments have little associated magnetic effect. Minor dykes transect the sediments and give rise to magnetic anomalies with amplitude less than 40 nT. More intense anomalies with amplitudes of a few hundred nT are associated mainly with granite intrusives, but metamorphic rocks mapped in the area present a similar magnetic pattern and are difficult to distinguish from the granites on magnetic evidence alone. Intense localized anomalies in the southwest corner of the area are interpreted as being due to intermediate to basic plugs.

The radiometric results (Fig. MA15) indicate low levels of gamma-radiation over the ST ARNAUD Sheet area, and the few anomalies appear to be associated with stream beds and drainage channels. None was recommended for further investigation.

Review of Wiso Basin aeromagnetic data NT (P.G. Wilkes)

A review is in progress of the aeromagnetic data which are available for the western and southern parts of Wiso Basin. Data from three sources have been combined to produce a map at a scale of 1:1 million showing depths to magnetic horizons. The three sources used are the Victoria River Basin surveys contracted by BMR to Adastra Hunting (1966) and GRD (1967) and a survey flown for American Overseas Petroleum Ltd in 1966 for which the results obtained are available under the terms of PSSA legislation.

There appear to be at least three magnetic horizons, the deepest of which does not necessarily correspond to geological basement. Depth estimates for all three horizons range from about 50 m to about 600 m below ground level. Work is in progress to see if formations known to be magnetic in the Tennant Creek area can be traced farther westwards. Computer modelling is in progress to determine whether the magnetic data can confirm the presence of the Lander Trough. The extensive Antrim Plateau Volcanics are clearly recognizable from the magnetic data. Hence data analysis is expected to better define the subsurface extent of the Volcanics, particularly where they have a thickness in excess of 50 m.

Airborne Reductions and Contracts Group (C. Leary, J. Rees, H. Hsu, P. Bullock, M. Riddell)

Program development. Development was concentrated mainly in rationalizing and streamlining the data management programs. Common sub-program routines have been incorporated in order to modularize the processing system for ease of maintenance and future development. Interpretative techniques are being added to the system to utilize the high-speed capabilities of the computer in those aspects of interpretation which lend themselves to automation. Documentation of the suite of programs is continuing.

The group abandoned magnetic tapes as an intermediate storage medium and substituted the demountable disc packs, provided by CSIRO, with a storage capacity of 100 million characters. Also the newly acquired on-line disc drive for permanent file storage was introduced.

Survey data processing and presentation. The status of the processing and presentation of data as it is expected to be at the end of 1975 is shown in Table 1.

Preliminary map releases. The maps of magnetic contours or gamma-ray stacked profiles released through the Government Printer and the relevant State mines departments during 1975 are shown in Table 2; copies of some of the maps are shown in Figures MA17 - MA30.

Officer Basin contract survey, W.A. A contract was awarded to Austral Airsurveys Pty Ltd on 7 July 1975 to make an aeromagnetic survey of 16 Map Sheet areas in the Western Australian part of the Officer Basin as shown in Figure MA16. The flying operations are expected to commence in November 1975 in areas A and B. All surveying should be concluded by September 1976, and the contract finalized in November 1976.

Magnetic Map of Australia. Contract work on the compilation of the continental portion of the Magnetic Map of Australia continued throughout most of the year. Phase 1 of the contract was completed in September with the delivery of preliminary compilations of aeromagnetic contours at a scale of 1:1 million as a 24-map series.

The contract is expected to be completed by the end of November with the delivery of a series of four maps showing final magnetic contours scribed at a scale of 1:2½ million. These maps will present all available magnetic data over the land areas in the NW, NE, SW, and SE quadrants of Australia. Marine magnetic data are being processed by BMR so that they can be included in the final contour map to be published in 1976.

TABLE 1: DATA PROCESSING AND PRESENTATION 1975

P = Processing completed PP = Processing in progress

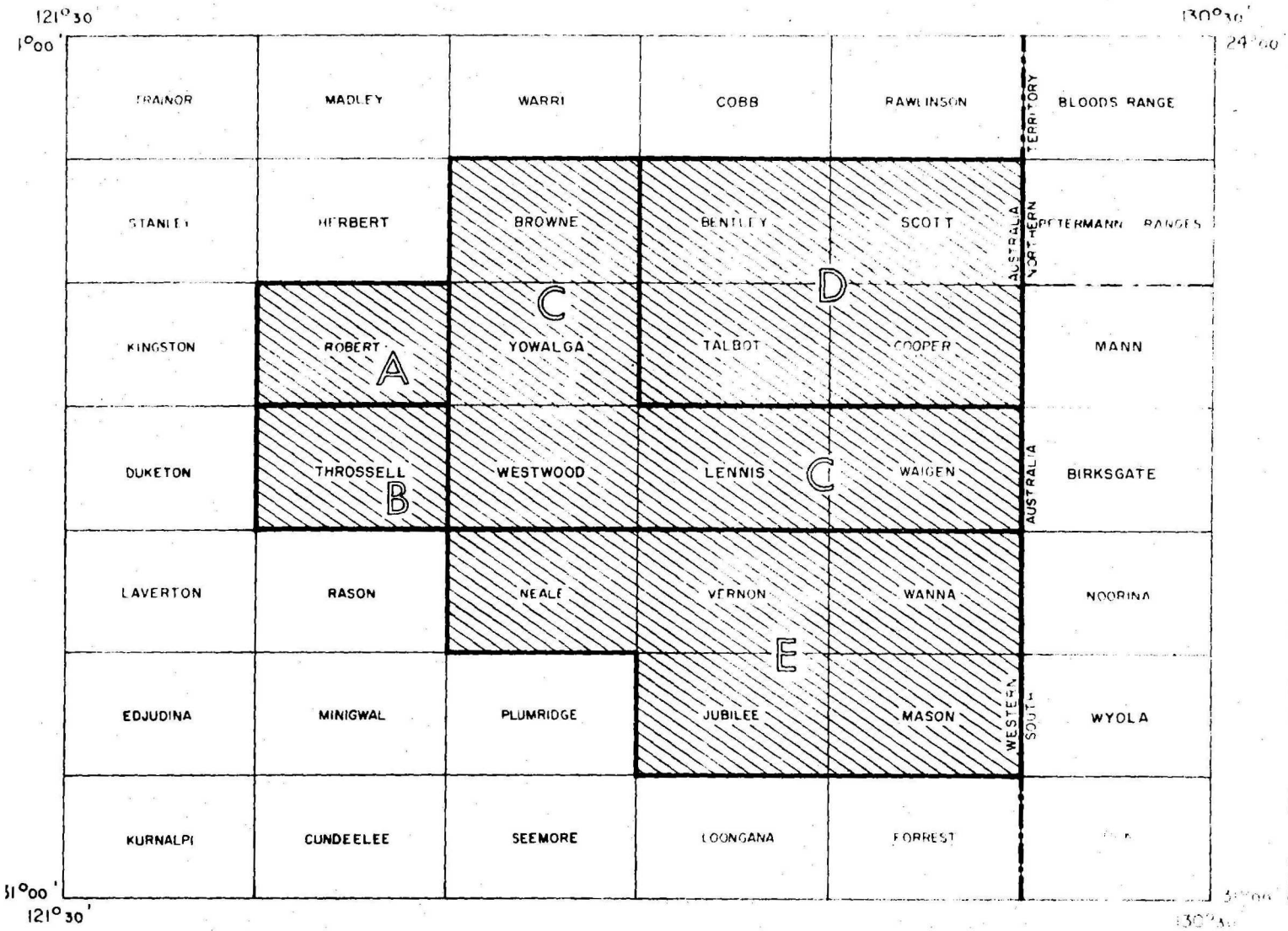
PROJECT	MAP NAMES	SURVEY CONFIGURATION					DATA STATUS		CONTOUR MAP PRESENTATION			PROFILE PRESENTATION		
		Mag	γ-ray	Doppler	Spacing km	Alt m	Mag	γ-ray	No. of maps	Scale	Data type	No. of maps	Scale	Data type
GAWLER BLOCK	WHYALLA	X	X	X	1.5	150	P	P	1	250 000	Mag	4	250 000	γ-ray
									6	100 000	Mag	1	250 000	Alt
	MAITLAND (PT)	X	X	X	1.5	150	P	P	1	250 000	Mag	4	250 000	γ-ray
									4	100 000	Mag	1	250 000	Alt
	LINCOLN (PT)	X	X	X	1.5	150	P	P	1	250 000	Mag	4	250 000	γ-ray
									2	100 000	Mag	1	250 000	Alt
	PORT AUGUSTA	X	X		1.5	150	PP	PP						
BROKEN HILL	BROKEN HILL (Regional)	X	X	X	1.5	100	P	P	1	250 000	Mag	5	250 000	γ-ray Alt
	BROKEN HILL (Detail)	X	X	X	0.3	100	PP	PP						
LACHLAN GEOSYN.														
	COOTAMUNDRA	X	X		1.5	150	PP	PP						
	ST ARNAUD	X	X	X	1.5	150	P	P	1	250 000	Mag	5	250 000	γ-ray Alt
PINE CREEK BLOCK	DARWIN/FOG BAY (PT)	X	X	X	1.5	150	P	P	2	250 000	Mag	5	250 000	γ-ray Alt
	PINE CREEK/ CAPE SCOTT	X	X	X	1.5	150	PP	PP						
	FERGUSSON R.	X	X	X	1.5	150	PP	PP						
	MT EVELYN	X	X		1.5	150	PP	PP						
	KATHERINE	X	X		1.5	150	PP	PP						
MT ISA BELT	DUCHESS	X	X	X	1.5	150	PP	PP						
EUCLA BASIN	COOK, OLDEA, BARTON	X			1.5	150	P							
	COOMPANA, NULLARBOR	X	X	X	1.5	150	P	P	1	500 000	Mag	4	250 000	γ-ray Alt
	FOWLER	X	X	X	1.5	150	P	P						
CARPENTARIA	HANN RIVER	X	X	X	3	150	P	P	1	250 000	Mag	5	250 000	γ-ray
	RUTLAND PLAINS	X	X	X	3/6	150	P	P	1	250 000	Mag	5	250 000	γ-ray Alt

TABLE 2: PRELIMINARY AIRBORNE MAP RELEASES 1975

PROJECT	MAP NAMES	CONTOUR		PRESENTATION		FIGURE NO
		No. of Maps	Scale	Data type	Release date 1975	
MAGNETIC MAP (AUST)						
	Narrandera/Hay Deniliquin/ Jerilderie	1	500 000	Mag	March	MA 17
	Horsham/Hamilton	1	500 000	Mag	March	MA 18
CARPENTARIA						
	Cape Melville	1	250 000	"	April	MA 19
	Ebagoola	1	" "	"	July	MA 20
	Holroyd	1	" "	"	"	MA 21
	Cooktown	1	" "	"	"	MA 22
	Hann River	1	" "	"	"	MA 23
	Rutlands Plains	1	" "	"	"	MA 24
LACHLAN GEOSYN.						
	Ballarat	1	250 000	Mag	July	MA 25
	St Arnaud	1	" "	"	"	
	Canberra	1	" "	"	Sept	MA 26
	Wagga Wagga	1	" "	"	"	MA 27
RED R. GEORGETOWN						
	Georgetown	6	100 000	Mag	July	MA 28
EUCLA BASIN						
	Nullarbor/Coompana	4	250 000	γ-ray	Oct	
	Fowler/Nuyts	2	" "	"	"	
	Nullarbor/Coompana Barton/Fowler Cook/Oldea	1	500 000	Mag	Dec	MA 29
GAWLER BLK						
	Whyalla	1	250 000	Mag	Nov	
	Maitland	1	" "	"	Dec	
	Lincoln	1	" "	"	"	
	Whyalla	6	100 000	"	Nov	
MT ISA BELT						
	Cloncurry	6	100 000	Mag	Apr	
	Prospector	1	100 000	"	"	MA 30

INDEX TO ADJOINING 1:250000 SERIES MAPS

MA16

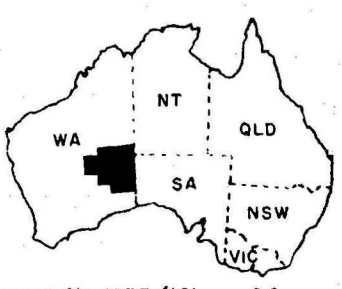


OFFICER BASIN AIRBORNE SURVEY, WA 1975

LOCALITY MAP

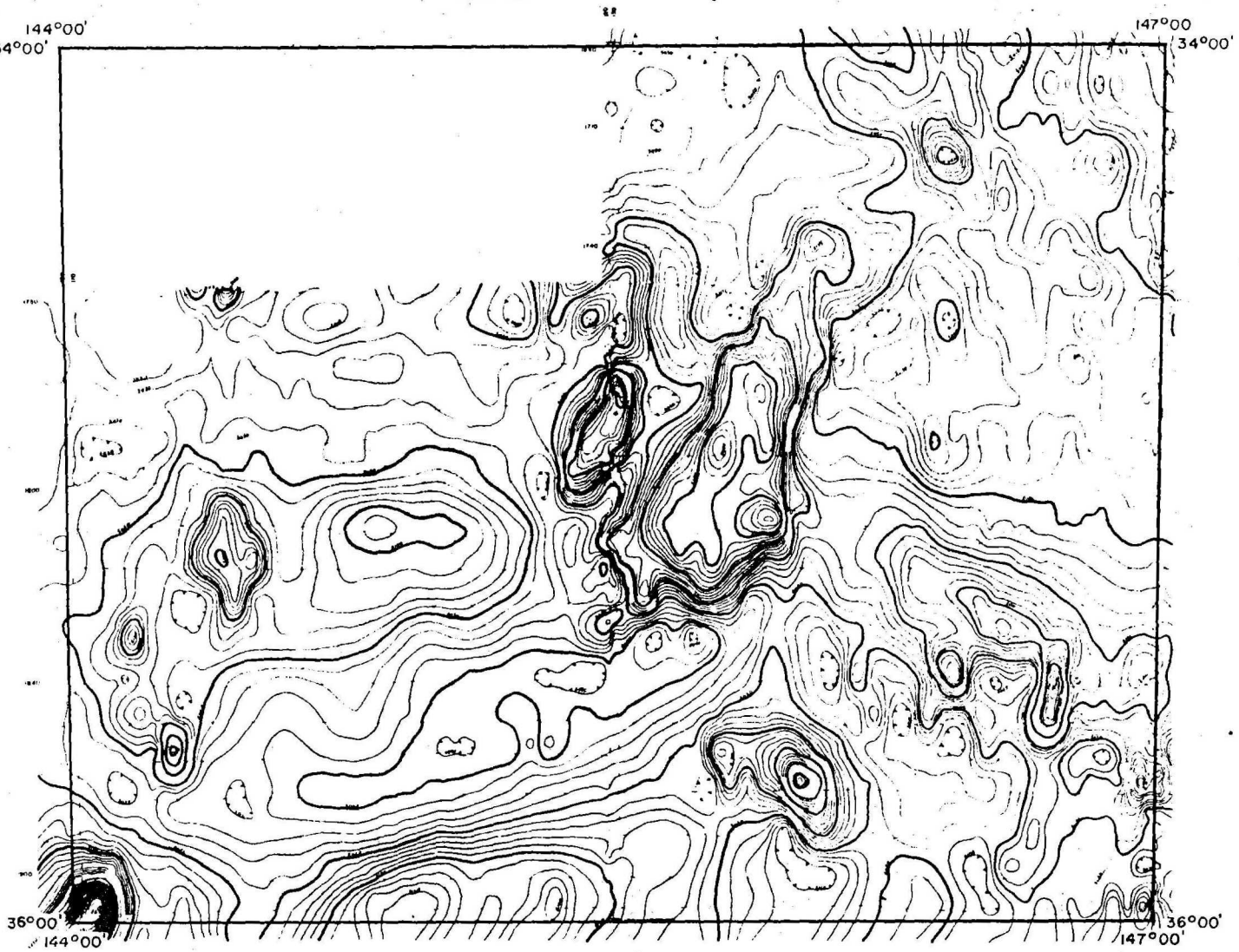
SCALE

100 0 100 200 300 KILOMETRES



Record No. 1975/161

G52/81-74A



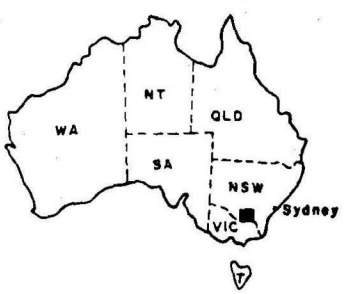
AIRBORNE SURVEY
HAY-NARRANDERA-DENILIQUIN-JERILDERIE, NSW 1974
TOTAL MAGNETIC INTENSITY

SCALE

20 0 20 40 60 80 100 120 140 160 180 KILOMETRES

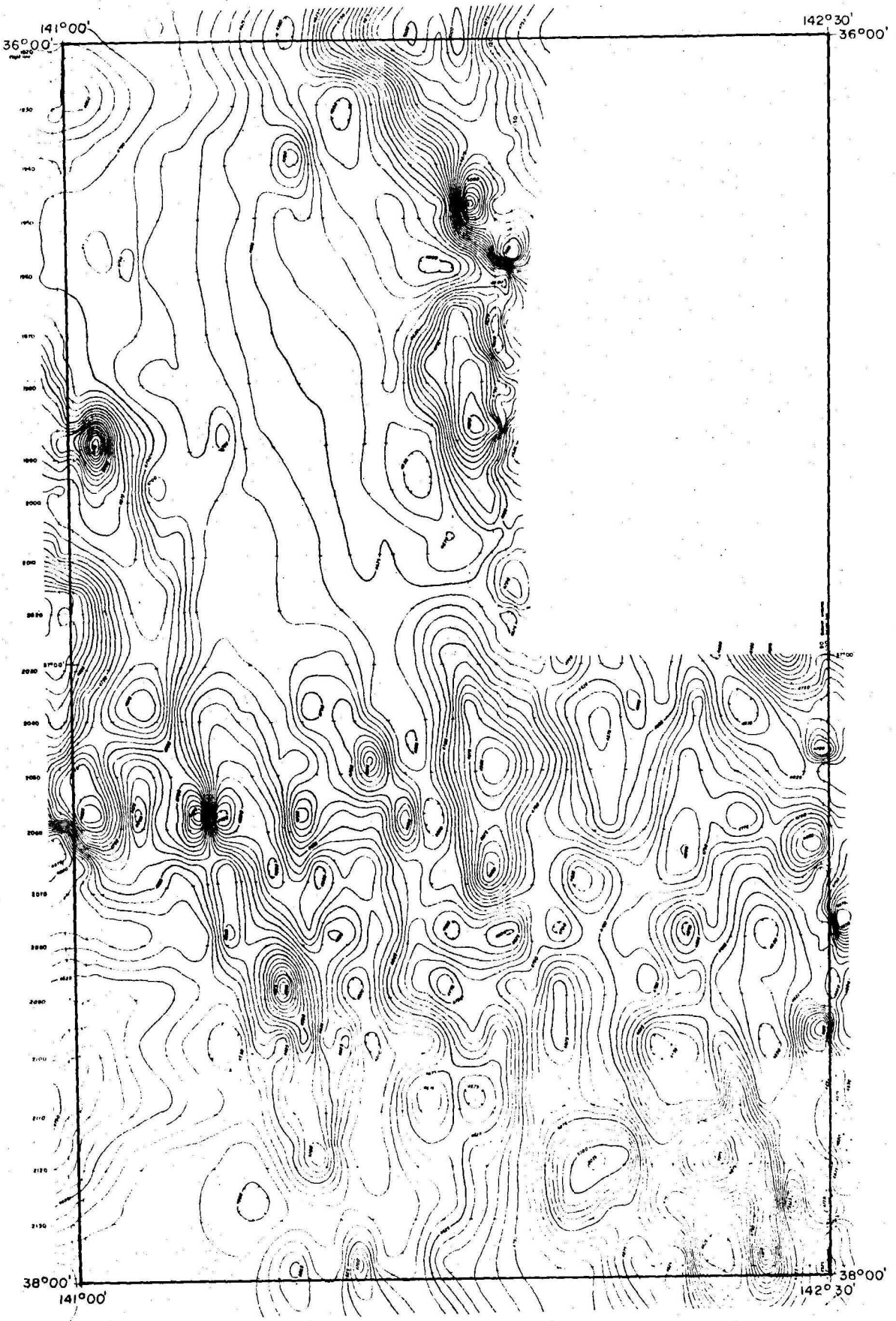
CONTOUR INTERVAL 10nT

LOCALITY DIAGRAM



REFERENCE TO 1:250000 MAP SERIES

POONCARIE	BOOLIGAL	CARGELLIGO	FORBES
BALRANALD	HAY	NARRANDERA	COOTAMUNDRA
SWAN HILL	DENILIQUIN	JERILDERIE	WAGGA WAGGA
ST ARNAUD	BENDIGO	WANGARATTA	TALLANGATTA



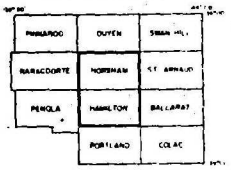
AIRBORNE SURVEY HORSHAM–HAMILTON, VIC. 1974

TOTAL MAGNETIC INTENSITY

5 0 5 10 15 20 25 Kilometres

CONTOUR INTERVAL 25 NANOTESLA

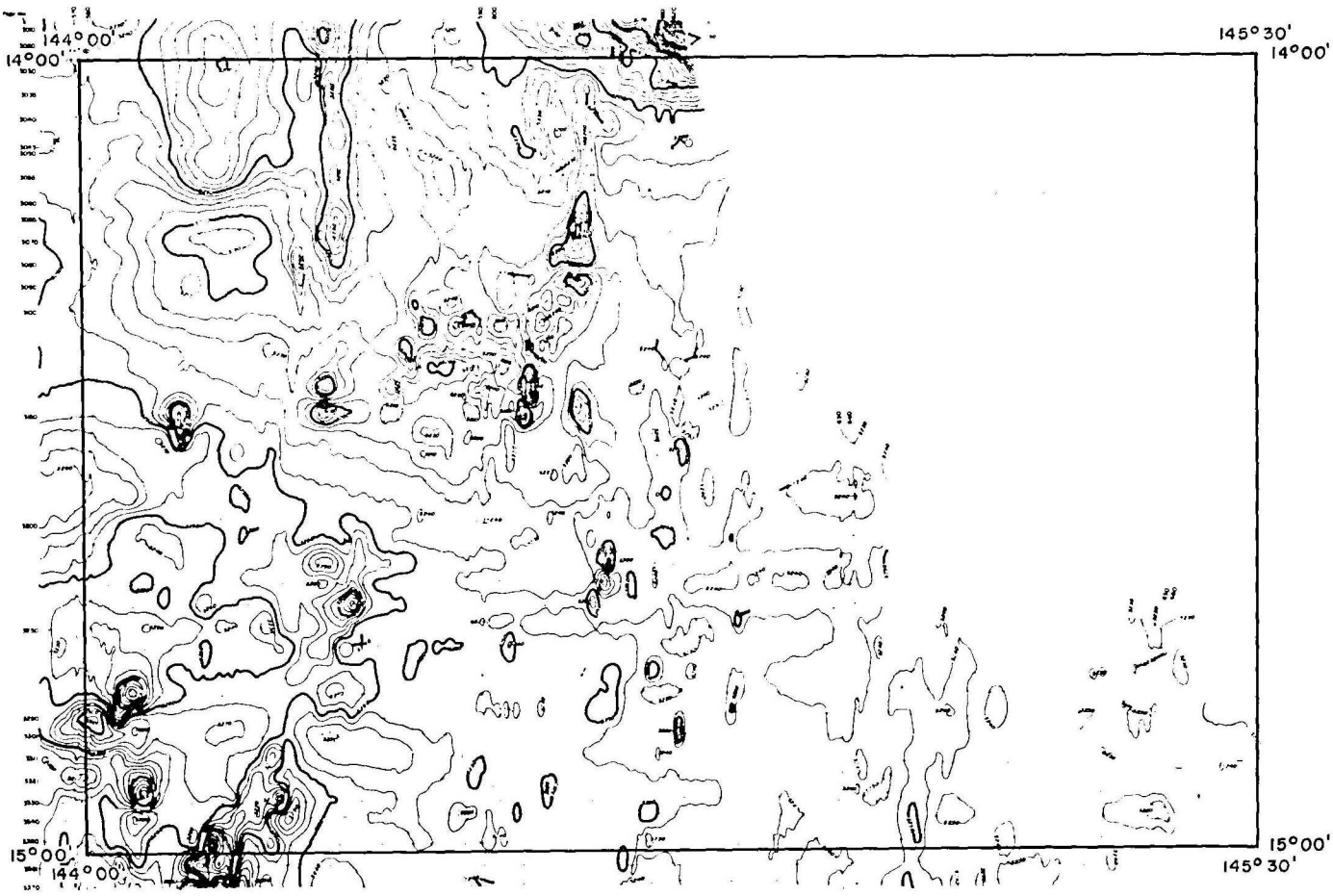
REFERENCE TO AUSTRALIA 1:250 000 STANDARD MAP SERIES



Record No. 1975/161

CAPE MELVILLE

MA 19



AIRBORNE SURVEY, CARPENTARIA BASIN, QLD 1973

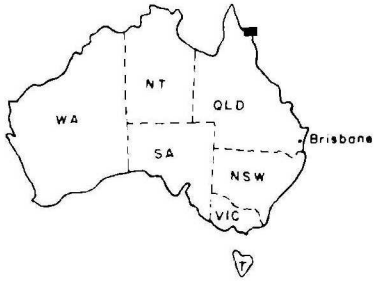
TOTAL MAGNETIC INTENSITY

SCALE

10 0 10 20 30 40 50 60 70 80 90 KILOMETRES

CONTOUR INTERVAL 10nT

LOCALITY DIAGRAM



REFERENCE TO 1:250 000 MAP SERIES

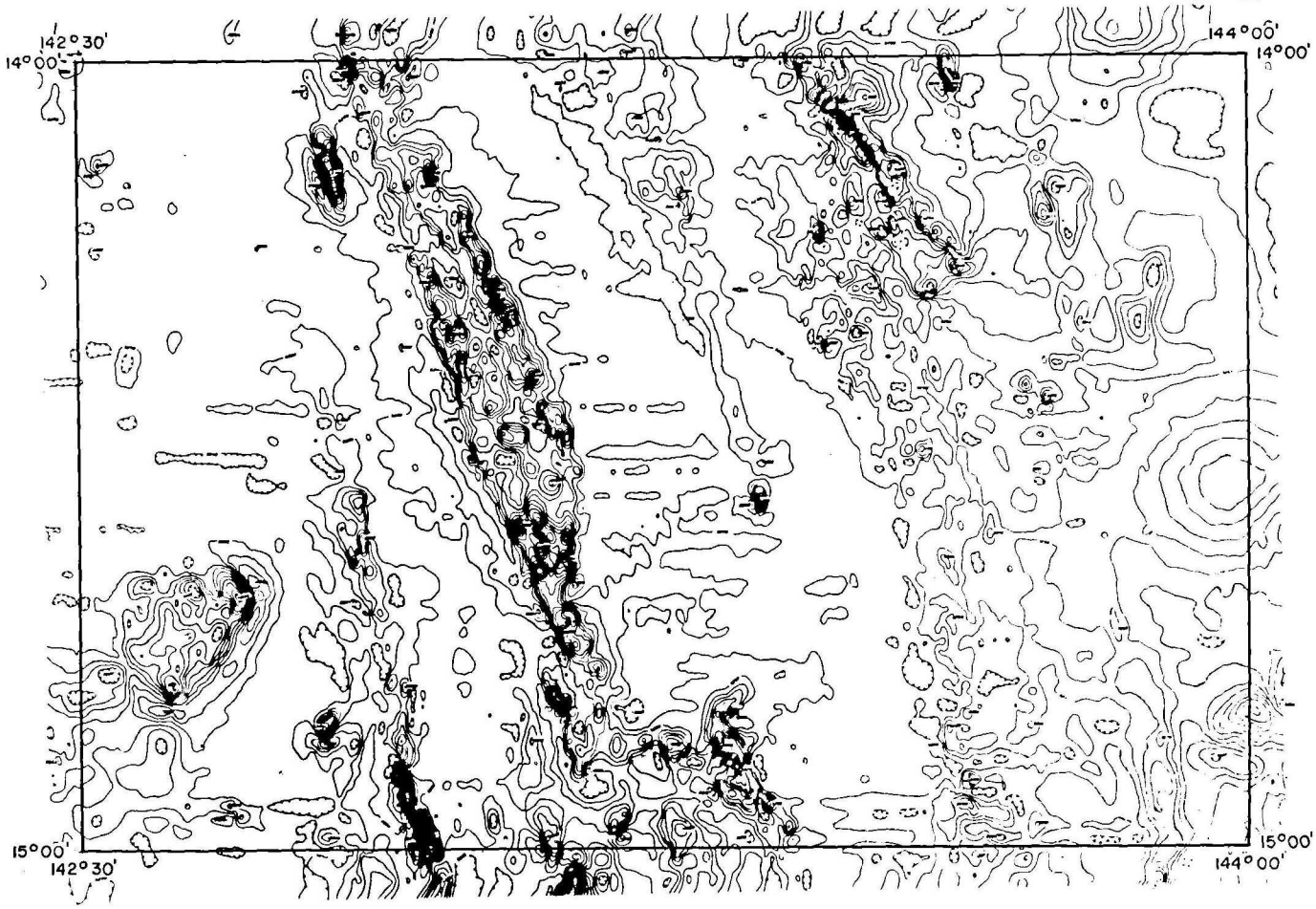
COEN	D55-5	D55-6
EBAGOOLA	CAPE MELVILLE	D55-10
HANN RIVER	COOKTOWN	D55-14

Record No. 1975/161

D55/B1-2-1A

EBAGOOLA

MA 20



AIRBORNE SURVEY, CARPENTARIA BASIN, QLD 1973

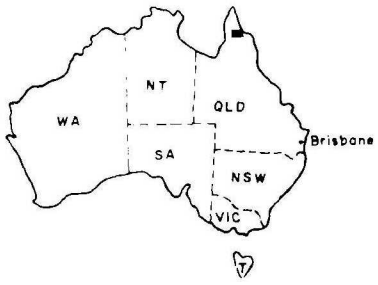
TOTAL MAGNETIC INTENSITY

SCALE

10 0 10 20 30 40 50 60 70 80 90 KILOMETRES

CONTOUR INTERVAL 10nT

LOCALITY DIAGRAM



REFERENCE TO 1:250 000 MAP SERIES

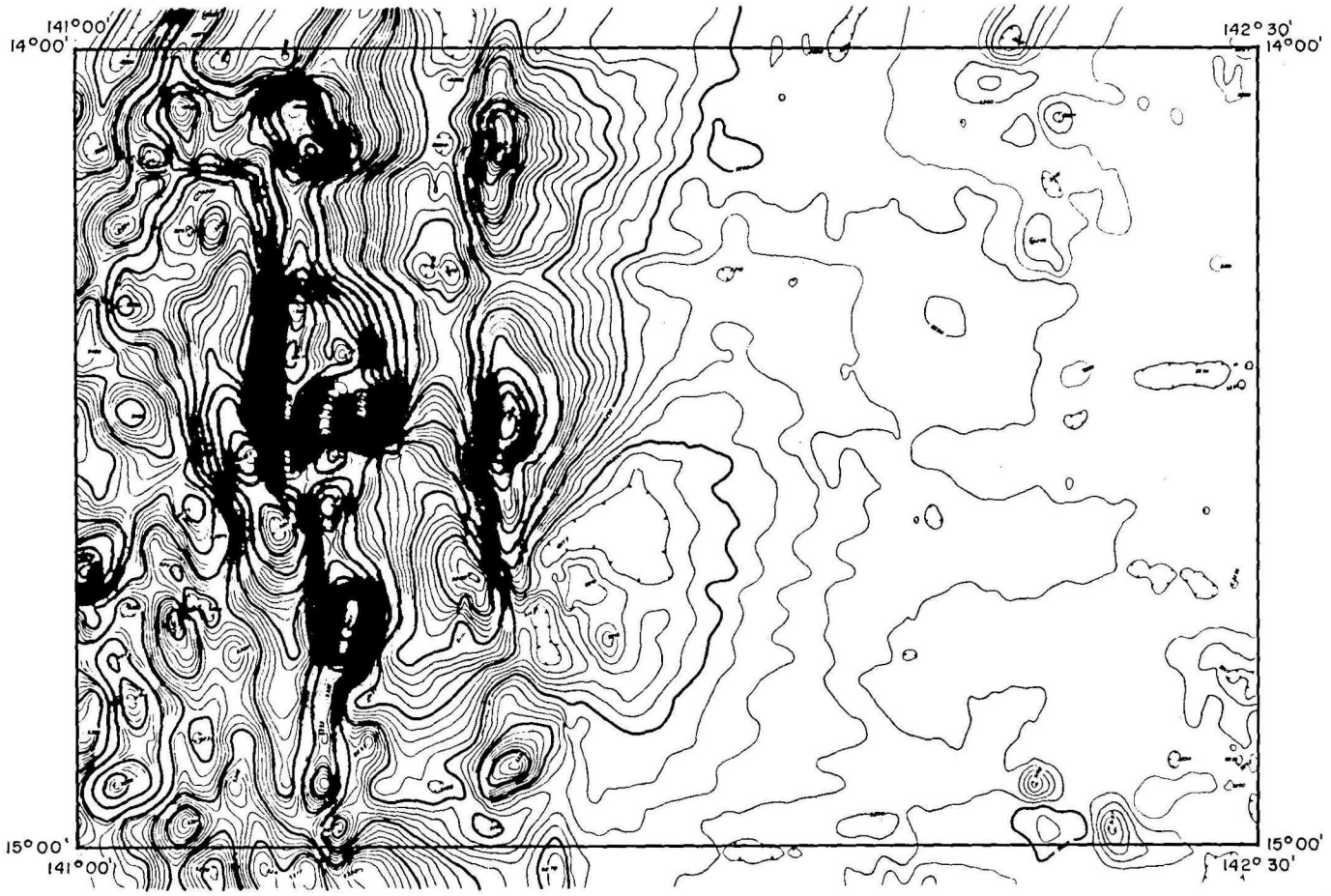
AURUKUN	COEN	D55-5
HOLROYD	EBAGOOLA	CAPE MELVILLE
RUTLAND PLAINS	HANN RIVER	COOKTOWN

Record No. 1975/161

D55/B1-20-1A

HOLROYD

MA 21



AIRBORNE SURVEY, CARPENTARIA BASIN, QLD 1973

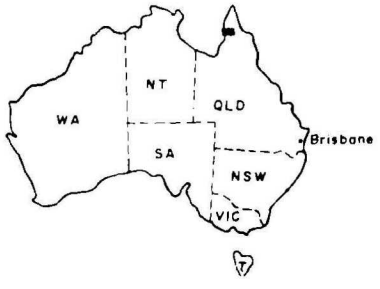
TOTAL MAGNETIC INTENSITY

SCALE

10 0 10 20 30 40 50 60 70 80 90 KILOMETRES

CONTOUR INTERVAL 10nT

LOCALITY DIAGRAM



REFERENCE TO 1:250 000 MAP SERIES

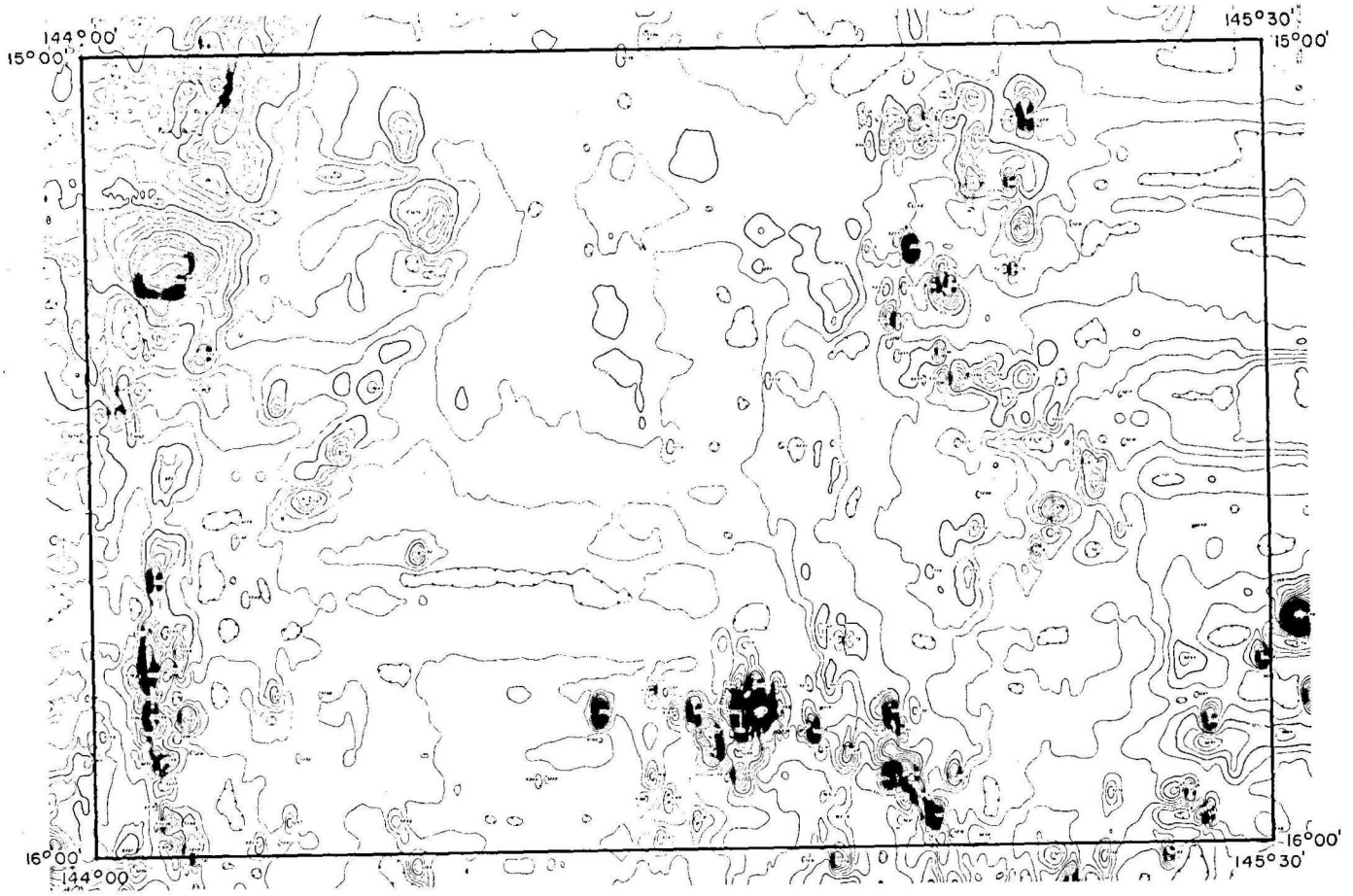
D54-6	AURUKUN	COEN
D54-10	HOLROYD	EBAGOOLA
D54-14	RUTLAND PLAINS	HANN RIVER

Record No. 1975/161

D54/81-21-1A

COOKTOWN

MA 22



AIRBORNE SURVEY, CARPENTARIA BASIN, QLD 1974

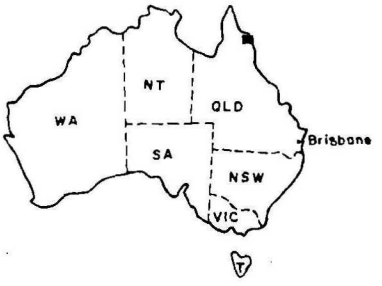
TOTAL MAGNETIC INTENSITY

SCALE

10 0 10 20 30 40 50 60 70 80 90 KILOMETRES

CONTOUR INTERVAL 10nT

LOCALITY DIAGRAM



REFERENCE TO 1:250 000 MAP SERIES

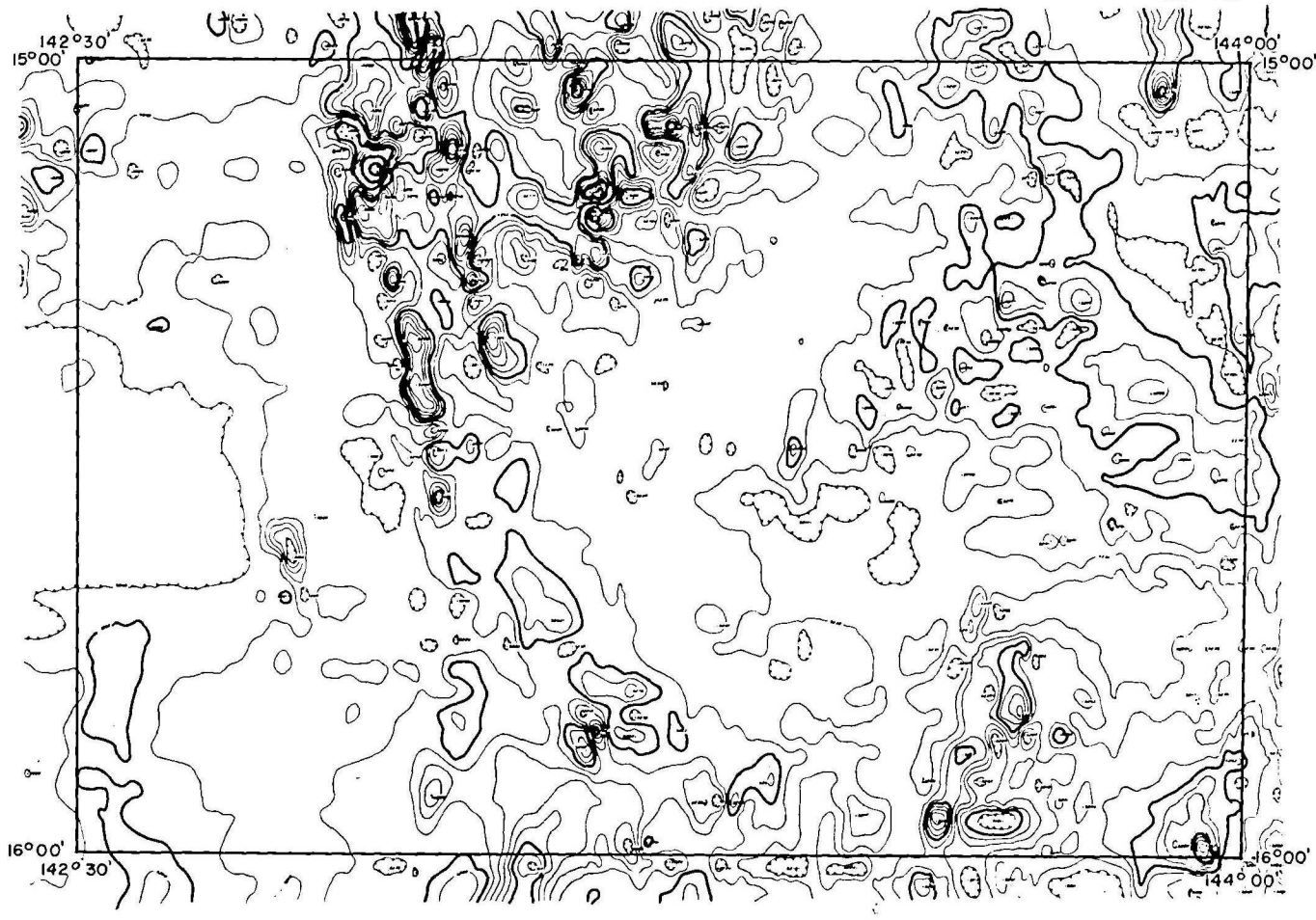
EBAGOOLA	CAPE MELVILLE	
HANN RIVER	COOKTOWN	D55-14
RUTLAND PLAINS	MOSSMAN	CAIRNS

Record No. 1975/161

D55/B1-3-1A

HANN RIVER

MA 23



AIRBORNE SURVEY, CARPENTARIA BASIN, QLD 1974

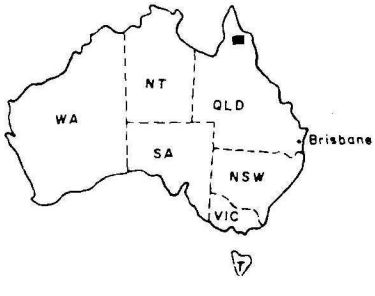
TOTAL MAGNETIC INTENSITY

SCALE

10 0 10 20 30 40 50 60 70 80 90 KILOMETRES

CONTOUR INTERVAL 10nT

LOCALITY DIAGRAM



REFERENCE TO 1:250 000 MAP SERIES

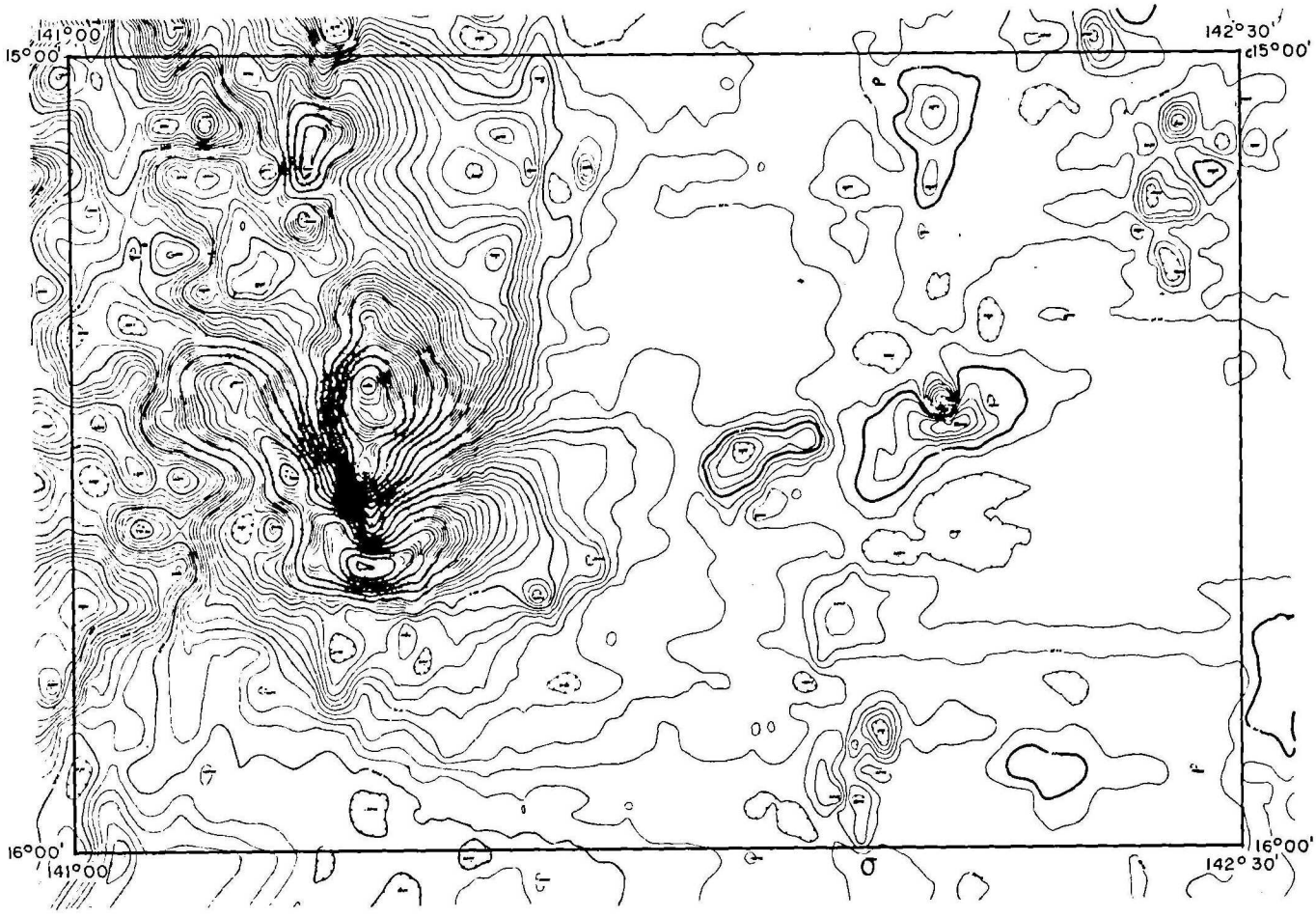
HOLROYD	EBAGOOLA	CAPE MELVILLE
RUTLAND PLAINS	HANN RIVER	COOKTOWN
GALBRAITH	WALSH	MOSSMAN

Record No. 1975/161

D54/B1-19-1A

RUTLAND PLAINS

MA 24



AIRBORNE SURVEY, CARPENTARIA BASIN, QLD 1974

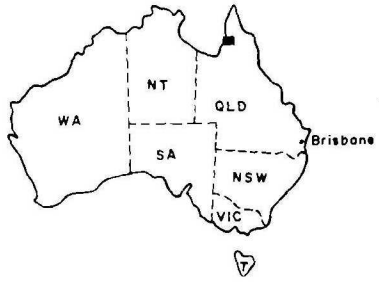
TOTAL MAGNETIC INTENSITY

SCALE

10 0 10 20 30 40 50 60 70 80 90 KILOMETRES

CONTOUR INTERVAL 10nT

LOCALITY DIAGRAM

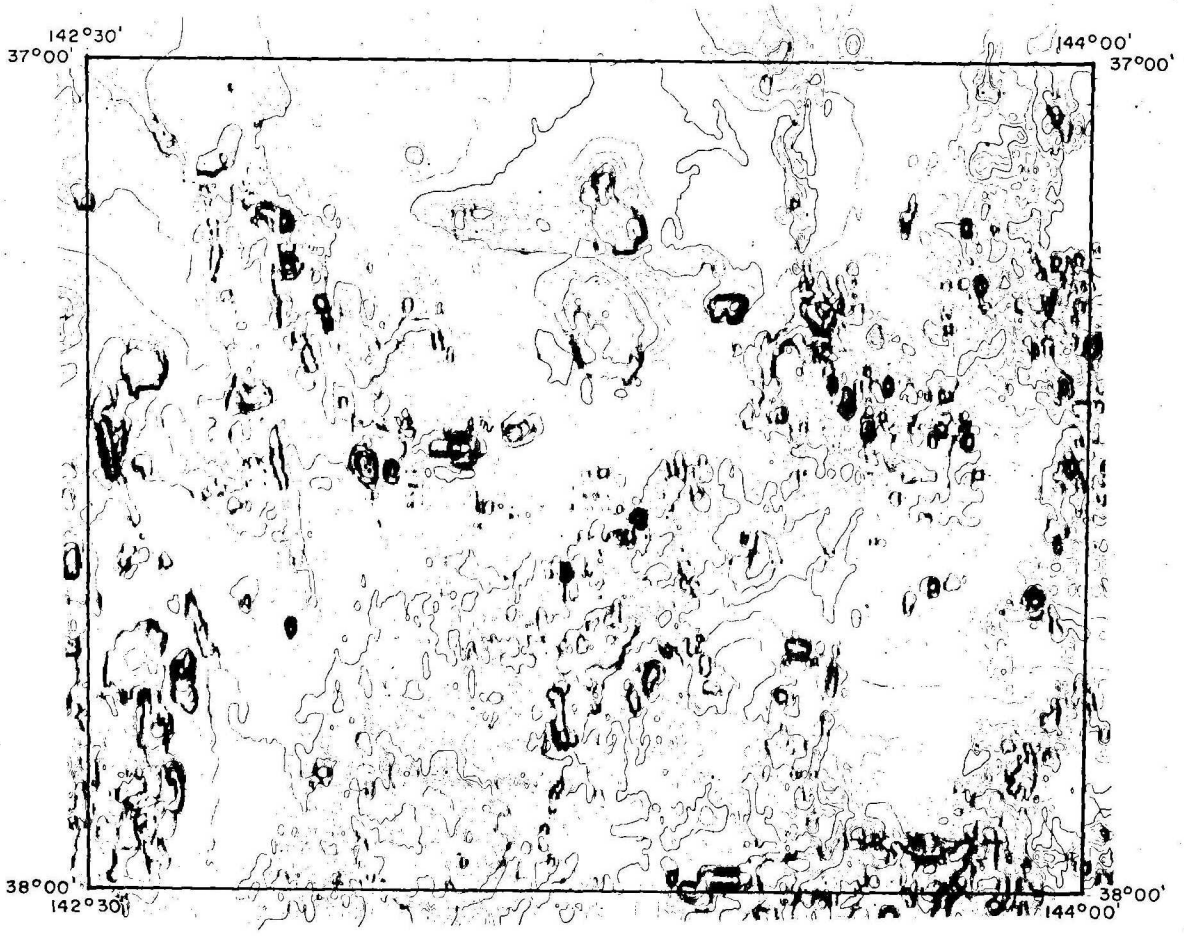


REFERENCE TO 1:250 000 MAP SERIES

D54-10	HOLROYD	EBAGOOLA
D54-14	RUTLAND PLAINS	HANN RIVER
CAPE VAN DIEMEN	GALBRAITH	WALSH

Record No. 1975/161

D54/BI-22-1A



AIRBORNE SURVEY BALLARAT, VIC. 1974
TOTAL MAGNETIC INTENSITY

SCALE

10 0 10 20 30 40 50 60 70 80 90 KILOMETRES

CONTOUR INTERVAL 25nT

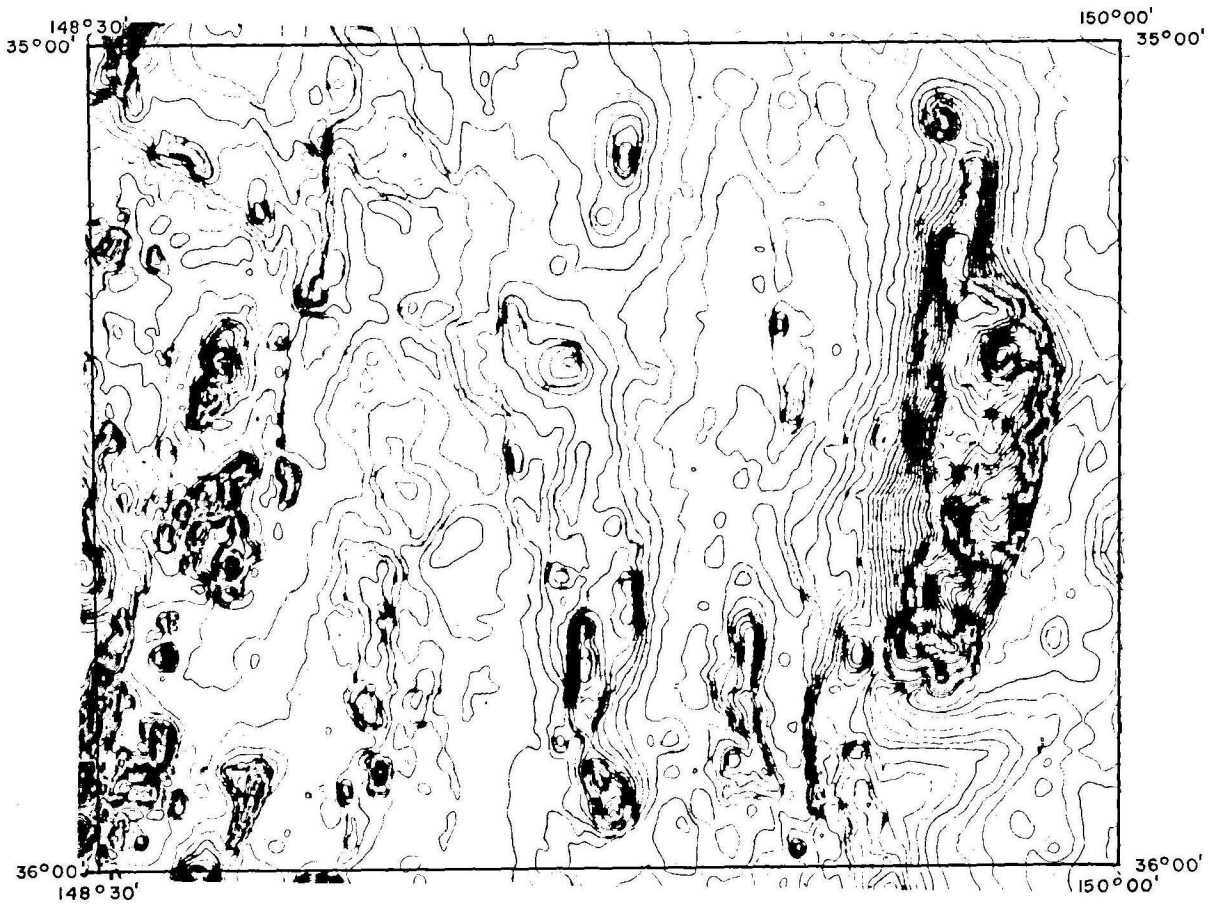
LOCALITY DIAGRAM

REFERENCE TO 1:250 000 MAP SERIES

HORSHAM	ST ARNAUD	BENDIGO
HAMILTON	BALLARAT	MELBOURNE
PORTLAND	COLAC	QUEENS -CLIFF

CANBERRA

MA 26



AIRBORNE SURVEY, CANBERRA-WAGGA WAGGA, ACT/NSW 1974

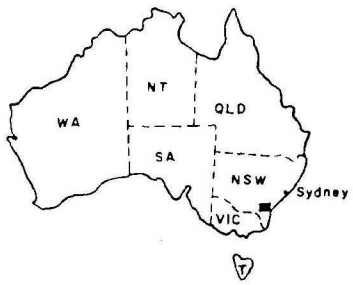
TOTAL MAGNETIC INTENSITY

SCALE

10 0 10 20 30 40 50 60 70 80 90 KILOMETRES

CONTOUR INTERVAL 25nT

LOCALITY DIAGRAM

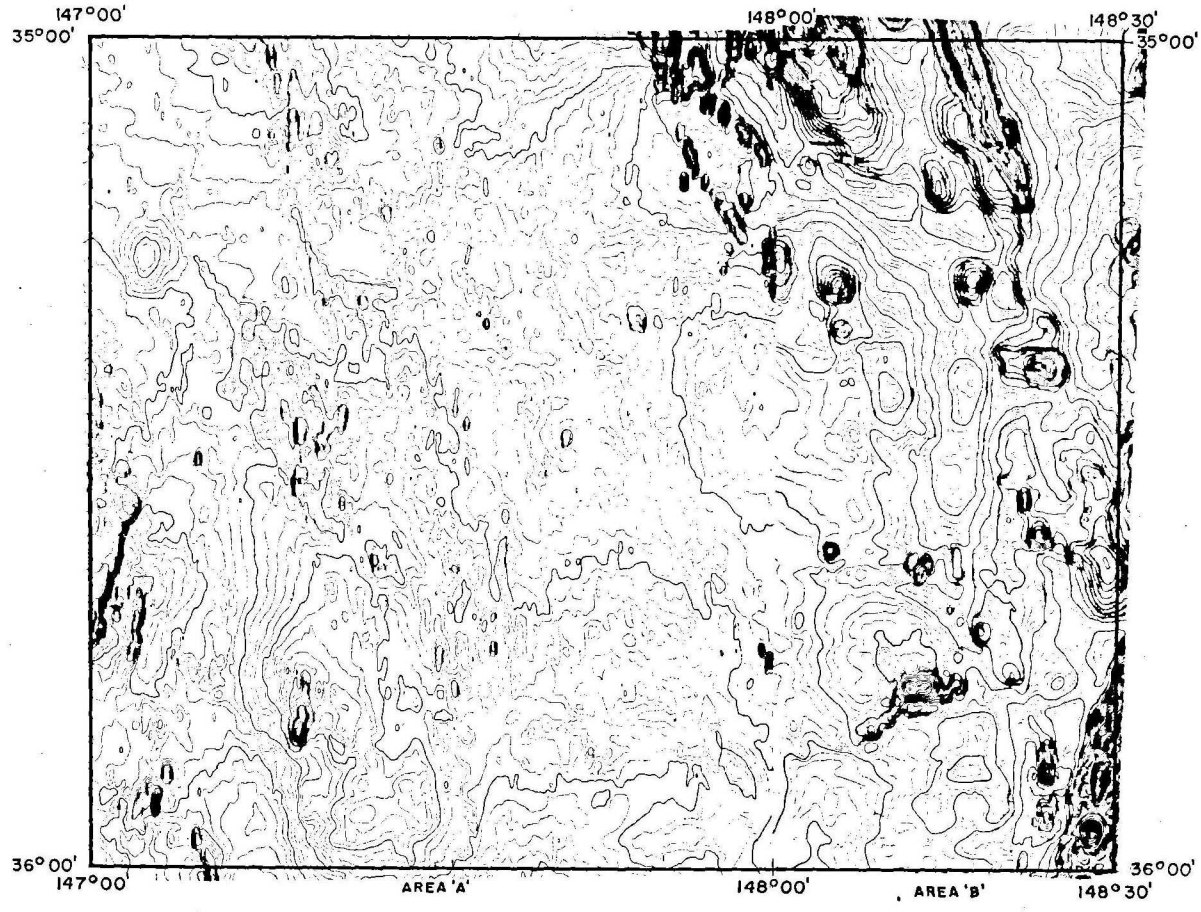


REFERENCE TO 1:250000 MAP SERIES

COOTAMUNDRA	GOULBURN	WOLLONGONG
WAGGA WAGGA	CANBERRA	ULLADULLA
TALLANGATTA	BEGA	

Record No. 1975/161

I55/BI-107-IA



AIRBORNE SURVEY, CANBERRA-WAGGA WAGGA, ACT/NSW 1974

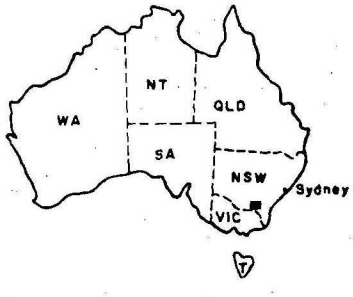
TOTAL MAGNETIC INTENSITY

SCALE

10 0 10 20 30 40 50 60 70 80 90 KILOMETRES

CONTOUR INTERVAL
AREA 'A' 10nT. AREA 'B' 5nT

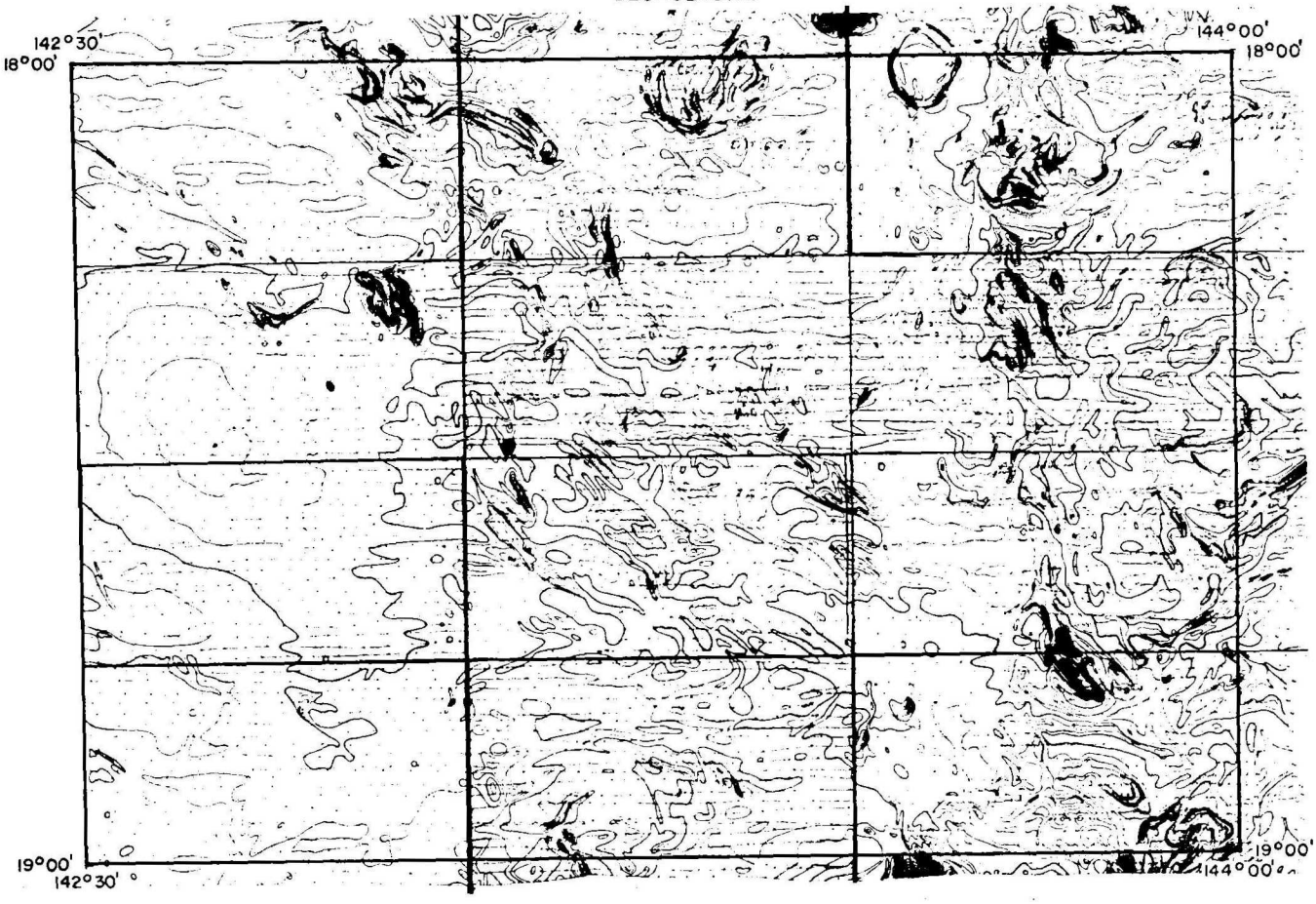
LOCALITY DIAGRAM



REFERENCE TO 1:250000 MAP SERIES

NARRANDERA	COOTAMUNDRA	GOULBURN
JERILDERIE	WAGGA WAGGA A B	CANBERRA
WANGARATTA	TALLANGATTA	BEGA

GEORGETOWN



AIRBORNE SURVEY, GEORGETOWN, QLD 1973

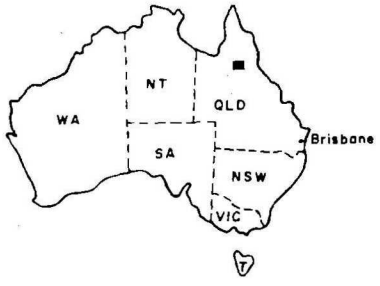
TOTAL MAGNETIC INTENSITY

SCALE

10 0 10 20 30 40 50 60 70 80 90 KILOMETRES

CONTOUR INTERVAL 50nT

LOCALITY DIAGRAM

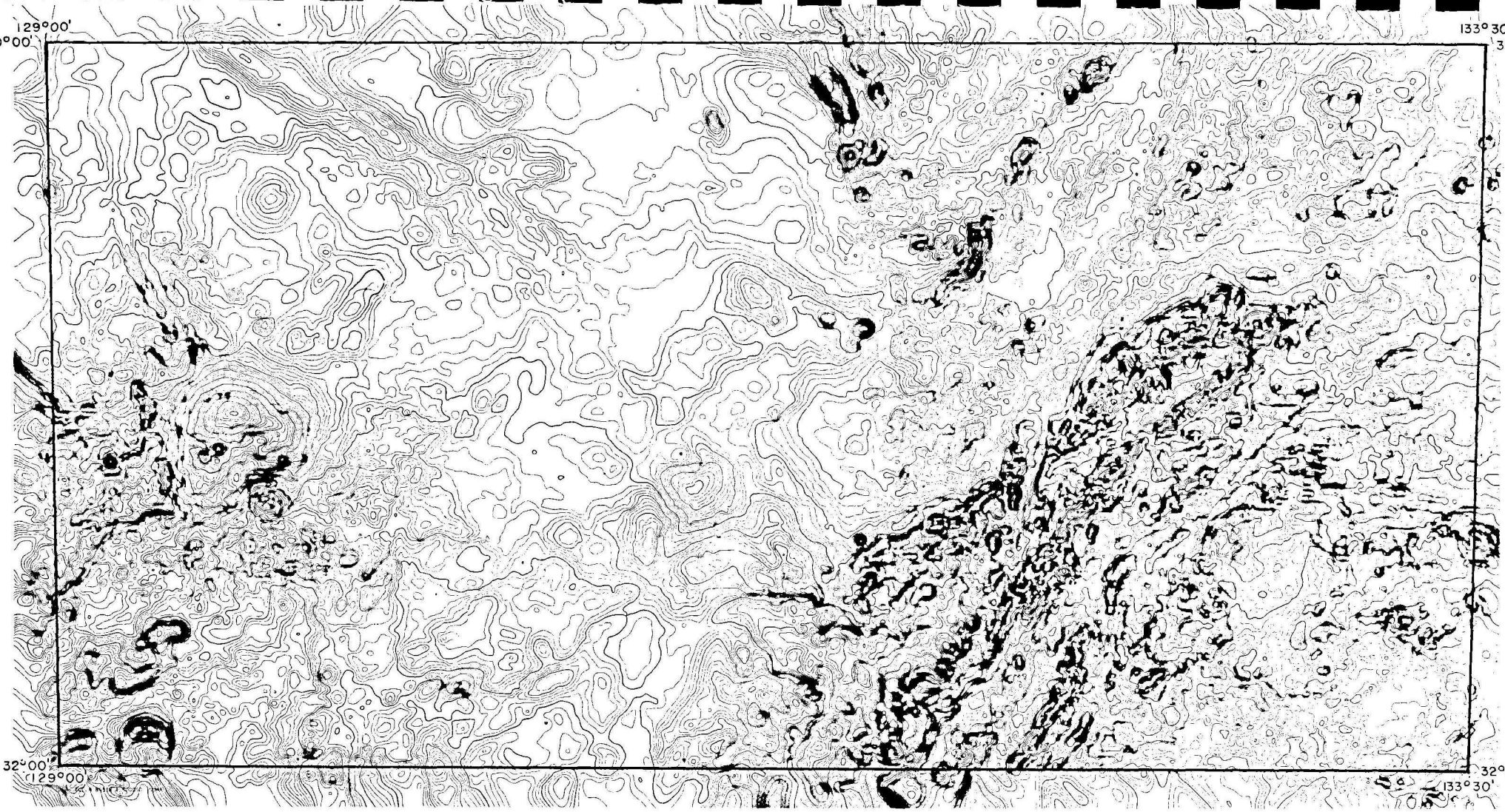


REFERENCE TO 1:250000 MAP SERIES

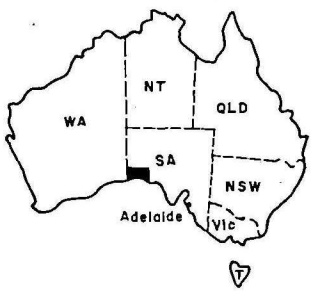
NORMANTON	RED RIVER	ATHERTON
CROYDON	GEORGETOWN	EINASLEIGH
MILLUNGERA	GILBERTON	CLARKE RIVER

Record No. 1975/161

COOK-OOLDEA-BARTON-COOMPANA-NULLARBOR-FOWLER



LOCALITY DIAGRAM



AIRBORNE SURVEY EUCLA BASIN, SA 1970 & 1972-73

TOTAL MAGNETIC INTENSITY

SCALE

50 0 50 100 150 KILOMETRES

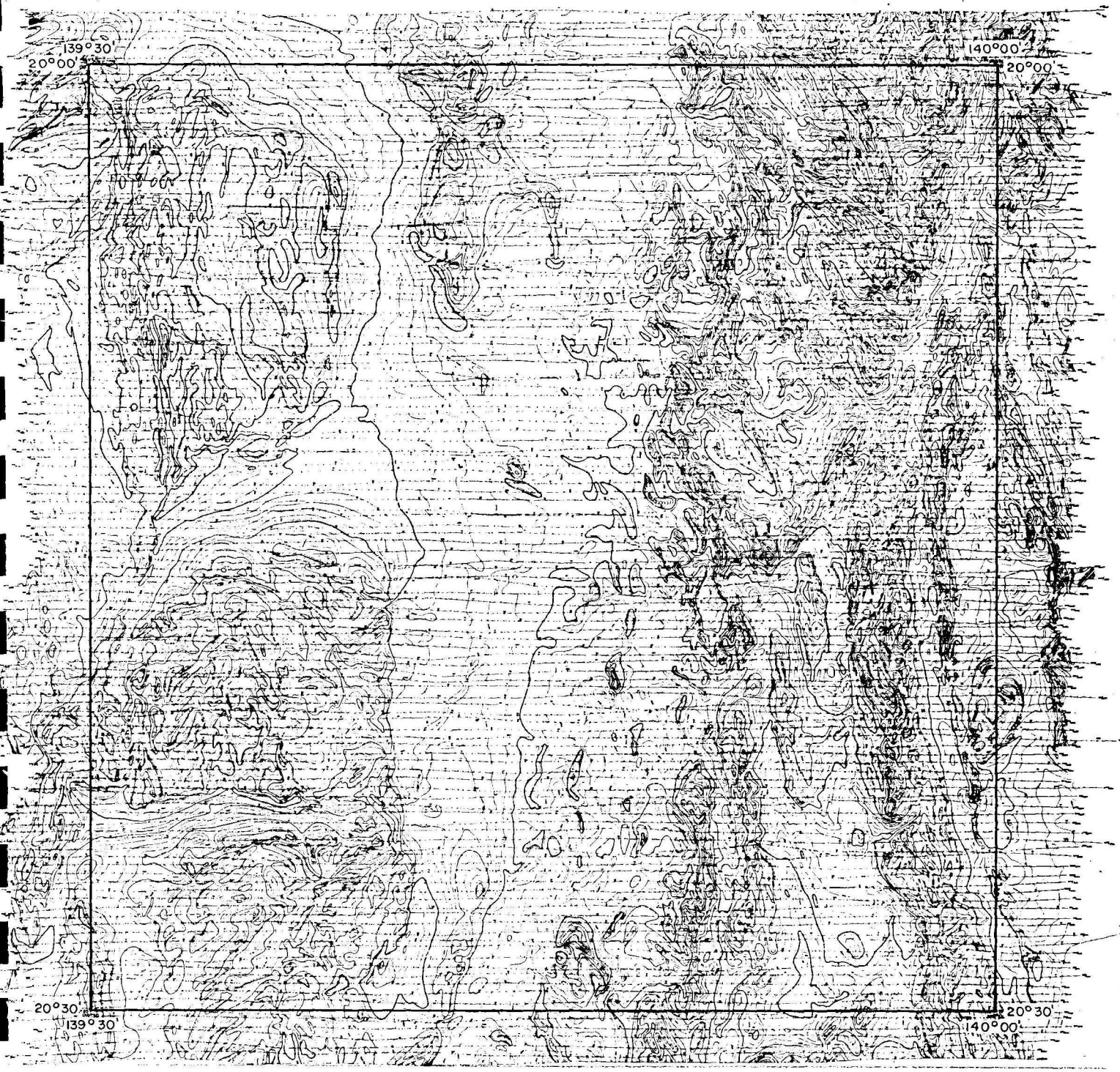
CONTOUR INTERVAL 50nT

REFERENCE TO 1:250 000 MAP SERIES

MASON	WYOLA	MAURICE	TALLARINGA	COOBER PEDY
FORREST	COOK	OOLDEA	BARTON	TARCOOLA
EUCLA	COOMPANA	NULLARBOR	FOWLER	CHILDARA
NOONAERA	I52-3	I52-4	NUYTS	STREAKY BAY

MA 29

'52/BI-6A



AIRBORNE SURVEY PROSPECTOR (DETAILED), QLD 1973

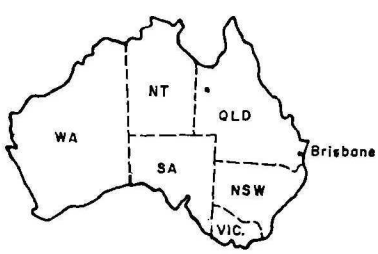
TOTAL MAGNETIC INTENSITY

SCALE

5 0 5 10 15 20 25 KILOMETRES

CONTOUR INTERVAL 5nT

LOCALITY DIAGRAM



REFERENCE TO 1:100 000 MAP SERIES

PROSPECTOR 6857	QUAMBY 6957	CLONAGH 7057
CLONCURRY		
MARY KATHLEEN 6856	MARRABA 6956	CLONCURRY 7056

Record No 1975/161

F54/BI-118 A

2. SEISMIC GRAVITY AND MARINE SECTION
(A. Turpie)

The only major survey made by the Section during 1975 was the seismic survey in the Galilee Basin. Minor surveys saw the measurement of gravity in the Melbourne area and of total magnetic intensity on the northwest continental shelf in association with the Division of National Mapping bathymetric survey. Once more the major tasks in the Section were the assessment and processing of data and interpretation of results from the Continental Margin Survey, 1970-1973. Again professional and technical staff from the Seismic and Gravity Groups worked in Marine Group to supplement the effort there, but, while seismic activity was increased by the carrying out of a major survey and continuation of review work, the gravity activity, after the completion of the helicopter reconnaissance survey of Australia in 1974, was allowed to decrease and mainly comprised completion of interpretation and reporting tasks on previous work.

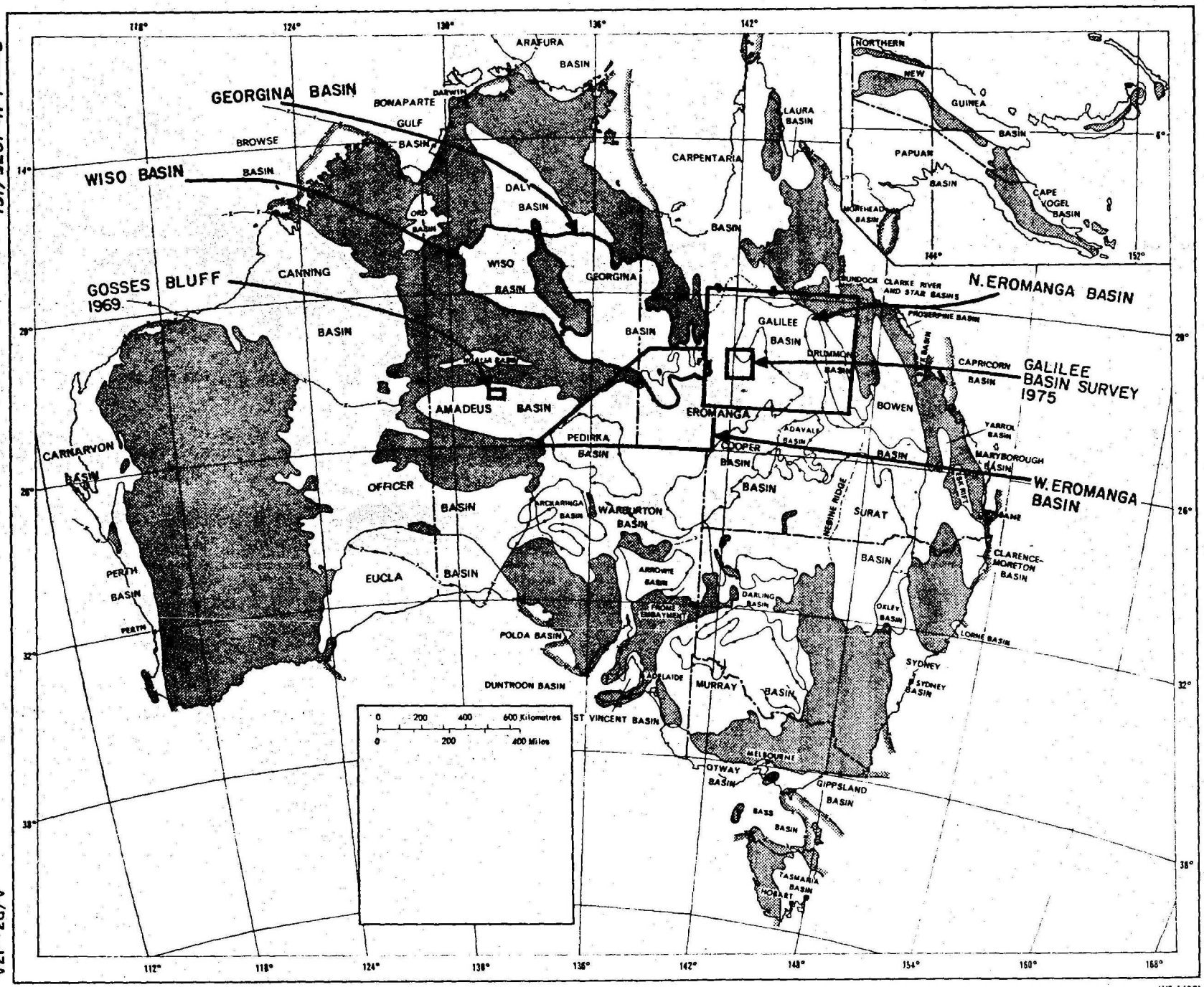
SEISMIC SURVEYS (F.J. Moss)

The areas covered in the work of the Seismic Group are shown in Figure SGM 1.

Galilee basin seismic survey, Qld, 1975 (P.L. Harrison, J.A. Bauer, D. Schmidt, F. Brassil, L. Hemphill, R. Enders, R. Cherry, L. Rickardson)

A seismic survey was conducted in the Galilee Basin from July to November 1975. The objectives of the survey were to obtain information on the thickness and structure of the Permo-Triassic sediments in the southwestern and northeastern parts of the basin and on the basin margins in these areas. The Geological Survey of Queensland (GSQ) is currently engaged in a stratigraphic drilling program in the Galilee Basin and is co-operating with BMR in the geological interpretation of the seismic results.

The survey commenced in July on a program of single-coverage reflection traverses across the Lovelle Depression in the southwestern part of the basin (Fig. SGM2). Traverse A was shot to tie private company seismic traverses southwest of Lovelle Downs No. 1 well to another running south from Ooroonoo No. 1 well, with the objective of defining the southern limit of the Galilee Basin. Traverse B, a cross-traverse on Traverse A, was shot to obtain better definitions of the eastern and western margins of the Lovelle Depression.



AREAS COVERED BY SEISMIC REVIEWS, REPORTS AND SURVEYS

AUS 1/291

SGMI

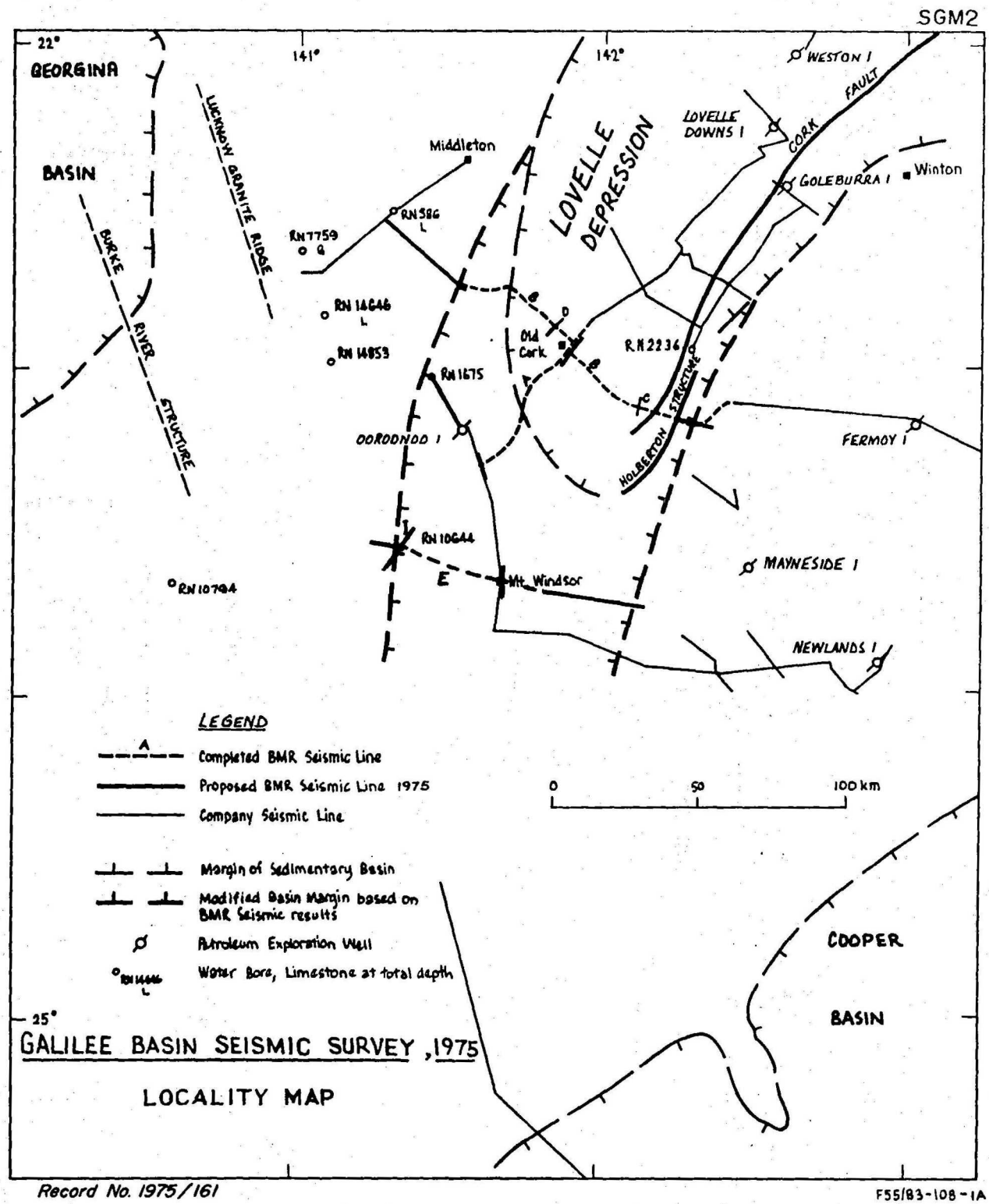
Traverses C and D, short cross-traverses on the southeastern and northwestern parts of Traverse B, were shot to obtain the true dips of the sediments. Fair to good quality seismic reflection results were obtained over most of the 200 km of traverses. Four main seismic reflection horizons, identified with the top of the Toolebuc Member, the top of the Hooray Sandstone, the top of the Permian, and the basement in the Lovelle Downs No. 1 well, have been followed with reasonable confidence along the private company reflection traverses south of Lovelle Downs No. 1 and along the BMR reflection traverses (Fig. SGM3). A better definition of the extent of the depression has been obtained.

In mid-September the seismic party commenced single-coverage reflection recording on an east-west traverse through Mount Windsor station and crossing the seismic traverse running south from Ooroonoo No. 1 well. The objective of this work was to investigate the extent and trend of a possible deep through of lower Palaeozoic/upper Proterozoic sediments, the presence of which has been suggested from a review of the previous seismic results. The seismic party spent the remainder of the 1975 field season on additional work in the Lovelle Depression, and the proposed seismic survey in the northeastern part of the basin will be deferred until 1976.

The eastern, western, and southern limits of the Lovelle Depression had been inferred previously from information from scattered petroleum exploration wells, water bores, and seismic surveys.

The eastern limit had been assumed to coincide with the Holberton Structure. The seismic results on Traverse B indicate that the Holberton Structure has a downthrow of about 300 m to the west, and that there is a fault, west of the Holberton Structure and with downthrow to the west of approximately 100 m, which may be an extension of the Cork Fault. The preliminary interpretation of the seismic results on Traverse B suggests that about 250 m of Permian lies on top of and to the east of the Holberton Structure. Thus the eastern margin of the depression is located more correctly to the east of the Holberton Structure, between the structure and the western end of a private company reflection traverse through to Fermoy No. 1 well, where there are no Permian sediments.

The approximate position of the western limit of the Lovelle Depression had been inferred from the presence of Permian sediments at the western ends of seismic traverses in the Lovelle Downs area, a thin Permian section in a water bore northwest of Lovelle Downs No. 1, and the absence of Permian in Ooroonoo No. 1 well. It is now placed tentatively at or beyond the western end of the part of Traverse B shot by mid-September.



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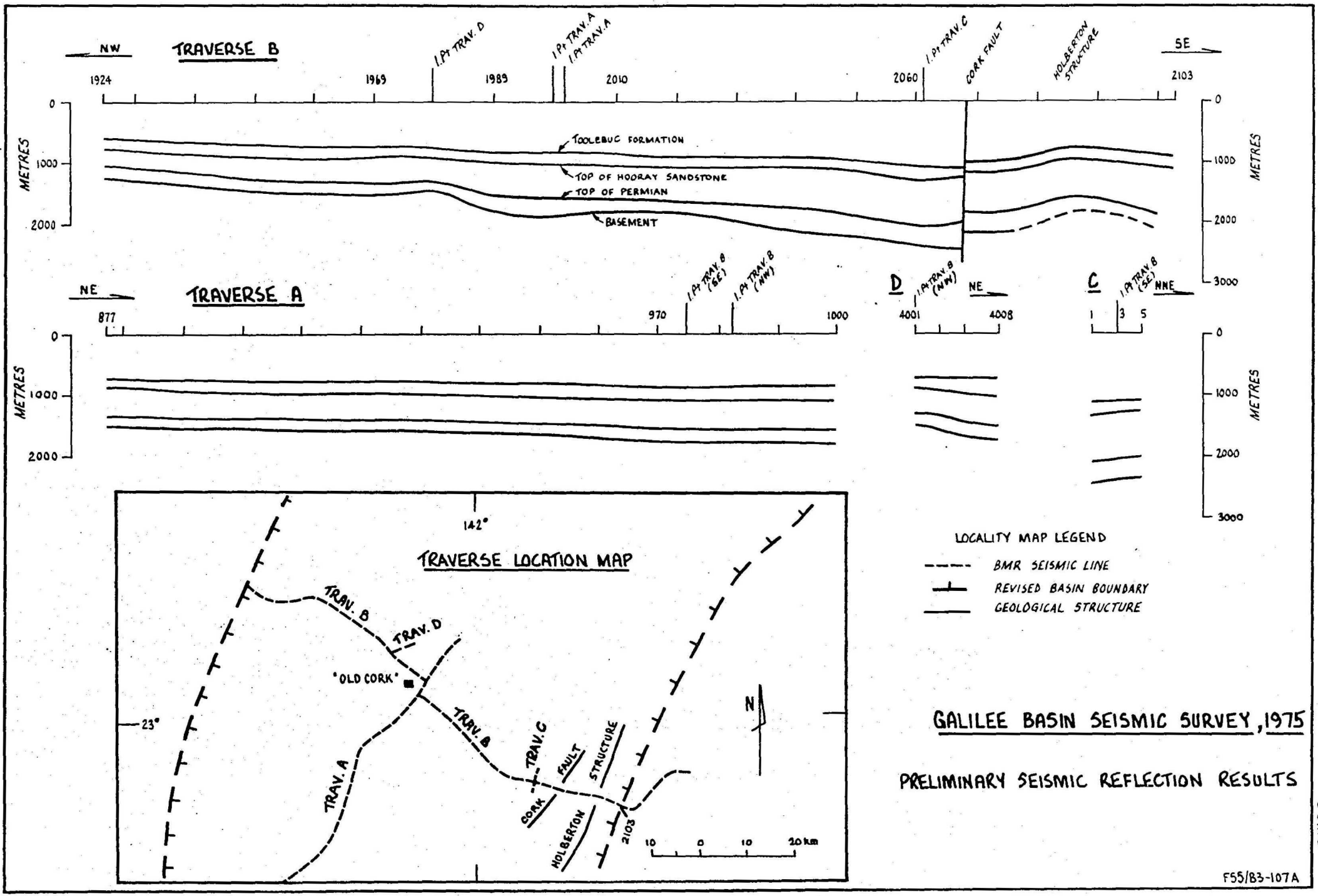

NW
TRAVERSE B
SE
1924
1969
1989
2010
2060
2103
I.Pt TRAV. D
I.Pt TRAV. A
I.Pt TRAV. A
I.Pt TRAV. C
CORK FAULT
HOLBERTON STRUCTURE
METRES
0
1000
2000
3000
TOOLEBUG FORMATION
TOP OF HOORAY SANDSTONE
TOP OF PERMIAN
BASEMENT
NE
TRAVERSE A
877
970
1000
I.Pt TRAV. B (SE)
I.Pt TRAV. B (NW)
D
I.Pt TRAV. B (NW)
NE
4001
4008
C
I.Pt TRAV. B (SE)
NNE
1
3
5
TRAVERSE LOCATION MAP
142°
23°
TRAV. B
TRAV. D
"OLD CORK"
TRAV. A
TRAV. B
TRAV. C
CORK FAULT
STRUCTURE
HOLBERTON
2103
N
10
0
10
20 km
LOCALITY MAP LEGEND
BMR SEISMIC LINE
REVISED BASIN BOUNDARY
GEOLOGICAL STRUCTURE
GALILEE BASIN SEISMIC SURVEY, 1975
PRELIMINARY SEISMIC REFLECTION RESULTS
F55/83-107A

SGM3

The southern limit was also arbitrarily inferred, from the assumption that the Permian thinned southwards and pinched out against granitic and metamorphic basement, recognized in Ooroonoo No. 1 and Mayneside No. 1 wells respectively. The preliminary interpretation of the seismic results on Traverse A indicates that the Permian is still present and is about 150 m thick at the junction of Traverse A with the private company seismic traverse running south from Ooroonoo No. 1 well. A review of the seismic results on this line indicates that the Permian sediments thin against a granitic basement high south of Ooroonoo No. 1 well, and that the Permian may be up to 400 m thick in the Mount Windsor area.

The aims of the survey for the remainder of the 1975 field season were to determine the eastern margin of the depression between Mount Windsor and Mayneside No. 1 well, to determine the western margin both in the vicinity of RN 10644 bore and in the Middleton area, to investigate the possibility that Permian sediments are present northwest of Ooroonoo No. 1 well, and to define the configuration of the granitic basement at Ooroonoo No. 1. CDP coverage was recorded at traverse junctions to provide control points for interpretation, with high-quality seismic reflection data and velocity information, and also on the northwestern extension of Traverse B, to better define the margin of the depression in this area.

The southern limit of the Lovelle Depression is now uncertain and further seismic reflection work is required to investigate the area south of Mount Windsor, to test the possibility of a link between Permian sedimentation in the Lovelle Depression and that in the Cooper Basin.

Pre-Eromanga Basins review (L. Tilbury, F. Brassil, A. Bigg-Wither)

The long-term seismic program review made in 1974 pointed particularly to a poor state of knowledge of the extent and form of the sedimentary basins beneath the Eromanga Basin. Proposals were made for more detailed studies of the geophysical results relating to these underlying basins with a view to determining where further seismic surveys could contribute to a better understanding of the geology of the region. A review of the area between latitudes 20° to 24°S and longitudes 141° to 147°E commenced in 1975; there the Permo-Triassic Galilee Basin and the Devonian-Carboniferous Drummond Basin underlie the Jurassic-Cretaceous Eromanga Basin. The Devonian Adavale Basin may underlie the Drummond Basin in the Koburra Trough, a deep trough which contains over 7 km of sediments and trends northwest beneath the northern Eromanga Basin.

Basic data were compiled from 32 exploratory wells, 9000 km of seismic traverses from 46 surveys, and reconnaissance gravity and aeromagnetic coverage. Stratigraphic tables, velocity information, and company interpretations were extracted from company reports and indexed for future reference.

Seismic shot-point positions were digitised to allow plotting of traverses at any scale and on any projection, to enable ties between surveys to be determined easily and to permit future computer-contouring of seismic horizons. Existing computer programs used for digitizing and plotting marine traverses were modified for the purpose. Shot-point positions have been plotted on standard 1:250 000, 1:500 000 and 1:1 000 000 maps (Fig. SGM4). Magnetic and gravity anomaly maps are being compiled initially at 1:500 000 scale.

Those seismic records from company reports which were of reasonable quality were reduced photographically for interpretation. However, most seismic records are of poor quality below the 'P' horizon (a very strong reflector from a sequence of Upper Permian coal measures), which effectively limits seismic penetration and gives rise to strong multiple reflections. As CDP reflection methods were not used in most of the surveys, the seismic information below the 'P' horizon is difficult to interpret in many areas. The poor records are being played back in the BMR playback centre to try to improve the record quality.

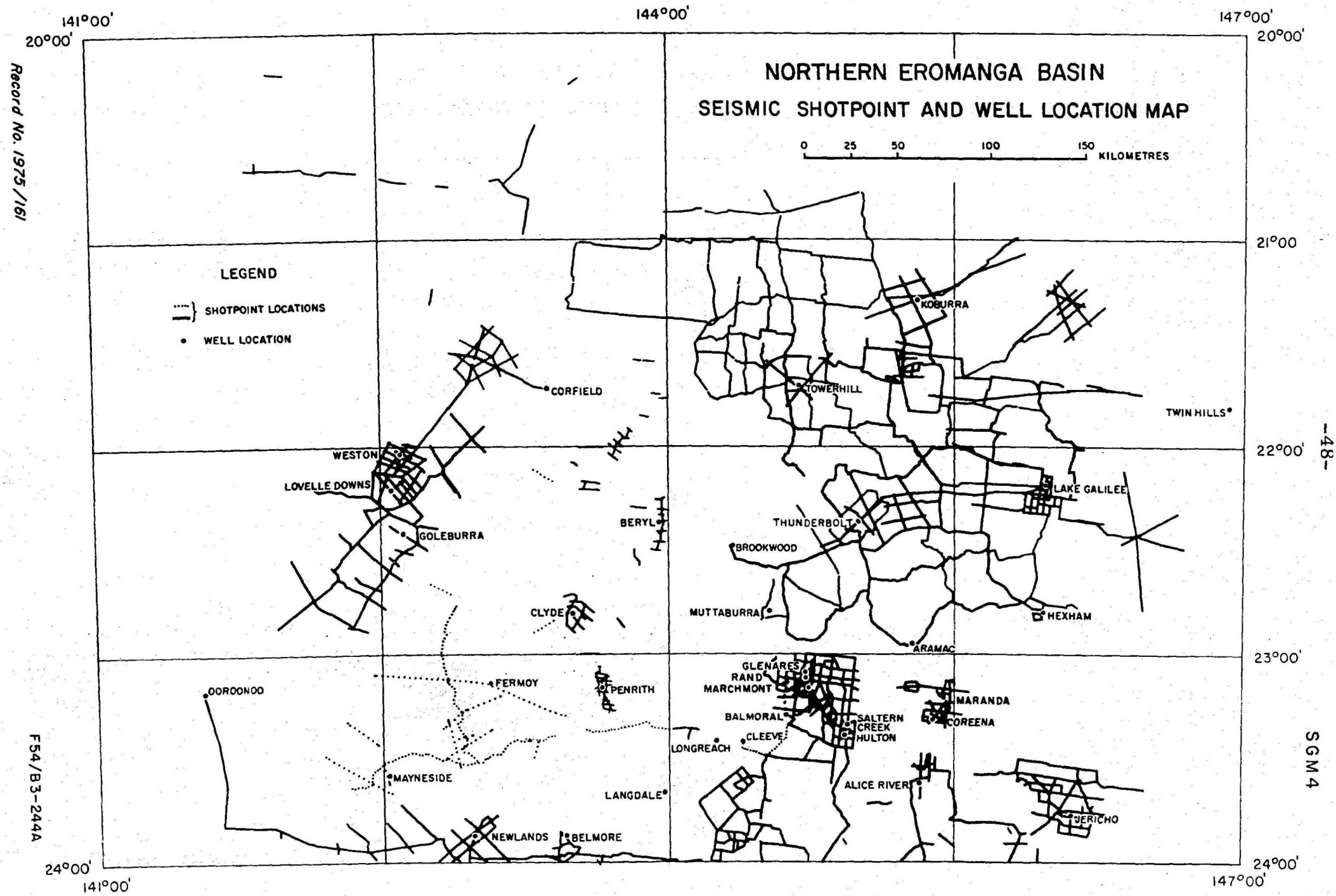
The processed seismic record sections are being interpreted, cross-sections are being drawn between wells using seismic control, and the assembly of contours of the 'P' horizon using maps from company reports has begun. It is proposed to draw cross-sections between all wells and to prepare isochron and structure contour maps of at least the 'P' horizon, the base of the Galilee Basin, and the basement.

Reports are being written on the procedure for production of computer-drawn seismic shot-point position maps, and on the progress of the pre-Eromanga basins review. The review work will continue into 1976.

Northwestern Eromanga Basin study, Qld (P.L. Harrison, J.A. Bauer)

A compilation of geophysical and geological information in the northwestern Eromanga Basin has been completed and reported on.

Information presented includes Bouguer anomaly contours, and structure contour maps of the base of the Rolling Downs Group and the base of the Eromanga Basin sequence.


NORTHERN EROMANGA BASIN
SEISMIC SHOTPOINT AND WELL LOCATION MAP
0 25 50 100 150 KILOMETRES
LEGEND
SHOTPOINT LOCATIONS
WELL LOCATION
141°00'
144°00'
147°00'
20°00'
21°00
22°00'
23°00'
24°00'
KOBURRA
TOWERHILL
TWIN HILLS
CORFIELD
WESTON
LOVELLE DOWNS
GOLEBURRA
BERYL
LAKE GALILEE
THUNDERBOLT
BROOKWOOD
CLYDE
MUTTABURRA
HEXHAM
ARAMAC
GLENARES
RAND
MARCHMONT
MARANDA
COREENA
BALMORAL
SALTERN CREEK
HULTON
CLEEVE
LONGREACH
OORDONOO
FERMOY
PENRITH
MAYNESIDE
LANGDALE
ALICE RIVER
JERICHO
NEWLANDS
BELMORE

The Eromanga Basin sediments form a deep trough up to 2200 m thick, in the Simpson Desert area to the south and become steadily thinner away from this area. Structural trends within the sediments clearly reflect trends in the underlying sediments of the Pedirka Basin in the south and the Georgina Basin in the northeast. All available data were used to define the boundaries and sediment thicknesses of the Amadeus, Georgina, and Pedirka Basins where they are overlain by the younger sediments of the Eromanga Basin, but there are substantial gaps in the knowledge of these basins.

Georgina Basin review, NT & Qld (S.P. Mathur)

The Geological Branch is making detailed field investigations as part of a long-term program to study the geological history of the Georgina Basin. A start has been made to compile, index, and review the geophysical information obtained by BMR and private companies, to assist in this study and to help determine where further seismic surveys could contribute to a better understanding of the geology.

Three preliminary cross-sections have been drawn by correlating lithological information in sixteen exploratory wells with the seismic results. The review is continuing.

Wiso Basin review, NT (S.P. Mathur)

The BMR is conducting a geological mapping and stratigraphic drilling program to remap the Wiso Basin at reconnaissance scale. A review has been started of the geophysical information obtained by BMR and private companies. Bouguer anomaly gravity maps, maps of magnetic basement, seismic survey results, and associated reports have been studied. The results from the only seismic survey in the basin will be reprocessed for further study before completing an integrated interpretation of all the available geophysical information. The project is continuing.

Gosses Bluff, NT (D.J. Milton, USGS, F.J. Moss, P.L. Harrison, J.A. Bauer)

Dr D.J. Milton, the principal USGS geologist working on the joint project, completed the geological contribution to the Bulletin on the joint geological/geophysical investigation of Gosses Bluff at the end of 1974. Detailed and regional geological maps of the Bluff prepared by Dr Milton are being drawn for publication.

The seismic reflection and refraction results from surveys in and around Gosses Bluff have been re-interpreted.

The structure of the deep sedimentary formations under the Bluff has been re-examined and greater allowance has been made for the effects of near-surface velocity variations, caused by brecciation and weathering of rocks within the disturbed zone outside the uplifted area. The Gardiner-Tyler Anticline under Gosses Bluff appears to be of considerably lower amplitude than previously interpreted. The maximum depth of the bowl of disruption caused by the astrobleme is now interpreted to be about 3500 m compared to 4500 m in previous interpretations.

Further work is required on the combined gravity, magnetic, and seismic results before integrating the geophysical and geological contributions in the Bulletin.

Deep crustal and upper mantle studies by seismic reflection and refraction (F.J. Moss, S.P. Mathur)

A report on the seismic reflection, refraction, and gravity investigations along the 1969 Geotraverse, WA, was completed for publication as a Bulletin.

Geological and geophysical information in central Australia was reviewed to interpret the structure of the crust and upper mantle in central Australia, and a paper has been prepared for publication in the BMR Journal. The interpretation is derived mainly from analysis of the regional Bouguer anomaly pattern and is supported by the results from deep crustal seismic reflection probes in the Amadeus and Ngalia Basins. The model shows folding of the crust with upwarps under the Arunta and Musgrave Blocks and downwarps under the basins, but with less severe folding than previously suggested.

Little further work has been done on the compilation of the results from the deep seismic reflection soundings made since 1955 during BMR seismic surveys throughout Australia.

Seismic data processing (G.L. Abbs, W. Trenchuk, L. Hemphill)

Throughout the year a large number of cross-sections were produced from private company data for the pre-Eromanga basins review; generally they showed improvement over previous presentations.

The playback centre has produced seismic cross-sections for the Galilee Basin seismic survey with a turn-around period of about one to two weeks.

The playback equipment continued to operate satisfactorily and required very little maintenance and repairs. Slight modifications were necessary for processing Carter Pulse-Width modulated tapes recorded by CGG.

Seismic equipment (F.J. Moss, G.L. Abbs, L.E. Hemphill, R. Enders)

The PT-700/PMR-20/TRO-6 analogue seismic equipment and ancillary equipment was thoroughly overhauled in preparation for the Galilee Basin seismic survey. A new Input/Output Seismic Source Synchronizer was acceptance tested, and integrated with the field equipment; its field performance has greatly improved communication between shooting and observing teams. One hundred and sixty new sets of 8 Hz GSC-20D high-grade geophones, with 8 geophones per set, gave no problems in the field during the Galilee Basin survey.

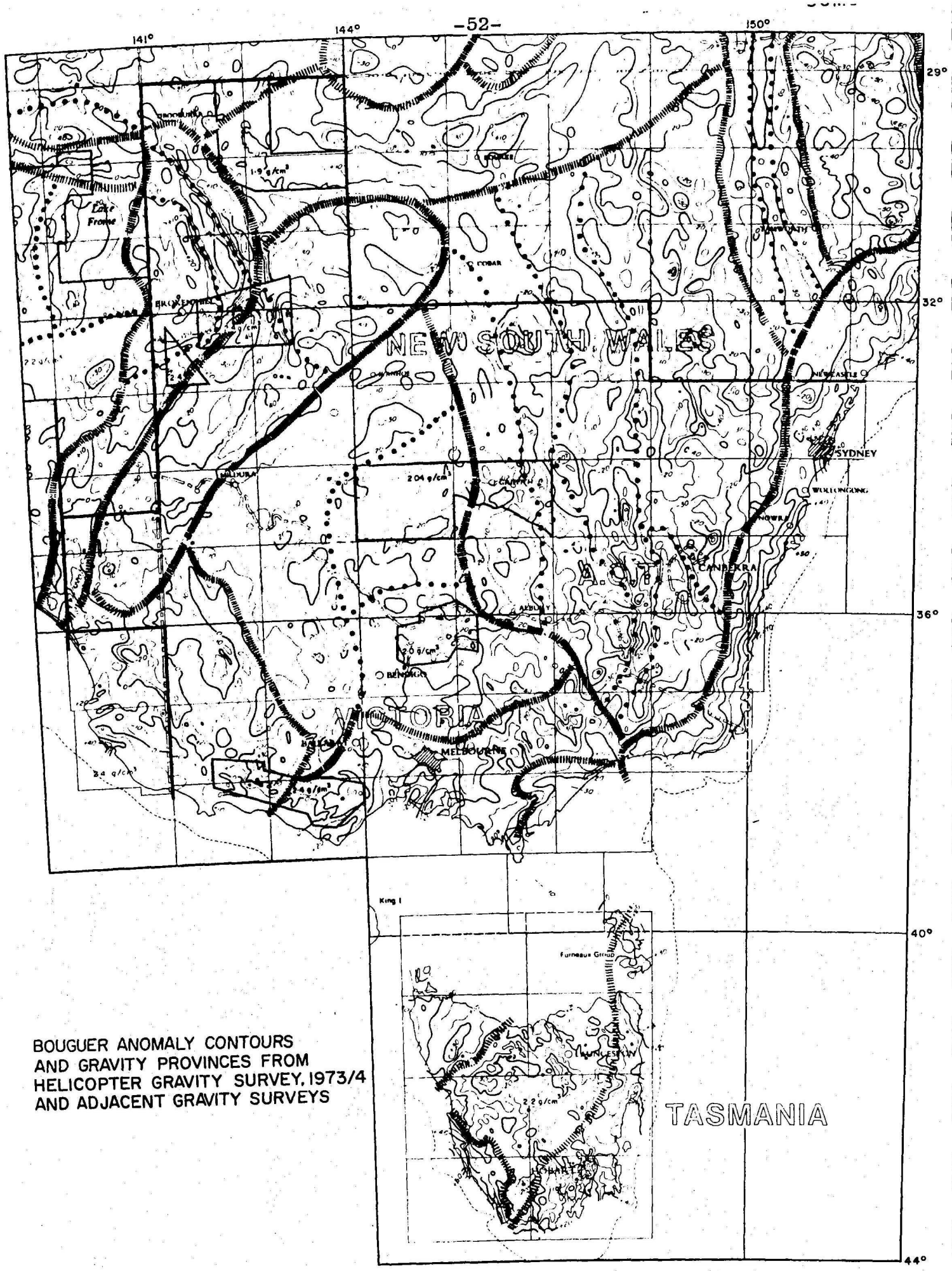
A six-channel 'Aquatronics' Telseis radio telemetry system has been received but has not yet been used in the field. It is proposed to use this equipment in survey areas mainly where the use of cables is impracticable but also to preview seismic refraction results, to increase the length of expanded-reflection spreads to provide additional velocity information at distances greater than those covered by normal spreads with cables, and to make land-to-marine ties in shallow waters inaccessible to normal marine seismic surveys.

An order has been placed for a digital seismic recording system for use mainly in sedimentary basin surveys; the system is expected to be delivered about March 1976.

GRAVITY SURVEYS (F.J. Moss, A.R. Fraser)

Contract reconnaissance helicopter gravity survey, NSW, Vic, Tas & SA 1973-74
(I. Zadoroznyj, A.R. Fraser, O. Terrons)

Field work for this survey was completed in October 1974, when about 80 follow-up new readings were made to check suspect readings and to increase the station density over anomalies of particular interest. About 7700 new gravity stations were read at 11-km spacing over most of the survey area but at 7-km spacing in Tasmania, the BROKEN HILL and MENINDEE 1:250 000 areas in NSW, and the PINNAROO and RENMARK 1:250 000 areas in SA. Final data processing was completed, and 1:250 000 Bouguer anomaly contour maps incorporating the results of follow-up work were released as dyeline prints and transparencies through the Government Printing Office.



BOUGUER ANOMALY CONTOURS
AND GRAVITY PROVINCES FROM
HELICOPTER GRAVITY SURVEY, 1973/4
AND ADJACENT GRAVITY SURVEYS

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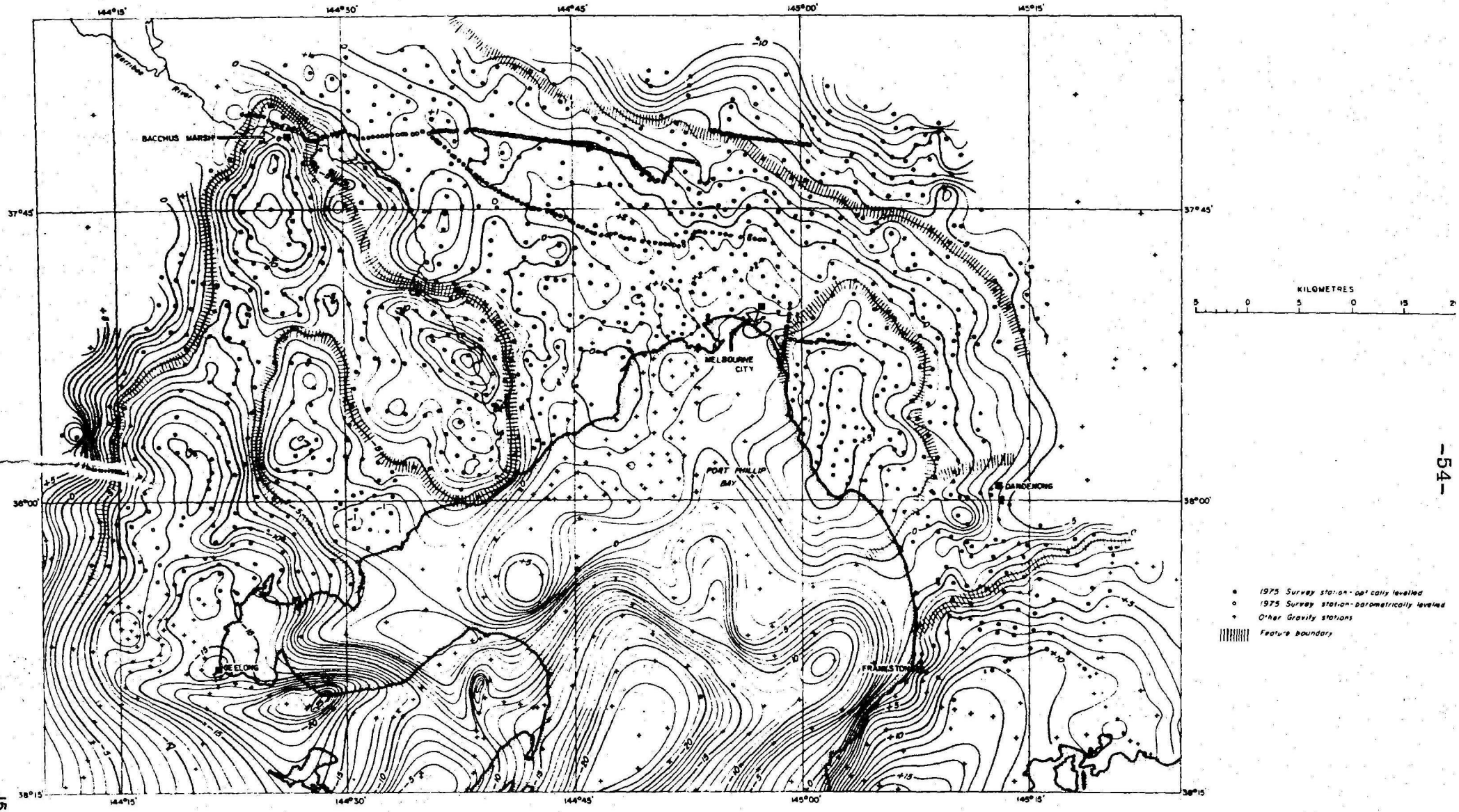
Record No. 1975/161

The Bouguer anomaly contour pattern over the survey area has been divided into a number of regional gravity provinces (Fig. SGM5). The distribution and inter-relation of the provinces suggest some previously unknown regional divisions within the metamorphic basement, and possible extensions of known units. North-northwest structural trends over the exposed Lachlan Geosyncline appear to be truncated under the southern Eromanga and Surat Basins, by a broad zone in which east to northeast trends predominate. The north-northwest geosyncline trends do not appear to persist westwards under the Murray Basin sediments, where gravity contours indicate mainly northeast structural trends in the basement. A regional gravity high encompassing the Willyama and Wonaminta Blocks extends southwards to the South Australian coast indicating a possible subsurface extension of lower Proterozoic metamorphics. Other noteworthy features include several intense gravity highs along the west coast of Tasmania, a regional high of varying width extending from northern NSW southwards through the Snowy Mountains into eastern Victoria, and marked gravity depressions associated with known sedimentary troughs in the western Murray Basin and the onshore Gippsland Basin.

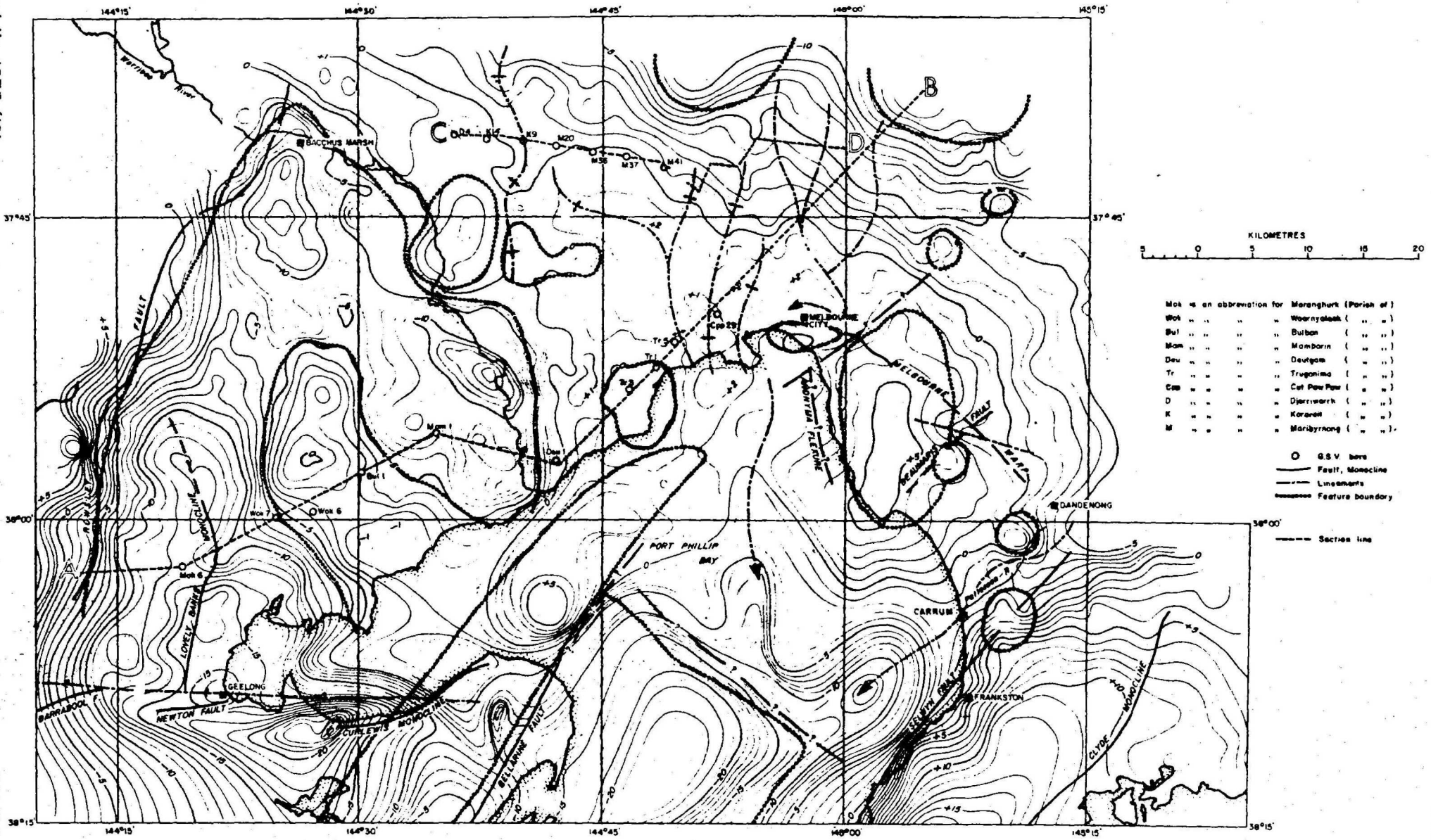
Melbourne area detailed gravity survey, 1975 (I. Zadoroznyj, J.C. Allen, O. Terron, J. Price; P. Gunn, Geol. Survey of Vic)

A detailed gravity survey in Melbourne and adjacent areas to the west was carried out in February and March 1975. The objective of the survey was to help define near-surface structure and so provide assistance to groundwater and engineering geological studies. A total of 1247 gravity stations were established along roads and tracks on an approximate 1.6 km grid, and at 0.3 or 0.5 km intervals along four detailed traverses. Rock densities were measured to assist in the interpretation of results. Figure SGM6 shows station positions and Bouguer anomaly contours at 1 mGal intervals and Figure SGM7 shows the relation between the contours and known or inferred structural features.

The western part of the survey area is dominated by a strong gravity low attributed to a large granitic body. The low has steep gradients in two flanks, one corresponding with the Rowsley Fault and the other with the course of the Werribee River. In the east of the survey area the gravity contours reveal a northerly orientated body of high density partly bounded by the Beaumaris Fault, the Melbourne Warp, and the Anonyma Flexure. Low gravity values indicate a probable sediment-filled trough along the course of the Patterson River near Carrum. The positions of basalt-filled valleys are indicated weakly in the gravity contours and some small

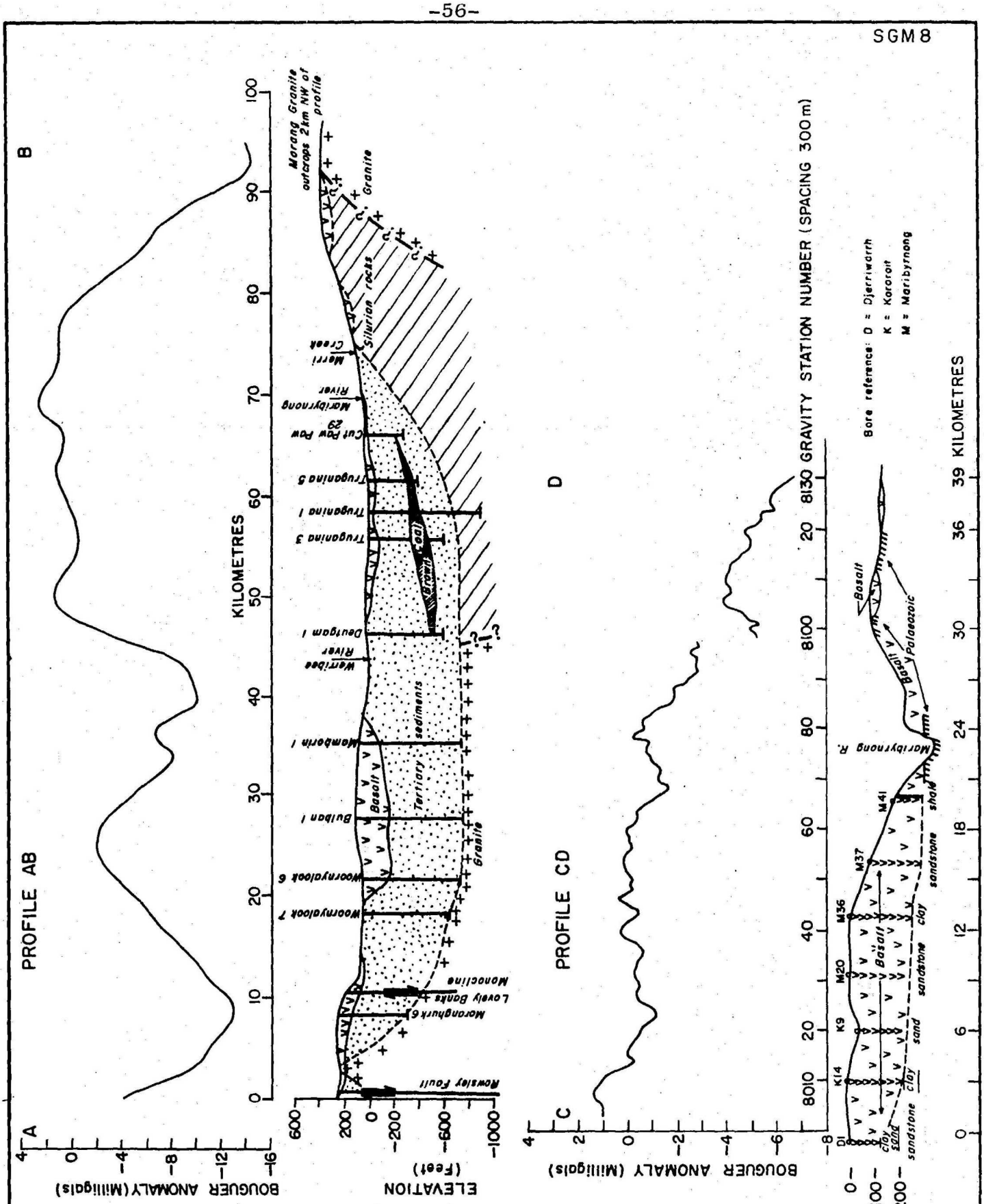


GRAVITY STATIONS AND BOUGUER ANOMALY CONTOURS (1 MILLIGAL INTERVAL)
FROM MELBOURNE AREA DETAILED GRAVITY SURVEY, 1975



BOUGUER ANOMALY CONTOURS AND STRUCTURAL FEATURES
MELBOURNE AREA DETAILED GRAVITY SURVEY, 1975

SGM 8



CORRELATION OF GRAVITY PROFILES AB AND CD

WITH GEOLOGICAL SECTIONS DERIVED FROM DRILLING RESULTS

isolated gravity highs are attributed to volcanic centres. Figure SGM8 shows correlations of the gravity profiles along lines AB and CD with geological sections derived from drilling results.

Gravity survey reporting projects (A. Fraser, W. Anfiloff, J. Bauer)

Revisions were made to a number of reports on detailed and reconnaissance gravity surveys and on gravity review projects. The major reports completed are as follows:

Kalgoorlie detailed gravity survey, WA, 1970. The operational and interpretative reports for this survey were revised. The interpretation of the survey results is discussed in the Geophysical Branch Summary of Activities for 1974.

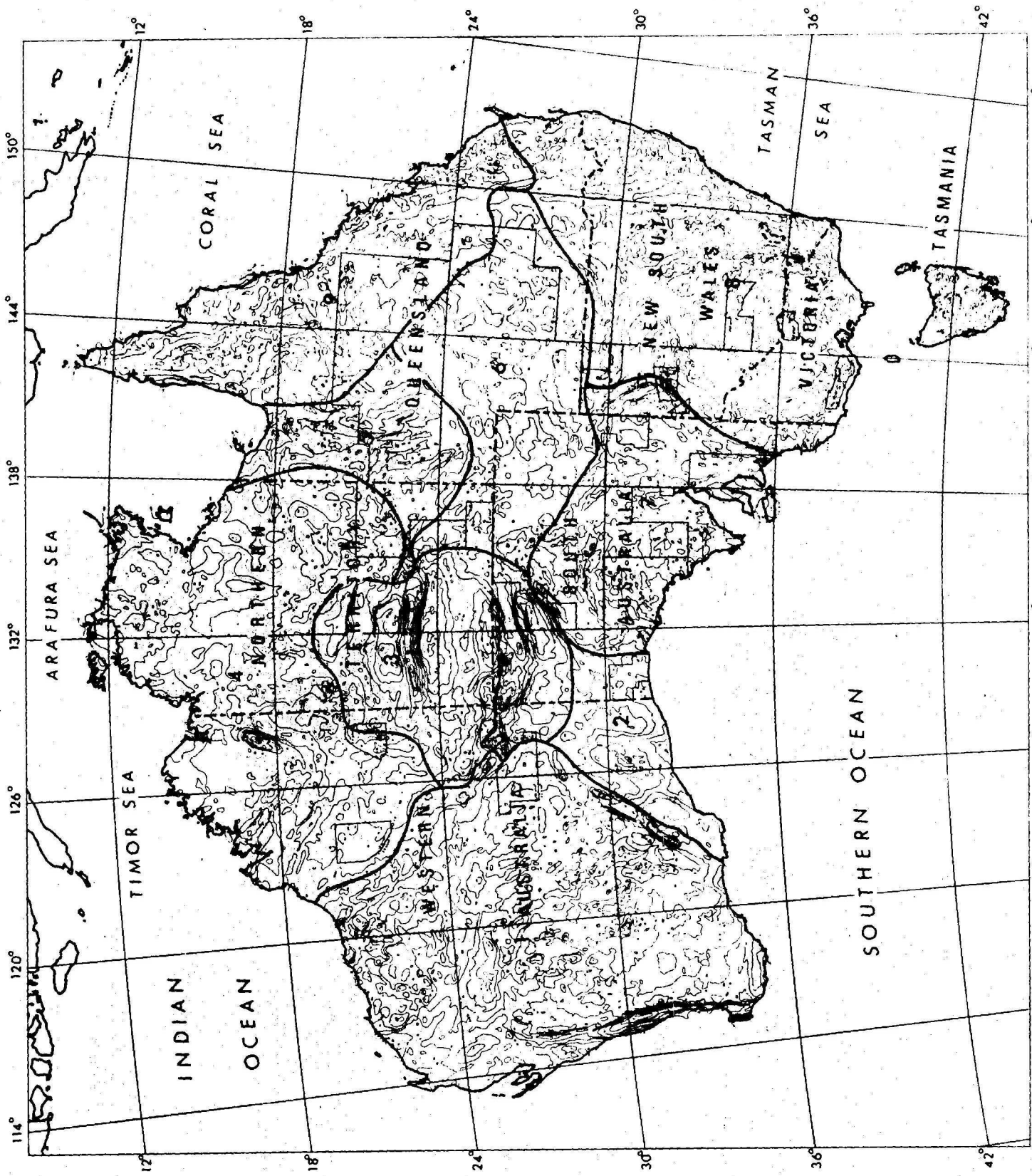
Arltunga Nappe detailed gravity survey, NT, 1973. Minor revisions were made to the report for this survey which is discussed in the Summary of Activities for 1974.

Reconnaissance helicopter gravity surveys, WA, & SA 1969-72.

Revisions were made to existing Records on reconnaissance helicopter gravity surveys in WA and SA 1969-72, which are to be published as Reports. The most significant amendment was to include discussion of the gravity field over the newly defined lower Proterozoic Nabberu Basin in the report for the 1971/72 survey, WA. The existence of high-grade metamorphic outcrops in the northern part of this basin tends to confirm that a strong gravity depression north of the Yilgarn Block is caused by a deep crustal or subcrustal mass deficiency.

Reconnaissance gravity survey of Australia (A. Fraser, F.J. Moss, A. Turpie)

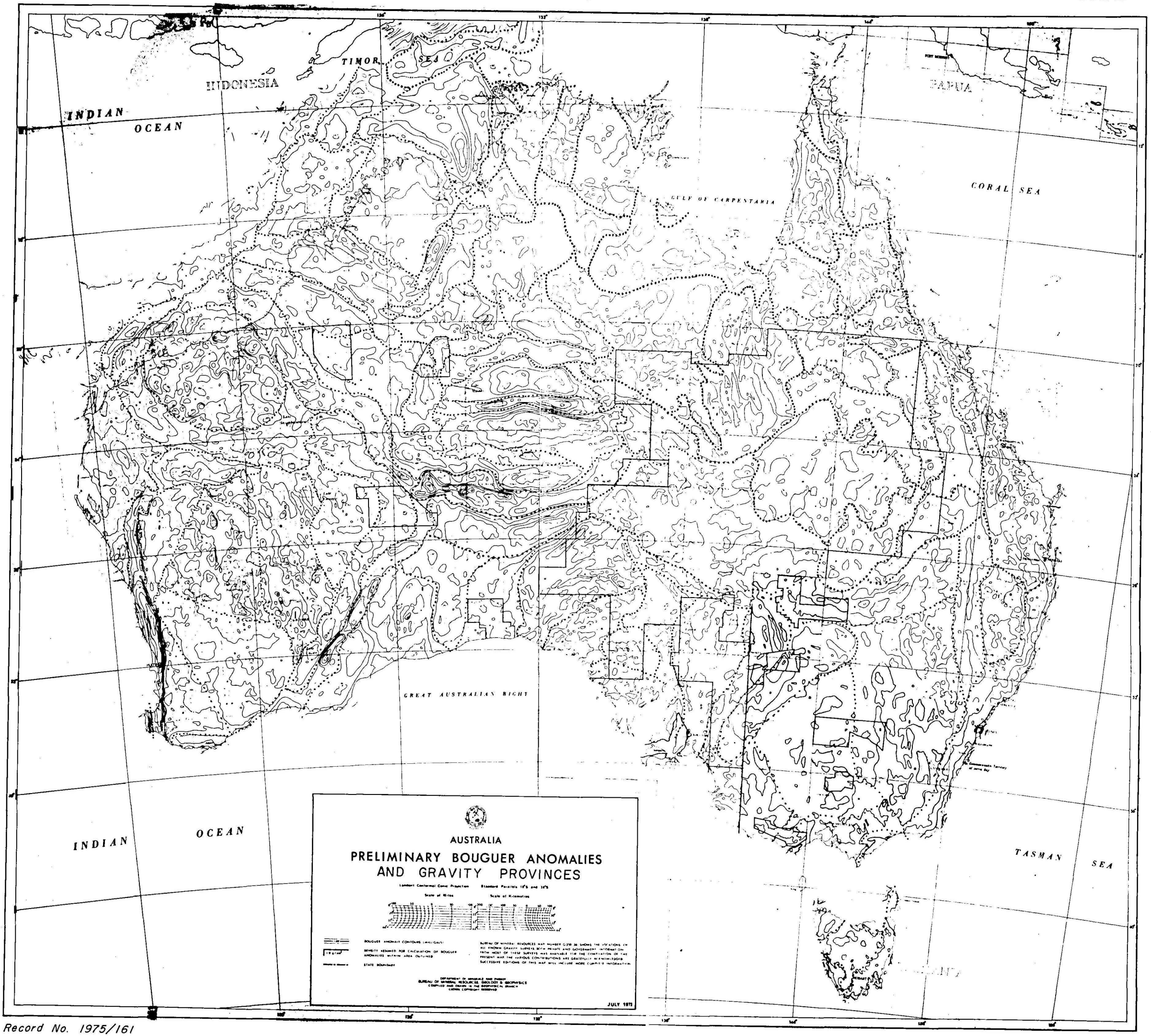
A paper was completed on the reconnaissance gravity survey of Australia; it outlines the general methods of reconnaissance gravity surveying in Australia and describes the main gravity features and their geological interpretation. Australia was divided into nine major gravity regions (Fig. SGM9) in order to discuss the distribution of orgenic provinces and metamorphic complexes in broad terms, and their probable subsurface continuations as indicated by the gravity results. Cases are presented in which gravity has helped to define the deeper sedimentary basins, e.g. the Amadeus Basin, and indicated possible extensions of mineral provinces, e.g. the Willyama Block.



BOUGUER ANOMALIES AND REGIONAL

GRAVITY DIVISIONS OF AUSTRALIA

A/B2-118A



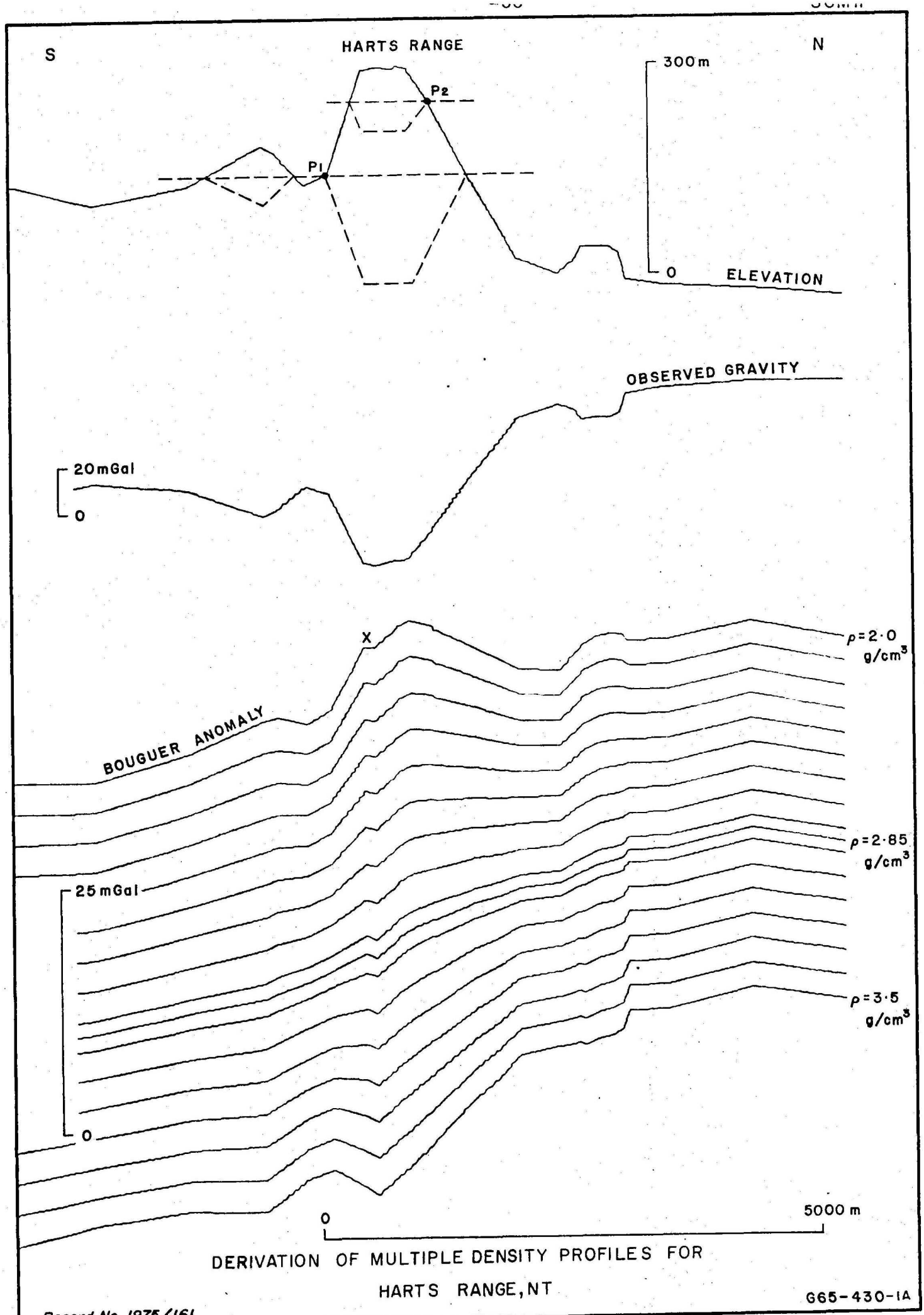
Record No. 1975/161

A report was prepared on the gravity provinces of Australia. This report updates the earlier work of Darby & Vale in Record 1969/110. About 100 regional gravity provinces are defined over Australia and its northwest continental shelf (Fig. SGM10) and the report discusses the significance of each in terms of known geology and geophysics. Valuable comments and criticisms were made by K.A. Plumb and H.F. Doutch.

Gravity survey techniques and equipment (W. Anfiloff, A.R. Fraser)

W. Anfiloff developed a method for directly computing terrain-corrected Bouguer anomalies at various densities from gravity and elevation measurements made across elongate, essentially two-dimensional topography. The combined Bouguer/terrain correction is obtained by computing the 2-dimensional gravitational attraction at each station, of the prism bounded by the profile of the topography, a line at sea level, and vertical boundaries at a large horizontal distance from the station. It is necessary to invert all parts of the elevation profile which are above the level of the station for which the reduction is being carried out, as demonstrated for points P_1 and P_2 in Figure SGM11, which shows the multiple density profiles across Harts Range, NT. The bulk density of a topographic feature can be estimated from the multiple density profiles using Nettleton's method. A value of 2.85 ± 0.05 g/cm^3 was estimated for Harts Range.

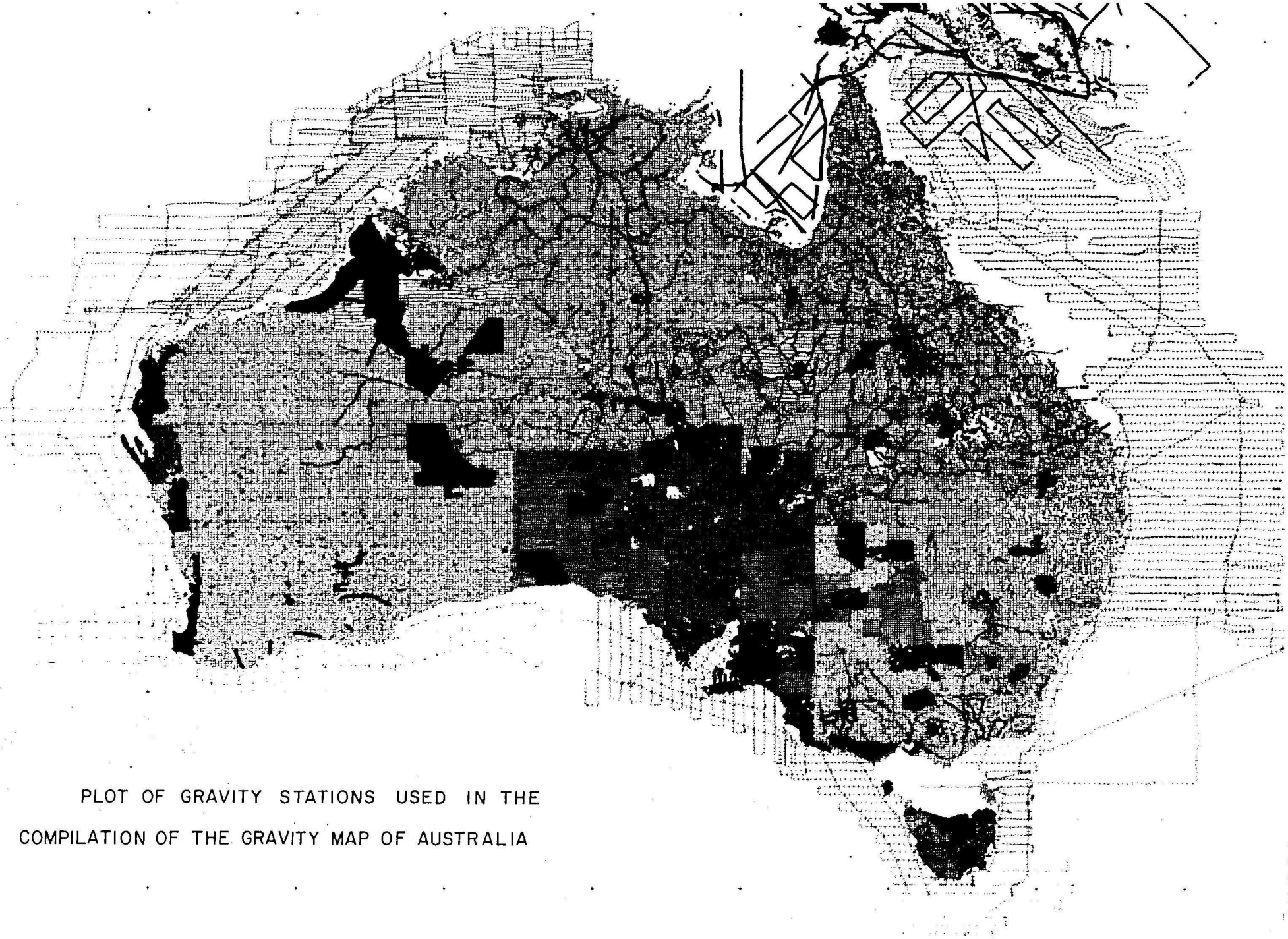
A.R. Fraser completed a report on the use of gamma-rays in rock density determination. For gamma-rays in the energy range 0.3 to 2.0 MeV, attenuation in a medium is a function of absorber electron density only. As electron density is approximately proportional to bulk density for elements of low or medium atomic number, rock densities can be determined by measuring the emergent intensity of a gamma-ray beam transmitted through a sample. A simple laboratory or field instrument can be constructed which could measure rock densities to better than one percent accuracy. A collimated beam of gamma-rays is directed through a rock sample of known thickness and the intensity of the emergent beam is measured with a sodium iodide detector and scaler circuitry. Corrections are made for the thickness of the sample, the temporal decay of the source, and the departure from proportionality of both density and electron density to obtain the bulk density measurement. The instrument could also be used to determine the porosity and saturation bulk density of sedimentary rocks of known composition. Helpful comments and criticisms were received from P. Wilkes and M. Idnurm.



DERIVATION OF MULTIPLE DENSITY PROFILES FOR HARTS RANGE, NT

G65-430-1A

Record No. 1975/161



PLOT OF GRAVITY STATIONS USED IN THE COMPILATION OF THE GRAVITY MAP OF AUSTRALIA

The 1:5 million Gravity Map of Australia (W. Anfiloff, D. Denham, O. Terron).

A data bank of gravity principal facts has been compiled for the production of a 1:5 million gravity map of Australia and its continental margin. The map shows Bouguer anomalies computed using a density of 2.67 g/cm^3 on land, and free-air anomalies at sea. The data bank contains principal facts for 85 000 BMR reconnaissance gravity stations over 83 percent of the Australian land area, about 200 000 gravity stations from surveys by State government organizations, private companies, and academic institutions over the remaining 17 percent of the land area, and 15 000 gravity values offshore taken from marine surveys by BMR and overseas institutions. Figure SGM12 shows a machine-drawn distribution plot of all stations in the bank. There are several small gaps in coverage but these do not greatly affect the contouring of data.

A comprehensive checking procedure was carried out to detect errors in the data bank. This has involved filtering to detect irregularities, and rapid contouring using a program by A. Hogan and R. Whitworth. As a final check, a set of 1:1 million contour maps were produced and subsequently made available for use in BMR. The 1:5 million map was contoured in six sections on BMR's drum plotter using the program of I. Briggs as modified by A. Murray; these were then hand scribed to make the composite map.

Assistance in writing geological explanatory notes, reports, and bulletins (A.R. Fraser, W. Anfiloff)

Assistance was given to geologists in the interpretation of gravity contours over The Granites-Tanami Block and the Canning Basin where geological mapping at 1:250 000 scale has been done recently.

Overseas visit by A.R. Fraser

A.R. Fraser attended the 44th Annual Meeting of the Society of Exploration Geophysicists in Dallas, Texas from 10 to 14 November 1974, and made post-conference visits to a number of companies and institutions in the USA to study recent developments in the use of gravity data in integrated geophysical and geological studies as applied to petroleum and minerals exploration. A number of techniques for the enhancement and interpretation of potential field data were studied, which could be used by the BMR in future detailed work. These include least-squares polynomial fitting of

gravity data for enhancing the gravity expressions of weak, shallow sources such as buried stream valleys or reefs, iterative 3-dimensional computer modelling of gravity fields over salt domes and igneous intrusions, and the combined interpretation of gravity and magnetic data over sediment-covered areas to obtain a crude representation of basement geology. Discussions were also held on the use of geophysical methods in exploration for porphyry copper deposits in the western USA, the correlation between gravity patterns and mineral occurrences in Alaska, and the interpretation of regional gravity features in America which appear to have parallels in Australia. Documentation for a 3-dimensional gravity modelling program by D. Plouff of the US Geological Survey, and a comprehensive bibliography of references on potential field interpretation techniques compiled by Geophysical Services International were obtained.

MARINE SURVEYS (R. Whitworth, F.W. Brown)

Continental margin survey, 1970-1973, and Gulf of Papua and Bismarck Sea survey, 1970

The greater part of the effort in Marine Group was again devoted to processing of navigation, bathymetric, gravity, and magnetic data from these surveys. In 1974 most of the work had been on assessment of data and development of processing techniques and programs, and, while these tasks continued into 1975, the emphasis moved to production processing of data through Phase 2 of the processing schedule: conversion to 1 minute data; selection and processing of best navigational data from satellite data and alternative ship speed data; application of Eotvos correction to gravity data; application of diurnal correction to magnetic data. In addition, with the co-operation of the ADP Section, programs were checked and tested in preparation for Phase 3: assessment of mis-ties in gravity and magnetic data networks; adjustment of misclosures by the method of least squares. Further work was done on the development of Phase 4: production of edit maps; final editing; production of final maps. It is expected that Phase 2 and most of Phase 3 processing will be completed by the end of 1975 and that production of final maps in Phase 4 will carry on through the whole of 1976. Progress in all aspects of the data processing was hampered by difficulties experienced with the Cyber 76 computer system.

For the numerical adjustment of gravity and magnetic data in Phase 3 the network of traverses formed by the whole survey is too large to be held in the computer. Therefore, in preparation for this phase of the processing, the survey

has been divided into blocks suitable for the computer, taking into account the layout of the cruises and the priority of the work. The 10 blocks are shown in Figure SGM13 with priorities numbered.

Considerable effort went into the interpretation and reporting of Continental Margin Survey data. In particular, a major study of the Exmouth Plateau was continued and a Bulletin was written on the Coral Sea Plateau.

Data processing

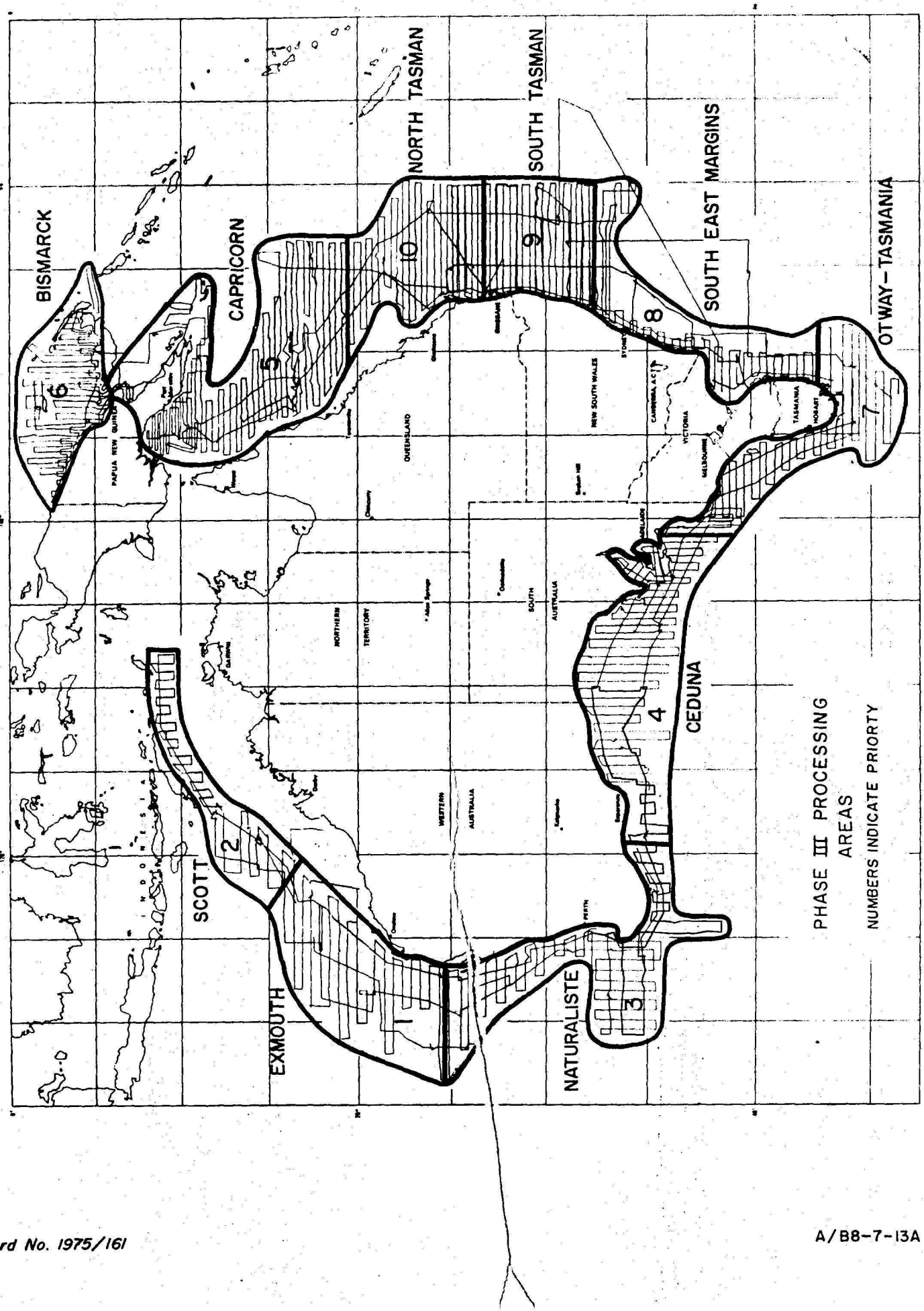
Use of the Cyber 76 computer, CSIRO Canberra. The growth of computer utilization during the early months of 1975 exacerbated several problems with the Cyber 76 system, which imposed exceptional demands on the Group. Although the Cyber 76 has a very fast central processor, its peripheral devices and system software impose serious restrictions on the style of processing. The availability of only three tape drives for most of the year severely hampered operations because the Group requires at least 3, and frequently more, tape drives. Late in the year a fourth tape drive was added but chances of getting tapes mounted on all four are slight. Early in the year the change from 7-track to 9-track tape drives caused problems with reading tapes.

To alleviate the tape problems, data files were assigned to system disc. However, this soon became overloaded and three new disc packs were then permanently assigned to the Marine Group. Large data files can be retained on these auxiliary discs and effective multiple-data-file handling is now possible.

Tape control system (R. Whitworth, C.R. Johnston). The large quantities of data used by the Group require about 1000 magnetic tapes for their storage. Tapes are created and released at rates up to 100 per week and this requires carefully planned handling and documentation procedures.

The computer-based tape control procedures for the CDC 6600 computer were adequate, but those for the Cyber 76 are not. Therefore, the Group developed its own computer-based control system, which has operated successfully for several months; handling errors have been almost eliminated and the man-power required for tape control has been reduced by 85 percent.

The marine program libraries (J.H. Fisher). The marine geophysical processing system regularly uses a large number of programs. In order to manage these programs a series of marine program libraries was created within the computer system.


BISMARCK
CAPRICORN
NORTH TASMAN
SOUTH TASMAN
SOUTH EAST MARGINS
OTWAY-TASMANIA
SCOTT
EXMOUTH
NATURALISTE
CEDUNA
PHASE III PROCESSING AREAS
NUMBERS INDICATE PRIORTY

The libraries are now stored on the on-line BMR disc pack in pairs, each consisting of a card image Fortran version for updating, and a compiled binary version for job use. There are eight libraries containing more than 450 routines: MARINE and WATER for program development; SERVICE and CONTROL for general control and housekeeping; PHASE 1, PHASE 2, PHASE 3, and PHASE 4 for specific processing.

For ease of operation and security, programs are updated and manipulated by two stored console programs: EDITJOB for development work; and LIBRARY, a general purpose console program, with options for updating, listing, deck manipulation, purging, and re-creation.

Navigational data processing (Program development: L.A. Tilbury, R.A.P. Garnett, C.R. Johnston, A.P. Hogan, J. Hudspeth; Data processing: J.C. Mutter, H.M.J. Stagg, P.A. Symonds). Navigational data recorded digitally on magnetic and paper tape during the survey were reprocessed using a package of programs developed on the Cyber 76 computer (Fig. SGM14). The two major programs are a satellite fix recomputation program (BMRFIX), and a program NAVCOMP that ties dead-reckoning data to satellite fixes in an acceptable manner. As a result, position errors are estimated to have been reduced to the order of 0.2 nautical miles and velocity errors to 0.2 knots.

The accuracy of a satellite fix depends on a number of factors, including satellite elevation, number, quality, and symmetry of Doppler counts taken, and the accuracy of the ship's position or velocity entered into the computation.

All fix positions were recomputed from the basic recorded data, and relative positions of consecutive fixes were compared with those given by the dead-reckoning system. Normally the difference was a few tenths of a mile but it often exceeded 2 miles.

Usually the largest component of this error was the effect on dead reckoning of ocean currents, not detected except in water depths less than 200 metres, where the sonar Doppler equipment locked onto the sea-floor. The next largest component was the effect on computed satellite-fix positions of errors in ship's velocity mainly caused by ocean currents.

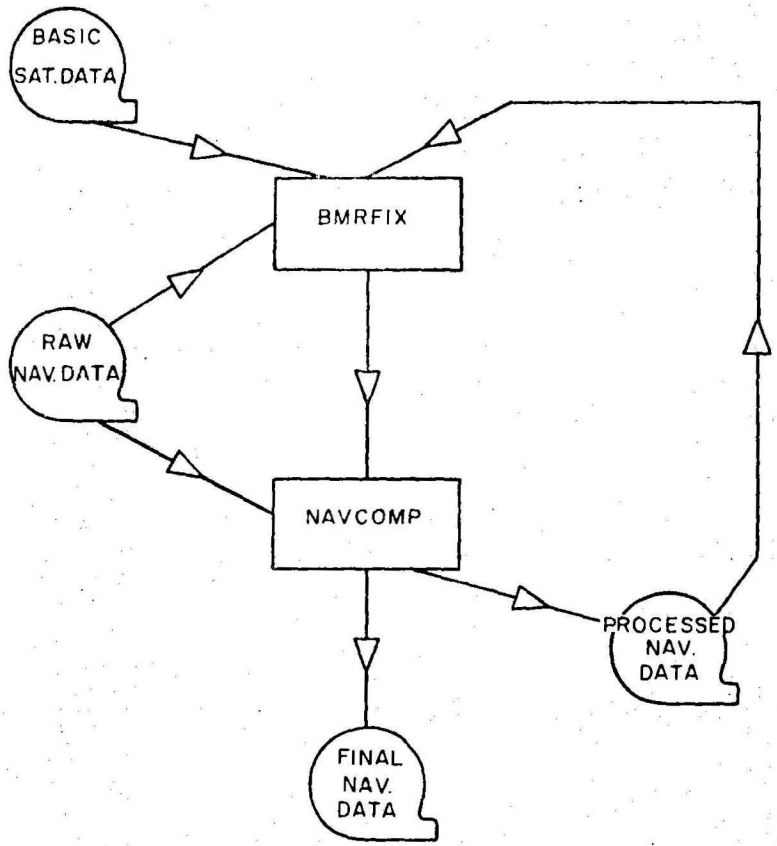


FIG. 1 BASIC NAVIGATION FLOW CHART

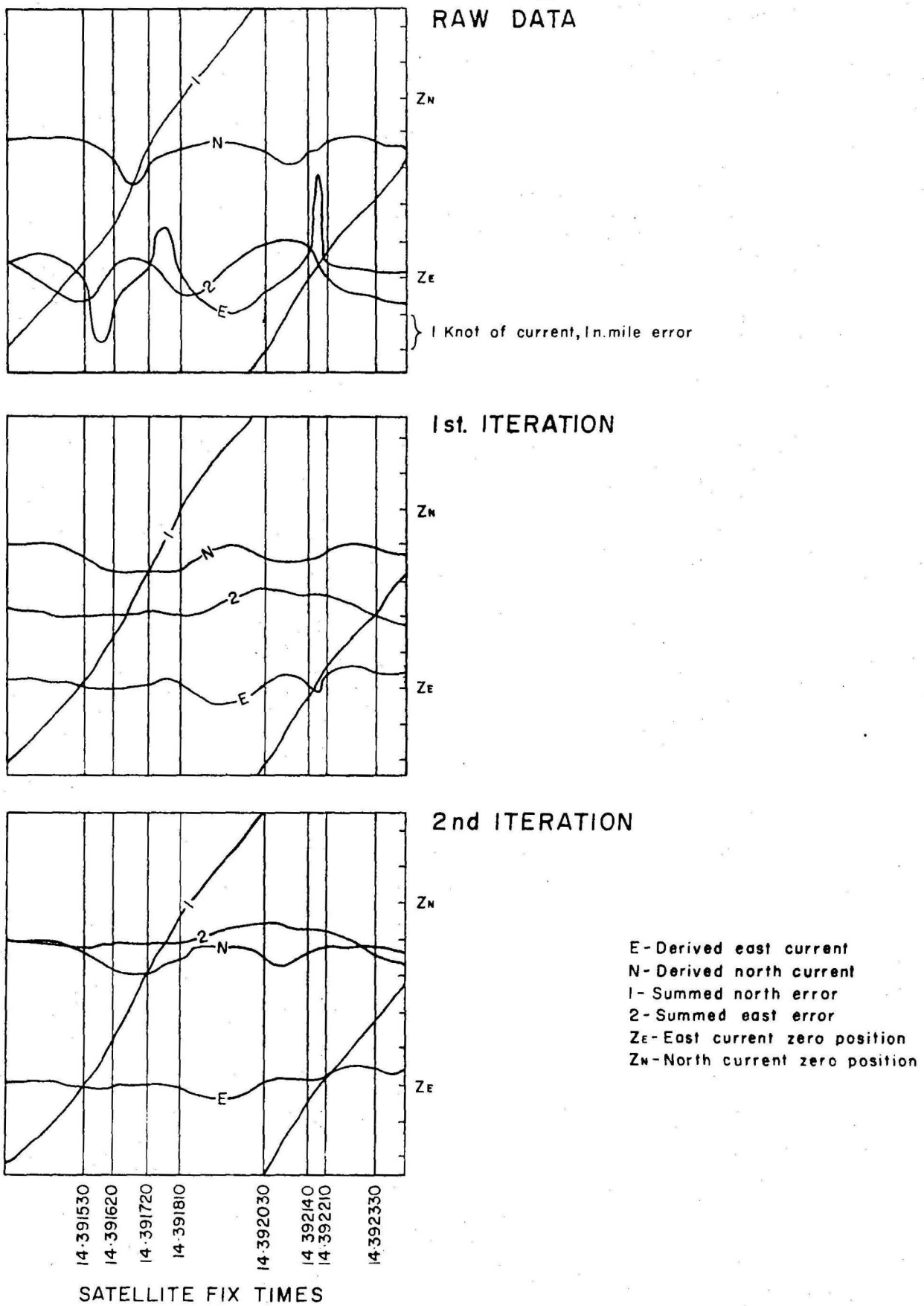


FIG. 2. TRACING OF PRINTER PLOTS PRODUCED DURING NAVIGATION PROCESSING

The dead-reckoned ship's track was adjusted to the satellite fix positions using an Akima function which distributes errors between adjacent fixes rather than over a range of several fixes in the way a spline function operates. Satellite fixes were recomputed using the new extimates of position and velocity obtained. These steps were repeated as necessary. BMRFIX provides listings to allow assessment of fixes so that bad Doppler counts and inherently bad fixes could be detected and discarded. Usually with good-quality fixes convergence was rapid through two terations and slow thereafter, while poor-quality fixes led to divergence or oscillation.

Figure SGM15 gives an example of apparent north and east currents computed at progressive stages of the iterative computation and shows the very large swings in the value of east current through fitting the dead-reckoned data to the initial fix positions. Such a rapid variation in current as that between 2140 and 2210 and a 15 milligal gravity anomaly, about 7.5 km wide, are most unlikely, particularly as the water depth is greater than 2300 metres. Since the anomalies in current and gravity occur in the period between two fixes it is likely that they have been created by errors in the fix positions. The traces on the second iteration plot vary smoothly and more realistically, confirming this interpretation. Further iterations produced negligible improvement.

All navigation data from the Continental Margin Survey were passed through this system during 1975. New track charts at 1:2.5 million and 1:1 million scales will be produced shortly.

Water depth processing (H.M.J. Stagg, P.J. Cameron, J.F. McIntyre, R. Tracey, R. Denardi). Digital water depths acquired from CGG for the Continental Margin Survey varied in quality. On a typical cruise (Survey 15 - cruise 3) about 60 percent of the one-minute depths differ by more than 30 metres from hand-scaled seismic depths and 20 percent differ by more than 100 metres. However, quality varied between cruises, suggesting that the recording problems varied, but the standard of hand digitizing also varied as was clearly demonstrated in plots from programs APROXWD and ADJWD (see below).

Problems appear to have arisen from: differences between data from different equipments Elac, Atlas, Raytheon and Seismic, particularly in bulk errors from cruise to cruise; offset corrections not being applied to depths determined from seismic sections; variations in Elac recorder sweep-speed; and inaccurate scales used for manually scaled values.

Water depths from seismic records were of good and consistent quality for the duration of the survey and it was decided to tie the one-minute depths to 10-minute seismic values.

In the later cruises the 10-minute depth-control points were taken from the Raytheon echo-sounder when it was working reliably, because of its greater accuracy.

The processing flow is illustrated in Figure SGM16. The two major processes are:

(1) Application of a bulk correction which can vary with depth and time (program APROXWD) so that the one-minute depths lie uniformly about the seismic depths over broad time intervals, generally a cruise.

(2) Linear adjustment of the one-minute depths to the 10-minute control points (program ADJWD). Shallow water depths mainly taken from the Atlas records were of acceptable accuracy and this adjustment was not made to depths less than 200 metres.

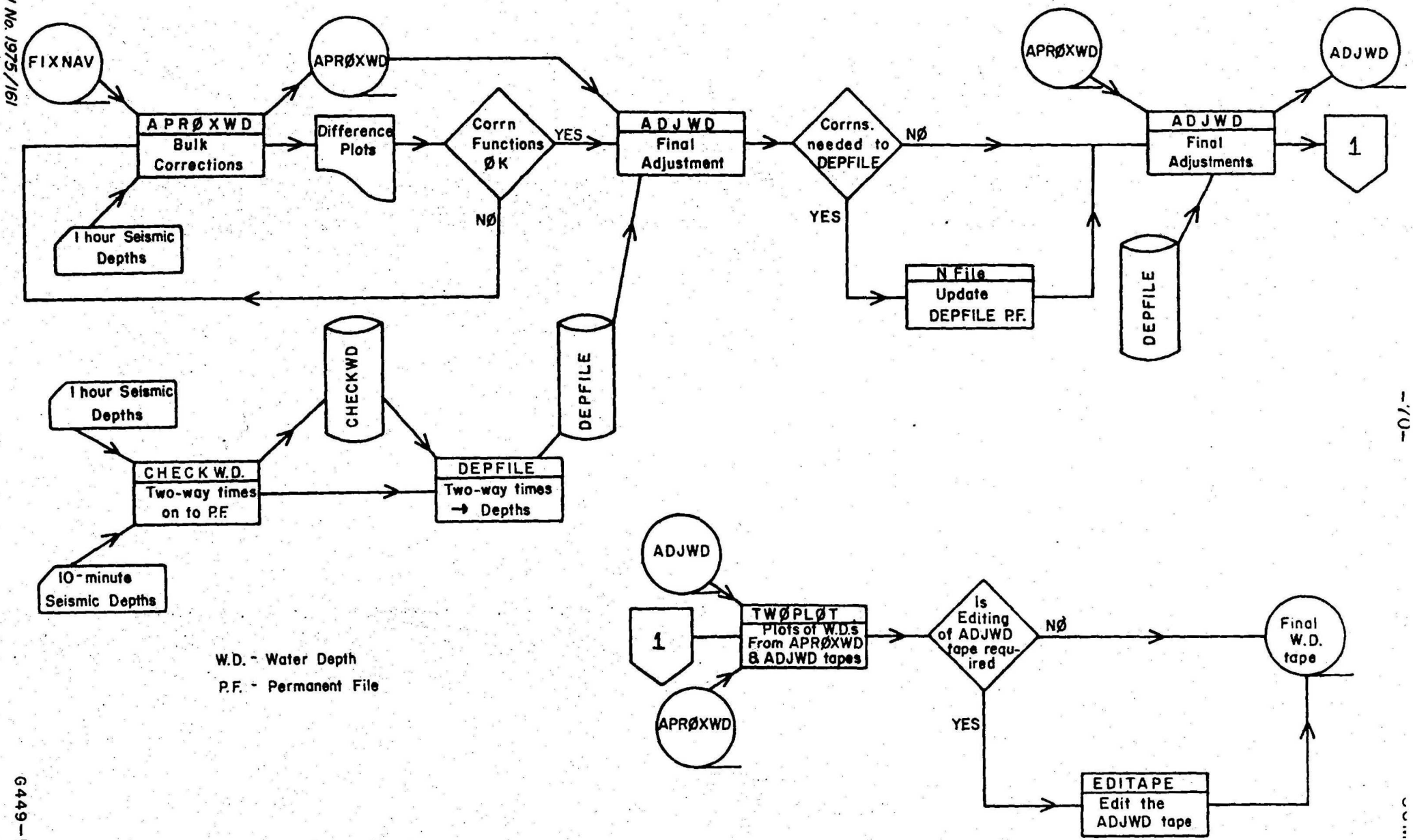
During the year development of programs and processing of data were completed. The most time-consuming task in the processing was the hand-scaling of seismic water depths, which required about one man-week per cruise, a total of 36 man-weeks.

As a final check on the data quality, profiles of water depths were plotted from the APROXWD and ADJWD tapes, and some final editing was done.

Magnetic diurnal variation corrections (G. Karner, H. Stagg, J. Mutter, J. Fisher, R. Tracy, J. McIntyre, R. Denardi) The magnetic field was monitored at shore stations established progressively around the coast by CGG during the Continental Margin Survey. The analogue records have been processed to give one-minute digitized values on magnetic tape.

The raw data were divided into three categories: good quality - no corrections needed; poor quality - unacceptable; and too poor for one-minute values but acceptable for 10-minute values.

Poor-quality data and data gaps (which ranged from hours to days) have been replaced by data from BMR magnetic observatories or by means of a splicing program which merged the observatory and monitor data. Computer programs



W.D. - Water Depth

P.F. - Permanent File

WATER DEPTH DATA PROCESSING

were developed and used to correct the errors introduced during digitizing and initial processing. Final plots of magnetic diurnal together with original and corrected data show that, in most cases, specific magnetic disturbance events and the daily variation have been fairly well removed (Fig. SGM17 a and b).

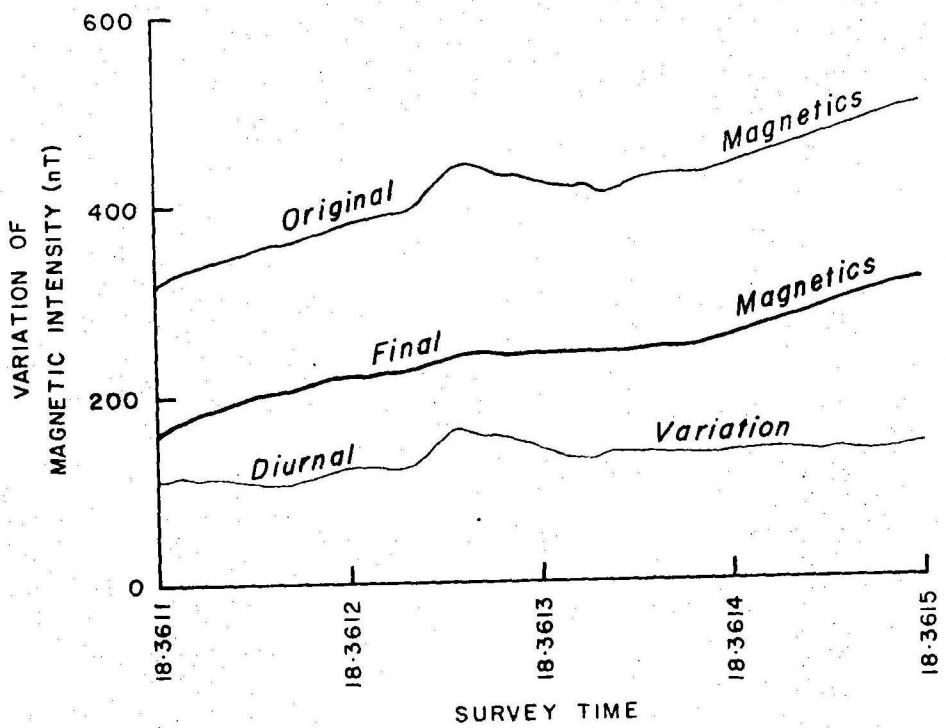
Magnetic jumps at turns (P. Petkovic). The total magnetic intensity data collected during the Continental Margin Survey sometimes contained spurious step anomalies ('magnetic jumps') when the ship turned. For various reasons the jumps were not recognized until late in the survey, but it was concluded that they were due to the ship. The sensor was towed about 180 m astern, but the distance was not kept constant, apparently in attempts to reduce instrumental noise. Unfortunately, the distances were not logged.

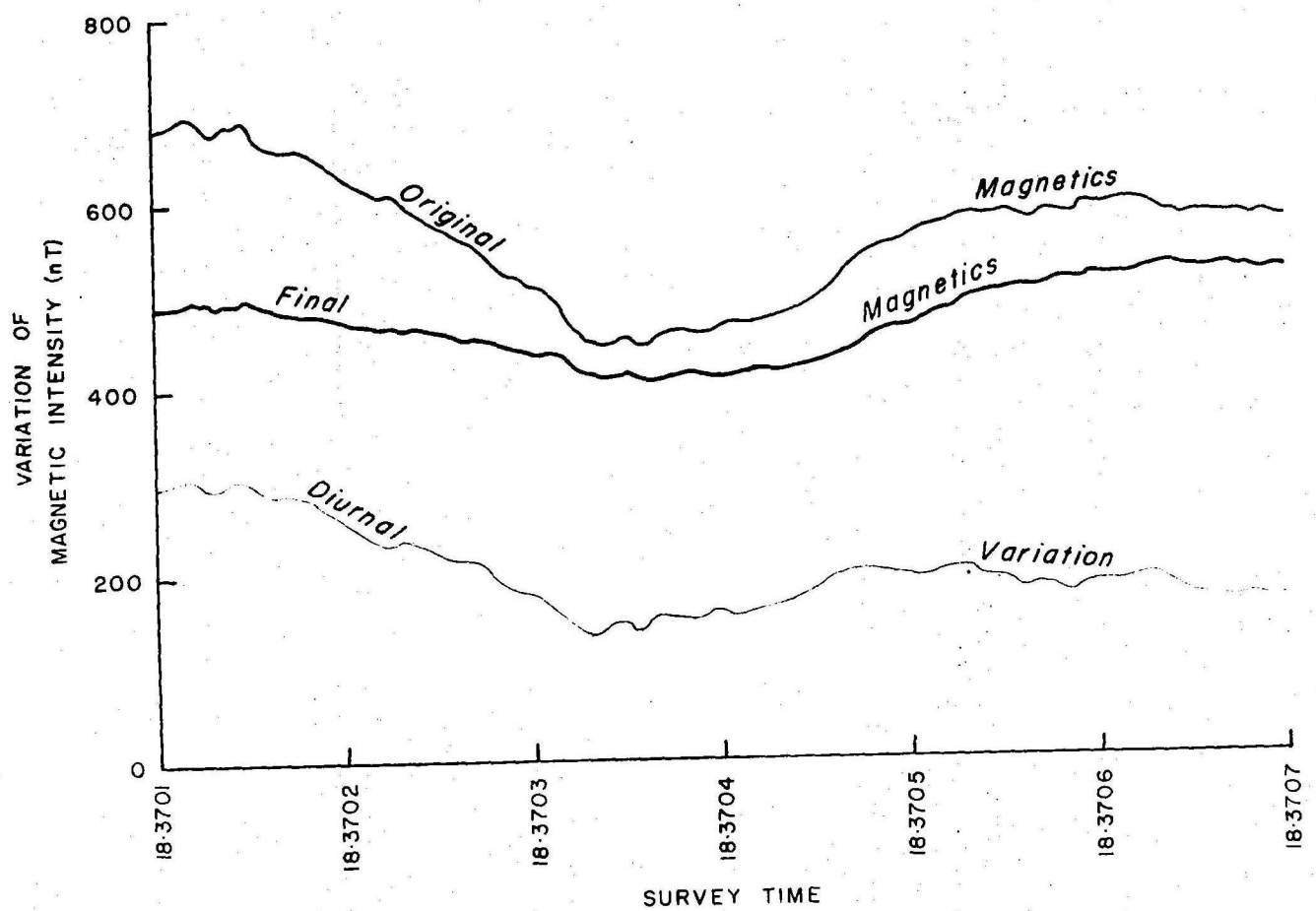
The correction eventually applied was a harmonic function which described the magnetic field astern of the ship in terms of the ship's magnetic heading. The coefficients in the function were calculated by statistical means from the jump information; out of more than 9000 identified course changes, nearly 5500 provided magnetic data suitable for the analysis. This was carried out cruise by cruise, yielding the result that 15 of the 36 cruises required correction for jumps. The result of some corrections is illustrated in Figure SGM18. The data within the period of a turn are spurious because the line-astern configuration of ship and sensor is lost but the improvement in continuity before and after the turn is clear.

Development of mapping programs (A. Hogan, P. Petkovic, R. Whitworth). Phase 4 of the marine data processing operation comprises routines that will generate maps presenting the data output from Phase 3. Effort was spent on modification and modularization of routines to simplify and improve the programs which produce the three basic map types: contours, profiles, data posting.

The greatest effort was expended on upgrading contouring program output from 'editing' to 'final map' standard.

The program is based on the principle of maximum smoothness, starts off with an approximation, and assigns the measured values to the nearest points on a regular grid. An initial set of values approximating the surface is set up over the whole grid and is then smoothed using Laplace's and Poisson's equations. The surface resulting after smoothing is saved in the form of strings of points along contours (contour strings). This makes for ease of drawing the contour



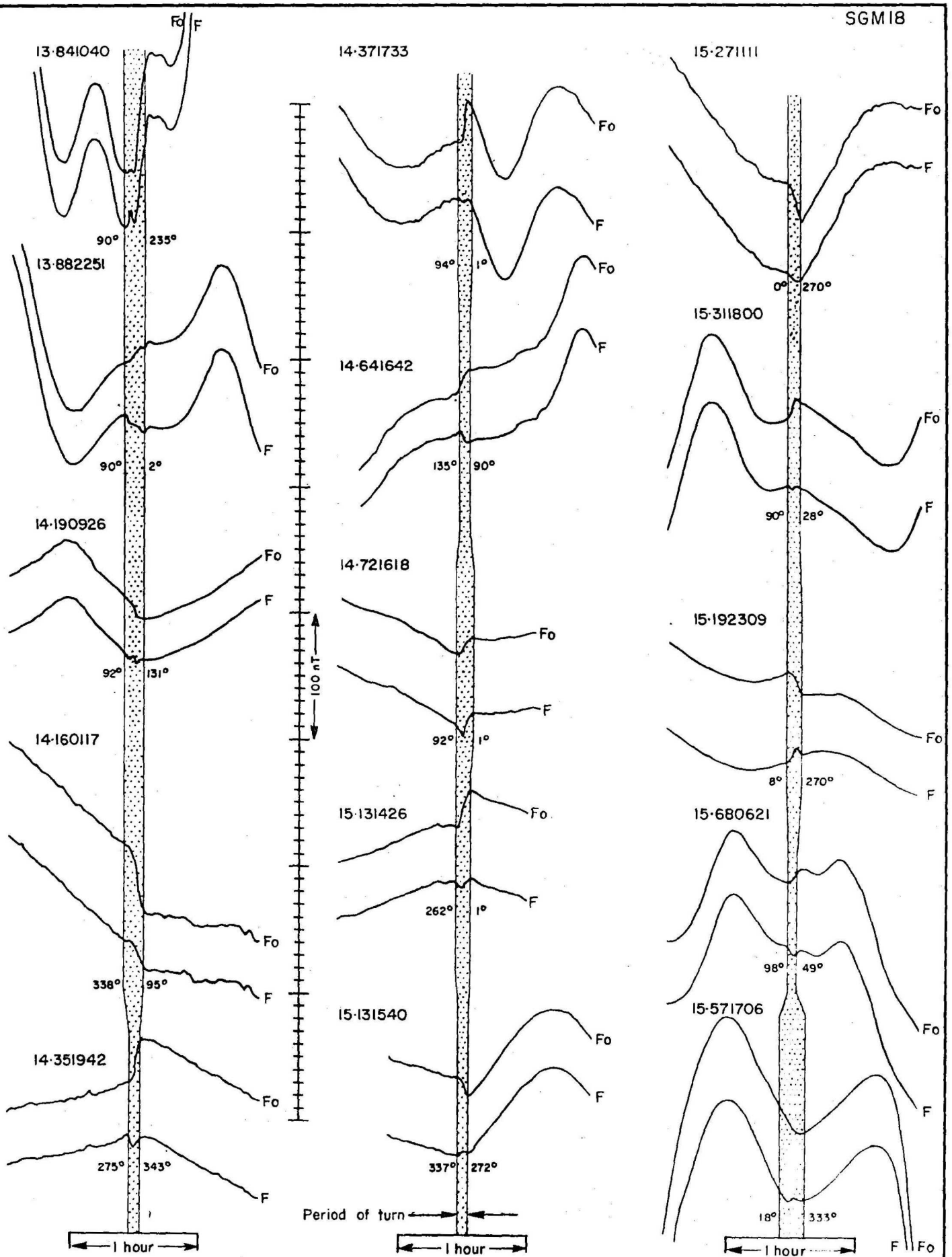


Note: Original and final magnetic traces are offset by 200nt

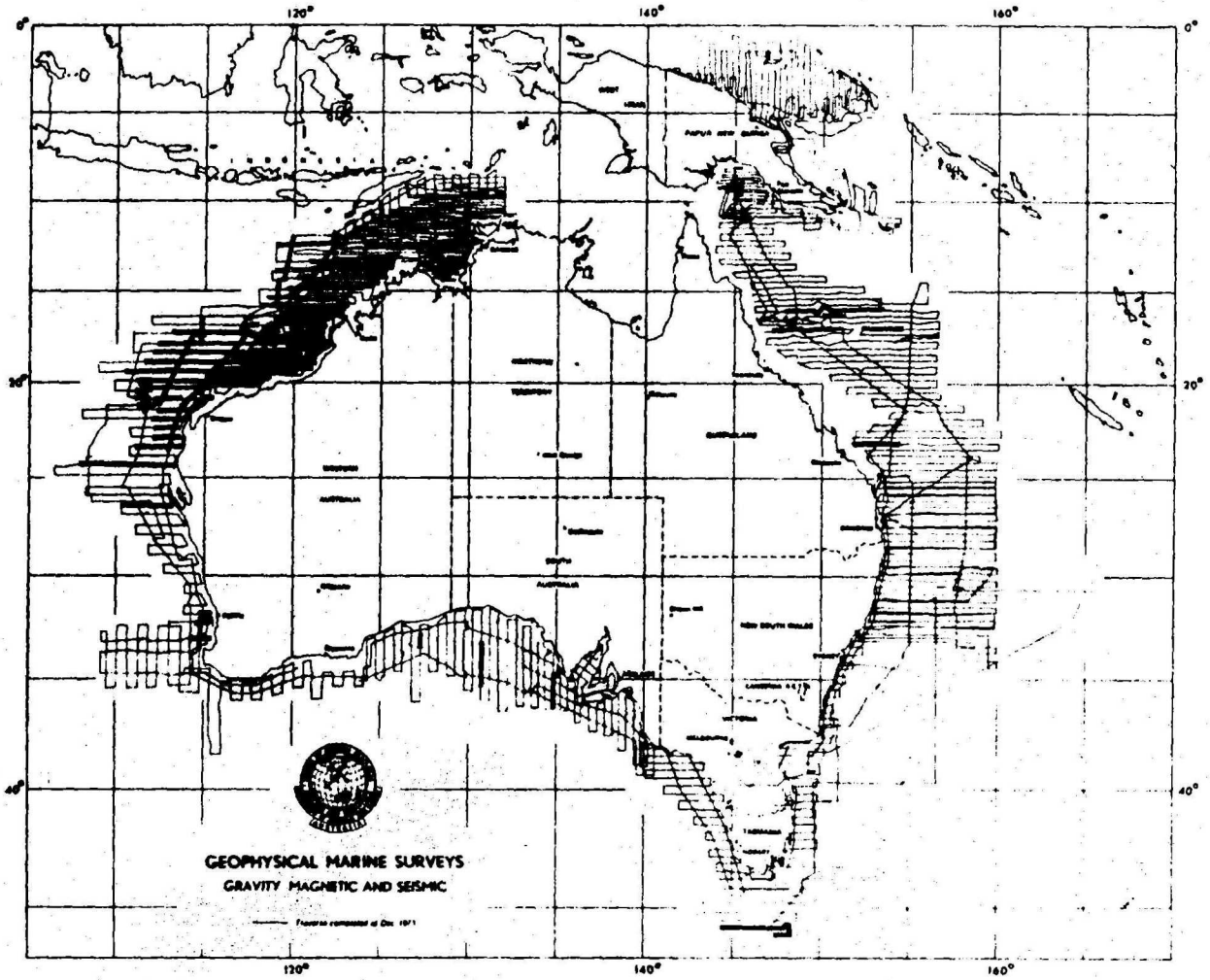
EXAMPLES OF REMOVAL OF MAGNETIC EVENTS

(SURVEY 18-CRUISE 2)

SGM18



EXAMPLES OF TURNS SHOWING MAGNETIC SHIFT CORRECTIONS



Traverses where seismic sections digitally processed shown by heavy line.

A/B8-70-1A

CONTINENTAL MARGIN SURVEY DIGITALLY PROCESSED SEISMIC SECTIONS

line but the method of drawing a smooth curved line through the points is still under development. To increase the accuracy of the surface the contour strings can be transformed to remove the distortion applied to the grid. The method of performing this transformation also requires further development.

Automated contour labelling that is aesthetically pleasing is difficult to develop. A first approximation is under test where labelling is done along zones specified by the user. Having the label in a break in the contour line and following the line curvature has yet to be tackled.

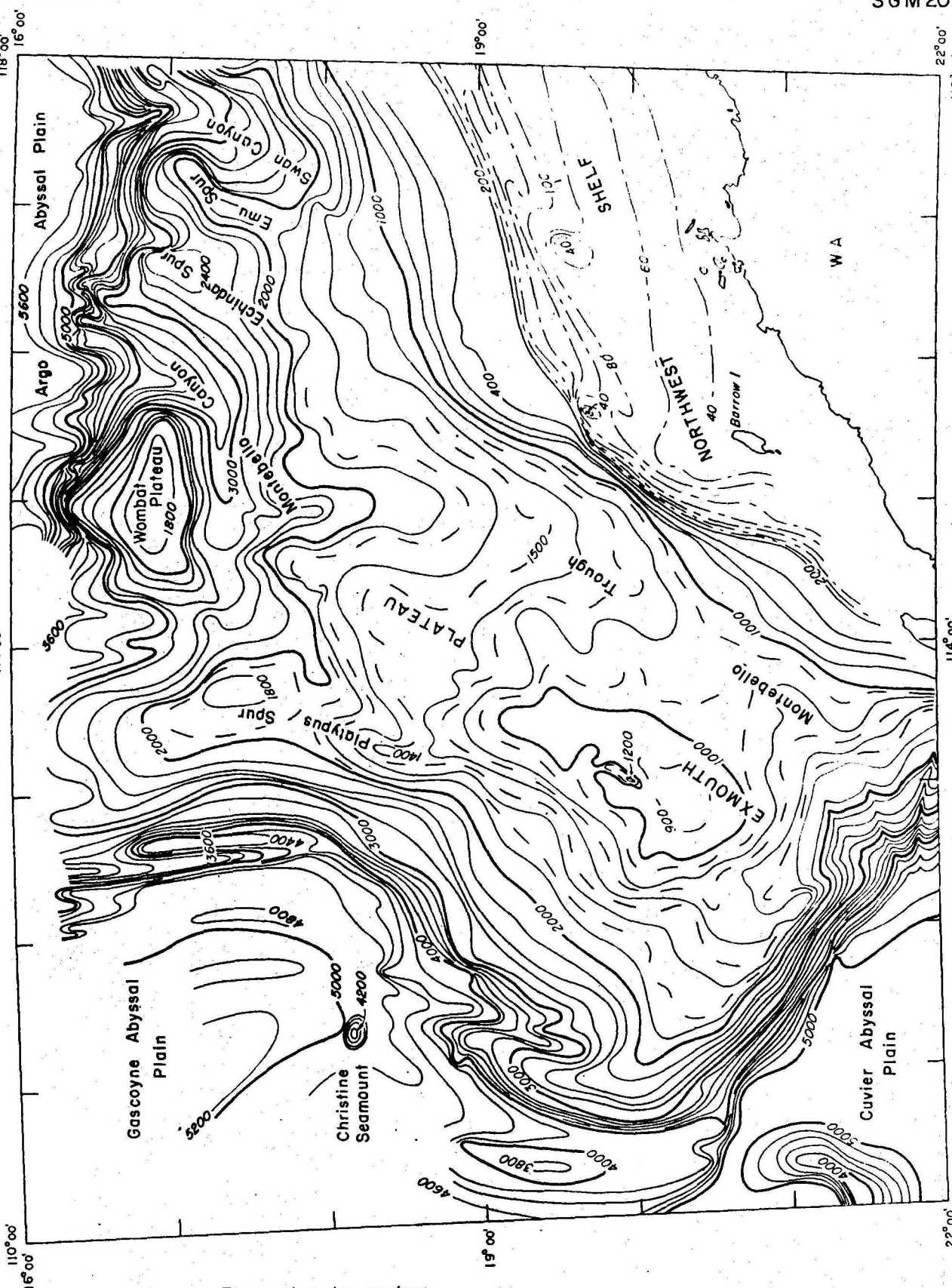
The profile program was re-organized so that there are three types of output: the profiles, the baselines, and the observation marks. This gives added flexibility at the drafting stage by allowing a user to produce a map containing only selected profiles and associated information at the plotting stage. Use of multi-colours or different pen thicknesses also become practicable with this approach. As the principal use of profile maps is for correlation, the program was changed so that profiles which ran predominantly north-south were all plotted with positive values to the right hand side of the baseline. Previously the positive side would change as the baseline moved past a north-south direction.

The data-posting routines were reorganized and generalized so that as many components as possible could also be used by the profile and track-chart programs. The problem of station annotation overwriting is reduced by a routine which can write at specific angles calculated according to the ship's track. Further improvements to reduce this problem are under investigation.

Seismic data transcription (J.K. Grace, R. Dulski, M. Amar). Transcription of analogue magnetic tapes of six-fold marine seismic records from the Continental Margin Survey continued during 1975; 161 copy tapes were lent to private companies for digital processing, of which 71 were new requests and had to be transcribed.

Geophysical Service International Ltd, Sydney has now digitally processed and stacked seismic data from 70 lines or part lines recorded during the Continental Margin Survey. This work has been done on behalf of various private oil companies and the processed data are held confidential for 12 months after the completion of processing. The degree of data enhancement due to processing has varied depending on the locality and water depth; sections recorded off the south and west coasts of Australia show the greatest improvement. The geographical positions of seismic sections that have been processed by GSI are shown in Figure SGM19.

SGM20



Thousand metre contour

Two hundred metre contour

One hundred metre form line

Twenty metre contour, shallower than 200 metres (Jones, 1973)

EXMOUTH PLATEAU BATHYMETRY

Record No. 1975/161

WA/B8-65A

Interpretation and reporting

Exmouth Plateau project (N.F. Exon, J.B. Willcox, P. Petkovic). The project is essentially an interpretation of BMR and company seismic data, and its prime purpose is to evaluate the petroleum potential of the Exmouth Plateau and adjacent areas (total area 300 000 km^2) offshore from Western Australia. Much of the interpretation of seismic lines was completed in 1974, and 1975 was spend preparing reports covering various aspects of the study.

A fairly comprehensive report presents a number of isochron maps, along with gravity, magnetic, and bathymetric maps and interpretations of seismic profiles. Tentative ages of seismic reflectors were arrived at by correlation with wells on the Rankin Platform. Sections of the report deal with structure, stratigraphy, geological history, and petroleum geology.

A second set of maps, in terms of depths and thicknesses, was prepared during 1975 and made use of accoustic velocity information from wells on the neighbouring shelf and seismic refraction studies. These maps will be incorporated in a Bulletin.

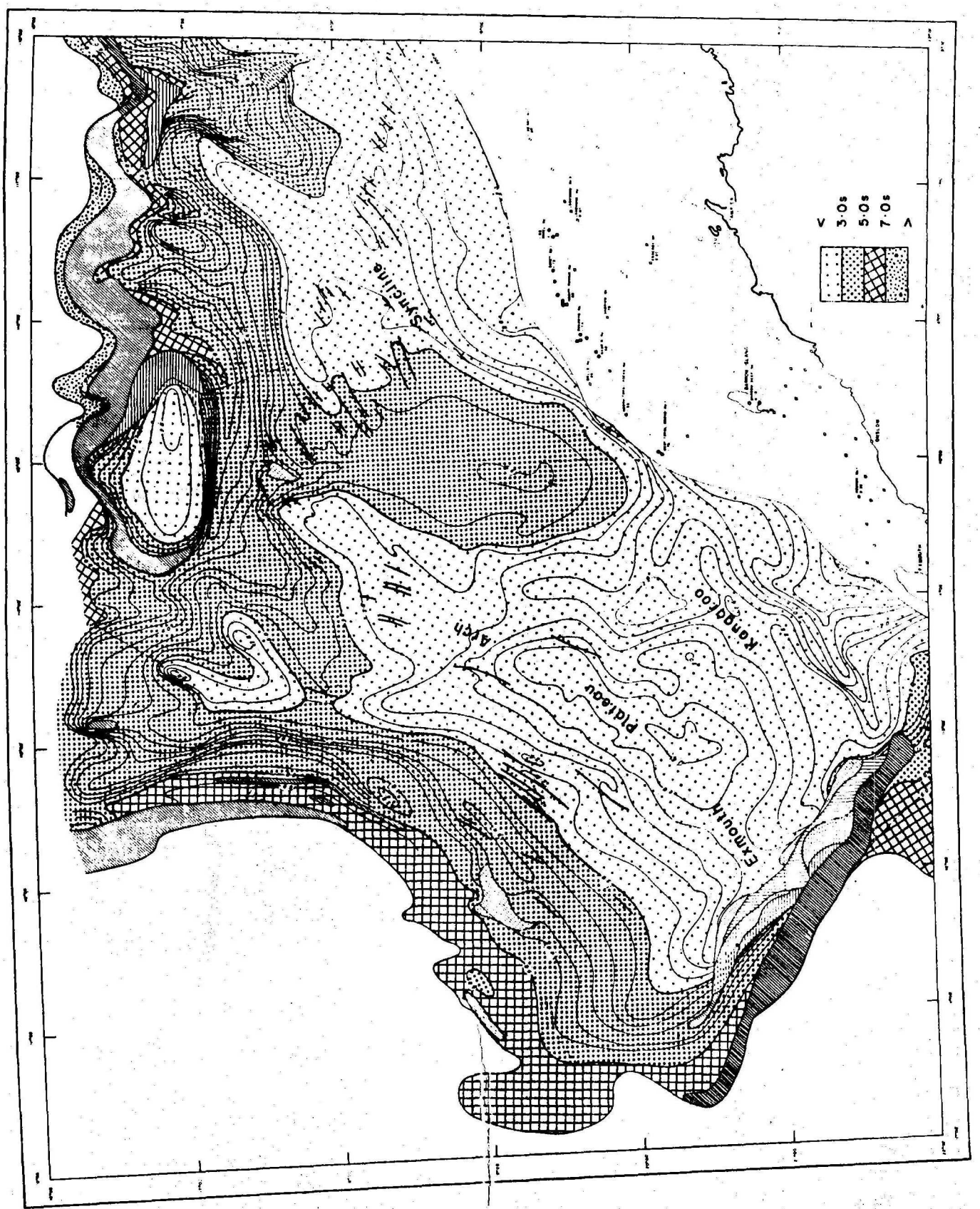
A paper is being prepared for the 1976 APEA Conference. It will deal mainly with the central area, which is probably the most prospective for petroleum, and will be orientated towards petroleum exploration.

Another paper is being prepared for the International Geological Congress. It will concentrate on the tectonic history of the area as a whole, with special reference to plate tectonics.

The more important findings of the study are now presented.

The Exmouth Plateau and its limiting outer slopes lie in water depths ranging from 800 to 5000 m (Fig. SGM20).

The dominant structural grain of the Plateau is northeast; the Kangaroo Syncline is a major downwarp lying 100 km northwest of and parallel to the Rankin Platform (Northwest Shelf), and the Exmouth Plateau Arch is a major rise 150 km northwest of and parallel to the Syncline (Fig. SGM21). There is extensive normal faulting of the pre-Cretaceous sequence, with blocks downthrown to the west and tilted to the east (Fig. SGM22). The structure is complicated by


Synclina
Arch
Kangaroo
Flatfoot
Exmouth
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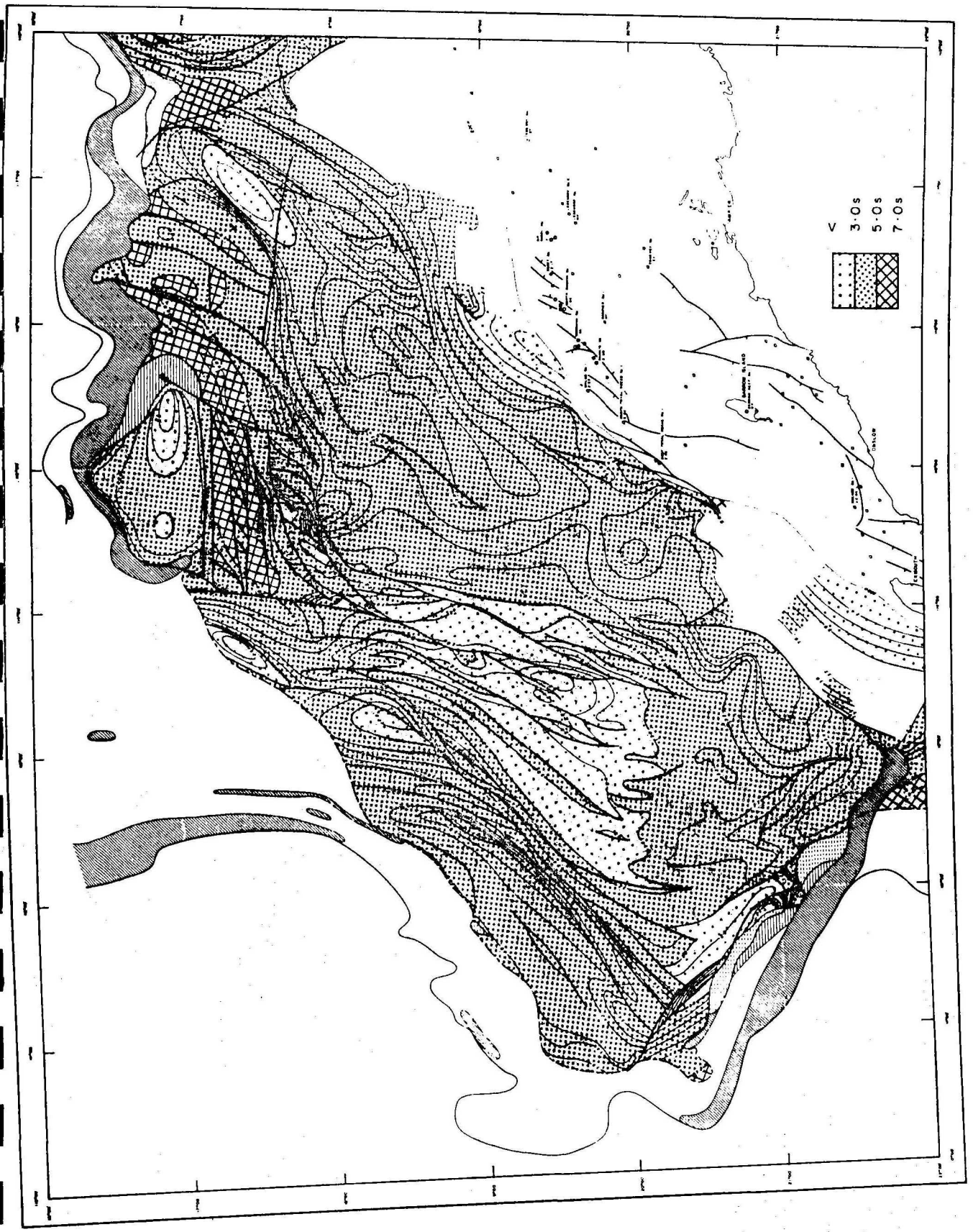
EXMOUTH PLATEAU
SENONIAN STRUCTURE
(TIME TO HORIZON C)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EXMOUTH PLATEAU
TOP TRIASSIC STRUCTURE
(TIME TO HORIZON F)

cross-trends: easterly in the north, and northwesterly in the south. The same structural trends affect the younger, post-rifting sedimentary column, and are visible in the bathymetry. The stratigraphy in this area is generally comparable to that for the Northwest Shelf.

Basement is overlain by up to 10 000 m of Phanerozoic strata. Little is known about the Palaeozoic sequence, but shallow-marine and terrestrial sedimentary rocks ranging in age from Silurian to Permian are probably present. The Palaeozoic sequence is overlain by up to 3700 m of Triassic shallow-marine to fluvial sandstone, siltstone, and shale (Locker Shale and Mungaroo Beds), which is extensively block faulted, presumably because of tension related to seafloor spreading. Unconformably overlying the uneven Triassic surface (Fig. SGM22) is up to 2000 m of Middle and Upper Jurassic pro-delta mudstone (Dingo Claystone) and Neocomian deltaic sandstone, siltstone, and mudstone (Barrow Group). It is believed that the northeast-trending spreading centre developed to the west in the Late Jurassic, separating this area from western Gondwanaland. At the same time a latitudinal transform fault, associated with abundant igneous intrusions, started to form the area's northern margin.

An average of 200 m of mid-Cretaceous shallow-marine siltstone and mudstone (Winning Group) conformably overlies the Neocomian. Early in the Late Cretaceous a northwest-trending transform fault probably started to form the area's southwestern margin; it too was associated with igneous intrusions.

The mid-Cretaceous beds are unconformably overlain by a carbonate sequence averaging 700 m in thickness, which ranges from Senonian to Recent in age. The unconformity is mapped in Figure SGM21. Two major hiatuses within the sequence are believed to be of Paleocene and Oligocene age. The Senonian-Maastrichtian carbonates were probably laid down in shallow water, and the Cainozoic carbonates in bathyal depths. In the Late Cainozoic the Exmouth Plateau Arch formed, and collapse along old latitudinal fault-lines in the north gave rise to half-grabens south of marginal sub-plateaus.

Suitable petroleum source rocks, especially pre-Cretaceous shales and siltstones, and suitable reservoir rocks, especially Triassic and Neocomian sandstones, appear to exist in the Exmouth Plateau area. The depth of burial has probably been adequate to form hydrocarbons from Early Jurassic and older source rocks. Many fault traps in Triassic sediments, analagous to those of the Rankin Platform, appear to exist. Other likely petroleum targets are stratigraphic traps in the Jurassic-Neocomian deltaic sequence. The area is potentially a major petroleum province.

Queensland Plateau (John C. Mutter). This structure was studied by correlating acoustic stratigraphy from seismic reflection profiles (obtained during the BMR Continental Margin Survey) with the age and lithologic data (available from Deep Sea Drilling Project hole number 209 drilled on the outer edge of the Plateau). BMR surveys came within four nautical miles of the drill site and allowed a close correlation to be made. This has enabled litho-acoustic units to be mapped over the Plateau and together with the mapping of faults and sedimentary structures has allowed a geological history to be postulated.

The drill-hole at DSDP Site 209 bottomed in middle Eocene shallow-marine sand-rich ooze. Above that was 135 m of middle to upper Eocene sand-bearing foraminiferal ooze, and this unit was separated by an unconformity from late Oligocene to Pleistocene foraminferal and nanno-fossil ooze. The change from dominantly terrigenous to wholly pelagic sedimentation indicates progressive deepening at the site from middle Eocene time onward.

The three lithologic units described above have been matched to the accoustic stratigraphy on BMR seismic reflection profiles (Fig. SGM23). Each unit has been correlated and mapped over the Plateau. The late Oligocene to Pleistocene pelagic cover is nearly uniform in thickness over the whole Plateau but both of the lower two units are more thickly developed in a basement trough on the outer edge of the Plateau. Faulting has disturbed only the middle Eocene terrigenous unit and is more intense on the western side along the flanks of the Queensland Trough. The gross structure of the basement shows northwest to north-northwest trending elevations and depressions strikingly similar to the structural style of the Tasman Geosyncline. These trends terminate on the outer edge of the Plateau at a steep, linear, northwest-trending scarp which is interpreted as a rift structure.

The geological history o the Queensland Plateau has been interpreted from the mapping described above and consists of the four basic phases shown diagramatically in Figure SGM 24. These are:

1. Uplift of the geosynclinal basement, probably in Late Cretaceous time. This is the time of, and hence may be related to, the Maryboroughan Orogeny.

2. Stabilization, erosion of basement highs and deposition of the erosion products in the adjoining depression. These sediments form the lowermost unit in DSDP 209. Deposition of this unit continued from Late Cretaceous to late Eocene.

3. Formation of the Coral Sea Basin in the late Eocene followed shortly afterwards by subsidence of the outer edge of the Queensland Plateau accompanied by some faulting. As source areas for terrigenous sedimentation were reduced the hemi-pelagic rock, found in the central cores at DSDP 209, was deposited. Coral reefs which grew on the outer edge of the Plateau were drowned while those on the more stable western side survived.

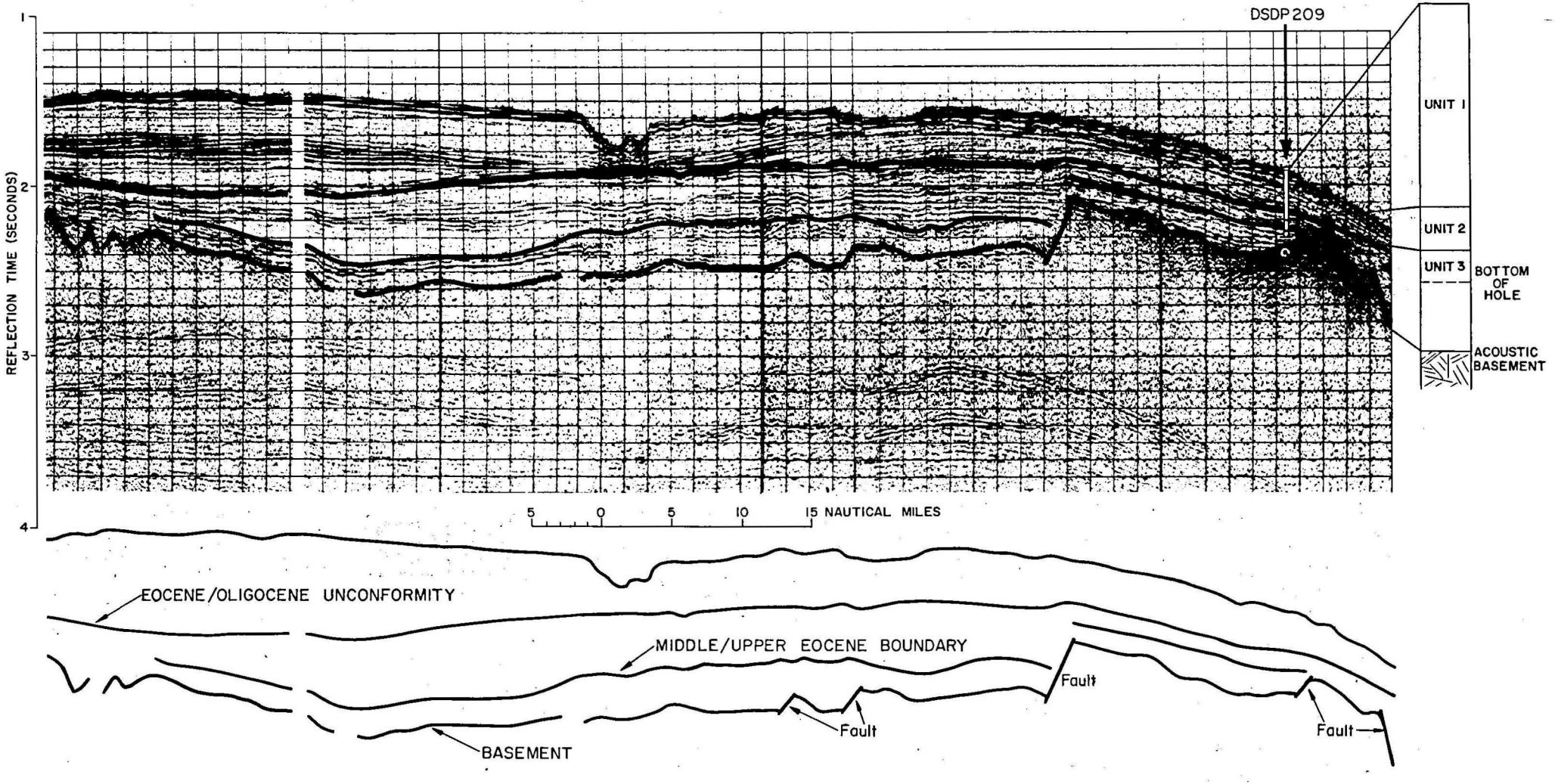
4. After, or possibly during, the Oligocene period of non-deposition, the Plateau began to subside as a unit. Almost all sources of terrigenous sediments became submerged and a pelagic blanket covered the Plateau. This sequence is represented by the uppermost lithologic unit in DSDP 209. Coral reefs on the flanks of basement highs were drawned during subsidence, and areas of active reef growth migrated to the tops of the highs. The Queensland and Townsville Groughs which separate the Plateau from the continental shelf and the adjoining Marion Plateau to the south probably formed in Oligocene time as the pre-Oligocene strata appear to be downthrown into the troughs.

Contract marine magnetic surveys (F.W. Brown, J.K. Grace, R. Dulski)

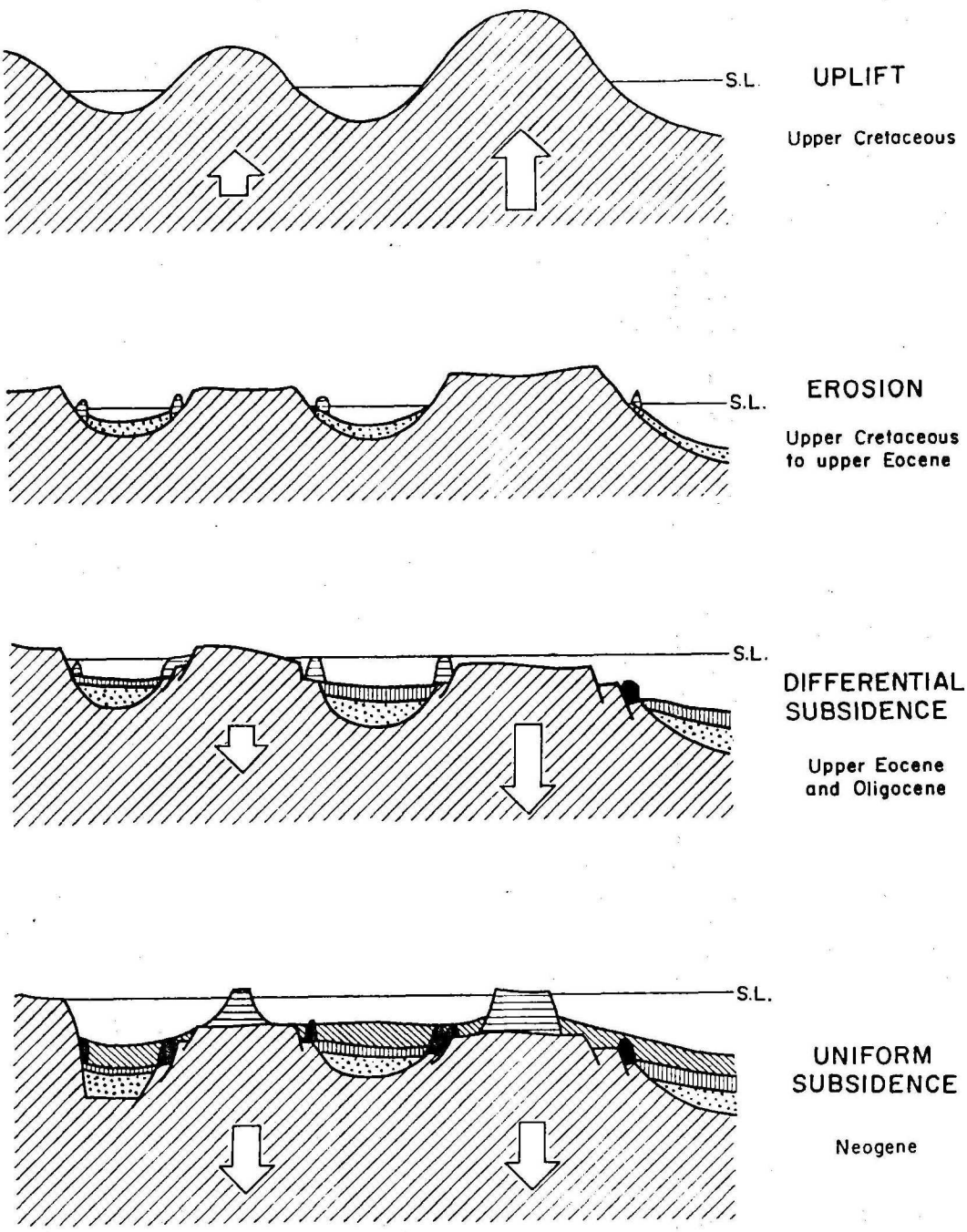
The contract marine magnetic survey which was still in progress towards the end of 1974 was completed in December 1974. It was one in a series planned in association with the Division of National Mapping which intends to make a bathymetric survey of the Australian continental shelf at a traverse spacing of 3 km, i.e. about the spacing of reconnaissance airborne magnetic flight-lines over land. The bathymetric work provides an opportunity to extend magnetic coverage at this spacing economically to the shelf edge.

Proton-precession magnetometers, complete with cable and sensor, quartz clock, and analog chart recorder were used both on the ship and at a monitor station placed conveniently in Broome. The ship's installation included a winch for streaming and recovering the cable and sensor.

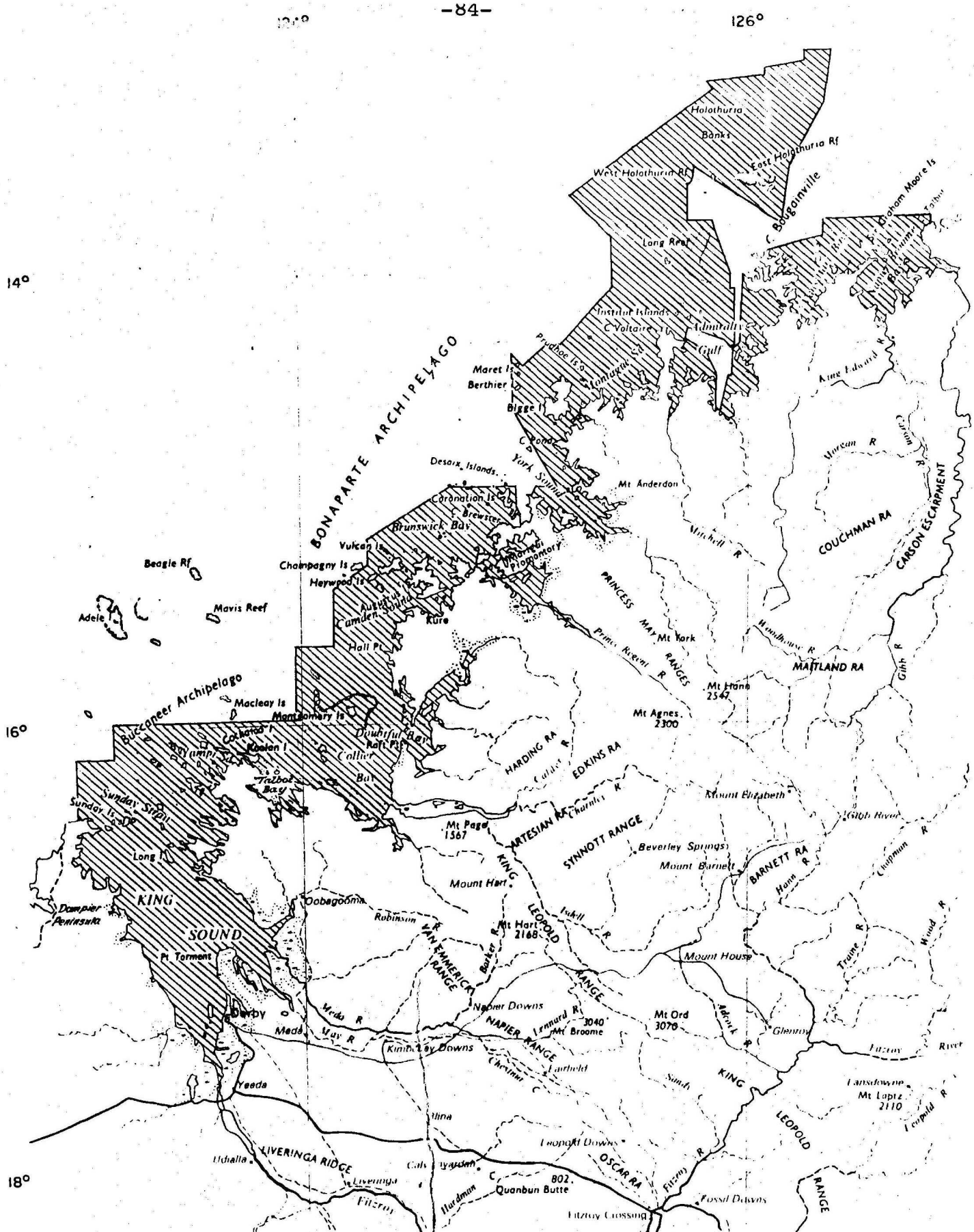
The contract completed in 1974 yielded 10 173 nautical miles of magnetic data in continuous analog chart form. Positions were determined about each ½ mile using Decca HIFIX radio positioning equipment operated by the contractor/ Further contract work commenced in June 1975 in waters bordering the Kimberley Basin, on the Northwest Shelf (Fig. SGM25). Much of this area has been found too hazardous, owing to shallow water and reefs, to stream the sensor safely, and only a small amount of magnetic data can be expected. This contract will be completed in January 1976.



QUEENSLAND PLATEAU SEISMIC SECTION



QUEENSLAND PLATEAU
SIMPLIFIED GEOLOGICAL HISTORY



CONTRACT
BATHYMETRIC AND MAGNETOMETER SURVEY
OFF THE COAST OF W.A.
1975

SCALE
0 50 75 100km

It is intended to digitize the magnetic records and positioning data, both on a time base. They can then be incorporated in standardized form with other marine data. A small amount of digitizing was done in 1975.

Co-operative marine survey with Lamont-Doherty Geological Observatory (J.C. Mutter, L.A. Tilbury, H.M.J. Stagg, R.A. Dulski, D. Jongsma, P.Petkovic). BMR is participating in a major marine study of the southeast Indian Ocean being undertaken by the Lamont-Doherty Geological Observatory. Four one-month cruises are scheduled for the period mid-November 1975 to mid-March 1976, and at least one BMR geophysicist will be aboard the survey ship (R/V Vema) during each cruise as a co-operating scientist. One of them will visit Lamont-Doherty to co-operate in interpreting the survey data after completion of the cruises. BMR is also providing explosives for crustal refraction shooting.

The cruises are designed to study regional structural anomalies on the mid-ocean ridge between Australia and Antarctica (an area of anomalously low magnetic field variation known as the marginal magnetic quiet zone, and structures in the Wharton Basin west of Australia. A wide range of geophysical and geological techniques will be employed.

Review of marine geophysical investigations over the Lord Howe Rise and Norfolk Ridge (D. Jongsma)

The Lord Howe Rise and Norfolk Ridge are two elongate submarine structures lying along the eastern side of the Tasman Sea. Both have a quasi-continental structure; seismic refraction and gravity data indicate that the crust under Norfolk Ridge is about 21 km thick and the crust below Lord Howe Rise about 25 km thick. This is in contrast to the 10-17 km thick crust of the Tasman and New Caledonia Basins.

Both features are about 1600 km long and their crests vary in depth between 750 m and 1200 m. Marine geophysical investigations and deep sea drilling results indicate that they separated from the Australian continent by rifting in the Tasman Basin during the Late Cretaceous. Several sedimentary basins within the flanks of Lord Howe Rise and Norfolk Ridge have been discovered by recent marine geophysical work in the area.

The Lord Howe Rise contains several small sedimentary basins with up to 3 km of sedimentary rocks. The upper 0.5 km of sediments consist of Cainozoic biogenic ooze. Since the Rise is thought to have been once joined to Australia, the basal sediments of these basins may be terrigenous and form a potential hydrocarbon source.

The Norfolk Ridge has a sedimentary cover less than 1 km thick but contains two sedimentary basins with sediments 3 km thick. It is not known whether the bulk of the Ridge is composed of older consolidated sedimentary rocks or igneous/metamorphic rocks beneath the recent basalt flows.

A compilation was made of all ships tracks along which geophysical data were collected. Appraisal of these and the data collected shows that there is insufficient coverage for a reliable assessment of the area's economic potential. A report has been written.

Review of geophysics and geology of Australian Island Territories (D. Jongsma)

This study was commenced in August to summarize the present state of knowledge of the geology and geophysics on and around Australian island territories outside the Australian continental margin. These are Macquarie Island, Lord Howe Island, Norfolk Island, islands in the Coral Sea, Christmas Island, and Heard and MacDonald Islands. The report on this study will include an assessment of the prospectivity of these islands and their surrounding shelves for mineral and energy resources.

Development of a data acquisition system (A. Hogan)

The data acquisition system used for the Continental Margins Survey, although operationally successful, contributed to increased cost and time of post-survey processing because of undetected errors in acquiring data. Additional hardware and error-checking routines are to be added to the DAS for future surveys to provide better acquisition procedures and automatic quality control leading to improved data at the acquisition stage and so reduced post-processing effort in future.

The new system is being developed through the complementary use of two programming languages: FORTRAN for the geophysically orientated tasks and ASSEMBLER for the operating system. The introduction of FORTRAN will decrease the need for specialized training of geophysicists in the detailed operation of the system.

The FORTRAN error-checking routines will be developed on the Cyber 76. This requires that the DAS operating system should mimic certain Cyber 76 features. Principally this has involved development in ASSEMBLER of a set of buffered I/O routines, timing facilities, and system and peripheral status-checking programs.

The introduction of a linked computer system to increase error-checking capabilities entailed most of the effort in developing these software additions. In this development the link is set up so that each computer sees the other as a peripheral device. A communication method suited to the DAS is being established to keep operating system size and complexity to a minimum.

Australian Geomagnetic Reference Field (AGRF) (J.J. Petkovic, R. Whitworth)

From an analysis carried out in 1974 of magnetic secular variation in the Australian region, it was demonstrated that much of the difficulty in merging magnetic survey data from different epochs was caused by errors in the International Geomagnetic Reference Field (IGRF). A mathematical model based upon the IGRF but using quadratic time-terms was tested using only local data. An acceptable fit to the observed secular change was obtained over the continent, but large and apparently spurious isopors were created in the surrounding oceans.

Rather than pursue a local field representation that would introduce its own difficulties as the area of coverage was extended, a solution that would in theory at least be acceptable to the international community was sought. Data from geomagnetic observatories throughout the world were used in a redetermination of the spherical harmonic coefficients for the model. The less accurate first-order magnetic station data available for the Australian continent were excluded from the determination but were used to assess the goodness of fit of the coefficients.

The worldwide distribution greatly reduced the erratic variations observed in areas of sparse data (4 in the Australian region, mainly the oceans). The mathematical stability of the adjustment method was improved, and the coefficients came closer to being independent as required by the theoretical relation of orthogonality. The fit of the data over the Australian region was somewhat poorer than before but, as a reasonable fit over the sphere was obtained, the slight degradation was considered acceptable. An RMS residual of 20 nT was obtained from this Australian Geomagnetic Reference Field (AGRF) compared with 120 nT using the IGRF. It had been hoped that the revision of the IGRF proposed by the International Association of Geomagnetism and Aeronomy (IAGA) at Grenoble in August 1975 would result in a model consistent with the AGRF. It was evident to R. Whitworth when he attended the Zmuda Memorial Conference in Colorado Springs in May 75 (see EOS, August 1975) that this would not be so. The

restrictions placed by IAGA on modifications to the coefficients will make the IGRF unacceptable in the Australian region until around 1985 at least. The insistence that only the rate of secular change may be modified and that the field must be continuous with the present day IGRF at epoch 1975.0 means that divergences of several hundred nanoteslas will occur in the region from 1965 to 1985.

Until the IGRF is brought into reasonable agreement with the observed secular change in the Australian region, the AGRF model generated should be used to allow integration of surveys obtained over the last decade and henceforth. The spherical harmonic coefficients will need to be adjusted from time to time to maintain the fit within acceptable limits (20 nT RMS say). The method of computation has been revised to allow significantly cheaper determination of the coefficients.

Overseas visit by R. Whitworth

While overseas from March to May, R. Whitworth attended three conferences in the USA and Japan, and visited about forty institutes, manufacturers, and geophysical contractors.

A paper on problems of magnetic secular variation in the Australian region was presented at the Zmuda Memorial Conference in Colorado Springs. Much useful discussion resulted from the small size and informality of the conference. However, it appears most unlikely that proposed modifications to the International Geomagnetic Reference Field model will correct its shortcomings sufficiently to allow its use in the integration of magnetic surveys.

The papers presented at the Offshore Technology Conference in Houston covered a wealth of subjects and were complementary to a large exhibition of equipment and techniques. Navigation was one topic of relevance, and several papers indicated that satellite navigation is continuing to improve steadily, mainly by the use of more sophisticated processing. LORAN-C radio navigation shows great promise in both performance and cost, and is being adopted as the standard system in the Coastal Confluence Zone of the USA.

The World Petroleum Congress in Tokyo proved to be of lesser value. There were fewer subjects of relevance and despite good organization, many papers had poor impact because of shortcomings in presentation. A contribution was made to Panel Discussion 5 on the Prospects of the Deep Ocean.

The major oceanographic institutes in the USA were visited and data exchange arranged with all of them. Data are already flowing in, but it will be some time before all the information can be assimiliated. Partly as a result of this visit arrangements are being made for co-operative studies with BMR on work proposed for the Australian region. In particular Lamont-Doherty Geological Observatory and Woods Hole Oceanographic Institution proposals could prove of benefit to BMR.

Several of the big geophysical contractors in Houston were visited to outline BMR proposals for future work and to establish dialogues with those companies with the necessary capability. Several difficulties associated with such survey work were aired. These included the importance of survey vessels to do the work, the use of union crews, and how the effects of inflation could be handled on a contractual basis.

3. OBSERVATORIES AND REGIONAL SECTION

(J.C. Dooley)

J.C. Dooley and B.C. Barlow attended the General Assembly of the International Union of Geodesy and Geophysics (IUGG) at Grenoble, France; in addition, Dooley attended a meeting of the Commission for Controlled Source Seismology (CCSS) in Paris, and visited Russia, Sweden, and UK.

The CCSS meeting was an informal meeting of specialists. Many results were presented on the structure of the crust and upper mantle in western Europe, with details of improved field techniques and interpretation methods. Vibroseis techniques have successfully recorded deep crustal reflections in USA and Canada. Marine seismic surveys were reported using ocean-bottom seismometers and long strings of sonobuoys. One session was devoted to the occurrence and significance of anisotropic velocity structures.

At Grenoble, Dooley attended interdisciplinary symposia relating to crust and mantle structure and composition, plate tectonics, heat flow, current tectonic movements, and mathematical analysis of geophysical data. He attended scientific sessions and working group meetings on magnetic observatories, instruments, and procedures, and on the magnetic field of the Earth and its secular variation. He also attended a meeting of the Working Group on Solid Earth Geophysics of the Scientific Committee for Antarctic Research.

Barlow attended the scientific and plenary sessions and working group meetings of the International Association of Geodesy (one of the seven Associations constituting the IUGG) relating to gravity measurements, improvement of the International Gravity Standard Network, compilation, storage and retrieval of international gravity data, and the future of the International Gravimetric Bureau. The joint project on tidal gravity measurement with Belgium was discussed with Prof. Melchior, and the proposal for absolute gravity measurements under the USSR-Australian science agreement was discussed with Prof. Boulanger.

The Council of IUGG accepted an invitation from Australia to hold the next General Assembly in 1979.

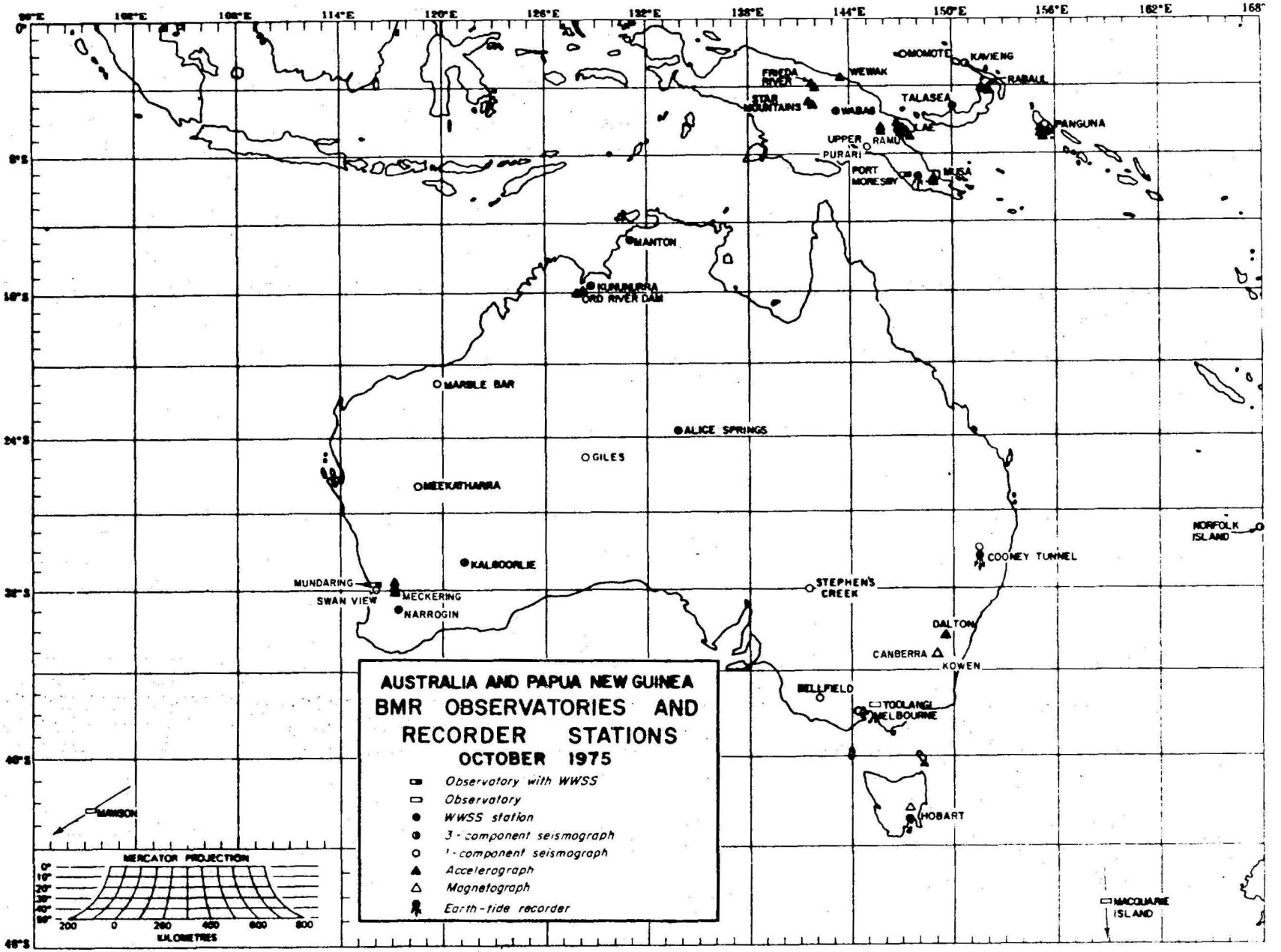
At the Institute of Physics of the Earth in Moscow, Dooley held discussions relating to various types of tidal gravity meters and tiltmeters, mathematical interpretation, and marine geophysical surveys. The Institute of Earth Magnetism, Ionosphere and Radio Propagation was visited in Moscow and Leningrad to discuss mapping of the Earth's magnetic field and secular variation. At Novosibirsk he visited the Geophysics Section of the Mathematics Institute, in connexion with determination of crust and mantle structure from earthquake arrivals: and the Institute of Geology and Geophysics, in connexion with use of S-waves in seismic prospecting, gravity investigations of crustal structure, and deep seismic sounding. At the Institute of Arctic and Antarctic Research, Leningrad, discussions were held relating to geological and geophysical investigations in Enderby Land and the Prince Charles Mountains.

In Sweden, a visit was made to Hagfors Observatory of the National Defence Research Institute, which has developed automatic seismic event detection and location methods, and studies of discrimination between natural earthquakes and explosions.

In UK discussions were held with a manufacturer of seismic recording equipment, and the Institute of Geological Sciences and International Seismological Centre at Edinburgh. J.P. Cull was visited at Oxford University, where he is nearing completion of his Ph.D. thesis on heat flow measurement.

OBSERVATORIES SUBSECTION (P.M. McGregor)

The Subsection deals with basic investigations in geomagnetism and seismology, and comprises four Groups situated at Canberra Headquarters, Mundaring (WA), Port Moresby, and Melbourne. Essentially, the Headquarters Group



(Based on G20-14)

handles those aspects of data derivation and distribution which require specialized equipment, access to computers and computing expertise, and carries out research involving data from several observatories; the other three Groups operate geophysical observatories, networks of regional seismograph stations and accelerographs, and carry out research on local problems. The HQ Group also directs operations at Antarctic Observatories and in the Northern Territory, and carries out regional magnetic surveys. Figure OR 1 shows the disposition of all recording instruments operated by the Subsection.

New seismograph stations were commissioned at Swan View tunnel and Narrogin (WA), and at Purari and Madang in Papua New Guinea. The Narrogin station will operate temporarily until the Seismological Research Observatory (SRO) is installed, probably in December 1975. A contract to drill the SRO borehole was arranged and the hole and associated vaultlet were completed by June. The hole is 105 m deep in granite and deviates less than 2^{o} from the vertical.

The World Standard Seismographs at the University of Tasmania continued to be operated for BMR by the University's Department of Geology.

Deferment of a large third-order magnetic survey from 1974 imposed a heavy strain on the HQ Group and consequently some of its projects were set back; nevertheless the Group was able to meet all those national and international commitments involving deadlines. All Groups except the Melbourne Group were understaffed throughout the year.

Headquarters Observatory Group (G.R. Small, M.J.M. Robertson, R.L. Paine, M.W. McMullan, A.J. McEwin, J. van der Linden, A. Bullock, E. Smilek)

Geomagnetism. Seventy-six observatory-months of magnetograms were scaled but only one month's data were reduced. This reduced the backlog in the scaling program but the minimal output in reduced data has delayed the final production of mean hourly values (MHVs).

The main problem in producing MHVs was caused by the time taken to convert the main computer program to the CYBER 76 system. This was started in September 1974 but was not completed until October 1975, partly because personnel had to be diverted to the magnetic survey.

The monthly issues of the Geophysical Observatory Report for May 1974 to June 1975 were prepared and distributed.

The Elsec automatic magnetic observatory (AMO) at Kowen Forest operated continuously except for minor losses. It performed successfully for about 90 percent of the year. The Adkin autodigital magnetometer, which is a fluxgate system, was tested during the year but it was found to be unreliable and unsuitable for observatory purposes; it is expected to prove adequate for first-order surveying.

Seismology. Analysis of the Alice Springs and Cooney seismograms continued throughout the year and preliminary bulletins were prepared and distributed for these stations and for Manton (Darwin), Toolangi, Norfolk Island, Bellfield, Stephens Creek, Macquarie Island, and Mawson. Final phase data for the International Seismological Centre (ISC) for all seismological institutions within Australia, Papua New Guinea, and the British Solomon Islands were compiled for the period December 1972 to November 1973 and sent to Edinburgh on magnetic tape. Each month about 6000 p phases were sent to ISC. Time-sorted bulletins for the same period were also prepared and distributed. Figure OR 2 shows the number of P phases reported by each BMR seismograph station.

The Manton total was affected by cyclone Tracy (25 December 1974) which destroyed the telemetry link and damaged the recording room in the Darwin office. However, the station was re-established at the vault and operated as a conventional station from 1 February 1975. The Canberra-to-Kowen telemetry line was completed in August and this enabled the Kowen test station to be operated when required. A visit to Giles was made in April to repair and modify the seismograph; the Alice Springs recorder was serviced also at that time; no visits to Cooney were required.

The regional 'Earthquake Data File' was fully operational throughout the year and about 20 100 hypocentres from the area 0-90°S, 75-165°E have now been stored on the file. Extensive use of the file was made and about 50 requests from within and outside BMR were handled.

Work started on a project to measure travel-times to ANU stations from quarry blasts. This was initiated to improve the crustal models used by the HYP071 earthquake location program so that the hypocentres of local earthquakes can be determined more accurately. A compilation of P-wave arrival-time residuals at most Australian stations was begun.

OR-2

P-WAVE ARRIVALS, BMR STATIONS
(SEP. 1974 -- AUG. 1975)

ALICE SPRINGS	6084
MANTON	5904
COONEY	2409
TOOLANGI	1276
NORFOLK ISLAND	157
BELLFIELD	969
STEPHEN'S CREEK	2786
MUNDARING	709
GILES — INOPERATIVE FOR FIVE MONTHS	177
KALGOORLIE	632
MEEKATHARRA	623
MARBLE BAR	476
KUNUNURRA	184
SWAN VIEW — STARTED APRIL 1975	24
PORT MORESBY	1674
MOMOTE	168
LAE	1797
WABAG	716
KAVIENG	126
TALASEA	214
PANGUNA	1140
MADANG — STARTED DECEMBER 1974	190
MACQUARIE ISLAND	246
MAWSON	1134
PURARI — OPERATION BEGAN JULY 1975	17

10 50 100 500 1000 5000 10000

(Based on G441-39A)

G82/2-166-1 A

Record No. 1975/161

Several small earthquakes (ML 1) felt near Belconnen were located north of the ACT border, and a Sprengnether seismograph was operated for a few days to detect aftershocks in an attempt to locate them with respect to known faults, but unfortunately the activity was too short-lived.

Strong ground motion. No damaging earthquakes took place in eastern Australia during the year and the SMA1 accelerograph at Dalton was not triggered.

The computer programs that reduce and process the accelerograms were restructured and 44 accelerograms were processed to August 1975, bringing the total to 50. All these were recorded in Papua New Guinea at Yonki, Lae, Rabaul, Panguna, and Musa.

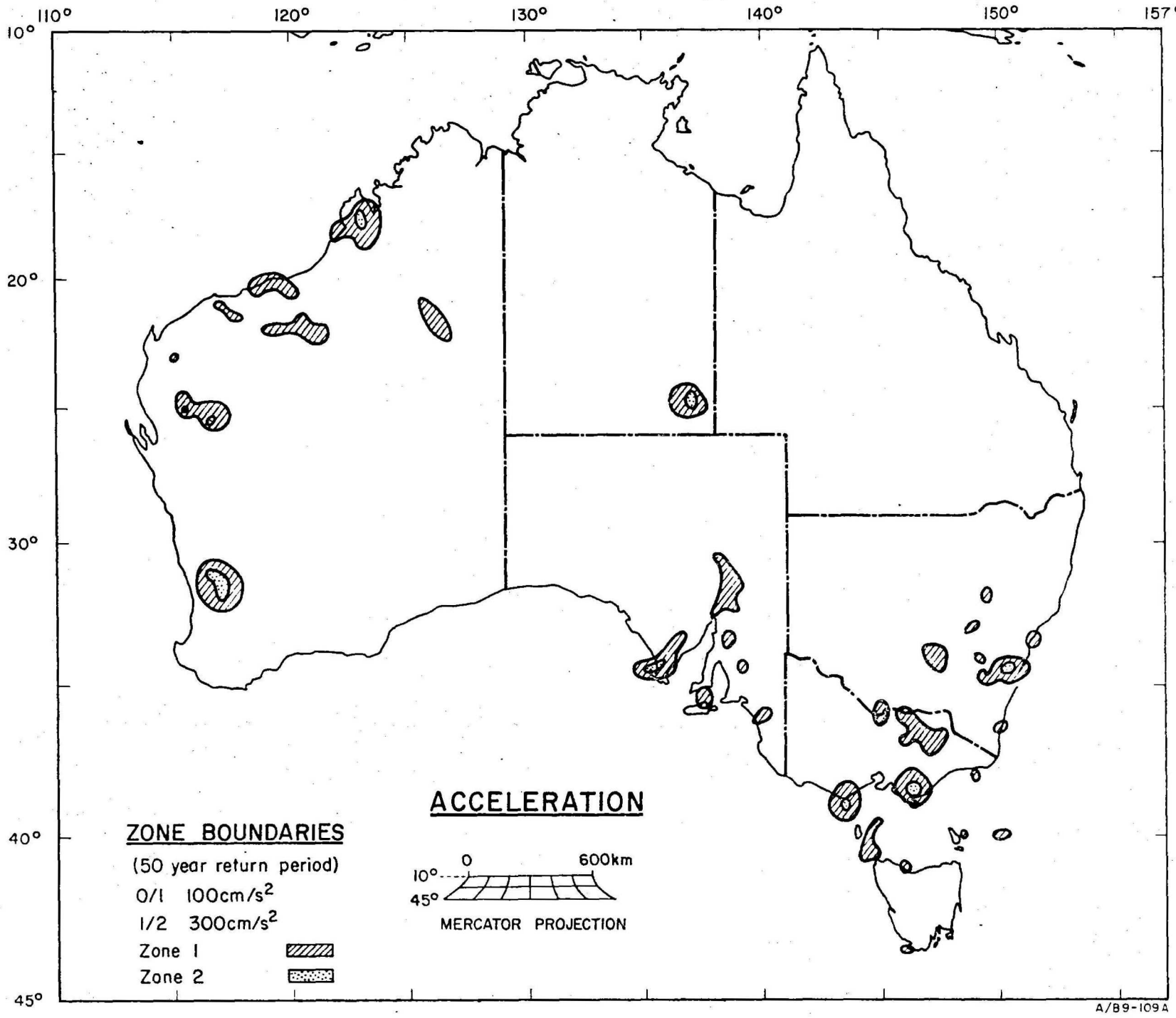
Earthquake risk maps of Australia were prepared using a computer program which selected events from the regional 'Earthquake Data File' and calculated maximum values of acceleration, velocity, and intensity at the nodes of a half-degree grid, using a scaling rule of the Kanai form $Y = ae^{bM}R^{-c}$. The parameters a,b, and c determined by Esteva & Rosenblueth for the Western United States of America were used.

For each node on the grid the Y values were plotted against the return period (years) on logarithmic scales. The results, which were compiled from the period 1960-1972, were extrapolated to give expected values of ground acceleration, ground velocity, and intensity for a fifty-year return period.

These values were plotted and contoured at the following zone boundaries:

Zone	0/1	1/2
Ground acceleration	1 m/s^2	3 m/s^2
Ground velocity	0.05 m/s	0.15 m/s
Intensity (MM)	6.5	8.0

The following nine Zone-2 areas together with the maximum expected ground accelerations for a fifty-year return period were delineated: Meckering (12 m/s^2); Gippsland (5 m/s^2); Picton (4.9 m/s^2); Cape Otway (4.5 m/s^2); Broome (4.2 m/s^2); lower Eyre Peninsula (3.8 m/s^2, excludes Port Lincoln); East of Carnarvon (3.2 and 3 m/s^2), and the Simpson Desert (4.0 m/s^2). Figure OR 3 shows the accelerations determined for continental Australia.


110°
120°
130°
140°
150°
157°
10°
20°
30°
40°
45°
ACCELERATION
ZONE BOUNDARIES
(50 year return period)
0/1 100cm/s²
1/2 300cm/s²
Zone 1
Zone 2
0
600km
10°
45°
MERCATOR PROJECTION
A/89-109A

Several meetings of the National Committee on Earthquake Engineering were attended and a zone map for the Australian continent was prepared in collaboration with other members of the committee. Work was also carried out on the draft notes to accompany the risk maps.

Regional magnetic surveys. From 24 April 1975 to the end of September a third-order magnetic survey was carried out over 91 1:250 000 map sheet areas as indicated by the hatched areas in Figure OR 4.

The three components, declination (D), horizontal intensity (H) and total intensity (F) were measured at the intersections of each 0.25 deg of longitude and latitude.

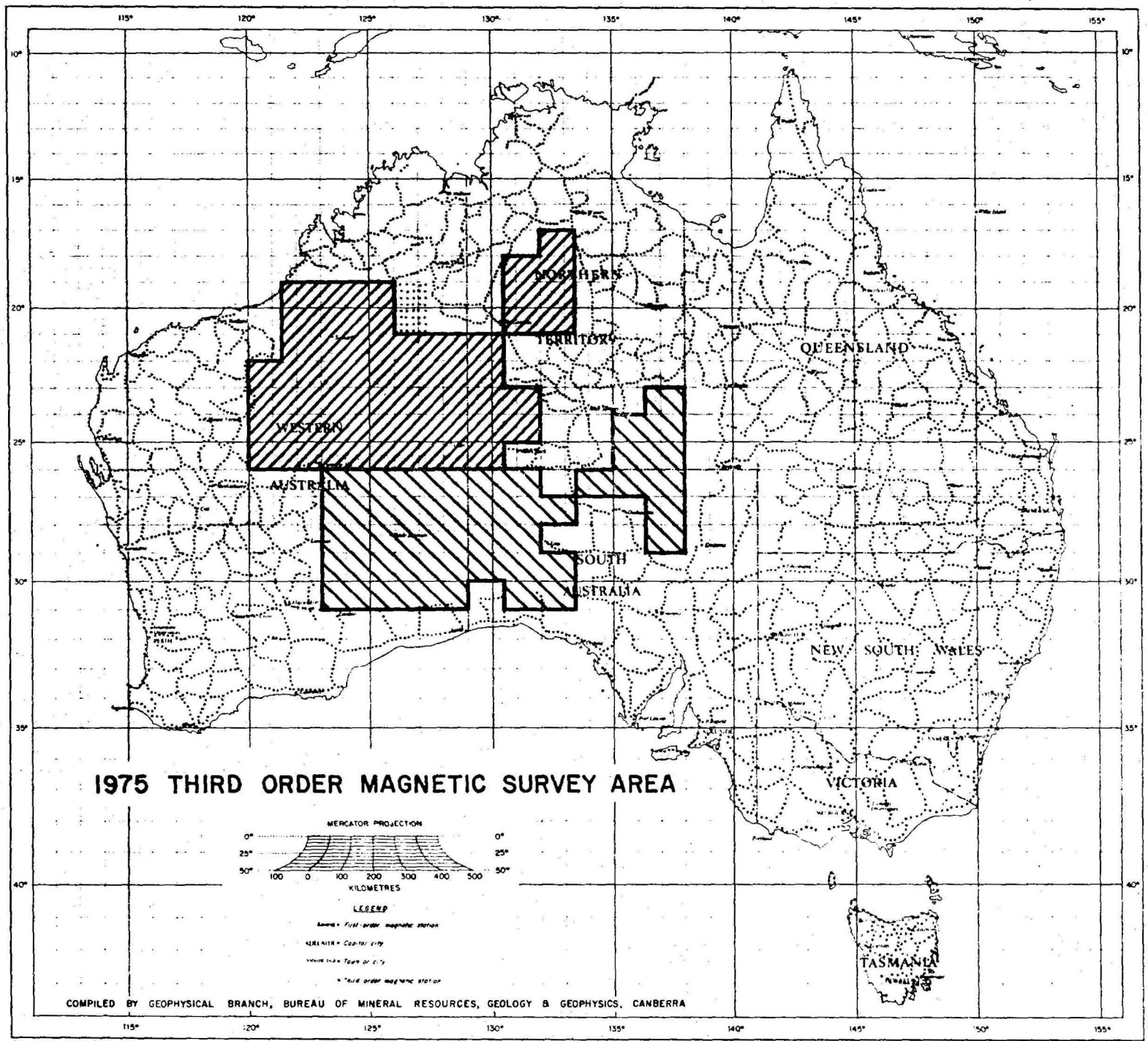
Owing to the inaccessibility of the region helicopters were used to transport the geophysicists and their equipment from station to station. The survey parties operated out of support camps set up along the few roads in the region. The helicopters used were an Enstrom, a Hughes, and a Jet Ranger after the Hughes crashed in June. The Enstrom was damaged in mid-September and the last five map sheet areas were surveyed using only the Jet Ranger. The helicopters and ground support were supplied under contract from Hookway Aviation Pty Ltd.

The 1975.0 magnetic declination map shown in Figure OR 5 was produced. It is based on a six-degree polynomial incorporating 5284 observations. The fit of the polynomial over Australia is, as a whole, very good and the standard deviation between the observed and computed values is 0.25^{o}; Figure OR 6 shows the histogram of the differences. However, in some areas, notably near Perth WA and Spencer Gulf SA, there are large areas containing regional anomalies where the observed values differ by more than 0.5^{o} from the computed values..

A declination map for 1975.0 of the Mawson-Molodezhnaya area was produced, based on the updated 1965.0 declination map of the Australian Antarctic Territory and on some scattered observations after that epoch. The accuracy of the isogonics is estimated to be $\pm$ 1.0 degree and of the secular variation about $\pm$ 2 minutes.

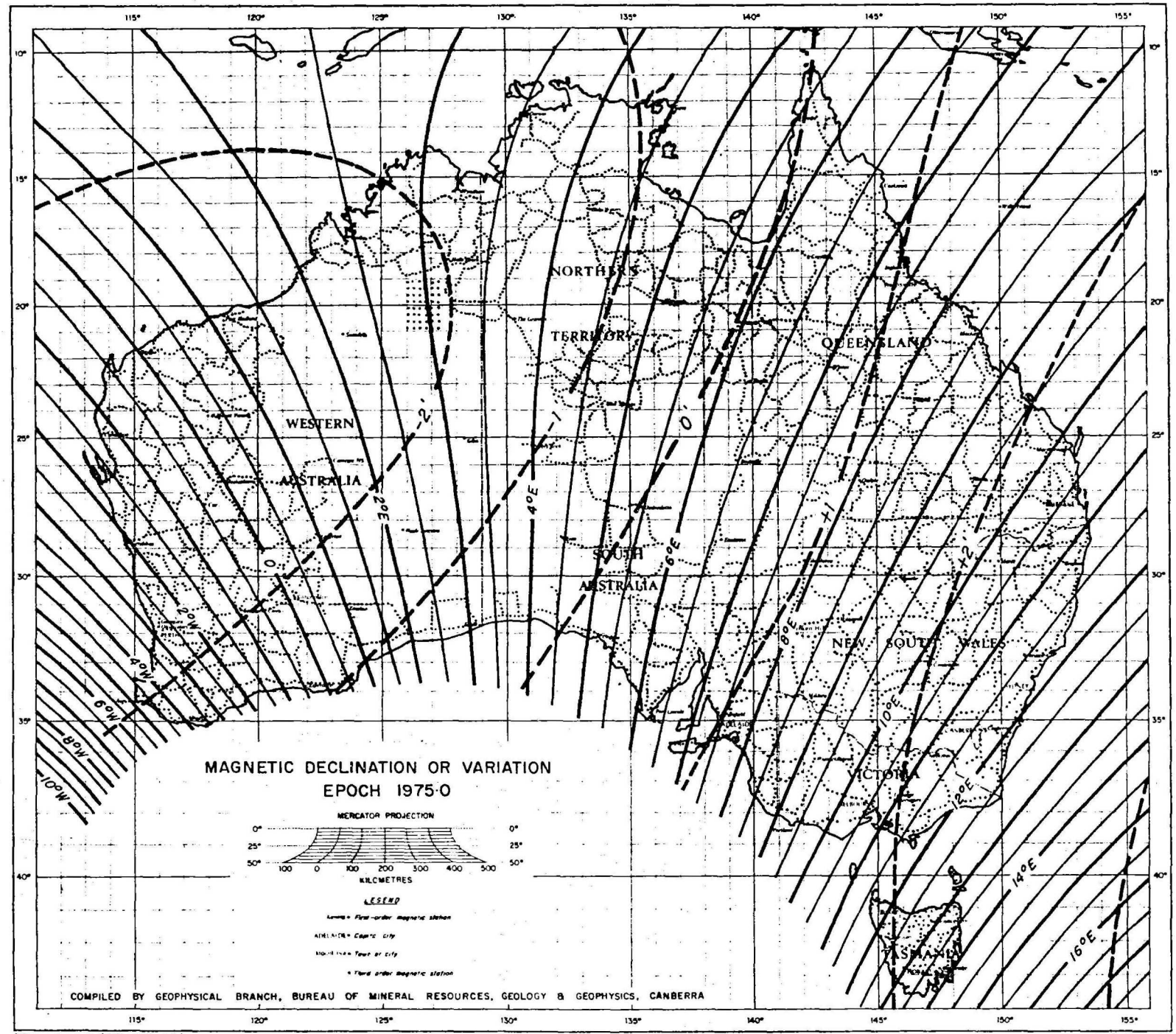
A third-order archive file was created and maintained during the year. It contains about 7000 observations from the period 1967 through 1975.

Secular variation project. BMR's Aero Commander (VH-BMR) will be utilized during November and December 1975 (and again in January and February 1976), to transport Observatory Group staff to several regional magnetic stations



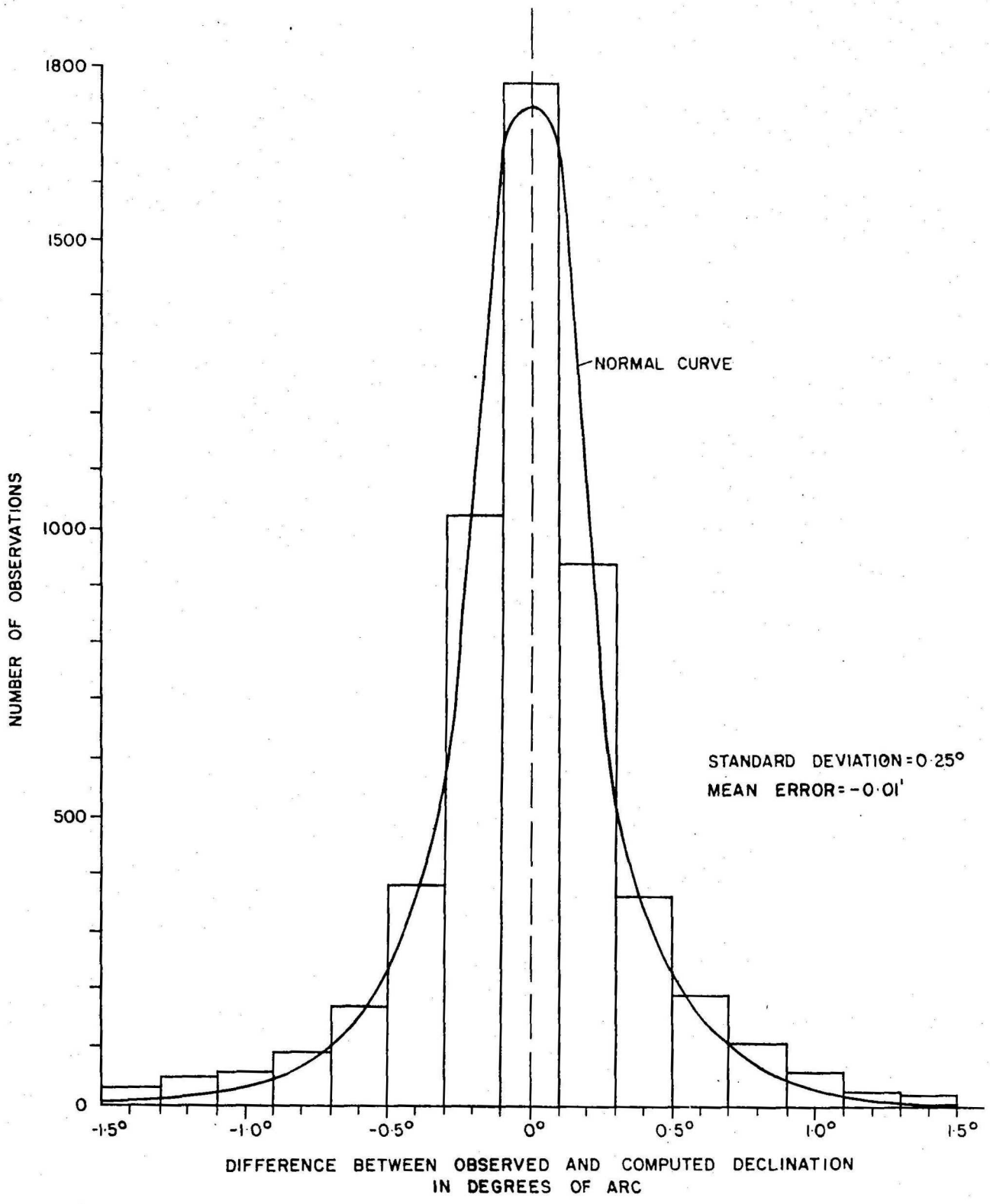
(Based on A/B9-122-1A)

A/B9-122-2A



(Based on A/89-122-1A)

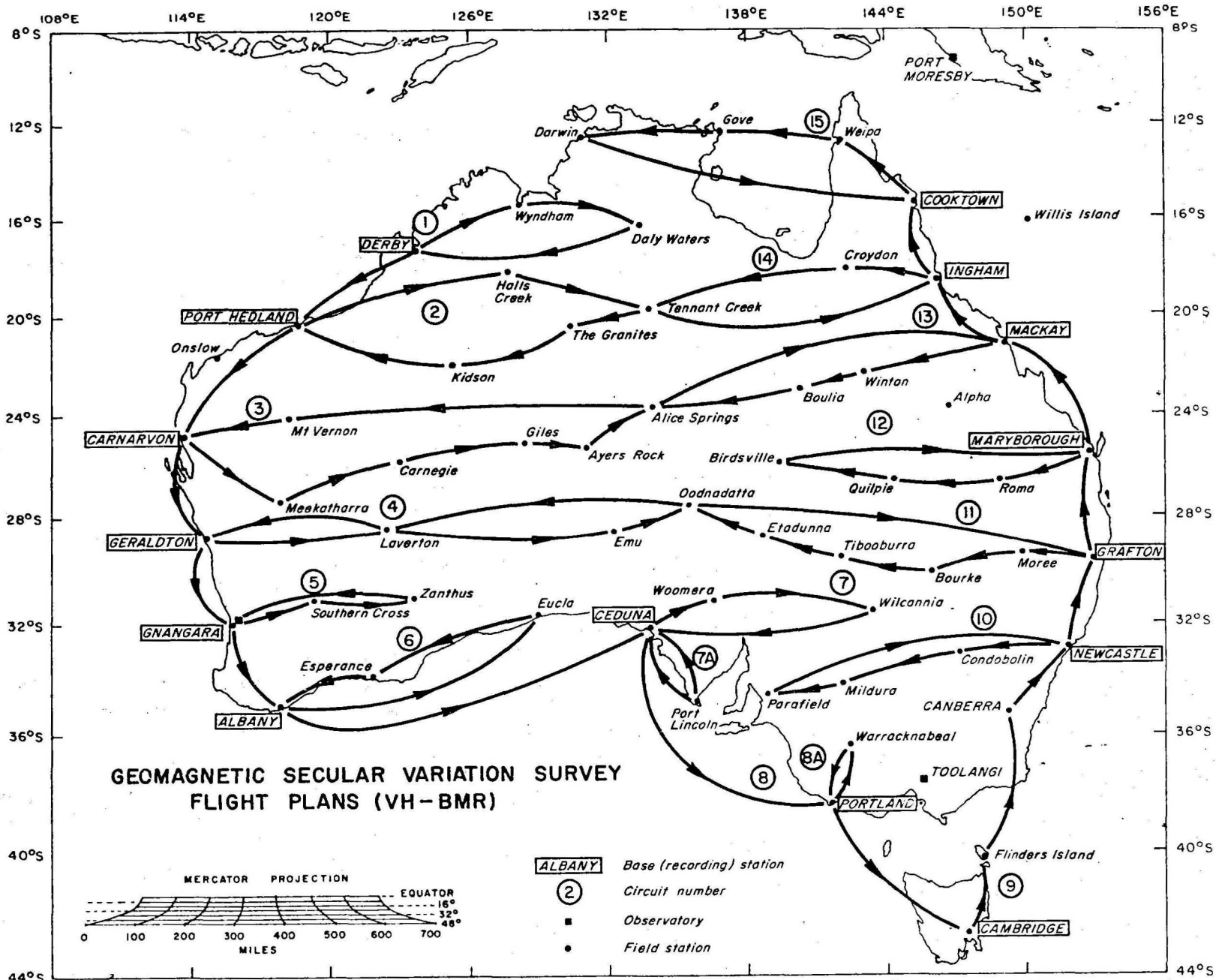
A/89-122-4A



AUSTRALIA (MAINLAND AND TASMANIA)

HISTOGRAM OF DIFFERENCES OF OBSERVED AND COMPUTED MAGNETIC DECLINATION

BASED ON 5284 OBSERVATIONS ADJUSTED TO 1975·0


GEOMAGNETIC SECULAR VARIATION SURVEY
FLIGHT PLANS (VH-BMR)
MERCATOR PROJECTION
EQUATOR
16°
32°
48°
0 100 200 300 400 500 600 700
MILES
ALBANY Base (recording) station
2 Circuit number
Observatory
Field station
108°E 114°E 120°E 126°E 132°E 138°E 144°E 150°E 156°E
8°S 12°S 16°S 20°S 24°S 28°S 32°S 36°S 40°S 44°S
PORT MORESBY
Darwin
Gove
Weipa
COOKTOWN
Willis Island
DERBY
Wyndham
Daly Waters
Croydon
INGHAM
Halls Creek
Tennant Creek
PORT HEDLAND
Onslow
The Granites
Kidson
MACKAY
Winton
Boulia
Alpha
Alice Springs
CARNARVON
Mt Vernon
Giles
Ayers Rock
Birdsville
MARYBOROUGH
Carnegie
Quilpie
Roma
Meekatharra
Oodnadatta
GERALDTON
Laverton
Emu
Etadunna
Tibooburra
Bourke
Moree
GRAFTON
Zanthus
Southern Cross
Eucla
Woomera
Wilcannia
CEDUNA
GNANGARA
Condobolin
NEWCASTLE
Esperance
Mildura
Parafield
CANBERRA
Port Lincoln
Warracknabeal
ALBANY
TOOLANGI
PORTLAND
Flinders Island
CAMBRIDGE

around the continental coast, in order to obtain First-Order measurements of total intensity. The opportunity will be taken to obtain (a) approximate First-Order measurements at the other stations, and (b) continuous long profiles across and around Australia; Airborne Subsection personnel will share this work.

The objects of the survey are to obtain more frequent geomagnetic secular variation data (for the production of a realistic Australian Reference Field) and to determine the wavelengths and characteristics of regional and crustal magnetic anomaly fields. It is intended to repeat the survey in 1977. Figure OR 7 shows the proposed traverses and the ground stations; traverses 1-9 are planned for completion in 1975, and the remainder for early in 1976.

Toolangi Geophysical Observatory Group (E.P. Paull, C.H. van Erkelens, G.H.Y. Thomas, J.F. Salib).

Standard programs. A La Cour normal-run magnetograph and 3-component short-period and long-period seismographs were operated continuously at Toolangi. An Elsec Proton Vector Magnetometer for the absolute measurement of horizontal and vertical intensity was installed at Toolangi in October 1974 and was used in conjunction with the other magnetometers. In July the 15 mm/hr La Cour recorder was replaced by a 20 mm/hr unit constructed in the BMR workshops. At Melbourne an accelerograph was maintained for the year but was not triggered, and the short-period visual seismograph ran continuously for the year. Physicists from the Antarctic Division were trained in geomagnetic measurements, for application at Davis and Casey in 1976.

Regional seismology. Short-period vertical seismographs were operated at Bellfield, (Vic), Norfolk Island, and Stephens Creek (NSW).

Minor earthquakes in Victoria occurred near Colac (22 January, ML 2.9, MM III), near Bendigo (7 March, ML 2.9, MM IV) and in the Echuca-Kerang area (5 May, ML 3.3, not felt).

Mundaring Geophysical Observatory Group (P.J. Gregson, R.S. Smith, G. Woad, B.J. Page)

Geomagnetism. The normal program of magnetic recording was continued; the Eschenhagen magnetograph was calibrated weekly. The level of the Elsec Proton Vector Magnetometer coils varied erratically until the bearings were checked (January) and the mating surfaces cleaned and extra holding screws added (February).

Preliminary data were distributed to Australian and overseas agencies; microfilm copies of the magnetograms were lodged at World Data Centre A.

Magnetic pulsation recording equipment was installed during March at the Mundaring Weir site and at Gnangara by the University of Newcastle; interference and power problems resulted intthe temporary suspension of recording at Gnangara in June.

Ionospherics. An IPS type IIIE ionosonde was operated continuously. Five additional parameters were scaled from 1 April (h'E, Es type, h'Es, foF1, and h'F). All data were distributed as required. The equipment operated well with only minor failures.

Seismology. Data from seismographs at Mundaring, Kalgoorlie, Meekatharra, Marble Bar, Giles, and Kununurra were distributed by telex to the National Earthquake Information Service, US Geological Survey. Monthly bulletins were distributed to Canberra headquarters, international centres, and other interested agencies. The Giles seismograph was inoperative until April but operated well for the rest of the year. A short-period seismometer was reinstalled in the Swan View Tunnel (SWV) in March after the housing had been repaired and fitted with an alarm. A Willmore seismometer was installed temporarily at Narrogin and signals were telemetered to Mundaring; it will remain in operation until the installation of the Seismic Research Observatory, expected in December 1975.

The establishment of a high-gain broad-band seismograph was well under way by September. This is a co-operative project with the US Geological Survey. The seismometer will be placed in a borehole at a depth of 105 metres near Narrogin; recording will be at Mundaring on both digital tape and analog recorders. The borehole and all ancillary works were completed by the end of September. The equipment should be operating before the end of the year.

Significant earthquakes occurred as shown in the Table.

Year 1975	Locality	Magnitude	Remarks
Mar 06	130 km SE Fitzroy Crossing	5.5	Maximum intensity MM5. Felt over area 400 km radius.
Apr 18	Near Ord River Dam	2.6	
Apr 18	100 km N Carnarvon	4.5	
May 11	Lake McKay	4.9	

Year 1975	Locality	Magnitude	Remarks
Jul 24	100 km E Marble Bar	5.0	Maximum intensity MM5. Felt over radius of 200 km.
Aug 23	Manmanning	3.5	
Sep 07	70 km E Narrogin		

Two accelerographs were maintained in the Meckering area without being triggered.

Stress measurement project. Six sites in the southwest seismic zone between Wongan Hills and Narrogin were selected for in-situ stress measurements, at the request of the Regional Structural Surveys Group.

Earth-tide recording. Equipment for recording earth-tides, belonging to the International Centre for Earth Tides (Belgium), installed at Mundaring Weir in July by Regional Gravity Group personnel, was operated in collaboration with that Group.

Port Moresby Geophysical Observatory Group (I.B. Everingham, I.D. Ripper, B.A. Gaull, S.N. Sheard, E. Hassel)

Standard programs. A La Cour normal-run magnetograph, a Worldwide Standard Seismograph, and supplementary seismographs were operated continuously at Port Moresby. The results were distributed regularly, as for Mundaring.

The seismicity computer storage and retrieval file was maintained. Earthquake hypocentres and intensity data from the area 0-12°S, 130-163°E were added to the file.

News media were given information on several felt earthquakes.

Regional seismology. Seismographs were operated at Kavieng, Lae, Momote, Talasea, Wabag, and Madang.

In addition, the seismograms from the Bougainville Copper Limited station at Panguna and the Purari River hydro-electric project at Wabo were analysed.

There were 20 accelerographs in Papua New Guinea operated by BMR, other Australian and Papua New Guinean government departments, the University of Technology, and mining companies. The accelerograph network needed maintenance visits every four months. Several triggerings occurred at Yonki, Lae, and Rabaul Observatory. Copies of accelerograms are available from the Strong Motion Data Centre, at BMR, Canberra.

Studies and reports were made or continued on seismicity, earthquake focal mechanisms, strong-motion results, and earthquake risk.

A report was prepared on a major earthquake (ML 7.2) which caused damage costing about $100 000 in southern Bougainville on 21 July. The earthquake caused a minor tsunami and intensities of MM/VII or more were noted with 50 km of the epicentre.

Using all available isoseismal maps the relation for intensity/distance/magnitude was found to be

$$I = 1.5M - 4.5 \log d + 5$$

where d = distance from hypocentre,
M is surface-wave magnitude, and
I the Modified Mercalli intensity.
The acceleration/intensity relation was found to be

$$\log A = I/3.1 - 0.3$$

where acceleration (A) is in cm/s^2.

Earth-tide recording. Equipment for recording earth-tides (for the International Centre for Earth Tides, Belgium) was removed on 21 March by the Regional Gravity Group.

Antarctic programs

Observatories (P.J. Hill, J.J. Silich). Standard observatory programs in geomagnetism and seismology were continued at Mawson and Macquarie Island, as part of the activities of the Australian National Antarctic Research Expeditions.

At both stations the drum rates of the normal-run La Cour recorders were increased from 15 to 20 mm/h, by fitting BMR-made drums. At Macquarie Island the search for a better seismograph site was continued.

Regional surveys (P.J. Cameron). Some regional magnetic and gravity measurements were obtained during the summer expedition to Enderby Land and on a tractor-train traverse from Mawson to Enderby Land. The number was disappointingly low owing to mishaps to the supporting aircraft, and to the very short stops on the traverse.

REGIONAL SUBSECTION (D. Denham)

Regional Gravity Group

Gravity compilation and preparation of maps (A. Murray, B.C. Barlow, P. Wellman, H. McCracken, D.A. Coutts).

Most of the Group's efforts were directed towards recomputation of Australian gravity data and by the end of 1975 the task should be complete. The principal facts for each gravity survey are being adjusted to Isogal gravity datum, Australian Geodetic Datum, and Australian Height Datum, for storage on computer magnetic tape. The gravity coverage comprises: BMR regional surveys - 83%; South Australian Mines Department regional surveys - 4%; oil company subsidized regional surveys - 5%; and semi-detailed, mainly subsidized oil company surveys - 8%.

The recomputation of data obtained by government organizations was carried out by those organizations; and the subsidized and unsubsidized private company data were recomputed by a geophysical company under contract to BMR. By the end of 1975 the contractor will have recomputed all company gravity surveys necessary to complete the Gravity Map of Australia. This work comprises 150 000 stations in 45 surveys and covers twenty 1:250 000 Sheet areas at regional coverage and 32 Sheet areas at semi-detailed coverage.

The computer programs for manipulating the principal facts were modified to increase their flexibility. The program for automatic plotting and contouring now allows manipulation of gridded data, and large areas can be contoured in one computer job. This was essential for contouring of the Gravity Map of Australia at 1:5 million scale, and for smaller jobs such as the production of maps of South Australia and the Canning Basin.

Earth-tides (B.C. Barlow, J. van Son, D.A. Coutts). Earth-tides are produced by variations, at a point on the Earth's surface, in the gravitational potentials of the sun and moon. Harmonic analysis of some earth-tide parameters yields the amplitudes and phase angles of the component waves, which may be compared with those derived theoretically for a hypothetical rigid Earth, in terms of amplitude factors and phase shifts.

Throughout the year deviations of the vertical were recorded at Cooney Observatory near Armidale using Verbandert-Melchior horizontal pendulums. Visits were made to maintain this equipment and install a long-period vertical seismograph (the latter to examine the vertical component of long-period noise). A six-month period of records has been computer-analysed at Brussels, Belgium, by the International Centre for

Earth Tides (ICET). Amplitudes and phase shifts are very dissimilar to those predicted. Amplitude factors for both components of all major waves are in the range 0.9-1.4, whereas realistic Earth models and overseas results give about 0.7. At Cooney phase lags of solar waves are larger than phase lags of lunar waves by about 15^{o} for semidiurnal waves and 8^{o} for diurnal waves, indicating thermal effects on the hillside. Furthermore, all northeast components of lunar and solar diurnal waves have phase lags of about 60^{o}; these are inexplicable at present as are phase advances and lags of up to 15^{o} in other components and waves. Corrections for topographic, cavity, and geological effects need to be assessed.

Earth-tides are being measured by four recording gravity meters in a co-operative project with ICET and the University of NSW. Records of three to six months' length have been obtained at Port Moresby, Canberra, Broken Hill, Armidale, and Mundaring, and recording at up to six other places is planned for 1976; Figure OR 1 shows where BMR will operate the recorders. Analysis of records by ICET gives amplitude factors for the major waves of about 1.16, which is within the range expected; a phase lag of 1^{o} to 2^{o} was found which is significantly different from the phase advance of 1^{o} to 2^{o} normally found in Europe. At the end of the project an exact analysis of the records will be made, and an improved tidal correction formula derived for use in the Australian region.

Calibration of gravity meters (D.A. Coutts). A tilt table is on loan to BMR from the Soviet Academy of Sciences from October 1974 to August 1976. This tilt table has the same operating principle as the Soviet GAG2 gravity meters used to establish the Australian gravity scale on the ACL and should give calibration factors consistent with that scale. The linearity of the meter reading with changes in gravity can also be checked. Owners of quartz-type gravity meters in Australia were invited to forward their meters to BMR for calibration on the tilt table and by November 15 gravity meters had been calibrated on the tilt table; they were also field-calibrated on the Canberra calibration range of 55 mGal.

Before calibration each meter was evacuated and its levels and sensitivity were adjusted. Data from five meters suggest that tilt-table calibration factors are several parts per thousand larger than the field calibration factors. (A similar trend was observed in earlier work in the USA using an American tilt table). In all five meters the gravity meter reading is linear (within experimental error) with changes of gravity.

When all available non-BMR quartz-type gravity meters have been calibrated on the tilt table, it is proposed to conduct further tests on BMR meters to determine changes with time and temperature in the tilt-table calibration factor.

Adjustment of the Australian National Gravity Network (H. McCracken). The Australian National Gravity Network or Isogal Network consists of a series of east-west traverses between towns or airports of almost equal gravity, connected by three north-south traverses. The network was established in 1964, 1965, and 1967. The Australian Calibration Line (ACL), a north-south traverse along the east coast, provides the scale for the network.

The original gravity values assigned to the network (the May 1965 Isogal values), were based on the datum Melbourne A = 979 979.00 mGal and the mean Australian milligal defined by pendulum observations at Melbourne, Cairns, and Darwin. These values had estimated uncertainties of the order of 0.2 mGal.

In 1973 a new datum value Sydney A = 979 671.86 mGal, and a new gravity scale, established to an accuracy of 2.5 parts in 10^5 by a co-operative BMR and Soviet survey along the ACL, were adopted for Australia. The 1973 standards introduce a change of 13.88 mGal in datum at Sydney and 5 parts in 10^4 in scale.

In 1975 the Isogal Network was adjusted using gravity values of ACL stations as fixed values defining the 1973 datum and scale. Intervals observed during the 1964-65 and 1967 Isogal surveys were corrected for earth-tides and meter drift. Meter scale-factors were determined that were consistent with the 1973 gravity scale. Adjustments were made for loop misclosures and new values were obtained with estimated uncertainties of 0.12 mGal or less.

The new values differed from the values that were obtained by a linear adjustment of the May 1965 Isogal values for the change in datum and scale. These differences were up to 0.2 mGal in Tasmania, Northern Australia, and in the vicinity of Perth.

The 1975 network adjustment increased the estimated internal accuracy of the network from 0.2 mGal to about 0.12 mGal; this will be improved further by a planned strengthening of the two weak north-south traverses (Darwin-Perth & Darwin-Adelaide).

Crustal Movements Gravity Survey, PNG (P. Wellman, H. McCracken). The Division of National Mapping and BMR are carrying out a joint, long-term project in Papua New Guinea, to measure surface movement, and detect deep crustal mass movement, on two active fault zones that are thought to be boundaries of lithospheric plates.

Survey markers have been established straddling fault zones in the Markham-Ramu Valley and the St Georges Channel area. The relative horizontal positions of the station were measured by laser geodimeter, and the relative vertical positions by first-order levelling in the Markham Valley and by observations of vertical angles in the St Georges Channel area. Differences in the acceleration due to gravity at the stations were measured by the Group using four calibrated LaCoste & Romberg gravity meters. Surveys have been carried out in 1973 in the Markham-Ramu Valley and in 1975 in both areas. A resurvey of both areas is planned for about 1980. Differences between the 1973 and 1975 Markham Valley observations are close to experimental error, so there has been little surface or subsurface movement in the area in this period.

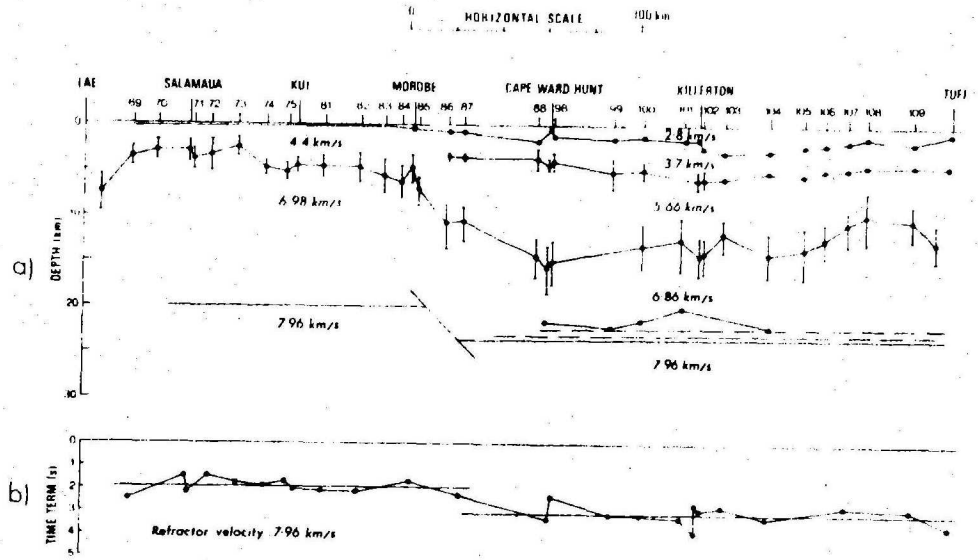
Australian Calibration Line and calibration ranges (P. Wellman, H. McCracken). The gravity meters used for the crustal movements survey were calibrated by observations at nine airports on the Australian Calibration Line (ACL). Earlier observations on the ACL showed an apparent regular change in gravity from year to year at some sites. The 1975 observations agreed closely with the 1973 observations, so the apparent gravity changes suggested by the earlier observations may have been due to observational errors.

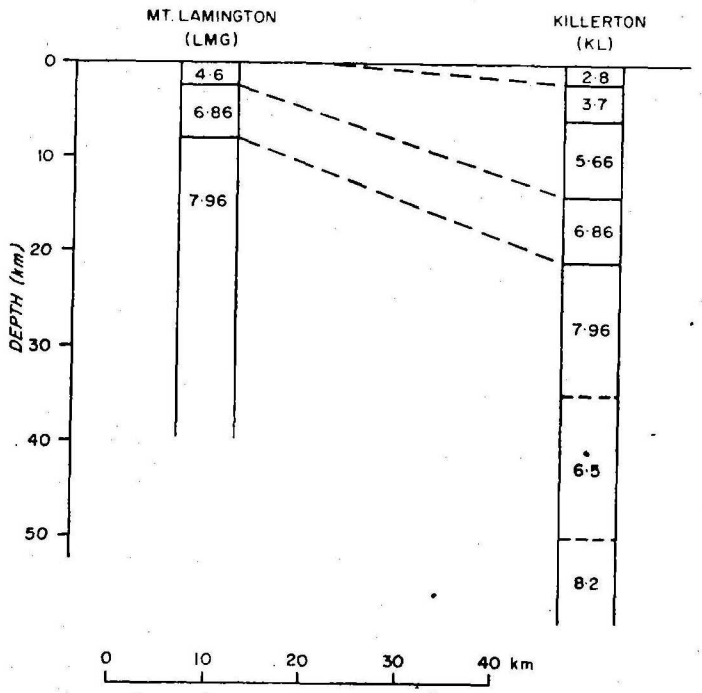
Observations were made using sets of LaCoste & Romberg gravity meters during 1974 and 1975 at the six calibration ranges on the ACL; and a further calibration range was established near Rabaul. New estimates of gravity interval on these ranges were calculated using these and earlier LaCoste & Romberg gravity-meter observations.

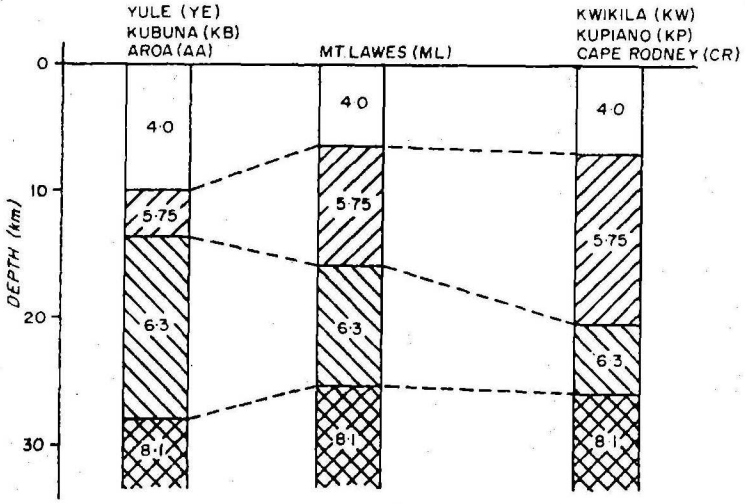
Antarctic gravity surveys (P. Wellman). Antarctic Division and BMR co-operated in carrying out gravity measurements using two LaCoste & Romberg gravity meters. Ties were made from Australianto Antarctic stations at Mawson, Casey, and Macquarie Island. Observations were made in Antarctica on a few rock outcrops in Kemp and Enderby Land, and along an ice-thickness traverse from Enderby Land to Mawson. This traverse is complementary to the existing line of coastal stations. A record is being prepared summarizing the 1966-1975 Australian gravity ties to Australian Antarctic bases and compiling all gravity observations in the Mawson-Davis-Prince Charles Mountains area.

Regional Structural Surveys Group

Interpretation of seismic data, east Papua (D.M. Finlayson, B.T. Drummond, C.N.D. Collins). Data processing and interpretation of records from the 1973 East Papua Crustal Survey continued throughout 1975. A one-week interpretation workshop was held in BMR during January and nearly all participants in the survey were able to attend. The scope of a first joint-authors paper was drafted at the workshop.


HORIZONTAL SCALE
LAE
SALAMAUA
KUI
MOROBE
CAPE WARD HUNT
KILLERTON
TUFI
4.4 km/s
6.98 km/s
2.8 km/s
3.7 km/s
5.66 km/s
6.86 km/s
7.96 km/s
7.96 km/s
a)
DEPTH (km)
b)
TIME TERM (s)
Refractor velocity 7.96 km/s


MT. LAMINGTON
(LMG)
KILLERTON
(KL)
4·6
6·86
7·96
2·8
3·7
5·66
6·86
7·96
6·5
8·2
DEPTH (km)
0
10
20
30
40
50
0 10 20 30 40 km


YULE (YE)
KUBUNA (KB)
AROA (AA)
MT. LAWES (ML)
KWIKILA (KW)
KUPIANO (KP)
CAPE RODNEY (CR)
4·0
5·75
6·3
8·1
DEPTH (km)
0
10
20
30

The seismic data have been interpreted by various methods and the gravity and magnetic data for the survey area were compiled concurrently. The initial emphasis in the seismic work was the interpretation by delay-time and wave-front methods, of data from the northeast and southwest coasts of the Papuan peninsula. Compilation of record sections and computer modelling of travel-time data assisted with the interpretations. Interpretation normal to the geological strike, along a line through Popondetta and Port Moresby, was conducted using ray-tracing programs and by considering the shot/station distribution as a fan-shooting pattern. Examples of initial interpretations are shown in Figure OR8. Extension of the seismic interpretations into the Coral and Solomon Seas was initiated.

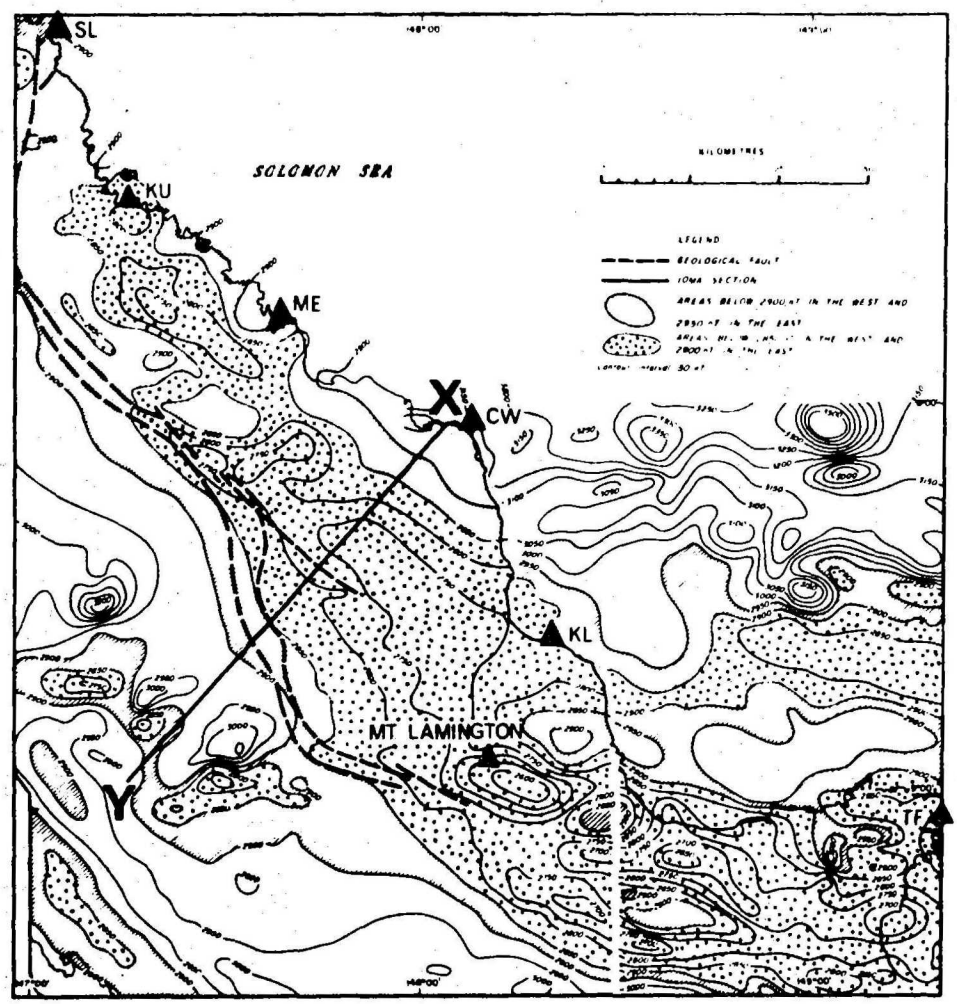
Some useful independent seismic travel-time information was obtained during the survey when recordings were made of a nuclear device detonated by the USSR at Novaya Zemlya on 27 October 1973. These recordings were examined to determine the relative time differences taken to traverse upper mantle and crustal rocks at near-vertical incidence.

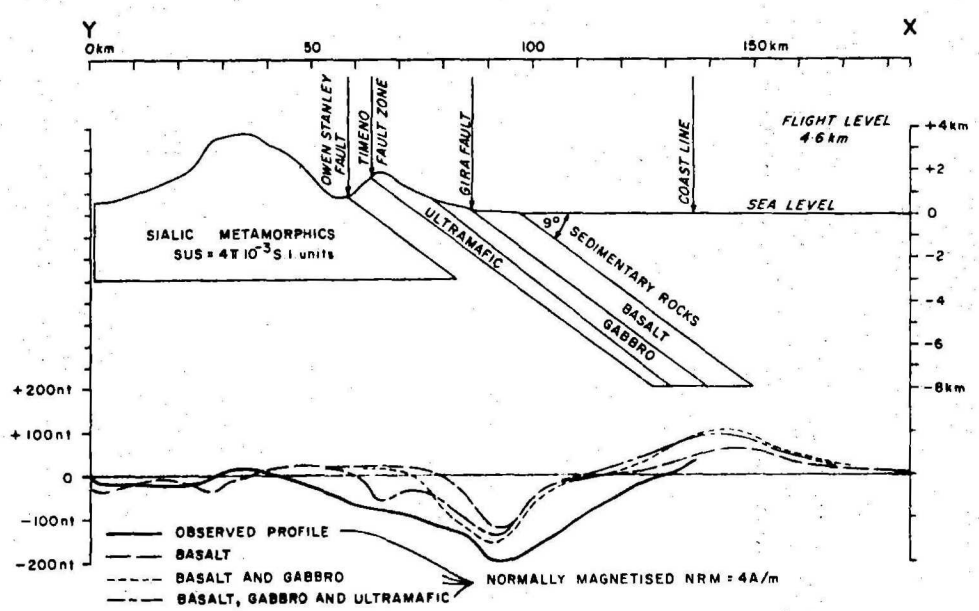
It is expected that further, more detailed, interpretation of data from east Papua will continue throughout 1976.

Interpretation of magnetic data, east Papua (J.B. Connelly). Magnetic data from the Papuan peninsula were interpreted as part of the East Papua Crustal Survey. BMR airborne magnetic data covering the whole of the peninsula and the Trobriand Platform, and BMR marine data over most of the Coral Sea and parts of the Solomon Sea are available.

A preliminary interpretation of the data showed that the northern part of the Papuan Ultramafic Belt is marked by a pronounced magnetic low. This low continues eastward to the Cape Vogel Peninsula, thus supporting the idea suggested by Davies and others that the Ultramafic Belt extends across this area. However, the magnetic character of the Belt in this area differs from that in the northern area and this presumably represents some tectonic difference. Magnetic models of the northern part of the Belt also support the idea of a northeast-dipping slab of oceanic crust as proposed by Davies, but the fit of the observed and calculated profiles is not good and refinement of this simple model is required to improve it (Fig. OR9).

A detailed analysis of the data was postponed pending the development of an automatic interpretative procedure which experience in previous magnetic work had shown to be necessary. A general iterative program written by G. Gibson of the Preston Institute of Technology was adapted for matching observed and computed magnetic profiles. The ground or sea-bottom surface is





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split into a number of vertical strips and the values of the magnetization vectors of the strips are iterated to produce a fit between observed and calculated profiles. This basic program was extended to cover both sloping strips and strips at varying depths, thus allowing dipping layers to be treated and enabling magnetic basement in sedimentary basins to be defined.

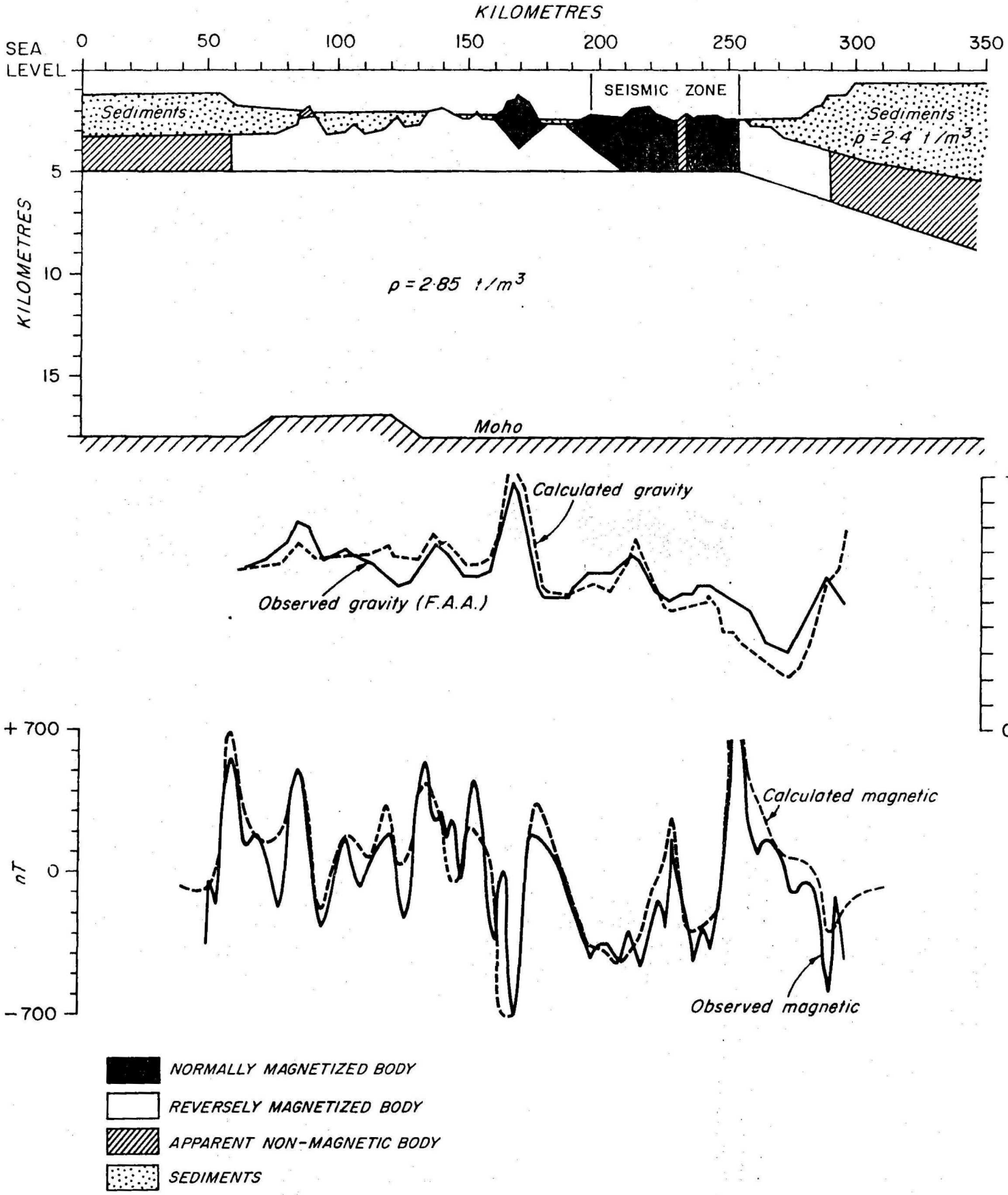
A number of problems were experienced, mainly with the size of the strips which if too small led to divergence of the successive iteration, and if too large led to an oversimplistic model which caused large steps in the calculated profile. To overcome these problems a second version was written, in which the strips were made very small and the iterated values of magnetization vector were spread by linear interpolation over a number of strips.

The program was tested against magnetic profiles along which the variations of magnetization vector were known. It produced very similar patterns of variations to those found by modelling, but the fit between observed and calculated profiles was superior.

Results from the Papuan Ultramafic Belt agree with the results from preliminary modelling, but a distribution of magnetization consistent with a single dipping interface at the Owen Stanley Fault could not be obtained. The material in the fault slice contributes to the anomaly; work on the nature of this contribution is continuing. In addition, the contrasting magnetic character of the area east of Mount Lamington was highlighted and work on the significance of this feature is also continuing.

Interpretation of geophysical data, Bismarck Sea (J.B. Connelly). A regional interpretation of BMR marine magnetic, gravity, and seismic reflection data in the Bismarck Sea was completed during the year. Maps of magnetic contours and sediment distribution were compiled, and two-dimensional magnetic and gravity models were produced along five north-south traverses. An example of the interpreted traverses is shown in Figure OR10. Earthquake hypocentres and focal-mechanism solutions were used to assist in defining the positions and directions of movement of major tectonic boundaries in the area.

Magnetic models and sediment distribution indicate a north-south extension rate of about 8 cm/year in the eastern part of the Sea. Asymmetric spreading is taking place along the Bismarck Sea seismic zone, with most of the extension taking place south of the zone. Earthquake focal-mechanism solutions from the eastern part of the seismic zone indicate that the N-S movement is being accommodated along two northwest-trending segments of the zone.



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This interpretation leads to a relocation of the relative pole of rotation between the two Bismarck Sea lithospheric plates to a position somewhere south and west of the sea. The interpretation also strongly supports the idea of an extensional origin for marginal seas, but the mechanics of the process are shown to be (a) different from those at mid-ocean ridges and (b) probably episodic, and (c) they may be reactivated across established trends, thus erasing magnetic lineations.

Interpretation of seismic data, Bowen Basin (C.D.N. Collins). Interpretation of results of the 1973 Bowen Basin deep seismic refraction survey of central Queensland was almost completed and final writing up is proceeding. Ray-tracing techniques were applied successfully to the crustal model interpreted from travel-time information. This model consists of a four-layer crust having a total thickness of between 35 and 40 km. The P-wave velocities for the layers are about 4.0, 5.5, 6.3, and 7.1 km/s respectively with an upper mantle velocity of about 8.1 km/s. Gravity profiles along and across the traverse were tested by a two-dimensional modelling program written by J.B. Connelly.

Geophysical Interpretation and Methods Forum, GIMF Late in 1974 the Group established a forum in which various Groups could discuss interpretations and methods used within the Geophysical Branch. The discussions took the form of one-hour talks where one or more persons gave a short informal lecture on aspects of interpretations; they were designed to enable discussion by specialist groups. Many of the topics were chosen to be of direct relevance to the work of the Regional Structural Surveys Group.

Seismic data processing system (B.J. Drummond, D.M. Finlayson, C.D.N. Collins). During 1975 the Group, in collaboration with the Electronics Subsection, improved considerably its data processing equipment. A prototype playback system for quarter-inch (Akai) tapes was built and tested, and specifications were drawn up for two production models. The new playback system has facilities for playing tapes at four speeds, with the tape replay speed locked to the crystal clock signal recorded on the tape in the field. This ensures precise tape speed control during playback and thus accurate demodulation of the frequency-modulated seismic channels.

The Group purchased a 12-channel Siemens jet-pen recorder, to replace a Gould Brush recorder which has a frequency response too low to take advantage of the higher replay speeds of the new playback system. A bank of variable filters is being purchased to improve noisy records.

Design work was also begun on a tape search facility which will give visual and digital readout of the time-code recorded on the tape in the field. The decoder will have facilities for searching the tape for a preset time, and will be interfaced with the BMR-Akai (¼ inch) and Thermionics (½ inch) tape reproducers and an analogue-to-digital converter. The analogue-to-digital converter is itself interfaced with the Hewlett Packard HP 2100 computer of BMR's ADP Section. This computer will allow most digital processing required by the Group to be done in-house. At the moment systems development is being undertaken with the digital equipment. Complete implementation of the new equipment awaits the arrival of the time-channel decoder.

The Group began to use the Gradicon digitizing table to obtain digital data from photographic or paper-chart seismic records.

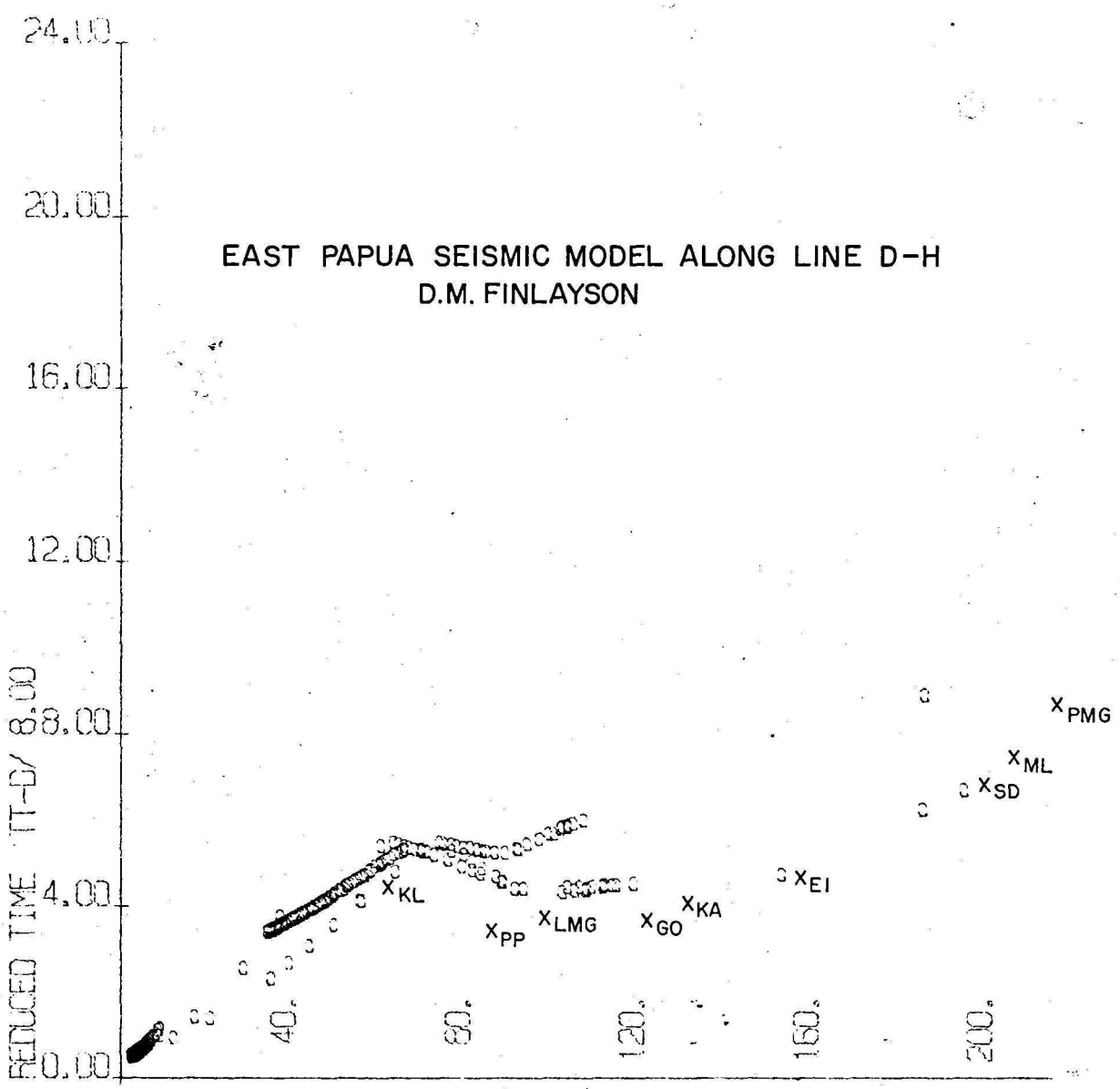
Considerable effort was expended in writing computer programs for digital processing of seismic data and the creation of a tape library. When the data processing system is fully operational, filtered seismic record sections should be available within days of arrival of a tape in Canberra from the field.

Seismic interpretation methods (C.D.N. Collins, D.M. Finlayson, B.J. Drummond). Several computer programs to interpret seismic travel-time data and to test models have been developed or are under development.

In the first category, a 'non-linear least-squares inversion' program, written by G.M. Gibson of the Preston Institute of Technology, is being adapted for use on the CSIRO Cyber 76 computer. A version suitable for handling small quantities of data is now running, and a version capable of handling large amounts of data is being developed. It is hoped to combine the techniques used in both versions. The basic program has applications in other areas such as gravity and magnetic interpretation.

Another program (STPSYN) by R.A. Wiggins, for inversion of travel-time data uses Wiechert-Herglotz integration of travel-time curves. This is presently with the ADP Section awaiting conversion to the Cyber 76. Attempts are also being made to run the program on ANU's IBM 360 computer.

Programs to test interpreted models either use ray-tracing techniques or generate synthetic seismograms from the models. A Program SEISRAY has been developed to trace ray paths through models with complex velocity distributions. This has proved useful in the initial interpretations of the complex East Papua Crustal Survey models. Figure OR 11 shows an example of the output from this program. Models can be adjusted to produce different travel-times and hopefully better fits of the calculated and observed data points.



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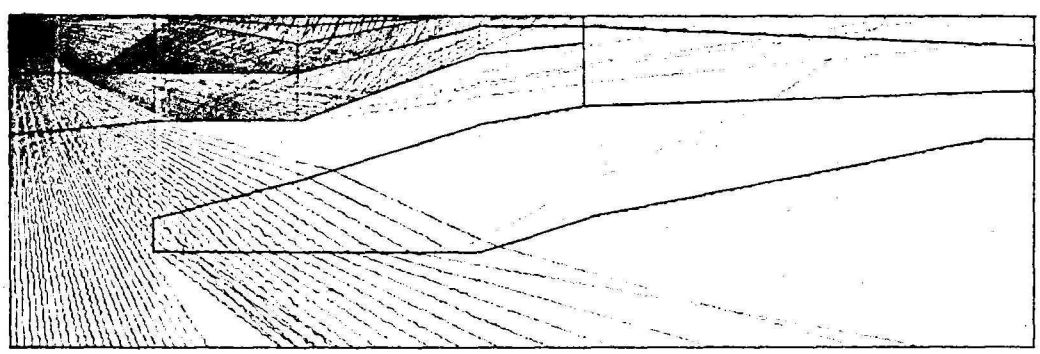


EXAMPLE OF SEISMIC RAY TRACING PROGRAM

Although ray-tracing techniques can be used to provide travel-time information for a particular model, the amplitude information produced is very limited. Synthetic seismograms are a more useful aid in interpreting amplitude features and a synthetic seismogram program (REFLEX) developed by K. Fuchs at Karlsruhe is being adapted to CSIRO's Cyber 76. This program uses simple, horizontal planar velocity boundaries; any vertical distributions of velocity can be accommodated.

A synthetic seismogram program by D.V. Helmberger and R.A. Wiggins is currently being converted to the Cyber 76 by the ADP Section. This program computes synthetic seismograms for a spherically layered Earth. Problems have arisen with the large size of arrays required within the computer, but it is hoped to have the program running soon, at least in a restricted form using relatively simple models.

It is proposed to use all these programs regularly in the interpretation of future crustal surveys.

Seismic tape recording equipment development (D.M. Finlayson, B.J. Drummond, C.D.N. Collins). During the 1973 East Papua Crustal Survey, several shortcomings in the BMR remote seismic tape recording equipment became apparent and in 1975 appropriate modifications and improvements were implemented in collaboration with the Electronics Subsection (See chapter 4).

In order to improve its portability the Akai tape deck, digital clock, Labtronics time-signal receiver, seismic amplifier and modulator, and power supply modules were compacted into a single, small Haliburton case. This reduced the bulk by two-thirds.

A single 12V power supply replaced the dual $\pm$ 12 V supply; this required insulation of the Labtronics radio receiver chassis. To ensure complete insulation, the Labtronics sets were rebuilt, and their size was greatly reduced. Polarity protection on the supply was also installed.

A prototype was produced at the beginning of 1975 and was thoroughly tested in the laboratory and field before a contract was let for the mechanical modification of all the Akai sets. The rewiring and electronic modifications to the equipment were done by the Group's own Technical Officers.

The original equipment consumed too much power - when operating automatically a set required two 80-Ah batteries for one week's operation. Most of the power was consumed in the crystal clock thermostatic control oven. A temperature-compensated crystal purchased in mid-1975 proved acceptable and all the clocks will be modified accordingly in 1976. The power consumption should be reduced further by the use of a DC motor in the tape recorders. A new motor was bought and will be assessed in 1976.

Gravity Map of Melanesia (J.B. Connelly). In conjunction with the Gravity Map of Australia, a Gravity Map of Melanesia is planned to cover the area 0-16°S by 140°-164°E and will be at 1:5 million scale, Lambert Conformal projection, initially in black and white but later in colour. It is expected that the black and white map will be produced in time for the International Geological Congress in August 1976.

The main sources of data were the BMR Regional Gravity Data File, which contains all BMR data from mainland Papua New Guinea, New Britain, New Ireland, and surrounding islands; hourly values from the BMR marine surveys; and marine data collected by the US Navy in the USS Shoup. Additional data which have been obtained are (a) those compiled by St John at the University of Tasmania in 1966, which included a regional coverage of New Guinea and a compilation of Oil Company work in the Fly River area prior to 1963; (b) subsidized Oil Company survey data obtained since 1963, which are being recomputed by BMR contract; and (c) Hawaii Institute of Geophysics marine data.

Other marine data from the area have yet to be supplied by the Hawaii Institute of Geophysics and Scripps and Woods Hole Institutes of Oceanography.

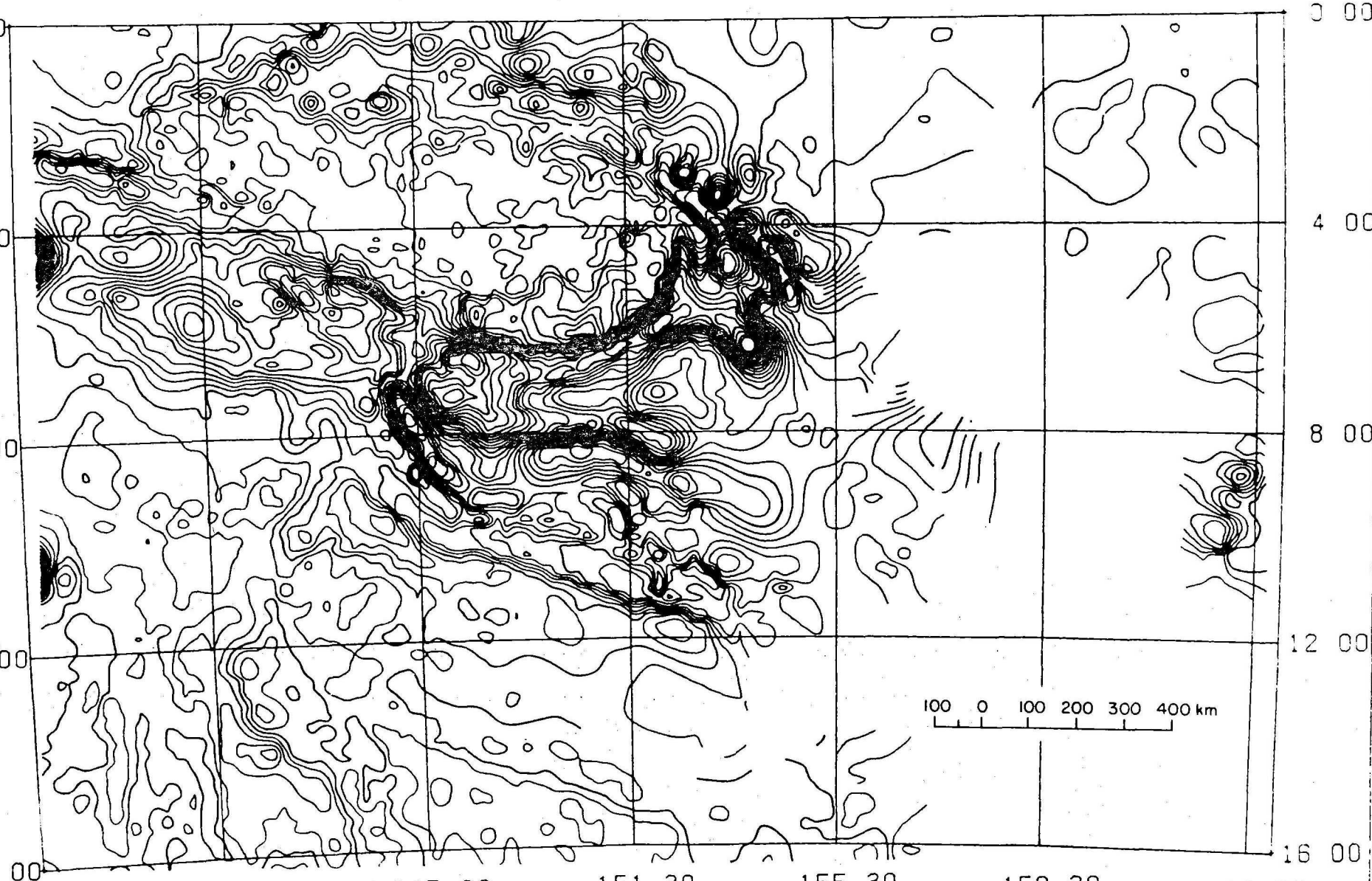
All data obtained to data have been checked for errors and a preliminary contour map has been produced (Fig. OR 12).

Stress measurements (D. Denham). Several meetings were held during the year to plan a joint BMR/CSIRO project to measure in-situ stress in Western Australia, and work already completed in the Australian continent was reviewed.

Determinations of principal stress axes from over-coring techniques at six widely separated sites in the Australian continent, and focal-mechanism studies from five earthquakes, indicate the presence of regional tectonic stresses acting close to horizontal and higher than would be expected if all the stress is caused by rock loading.

GRAVITY MAP OF MELANESIA

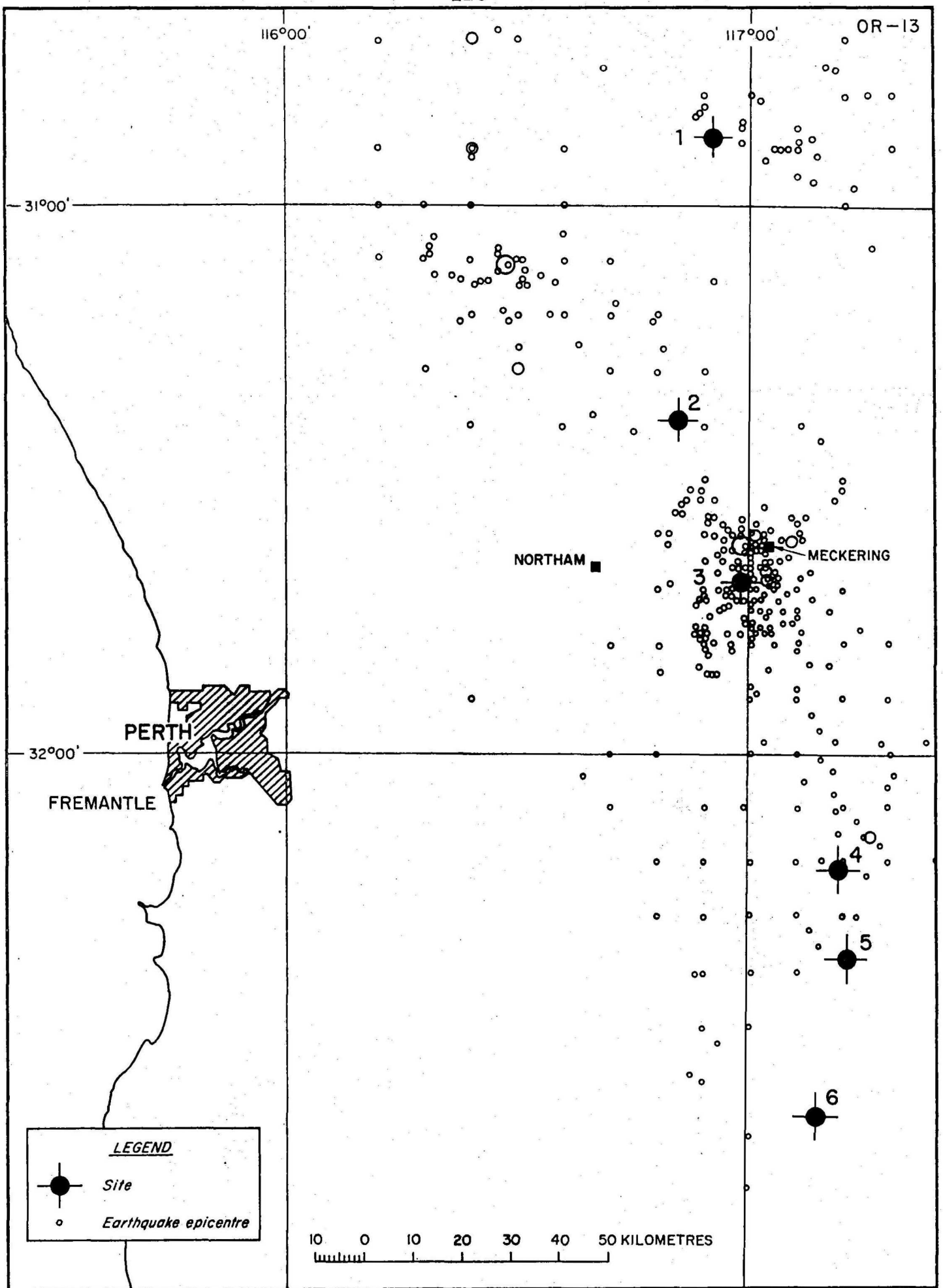
Record No 1975/161



UNIVERSAL TRANSVERSE MERCATOR PROJECTION ZONE 56 (AUSTRALIA SERIES)

CONTOUR LEVELS AT 20 AND 100 MILLIGALS

PNG/BIO-331A



DISTRIBUTION OF EARTHQUAKES NEAR PROPOSED STRESS MEASUREMENT SITES

Record No. 1975/161

H50/B10-4A

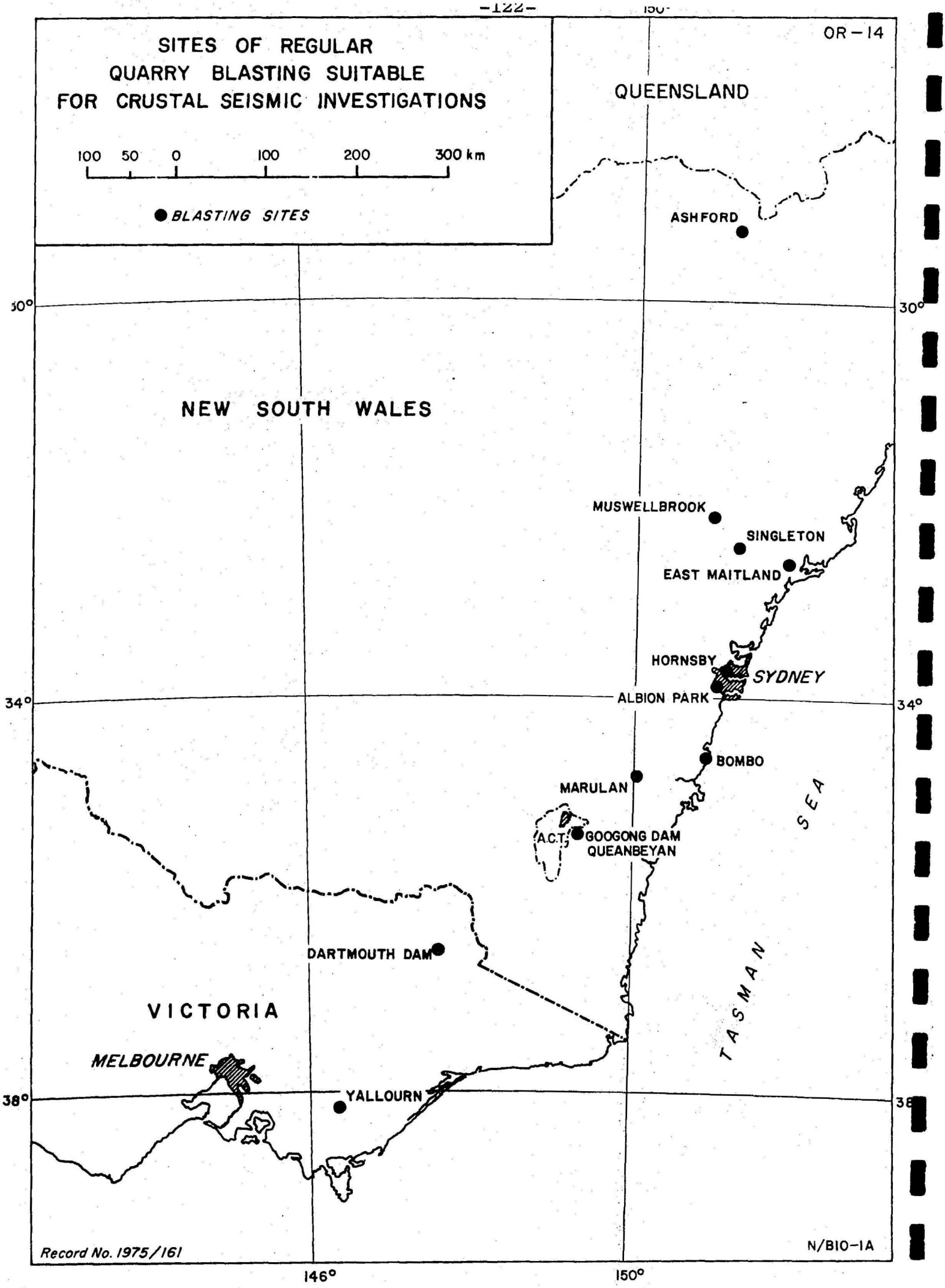
Except for the results in the centre of the continent all observations reveal a predominantly E-W direction for the axis of maximum principal stress. In the eastern half of the continent the axes dip to the east and in the western half they dip to the west. This could arise from stresses induced in the Australian Plate as it moves across the Earth's surface: owing to the ellipticity of the Earth the lithosphere must deform when its latitude changes and hence as the Australian Plate moves northwards the decreasing principal radii of curvature of the Earth introduce compressional stresses.

The anomalous observations from central Australia both give a N-S axis of maximum principal stress, which is probably due to residual tectonic stress from an old orogeny. For example, the residual stresses from the Alice Springs orogeny (300-400 m.y. B.P.) may still be contributing significantly to the regional stress field at the centre of the continent.

To provide further information on the regional stress field in Western Australia it is proposed to measure the in-situ stress, using overcoring techniques in shallow boreholes, at six sites near and within the southwest seismic zone (in which the Meckering earthquake took place in 1968).

The site requirements are unweathered competent rock either cropping out or lying very close to the surface in areas of low topographic relief. The six sites, shown in Figure OR 13 and tested in May 1975 by near surface refraction techniques, meet these requirements, and it is proposed that the measurements be made early in 1976. Figure OR 13 also shows the position of the southwest seismic zone in relation to the six sites.

Quarry blasts in southeast Australia (D.M. Finlayson). A considerable amount of seismic crustal information could be obtained in SE Australia using the Group's seismic tape-recording equipment and routine, large, quarry and mining blasts. Enquiries were made through mining companies, engineering contractors, and the Victorian and New South Wales Mines Departments about the scope of blasting activity, and Figure OR 14 indicates sites where major blasting is taking place. It is planned for BMR to record along the line Marulan-Canberra-Dartmouth early in 1976 to take advantage of quarrying connected with the construction of the Dartmouth Dam.


SITES OF REGULAR
QUARRY BLASTING SUITABLE
FOR CRUSTAL SEISMIC INVESTIGATIONS
100 50 0 100 200 300 km
BLASTING SITES
OR-14
QUEENSLAND
ASHFORD
30°
NEW SOUTH WALES
MUSWELLBROOK
SINGLETON
EAST MAITLAND
HORNSBY
SYDNEY
ALBION PARK
34°
BOMBO
MARULAN
A.C.T.
GOOGONG DAM
QUEANBEYAN
SEA
TASMAN
DARTMOUTH DAM
VICTORIA
MELBOURNE
YALLOURN
38°
146°
150°
Record No. 1975/161
N/B10-1A

Heat flow research (J.P. Cull). Research continued throughout the year at the Geology Department, University of Oxford, into various aspects of heat-flow measurement and interpretation. Progress in this work during 1975 is described below.

After developing the maximum gradient technique (MGT) for measuring thermal conductivity in 1974, extensive results have been obtained at high pressures for samples of rock representative of the Earth's crust and upper mantle. Pressure derivatives of thermal conductivity generally are linear and in excess of 0.15 (mcal cm^{-1} s^{-1} K^{-1} $kbar^{-1}$) for medium- and coarse-grained samples. As grainsize decreases, however, the effect of pressure also decreases; in extremely disordered samples, such as glass, the pressure derivative can become slightly negative. These observations are in qualitative agreement with theory, but the derivative in coarse-grained rocks is larger than predicted.

The variation of thermal conductivity with temperature has been determined previously for single minerals. However, these results have only emphasized the complex nature of heat transfer at high termperatures and the difficulties in predicting values in rocks from the behaviour of component minerals. The MGT has now been adapted for use in tube furnaces and direct routine measurements in rocks can now be made by this technique; data needed for the modelling of local features can be readily obtained with simple and inexpensive apparatus.

Measurements of thermal conductivity in dunite at temperatures up to 1000 K have confirmed the general observations of previous workers; the radiative component is suppressed considerably by increased optical absorption, but not to the extent reported by Schatz & Simmons for their sample of Twin Sisters dunite.

At the cessation of drilling, temperatures have been measured at two points within a borehole in north Yorkshire. The decay of temperature can be related to the equilibrium temperatures and consequently heat flow can be determined. The technique has been used successfully to predict temperature at one depth in a cased borehole near Oxford. Considerable savings, both in time and money, are anticipated with this technique; casing of the boreholes may no longer be necessary and access to sites will not be required for more than one or two days after drilling (compared with up to 12 months for conventionally cased holes).

The thermal conductivity of unconsolidated sediments can be measured with a conventional needle probe. However, the appropriate line-source solution requires that heat be supplied to the probe for at least 3 minutes and in some circumstances convection can be induced during measurement, rendering the result meaningless. The MGT has now been adapted to provide an alternative to the needle probe. Twin parallel needles are used, one housing the heat source and the other containing a thermistor sensor. Measurements take less than 20 s and consequently the risk of convection is minimized.

4. GEOPHYSICAL SERVICES SECTION

(M.G. Allen)

The section comprises three Subsections: Electronics, Mechanical, and Services. The Electronics and Mechanical Subsections are concerned primarily with equipment development, construction, and maintenance; the Services Subsection covers procurement and utilization of equipment, measurements of physical properties of rocks, engineering geophysics, and geophysical drafting. In 1975 supervisors spent a lot of time on organization and staff proposals in their own areas and on major changes proposed in the section's structure.

ELECTRONICS SUBSECTION (K.J. Seers)

The subsection is divided into two groups: Instrument and Systems Development Group and Electronic Maintenance and Testing Group.

Instrument and Systems Development Group (Y.S.B. Liu, M. Gamlen, A.S. Scherl, R. Gan, F. Clements, P.J. Hillman, K. Jurello, A.B. Devenish, W. Bishop, W. Greenwood)

This Group comprises four units: Instrument Development; System Development; Instrument Laboratory; and Electronic Drafting.

The principal functions of the Group are to design original geophysical instrumentation for in-house use, to design and advise on complex electronic installations at systems level; to provide instrument laboratory facilities for maintenance and calibration of electronic instruments; and to provide electronic drafting and documentation support. Throughout the year the Group was occupied entirely in design, construction, and installation jobs, and consequently the writing of reports and handbooks was severely curtailed.

MFS-7 Airborne fluxgate magnetometer. The electronics for the magnetometer were developed totally by this group. The detector head is an ASQ10 unit as used by naval tracking aircraft. Construction of No. 3 ruggedized magnetometer was completed in January 1975. Flight tests in the Aero Commander (VH-VMR) proved that the magnetometer was equally suitable for this aircraft. Both the Twin Otter (VH-BMG) and Aero Commander (VH-BMR) aircraft are now equipped with the MFS-7 fluxgate magnetometers, and although there were various minor operational problems with them, 1975 was the most productive year since the magnetometer was introduced in 1973.

Work on No. 3 detector head was not finished until 19 May 1975. Together with the No. 3 magnetometer, this provides one complete back-up system for either aircraft.

The electro-mechanical maintenance of the ASQ-10 detector head requires sophisticated test facilities, specialized technical personnel, and an adequate range of spare parts. The RAN has all these facilities at Nowra Naval Air Station and has agreed to service BMR's ASQ-10 magnetometer heads as part of their approved program, at no cost to BMR.

In the first half of this year, all three magnetometers were plagued by a beat signal on the magnetometer output caused by interference from other nearby equipment. The problem was solved temporarily by tuning the frequency of the interfering instruments to keep the beat frequency outside the magnetometer passband. A more permanent solution, possibly requiring magnetic shielding, will form part of the investigation for the No. 4 magnetometer due to be constructed next year.

Regional Structural Surveys Group playback system. The system is required to replay seismic information recorded on portable recording systems developed previously by the Group.

The speed control for the prototype tape playback system, incorporating both a tachometer optical reference and a pre-recorded 50-Hz reference, was completed by the middle of the year. The system as it stands can now playback at four speed ranges: 15/64, 15/32, 15/16, and 17/8 inches per second.

A two-channel f.m. demodulator was constructed and the four preamplifiers were modified.

Some badly recorded tapes from the East Papua crustal survey were replayed successfully, enabling their information to be recovered for the first time.

An attempt to incorporate a 4:1 reduction gear box to extend the playback speed to 15/256 inches per second was abandoned partly because of problems encountered in backlash and oil leakage of the gearbox, and partly because such a low speed was no longer mandatory, as the new chart recorder can accommodate the present range of playback speeds.

Design for the time-decoder and interface circuitry to the HP 2116 computer was completed in August. However, due to shortage of technical grade staff, the construction of this unit will probably not commence until early next year.

Digital F magnetograph. This digital data acquisition system was designed for observatory applications; it was also proposed to use one of the magnetographs for the regional survey utilizing VH-BMR, but it was not available in time. The system will comprise an XMA-2 magnetic controller, NCE-1 digital clock, PP1 power supply, MNS-2 or Elsec 595 proton-precession magnetometer, incremental magnetic recorder, and strip chart recorder.

The incremental recorder would not write reliably, and the manufacturer has since withdrawn this model from the market. Substitution of a different incremental recorder will probably involve some redesign of interface circuitry.

Preparation of the various components of this system, which included the contruction of XMA-2 controller and modification and interfacing of other instruments, was well advanced by November, and the system is expected to be checked out this year.

Automatic Magnetic Observatory controller. A magnetic controller XMA-1 was constructed for use in the Kowen Forest AMO. The controller is to enable the interfacing of an incremental magnetic tape recorder with the existing system, and the eventual replacement of the paper punch. Similar difficulties were experienced in obtaining reliable writing from the same incremental recorder, and an alternative incremental recorder will have to be used.

MNS-2 proton-preccession magnetometer. Work carried out on this instrument included construction of a new production phase-locked loop, feasibility study of an input digital filter, and redesign of detector-head housing.

A working digital filter was successfully incorporated and preliminary results showed a halving of the residual noise, but further investigation is required to extend the dynamic locking range of the filter to cover the whole bandwidth.

Two experimental types of detector-head housings, one spherical and one cylindrical, designed for complete submersion of the detector coil, were constructed and tested during the year. These new heads gave a marked improvement in the performance of the magnetometer, but improved design is necessary to reduce overheating.

Although the MNS-2 magnetometer was not used in either aircraft during the year, it was used for airborne ground-reference stations and in metalliferous surveying. Three magnetometers with the new phase-locked loop are required by the Observatory Subsection to give coverage down to a field strength of 16 000 nT.

Compared with commercial instruments the MNS-2 has similar resolution and higher slew rates, for which there are BMR applications. It is therefore proposed to continue in 1976 with detector/preamplifier optimization.

Airborne timer. The new airborne timer, incorporating a clock generator, radio-altimeter digitizer, and computer/camera interface circuitry was completed, and is expected to be installed in VH-BMG during the interfield season early in 1976.

A synchro/digital convertor digitizing system was designed which gives along- and cross-track information from the synchro transmitter and tracking oscillator of the navigational Doppler; it is expected to be installed in VH-BMG early in 1976.

Aero Commander data acquisition system. The Datamatic data acquisition system was modified substantially by including an analogue-to-digital convertor and digital voltmeter interface circuitry. A second Datamatic acquisition system, mechanically redesigned to BMR's specification, was delivered early in the year. Five circuit cards of BMR design have to be incorporated into each of these units. These modifications are expected to be completed by the end of the year.

Magnetic compensator. A prototype constant-current magnetic compensator was constructed and installed in VH-BMR. The new compensator gives a wider compensation range as well as more stable compensation. A second production model is expected to be installed in VH-BMG early next year.

TAM-7 marine amplifier. Design and construction of the prototype amplifier were completed for use in the marine data acquisition system in the next major marine survey. Test results showed that the performance of this amplifier was one order better than the specification.

Mechanical design of the bin and module was completed with the co-operation of the Mechanical Engineering Design Group.

Eight-channel D/A converter. This digital-to-analogue converter was designed for use with the HP 2100 computer. It will be used by the airborne and ADP groups as well as in the magneto-telluric acquisition system.

Some trouble occurred in interfacing with the computer due to the slower CMOS-logic devices used in this unit. The problem was solved by using the faster TTL-logic devices, but with a heavier current consumption as a penalty.

Magnetogram digitizer. This system was developed to replace obsolete and unreliable equipment used to digitize observatory magnetograms. The new system comprises the existing scaling table, an HP 2114 mini-computer, and a control unit. The control unit which was designed and built will be used as a keyboard input-controller for the mini-computer. The major part of this project is in the writing of the software, which will be done in association with the ADP Section.

Regional Structural Surveys Group remote recording seismographs. Eight more dual TMF2 modulators were constructed by contract and extensive laboratory and environmental tests were carried out on them.

A new temperature-compensated crystal oscillator, designed to cut the power drain of the system, was successfully incorporated into the clock, the clock and power supply were modified to reduce possible damage due to transients, and the recording system was repackaged to reduce the size, weight, and power drain.

General purpose clock/timer. Design commenced on a versatile universal clock/timer for general use by different groups in BMR. It was proposed that the instrument should have various optional plug-in units to meet different requirements. The project was initiated by the Observatory Subsection, but it is expected that the final unit will be suitable for other applications like marine and crustal studies.

Radiometric scaler RAS-1. This is the digital scaler designed to count the four channels in the airborne gamma-ray spectrometer. Three production units were completed during the year so that each aircraft now has a 100% back up.

The handbook for this unit was also completed.

Installation and servicing of equipment in survey aircraft. Owing to the shortage of airborne technical staff, the Development Group staff again devoted considerable time during the year to the commissioning and maintenance of electronic equipment in both BMR aircraft.

Both the MFS-7 fluxgate magnetometers and MNS-2 proton magnetometers required regular preventive maintenance and trouble shooting. One reason for the involvement of Development Group staff on this type of work was the lack of handbooks on both magnetometers. This situation should be alleviated when both handbooks are completed next year.

The commercial DCE inverters in both aircraft failed frequently or caused trouble in other systems. A design investigation culminated in a number of modifications, and no further problems have occurred. Three of the four commercial radio-altimeters held by the Airborne Subsection developed serious trouble at the same time. As the Australian agent did not have the requisite microwave test and maintenance equipment, it was decided to set up BMR facilities for this purpose. The test system and power supplies were designed, but implementation depends on delivery of various items of test equipment.

The combined project with the Observatory Group in November required the installation and commissioning of the Geometrics 803HP proton precession magnetometer in the Aero Commander VH-BMR.

Transient electromagnetic equipment modification. In conjunction with one professional officer from EM & T laboratory, the MPPO-1 TEM set was modified to increase its sensitivity and reduce noise and jitter. Additional circuits with special notches centred on the frequencies of the VLF transmitting stations.

AF demagnetizer. A timing circuit was designed for use with the alternating field demagnetizer for palaeomagnetic measurements, and help was given with its construction.

Lectern for IGC. Work was completed on a prototype lectern employing electronic timing and comprising three separate consoles for use in the conference rooms for the 25th International Geological Congress in 1976.

Marine data acquisition system. In conjunction with the Marine Subsection, the system design for a new marine digital data acquisition system for the next major survey was formulated. The proposed system, incorporporating two HP 2116B mini-computers, will process both digital and analogue signals from seismic, gravity, magnetic, oceanographic, and navigational sensors.

The Development Group will be responsible also for the design and construction of the following: general purpose marine amplifier/filter units including bin and module systems; D/A convertors; trigger pulse generator; timing control unit; shot relay unit; and various interface circuits.

Continuous recording magnetometer. Work commenced on the investigation of a continuous recording magnetometer for ground traversing by the Engineering Geophysics Group. The systems at present under consideration include 3-component fluxgate magnetometer, 3-component cryogenic magnetometer, proton-precession magnetometer, and alkali vapour magnetometer. However, to meet an immediate need in next year's Christmas Island survey, assembly was begun of a proton-precession magnetometer system.

Telemetry system investigation. An investigation is in progress to determine whether the Telseis seismic telemetry system can be used with additional recording and timing equipment for regional structural surveys requiring continuous operation.

Instrument laboratory. New instruments acquired this year comprised a Tektronix 7904 oscilloscope-based test system, a Hewlett-Packard 330B automatic synthesizer, a Hewlett-Packard 7100B two-channel potentiometric recorder, balanced attenuators, portable digital voltmeter, and other minor items.

The group continued to provide guidance in the use of the large range of test and measurement equipment held in the instrument pool; and advice on precision measurement capability and measurement technique as required.

The workload on the laboratory continues to increase. There are now more than 140 major instruments with another 200 minor devices available for general use. Rapid increases in the resolution and dynamic range of geophysical instruments will require upgrading of the calibration facilities of the instrument laboratory in the near future.

Electronic drawing office. The drawing office continued to provide its supporting service in electronic drafting and documentation. Work completed during the year comprised 40 schematics, 36 sets of printed circuit artwork, and 23 mechanical drawings.

Electronic Maintenance and Testing Group: (A.G. Spence, R.W. Cobcroft, A. Zeitlhofer, M. Jones, M. Bower, P. Clements, C. Rochford, W. Harkness, R. Curtis-Nutall, G. Green, J. Everell).

The chief activity of this group is to prepare and service geophysical equipment, especially for those Groups with no technical staff of their own.

The Observatories Subsection was assisted in setting up another seismograph station at Kowen Forest ACT, from which signals are telemetered and displayed on recording equipment in the BMR building in Canberra. Maintenance was carried out on similar installations at Alice Springs and Giles. Throughout the year ancillary observatory equipment was repaired or modified. Extensive work was done on an Adkin 3-component fluxgate magnetometer after repeated breakdowns.

The Engineering Geophysics group was assisted in preparations for its surveys at Albury-Wodonga, at Lake Purrumbeet in Victoria and at Nebo in Queensland. A radio transceiver was installed in the shooting compartment of their new 'explosives' vehicle.

Equipment was prepared for loan to various external organizations. The main requests were for marine sparker equipment from Dr Kroenke of CCOP-SOPAC for use at Fiji; for engineering seismic equipment from the Geological Survey of PNG; and for a borehole logger from Water Resources Branch at Alice Springs.

The magneto-telluric system was prepared for field use, and installed in a 4 x 4 walk-through panel van in co-operation with the Heavy Workshop Group. A Technical Officer from the Group took part in the survey across the Wentworth Trough in the Murray Basin.

Transceivers were serviced, and transmitter frequencies were checked with Telcom throughout the year. A design fault was detected in one batch of new Codan transceivers; it caused RF instability and loss of output power, but it was subsequently corrected by the manufacturer when brought to his notice.

The group was increasingly called upon to service or install equipment permanently placed in the BMR building. It was involved in the installation of a new Statfile camera, a welding unit, and various minor items in the geological laboratories and it fulfilled urgent requests for repairs to equipment in the Drawing Office, the photographic laboratory, and geological laboratories.

The group participated in investigations into the performance of the 9-element sparker-array, the seismic recording system used by the Marine Geology Group, and transient EM equipment.

The 9-element sparker-array marine seismic energy source failed to achieve the directivity and increased output predicted by design theory. The Group set up the sparker system to operate in a portable swimming pool filled with salt water and devised measuring systems for a series of experiments which were carried out under the direction of the Mechanical Subsection, and which are reported on by that Subsection.

Marine Geology's seismic profiling recording equipment comprises a Sony magnetic tape recorder, a Huntec signal processor, and an EPC facsimile recorder. Broad-band recording on magnetic tape was expected to yield useful data that would not be seen on the narrow-band monitoring record obtained during the survey. However, tape playbacks of 1974 survey data using different processing parameters (filters, gains, etc) failed to show any additional sub-bottom data; in fact it was sometimes difficult to obtain records as good as the original monitoring records. The reasons for these deficiencies are being investigated. A lot of systematic noise (boat noise etc) appears on the tapes. Procedures for ensuring optimum matching between system components and optimum recording conditions are being investigated.

The Group collaborated with the Metalliferous Subsection and the Electronic Design Group in improving our Russian-built MPPO-1 transient EM equipment. It took part in the demonstration of the MPPO-1 equipment to Department of Housing and Construction officers concerned with the clearance of the Holsworthy artillery range. Part of a TEM receiver (the signal input and processing system) was built and tested. It can be used in conjunction with the MPPO-1 receiver to upgrade its performance for the Holsworthy project, where the problem is to locate small artillery shells under a maghemite layer. It is proposed to build an independent TEM system especially for detection of artillery shells etc.

The Group's contribution to the training of Trainee Technical Officers continued as in previous years. The Group also received a Technical Officer from Toolangi Observatory for a short period for induction into new methods and equipment.

MECHANICAL SUBSECTION (J.H. Mulder)

The Subsection comprises three groups: Mechanical Engineering Design, Mechanical Instrument Construction, and Mechanical Maintenance and Testing.

Throughout the year the machine shop was understaffed and delays in the construction of workshop jobs were inevitable, even though work was sent out to private contractors. A submission was forwarded to have two positions returned from the Departmental vacancy pool to bring the machine shop staff up to the required strength, i.e. one Foreman, one Senior Instrument Maker, and four Instrument Makers. The transfer of a Maintenance Mechanic's position from the pool to the Mechanical Subsection was also requested.

Mechanical Engineering Design Group (D.B. Stewart, J.W. Rutledge, G.W. Thom)

Shallow seismic profiling equipment. The acoustic performance of the 3 x 3 marine spark-array depth-controlled towfish developed last year was unsatisfactory, and reasons for failure were investigated on the towfish submerged in a 4 m diameter plastic swimming pool filled with salt water. The main reason for failure was that the sparkers do not emit identical pulses with energy peaking at 1000 Hz as required by design. One cause of this was an uneven distribution of energy between sparkers, and another appears to be a high-frequency electrical oscillation due to underdamping in the sparker discharge circuits when 9 sparkers are operated in parallel.

On the other hand the measurements showed: (1) that the reflector plate does give acoustic reinforcement but at about 60% efficiency due to its limited stiffness; (2) that noise due to acoustic ringing of the reflector plate is about 1/20 the acoustic output and should be insignificant; and (3) that the rubber bubble-pulse suppression device is effective under the correct discharge conditions.

Modifications to produce an even distribution of energy between sparkers, and to control the electrical damping of the discharge circuits, have been made, and at time of writing further tests were about to commence.

A new type of marine sparker was designed. It is housed in a container and has a diaphragm in contact with the transmitting medium. Its chief advantages should be compactness, reinforcement of acoustic pulses by reflection, simplified maintenance, and controlled damping of the bubble-pulse. Land applications of this sparker are under examination.

12 tonne hydraulic rock splitte. Splitting tests were conducted successfully on a variety of rock types and sizes.

20 kVA diesel alternator modifications. Modifications were designed for this trailer-mounted diesel alternator to overcome the problem of engine-bearing seizure during long tows over rough terrain. The equipment was reconstructed and testing was started.

Borewater flow test unit. A trailer-mounted bore flow test unit was designed, the principal item being a hydraulically powered demountable jib-crane for insertion and removal of a bore pump and casing down to depths of 50 metres.

Shallow penetration marine core drill. Brought-in components were adapted to construct a pneumatically powered rotary drilling machine with an impact attachment to sample coral to a depth of 300 mm in a 20 mm diameter hole. Laboratory and field tests on the Barrier Reef were successful. The equipment is operated hand-held by one man underwater.

Bin and module system. A bin and module system was designed for amplifiers for the marine data acquisition system under development by the Electronics Design Group. The main feature of the design is the use of off-the-shelf aluminium structural sections to house the modules as this considerably reduces the labour of manufacture.

Heavy-mineral sand sampling. Inspections were made of two types of core drills with the Marine Geology Group; one was a dual-tube, reverse-circulation machine which was seen working in Bundaberg harbour; the other was a small diameter vibracorer at the factory of the makers in Southport. Neither was ideal for BMR's application.

Aircraft ground power unit. Acceptance tests for the McColl aircraft ground power unit were attended at the maker's works prior to delivery.

Mechanical Instrument Construction Group (A.H. Booth, G. Renton, A. Kores, T. Piggott, G. Lockwood, R.J. Westmore, L.S. Darcy, E.C. McIntosh, R.L. Gibbs)

This Group comprises the machine shop, the heavy workshop, and the model maker's shop. It is mainly concerned with the construction of equipment and instruments, with modifications of existing equipment, and with the construction of prototype experimental equipment.

The Group contributed to the following major projects:

Marine Surveys. Construction of a fibreglass tow vessel which incorporated the mounting of two Raytheon pingers; modifications to a 9-element sparker array twofish.

Metalliferous Group. A borehole cable reel was reconstructed and modified with an improved braking system and stronger gearbox.

Rock Measurement Group. A tumbler and field coil platform was made for an alternating-field demagnetizer for rock core samples; a steel trolley was made to carry instruments and rocks between laboratories.

Airborne Group. An experimental fibreglass housing for a sensor was constructed for an MNS2 base station proton-precession magnetometer.

Geological Metalliferous Group. A small hand press was made for the preparation of glass fusion discs for an X-ray refractometer.

Palaeontological Group. Construction of a 12 tonne capacity rock splitter was completed. The equipment has been delivered to the Group but awaits connexion to the 3-phase power supply.

Observatory Subsection. Work progressed slowly during the year on modification of a number of La Cour magnetograph recorders. The slow progress was partly due to staff shortages and delays in delivery of suitable materials.

Core and Cuttings Laboratory. A guard, table, and chisel were made for a rock core splitter.

Miscellaneous. Many panels were engraved and chassis components manufactured for instruments which are under design and construction by the Electronic Subsection for geophysical field parties. Motor generators, chain saws, pumps, outboard motors and other gear were repaired or serviced for field use. A large number of wooden boxes to carry instruments and heavy equipment were manufactured. Racks were fitted in vehicles to accommodate electronic measuring instruments.

Mechanical Maintenance and Testing Group. (R.B. Grigg, D.O. Stevens, S. Prokin).

The Group overhauled, repaired and tested field instruments such as Mechanism micro-barometers; Elsec proton-precession magnetometers; a Widco logger; Esterline-Angus, Speedomax, Rustrak, and Hewlett-Packard recorders; Creed tape perforators; a BC-8A blaster; a VT6 camera including adjustments of its galvanometers; a Portalogger reel; a Geometrics magnetometer sensor support; and an Askania declinometer circle. A set of Gerber scales were repaired; an ASQ-8 fluxgate magnetometer head was made up from available spares; and a number of graticules were made for use with the Gradicon digitizing and plotting tables. Worden gravity meters used by BMR and other organizations were evacuated as required.

SERVICES SUBSECTION

The subsection comprises four groups: Procurement, Rock Measurements, Engineering Geophysics, and Geophysical Drawing Office.

Procurement Group (P.E. Mann, S. Waterlander, W.E. Gunner).

The Procurement Group made technical investigations, wrote specifications, and assessed tenders on a wide range of plant and equipment approved in the Geophysical Branch buying program. The costliest items purchases were a digital recording system for seismic surveys for oil exploration, and a mini-computer to form the core of a digital acquisition system capable of adaptation to meet the needs of engineering seismic and magneto-telluric surveys. Liaison with the ADP section was maintained when drawing up specifications for computer or peripheral equipment. Assistance was given in preparing tender specifications for a scanning electron microscope and assessing tenders for an automatic photo-microscope required by the Geological Branch.

Rock Measurement Group (M. Idnurm, R.I. Eaton)

About 850 rock and sediment samples were measured during the year. The principal measurements comprised uniaxial compressive strength, elastic moduli, Shore hardness, magnetic susceptibility, remanence, electrical conductivity, and induced polarization. Except for a series of measurements for the Department of Housing and Construction, Sydney, all requests were received from within the Bureau. The projects for which particularly significant numbers of measurements were made were the Arunta Complex Project (magnetic measurements), the Engineering Geology survey of the proposed Ginninderra tunnel line (mechanical properties), and the project on the age determination of weathering in southwest Queensland (palaeomagnetic).

Work was commenced on the age determination of deep weathering in southwest Queensland using palaeomagnetic techniques. After making a brief feasibility study of this method a field party collected 94 orientated hand samples from the weathering profiles. Stepwise thermal demagnetization was carried out on 40 pilot specimens, and stepwise chemical demagnetization on 30 pilot specimens. This work is expected to be completed in early 1976.

A 1.8 MN rock mechanics testing machine was purchased and installed. Construction of an alternating-field demagnetizer was well advanced at time of writing and test runs are scheduled for late 1975 to detect any spurious magnetization which may be introduced in the samples by this equipment. A series of test runs were carried out to detect and eliminate electrode polarization errors in laboratory IP measurements. Modifications to the IP cell now permit reliable measurements on most types of saturated rock and sediment samples. A modified sample-clamping vice was constructed for the diamond saw. The Sharpe susceptibility meter was recalibrated and its performance compared with the Bidon susceptibility meter.

Engineering Geophysics Group (E.J. Polak, F.J. Taylor, G.R. Pettifer, D.C. Ramsay, C.L. Horsfall, D. Bennett, G.S. Jennings, D.H. Francis, R.F. Moore)

In the first two months of 1975 the number of geophysicists in the Group was reduced from 8 to 5 (the establishment number). The change resulted in curtailment in the number of surveys and the extent of services provided to Australian Government Departments and Authorities.

ENGINEERING GEOPHYSICAL SURVEYS FOR AUSTRALIAN GOVERNMENT DEPARTMENTS

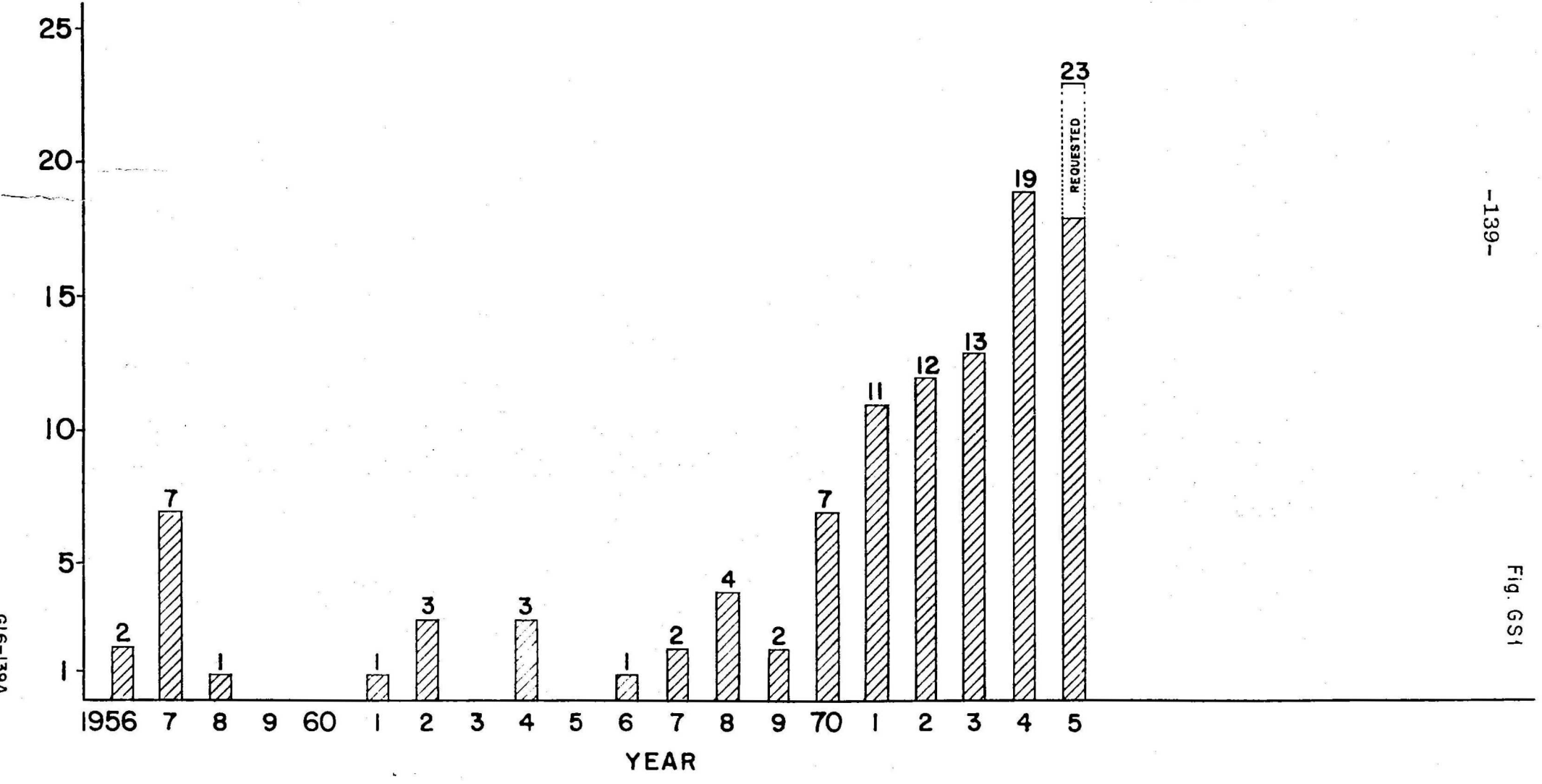


Fig. GS1

G16-139A

Figure GS1 shows the trend of engineering surveys for Australian Government Organizations over the last 20 years.

Several members of the Group attended courses and seminars:

ACT engineering surveys. These surveys comprise the bulk of the service work carried out by the Group. They can be grouped into two kinds of service: exploratory - the collection of general geological, structural, and engineering data; and detailed studies - to provide factual data for specific projects. These geophysical data allow more competitive tendering.

During the year concentration of surveys in some suburbs allowed an increase in efficiency of the Group.

(1) West Murrumbidgee surveys. The proposed suburb is located on the left bank of the Murrumbidgee River in the Point Hut Crossing area. The development will ultimately house 70 000 people.

(1a) Murrumbidgee Fault investigations. The fault runs roughly north towards the western margin of the area, but it is concealed by alluvium and hillwash. Seismic refraction work indicated places where the rocks were sheared and gave depths to fresh rock, which differ on either side of the fault. Some magnetic traversing indicated the extent of the fault zone.

(1b) Foundation conditions for reservoirs. Four kilometres of seismic refraction work was done on 20 possible sites for proposed water supply reservoirs. The purpose of the surveys was to provide excavation data for final selection of reservoir sites and for calling tenders. Some sites were rejected because faults were detected, and some because excessive blasting would be needed.

(1c) Murrumbidgee Bridge No. 3. The bridge will connect the new suburb with the Civic area via Yarra Glen or Tuggeranong Freeway. Depths to high-velocity bedrock (dacite) at each of the pier sites and along the centre line of the proposed bridge varied from 0.5 to 8 m. The data were required for tendering purposes.

(1d) Drainage investigation. An area of alluvium near Freshford farm is waterlogged and drainage will be required before any construction is carried out there. Seismic refraction work indicated that the bedrock has seismic velocities between 4600 and 5000 m/s and is at depths between 10 and 25 m.

(2) Gungahlin development area. The Gungahlin area forms a triangle between the Federal and Barton Highways and the ACT/NSW State Border. The area will be developed as a major division of future Canberra. Three main objects of investigation were:

(2a) The continuity of the City East Fault. The fault had been located previously in the City East car park area near the Monaro Mall. Seismic refraction work this year detected the fault in the Racecourse area where seismic velocities in the fault zone did not exceed 2000 m/s. Weathering is much deeper (down to 100 m) than in the City area (70-80 m). A strong reflection from a depth of 190 m was also recorded.

(2b) Crace Industrial Complex. Seismic work was carried out to assist in geological mapping of deeply weathered zones associated with faults and contacts mapped in the town centre area.

(2c) Rippability tests. Seismic velocities were compared with augering results to correlate seismic velocity and rippability. The results show that auger refusal takes place when the velocity reaches about 500 m/s; material with this velocity is still rippable.

(3) Belconnen town centre investigation. Seismic refraction work was done in conjunction with geological mapping and drilling over the proposed sites of high-rise buildings. The seismic data revealed the presence of a major concealed fault, the Deakin Fault, passing under several of the building sites. Further seismic work was done in outer areas of the town centre to provide general information on foundation conditions.

(4) Dairy Flats sand and gravel reserves. Three resistivity traverses were made across the river flats adjacent to Dairy Flats road. The Wenner configuration of electrodes was used with a spacing of 10 m. Some correlation was noted between apparent resistivity highs and the location of present-day flood channels, but deeper probing did not indicate the presence of higher-resistivity sands and gravels. The samples of sand collected from boreholes contained more than 40 percent clay, indicating that clean sands may not exist in this area. It is proposed to traverse the area using the IP technique.

(5) Pialligo. Sixteen seismic refraction traverses were made over a filled-in section of the rubbish dump. A light-industrial suburb is planned to be built on this old dump and information is required on the compaction and depth of fill.

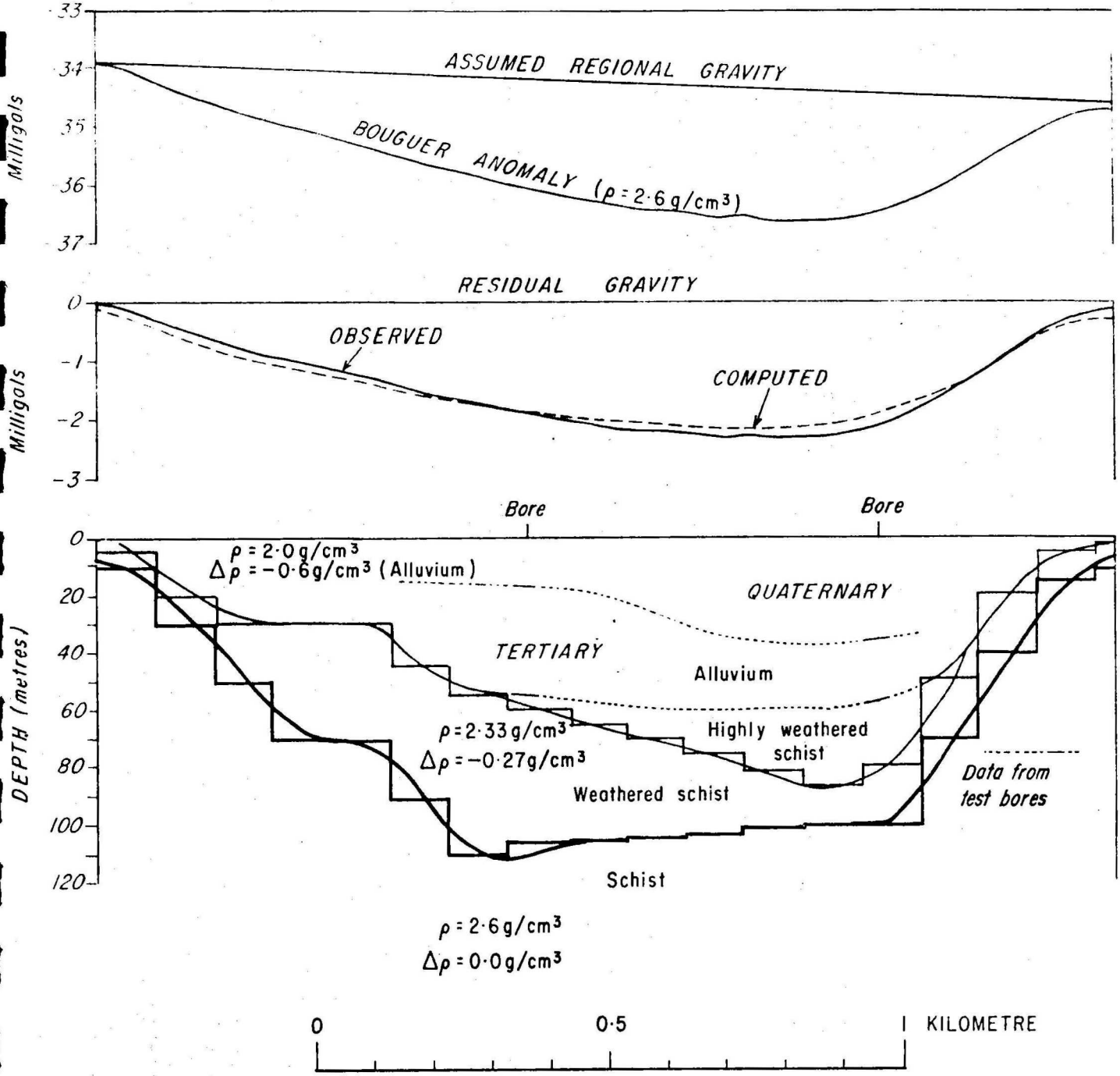
(6) Googong pipeline. Thirty-eight seismic refraction traverses were made along sections of the Googong pipeline route between the proposed Googong Dam, NSW and the Campbell Reservoir, ACT. The purpose of the survey was to determine the conditions of excavation for the pipeline; to enable excavation by backhoe to the required depth of 5 m, blasting will be required at at least 25 of the sites. The dacite near the Googong Dam is particularly resistant to weathering and the Ainslie Volcanics are generally less resistant.

(7) Mount Stromlo Tunnel seismic survey. A seismic refraction survey was carried out along part of the proposed route of a bulk water main running from Mount Stromlo to Higgins Reservoir. The results indicate that the tunnel will be driven through weathered rock. Furthermore, from previous experience in an adjacent area, this weathering pattern is likely to be complex with only slightly weathered boulders surrounded by material in a much more weathered state. This will present problems when driving the tunnel.

(8) Ginninderra Tunnel. A seismic refraction survey was carried out along the route of the proposed Ginninderra sewer tunnel which runs for 6 km on the western side of the Belconnen suburbs and connects the northern suburbs of Belconnen with the North Molonglo sewerage treatment works on the Molonglo River. Bedrock velocities ranged from 2200 m/s in sheared granite, to 5000 m/s in dacite; depth of weathering varied from 5 m to about 40 m. Geological boundaries, faults, and shear zones were located from the seismic data. Over most of the length of the tunnel the bedrock boundary is about 30 m above the tunnel level.

Albury/Wodonga survey. A geophysical survey was conducted for the Albury/Wodonga Development Commission. The survey was concentrated in three main areas: in the Thurgoona and Middle Creek areas to determine foundation conditions, and in the Murray River flood plain to locate gravel and sand deposits. Four geophysical methods were used: seismic refraction, gravity, magnetic, and resistivity. The main findings were:

Fig. GS2



DOCTORS POINT GRAVITY PROFILES
ALBURY - WODONGA GEOPHYSICAL SURVEY

J55/B5—135-1A

(1) In the Thurgoona area seismic refraction data indicated a three-layer velocity profile. In the top layer with an apparent velocity of 600 to 900 m/s, investigation using closely spaced geophones revealed velocity-lamination. The third layer, the bedrock, with a seismic velocity of 3300 to 6000 m/s occurred at depths of 70 to 100 m, showing very deep weathering.

(2) In the Middle Creek area weathering as shown by the seismic method was generally deep, to a maximum of 80 m. Seismic evidence of localized uplifts of bedrock was supported by the gravity data. Changes of the bedrock type were located with the magnetometer.

(3) In the flood plains area resistivity depth-probing showed that the gravel and sand deposits are more localized than expected, and that they occupy narrow valleys either in the bedrock or between levee banks in the alluvium. Figure GS2 shows one of the valleys as interpreted from the gravity data using a Wang 600 desk calculator and a program developed by the Group. The gravity model has been adjusted to suit the seismic and borehole evidence.

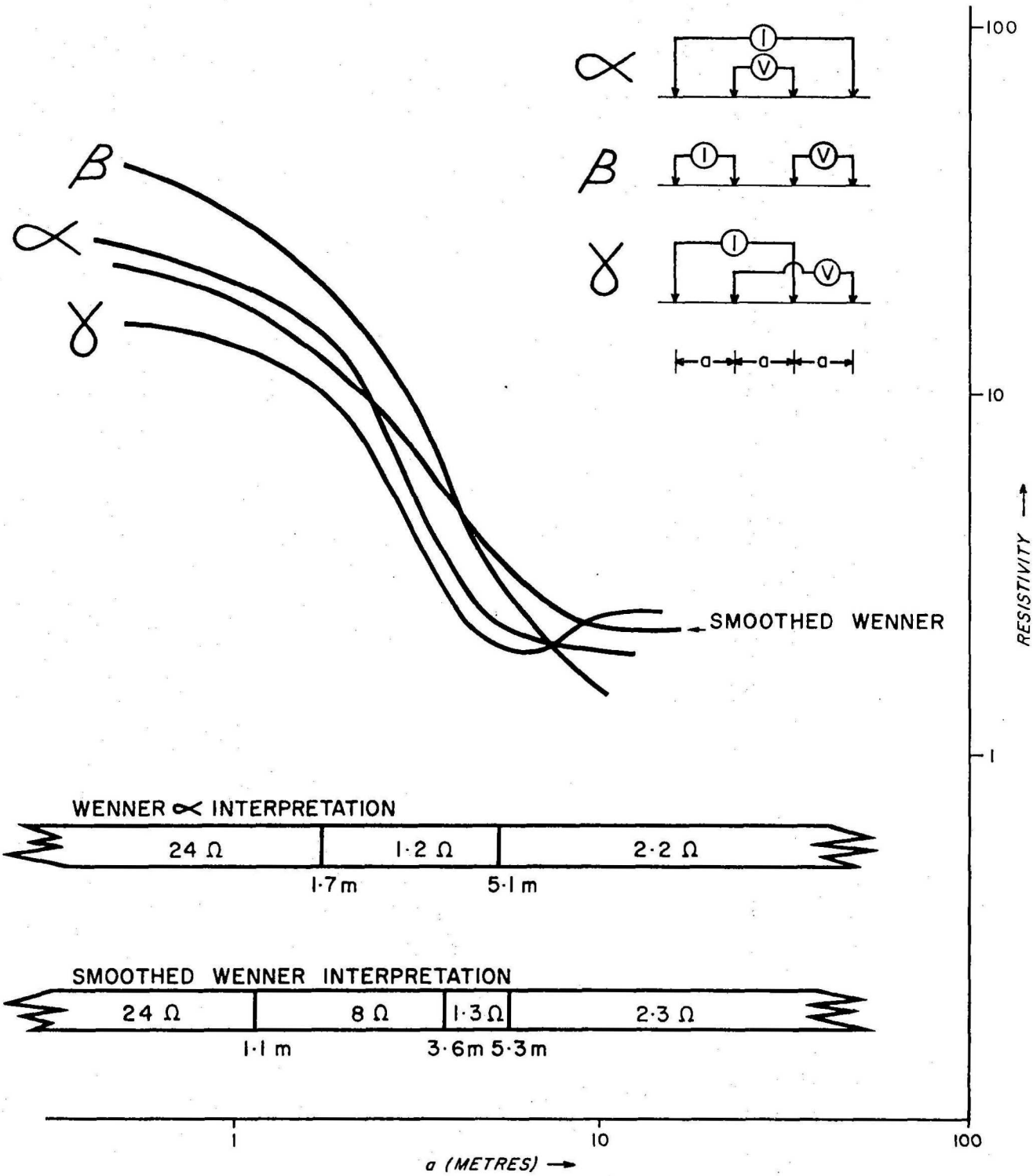
Development of shallow profiling equipment. The 9-element spark array built in 1974, designed to peak the energy at 1000 Hz and direct it vertically downwards, failed to operate at sea in the way predicted by theory and indicated by initial tests. Further testing was done in 1975 as reported by the Mechanical and Electronic Subsections.

Replay of magnetic tapes from the Marine Geology Group's 1974 survey produced no improvement on the records obtained during the survey; investigations made by the Electronics Subsection have been reported elsewhere.

Investigation of resistivity techniques

(a) Wenner Tripotential Method. In this method the data obtained from three different arrays (Fig. GS3) provide a theoretical means of smoothing Wenner depth-sounding curves. However, results obtained with the method show effects that are incompatible with the assumption of a layered medium. Because of the interpretational difficulties experienced with the technique in PNG surveys, an experimental depth probe was taken on Moruya beach, NSW, where two horizontal layers and a large resistivity contrast could be assumed. The interpretation of the conventional Wenner curve and the smoothed curve indicated that the smoothing process had introduced an apparent intermediate layer above the low-resistivity saltwater layer (Fig. GS3).

Fig. GS3



WENNER TRIPOTENTIAL METHOD

G16-138 A

(b) Reverse Schlumberger resistivity sounding. The reverse Schlumberger arrangement in which current is applied through the inner electrodes (MN), is safer than the conventional Schlumberger survey for large separations and also minimizes power losses in a long cable. The practical feasibility of the method was investigated over the Braidwood granite batholith (NSW). The results show agreement in resistivity values to 3 percent for outer electrode spacing (A B) less than 800 m, but accuracy deteriorates to 10 percent for A B greater than 2 km. The best results were obtained for an AB/MN ratio of less than 8.

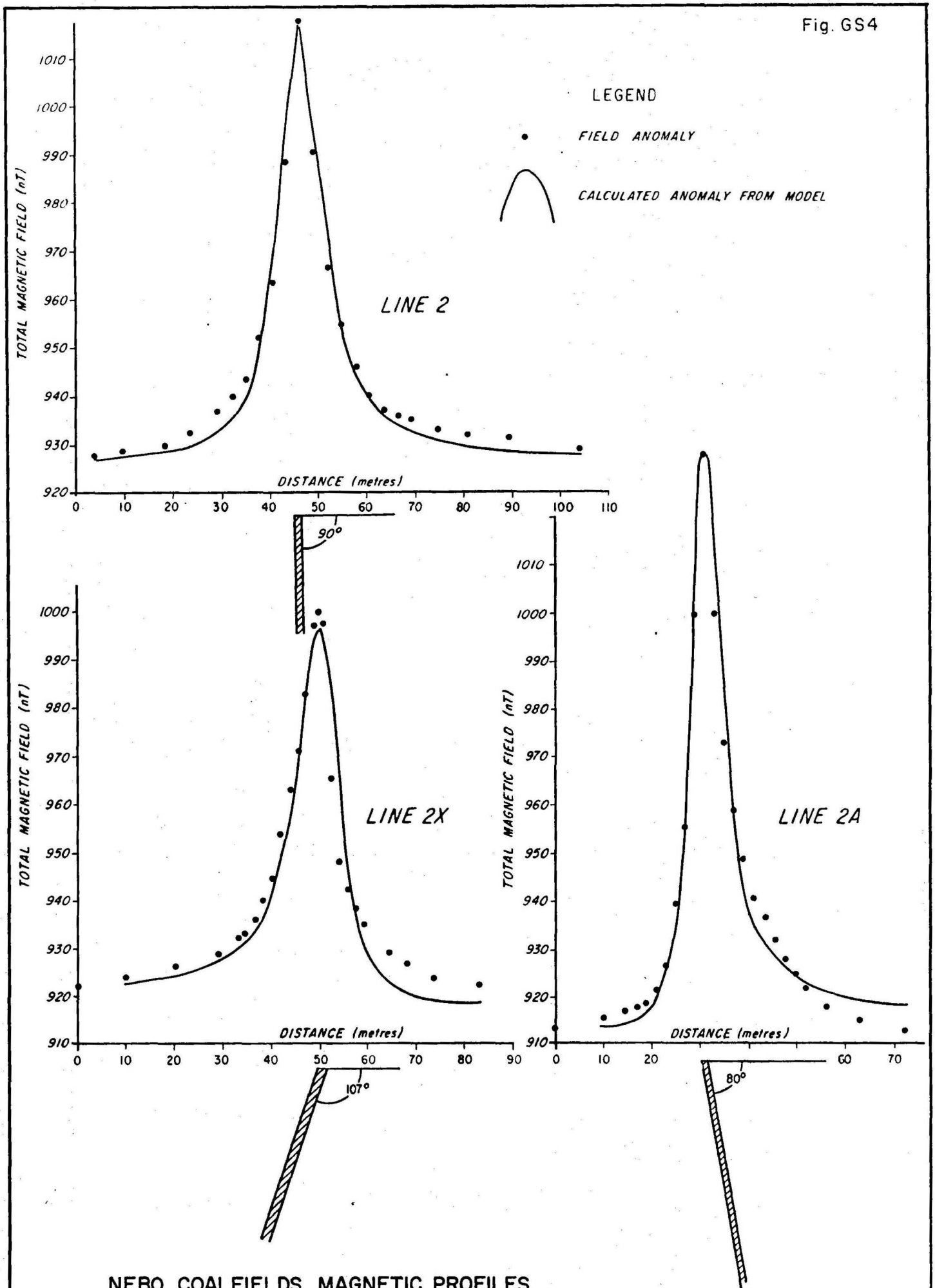
(c) Resistivity depth probe matching in the field. The Gosh filter method has been programmed for the HP65 calculator enabling field parties to calculate multi-layer resistivity curves in the field in less than five minutes.

Development of desk calculator programs. During the year a number of programs were written for the Wang 600 calculator and X-Y plotter to aid interpretation of geophysical data.

Figure GS4 shows the interpretation of magnetic anomalies in the Nebo Coalfield area (Qld). Most of the magnetic anomalies mapped in this area resemble those due to thin dykes. The calculator matches the field data and draws the theoretical profile to suit the field data. Other programs developed include:

1. Gravity anomaly over a two-dimensional sedimentary basin with one density contrast.
2. Gravity anomaly over a two-dimensional sedimentary basin with two density contrasts.
3. Gravity anomaly over a two-dimensional irregularly shaped buried body.
4. Gravity anomaly due to a three-dimensional restangular prism.
5. Magnetic anomaly over an infinite thin dyke.
6. Magnetic anomaly over an infinite thick dyke.
7. Interpretation of 6-layer resistivity model.
8. Calculation of Dar Zarrouk parameters and plotting of Dar Zarrouk curves.
9. Interpretation of buried point and vertical line electrode measurements.

Fig. GS4



NEBO COALFIELDS MAGNETIC PROFILES

F55/B5-15A

10. Seismic refractor modelling, reciprocal geophone interpretarion, intercept time, and inflection-point depth determination.

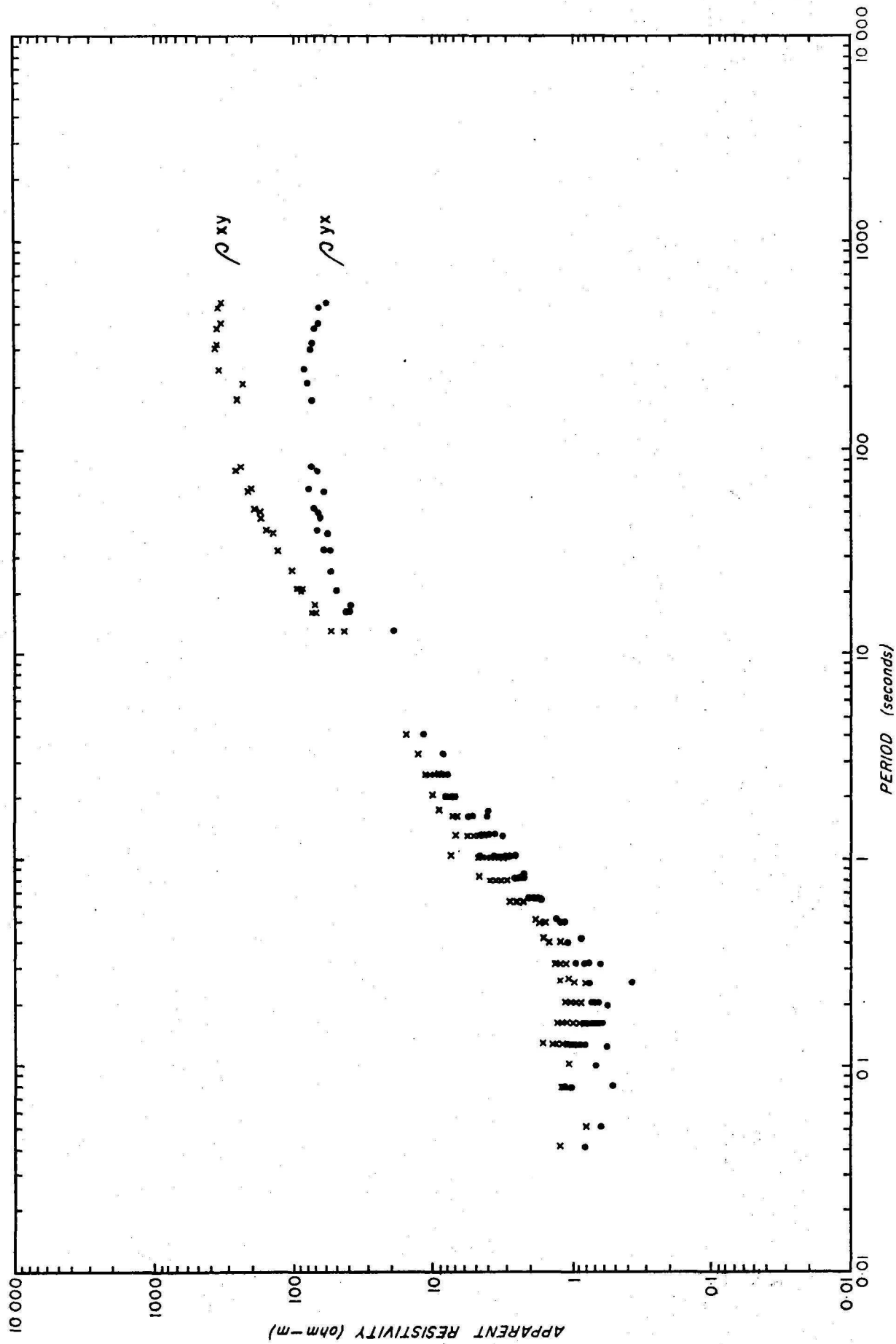
Well logging. The program of water-bore logging in the Great Artesion Basin was continued. Fifty deep bores were logged in northern and northwestern New South Wales, and 47 in the Hungerford-Charlesville area of Queensland. The usual set of logs was obtained, viz. gamma, neutron, temperature, differential temperature, and collar locator in non-flowing bores (NSW). In the flowing bores (Qld), flowmeter and caliper logs were also obtained.

A new index of all bores logged by BMR was completed. Data were abstracted for temperature gradient calculation; information from more than 80 percent of all bores for which there are temperature logs are now included in the abstract.

Cooper Basin magneto-telluric survey. Final data selection and quantitative interpretation was completed for all five sites occupied in the Cooper Basin in August 1974. Interpretation of the geological significance of the final models is not yet complete. Despite this, three broad conclusions can be drawn. Firstly, good agreement has been found between the acquired data and the response curves calculated from models based on interpretation of electric well-logs. Secondly, structural information obtained from the tensor rotation and tipping vector analyses agrees well with results obtained from other geophysical techniques and drilling. More importantly, structure is apparent at depth (below the Permian); the structure of the pre-Permian and the nature of the basement is not apparent from seismic data. Thirdly, there appears to be little or no significant anisotropy in the total section.

Wentworth Trough magneto-telluric survey. A joint magneto-telluric survey was conducted in the Murray Basin, NSW, in June and July 1975, by BMR and Macquarie University. In seven weeks, data were acquired at eight sites along a line 80 km long running approximately northwest through the town of Pooncarie, which is at the centre of a northeast-trending feature referred to as the Wentworth Trough. The survey was prompted by the completion of BMR contract gravity surveys which showed a gravity anomaly of -35 mGal centred on Pooncarie and trending in the same direction as the Trough. The anomaly was at first thought to be due to a thickening of sediments within the Trough, but the existence of granitic basement at relatively shallow depths in nearby areas cast considerable doubt on this idea. The aim of this survey therefore was to establish the origin of the gravity low by mapping the depth to basement across the Trough, a problem well suited to the magneto-telluric method.

Fig. GS5



I54/B13-1A

After completion of the survey, over six hundred 2048-point recordings were processed at BMR and plots were produced of apparent resistivity and phase for the two orthogonal components (obtained by rotated tensor analysis). Reliable data have been obtained in the range of periods 0.03-2000 s for most sites. Some qualitative conclusions can be drawn immediately from these data. At the short periods (shallow depth), the closeness of the two apparent resistivity components suggests that the near-surface material is isotropic; apparent resistivity values typically lie within the range 0.7-1.5 ohm-metres. A subsequent DC resistivity survey in the same area confirmed these values. Up to a period of 10 s, the two curves continue to follow each other closely. Above this period, however, they diverge rapidly and at their respective maxima (see Fig. GS5) differ by a factor of 4, indicating significant anisotropy at depth. However, little more can be deduced from the data until quantitative interpretation has been completed. At present the origin of the gravity low remains in doubt.

Development of magneto-telluric software. Improved tensor-rotation and tipping-vector analysis techniques have been added to the MT data processing system by D. Kerr (ADP Section). Comprehensive apparent resistivity, phase, and rotation angle plotting programs were written to run on the HP 2100 computer with output on either the Gould 5000 or Calcomp plotters. One-dimensional modelling facilities on the HP 2100 have been updated to allow the assessment of the influence of individual model parameters on the magneto-telluric response curves.

Geophysical Drawing Office (P.M. Gillesphe, B.C. Hamilton)

Ground Surveys Group (R. Inglis, L. Bonazzi, R. Watson, W. Pearson, F. Simonis, B. Holden, J. Rayner-Sharpe, J. Janink, A. Jaensch, S. Hellier, K. Somerville, M. Schunke, A. Millynn, R. Jokinen). This group is responsible for the drafting requirements of the five geophysical groups listed below. In addition work was done for the Gravity, Marine, Magneto-tellurics and Petroleum Technology Groups, Operations Branch, Geological Branch, and Central Office. It provides a plan printing service for the whole of BMR and does routine clerical duties, stores procurement, and registration and filing of plans for all the Geophysical Drawing Office. A Draftsman Grade 2 conducted training exercises for Trainee Draftsmen and Drafting Assistants in the Geophysical Drawing Office. Work completed during the year was:

(a) Engineering Geophysics Group. Ninety-one plates were finalized for surveys carried out at Cape York (21); Albury-Wodonga (14); Googong Pumping Station (8); Nebo Coalfield (8); Ginninderra (8); Molonglo Parkway (5); Tuggeranong (4); Madang (2); Shallow profiling (2) Rockhampton Airport (2); Western Port (1); and various ACT surveys (16).

Sixty-one slides were prepared, for presentation at: ANZAAS (13); Explosives Symposium (13); and Groundwater Seminar (35).

(b) Metalliferous Subsection. Seventy-two plates were drawn for surveys at Elura Prospect, Cobar (16); Cloncurry/Mount Isa (16); Cloncurry, 1973 (14); Tennant Creek, 1973 (8); Tennant Creek, 1969 (8); magnetic survey for opal, SW Queensland (8); and Mary River (2). Fifty-six reductions were also made of radiometric logs.

(c) Observatories Subsection. A total of 181 plates were drawn: Solomon Islands focal mechanisms (38); focal mechanisms, 1975 (13); PNG volcanoes (12); IUGG conference (12); Taylor Memorial Volume (10); Tsunami PNG preliminary catalogue (7); Stephens Creek (7); central Australia crustal project (7); earthquake data file (7); Australian preliminary seismic zones (6); Cooney seismograph (6); detection capabilities of Australian seismic observatories (6); and other projects (50). Twelve slides were also compiled for use at the IUGG Assembly.

(d) Regional Structural Surveys Group. Thirty-nine plates were drawn comprising East Papua (24); Bismarck Sea (13); and SW Pacific Workshop (2).

(e) Seismic Surveys. Seventy-one plates were drawn: Deep crustal tests (24); East Otway Basin (19); Galilee Basin presurvey report (13); NW Eromanga Basin (7); Gosses Bluff (6); and long-term proposals (2). Three slides and 3 drawings for overhead projector were also prepared.

(f) Miscellaneous. Production of slides for lectures (44), labels and captions for Museum (210), name tags (94). Thirty-seven marine drawing, 26 drawings for Operations Branch (includes editors), and 110 miscellaneous drawings; amendments and additions were made to 745 plates for Records and 85 250 prints were made for Records and for use in BMR.

Airborne Surveys Group (W. Gerula, A. Rudka, A. Parvey, K. Barrett, I. O'Donnell, T. Kimber, P. Corbett, M. Steele, P. Kersulis, M. Preier, G. Clarke). The work consists of presurvey compilation; survey data compilation including flight-path recovery and digitization; drawing of plates for Records and Reports; preparation of data for preliminary release; and quality control of contract survey data.

(a) Compilations. Presurvey data were compiled for Whyalla/Lincoln/Maitland, SA; Port Augusta, SA; Broken Hill, NSW; Pooncarie, NSW; Cootamundra, NSW; Bairnsdale, Vic; and Darwin/Katherine NT. Presurvey compilation was also completed for the Officer Basin, WA contract survey. Survey data were compiled for Carpentaria Basin Qld 1973-74; St Arnaud Vic, 1974; Whyalla/Lincoln/Maitland, SA 1975; Broken Hill, NSW 1975; Port Augusts, SA 1975; and Canberra/Wagga Wagga 1973-74;compilation was continued for Darwin/Katherine, NT 1974, and commenced for Cootamundra NSW 1975.

The compilation of the Magnetic Map of Australia was continued.

(b) Plates and slides. Twenty-four plates were drawn for Reports, 76 for Records, and 205 for other purposes; 33 maps were prepared for preliminary release of data, and 42 slides for lectures. Amendments and additions were also made to 156 plates.

Gravity Surveys Group (R. Sandford, R. Buckley, L. Kerec, L. Hollands, E. Krams-Steins, A. Maxwell, N. Price). The group continued to handle most of the marine work as well as the gravity work.

(a) Gravity surveys. Helicopter gravity surveys in NSW, Vic, Tas, 1973-74 were completed up to the letting of the contract for the final drafting of fifty-eight 1:250 000 Bouguer anomaly maps; helicopter gravity survey, WA 1971-72; fifty-six 1:500 000 maps were printed and released; the updating of eighteen 1:250 000 Bouguer anomaly maps incorporating private company data was commenced; drawing of plates for reports of helicopter gravity surveys in SW Western Australia, central Western Australia, NW Western Australia and SW South Australia was nearly complete; the Gravity Map of Australia (1:2 534 400 scale) was updated and colour-proofed; scribing of the multi-colour edition at 1:5 million scale was commenced.

(b) Marine surveys. Plates and figures were drawn for Records on the sediments and structures of the Australian continental margin (35), the Exmouth Plateau seismic results (44); and for a Bulletin on the Coral Sea Plateau (34). Overhead projector transparencies (26) and slides (15) were made for lectures on plate tectonics.

(c) Miscellaneous. Ninety plates, 6 slides and 3 overhead projector transparencies were drawn for gravity survey; 62 plates, 5 slides and 38 overhead projector transparencies for marine surveys; 16 plates and 21 slides were prepared for APEA; 19 plates for Summary of Activities 1974 (33 plates were also prepared for reduction); 88 marine seismic sections were annotated and reduced. Twenty drawings and 36 overhead projector transparencies were made for miscellaneous uses, and 68 plates were amended.

Cartographic Group (I. Cravino, P. Moffat, K. Dinakis) The Group prepares fair drawings for lithographic reproduction. Nine 1:250 000 aeromagnetic maps were litho-printed (GLENBURGH, ROBINSON RANGE, PEAK HILL, NABBERU, STANLEY, PERENJORI, NINGHAN, MOORA, and BENCUBBIN); Four others (PERTH, KELLERBERRIN, PINJARRA, and CORRIGIN) are at the deep-etch positive stage ready for printing. All of the areas are in Western Australia.

From the Queensland 1973 airborne survey, scribing of the magnetic contours was completed for the WESTMORELAND and CLONCURRY 1:250 000 Sheets.

The seventeen 1:250 000 base maps completed were in Victoria: BENDIGO, WANGARATTA, and TALLANGATTA; in Northern Territory: MELVILLE ISLAND, COBOURG PENINSULA, ALLIGATOR RIVER, MOUNT EVELYN; in Western Australia : RASON, MINIGWAL, PLUMRIDGE, CUNDEELEE; in ACT/NSW:CANBERRA, WAGGA WAGGA; in Queensland: WESTMORELAND, CLONCURRY; and in South Australia: RENMARK, PINNAROO. Another ten are in progress.

Geophysical plates in the Pictorial Index and three Geophysical brochures were updated.

Automated Cartographic Group (G. Lamberts, D. Suter). The group completed the following work:

(a) Flat-bed plotter Airborne:T.M.I. contours (35); flight-path plots (14); multi-channel spectrometer profiles (5); min/max (18); contour cuts (1); stacked profiles (2); Marine: profile plots (7); residual magnetic graphs (3); contours (6); track maps (6); graticules (7); graph (1); AGRF plots (26); Australian coastline (8); station plots (1); Gravity: Bouguer anomaly contours (22); station plots (10); Australian coastline (1); graphs (4); Magneto-tellurics: plots (5); graphs (44); Regional Gravity: Bouguer Anomalies (6); station plots (11); map graticules (4); Drawing Offices: graticules (2); map grids (15); flight lines (1); Australian coastline (19); Seismic: well locations (3); shot-point plots (1); Miscellaneous: CSIRO (18.07 hours); Forestry (10); DCA (11.50); machine and program tests (30.74); demonstrations (8.08); time lost due to faults (4.33); miscellaneous time lost (11.84); System down: (291.40).

(b) Drum plotter Airborne: T.M.I. contours (65); flight-path plots (99); min/max (25); multi-channel spectrometer profiles (2735); stacked profiles (152); levelling (31); contour cuts (10); 3-D models (3); profiles (11); grids (8); Australian coastline (1); Marine: Varplot (1); contours (108); graphs (7); magnetic residuals (18); track maps (24); sections (32); profiles (297); magnetic diurnals (24); simulated seismic stack (6); map of Australia (14); map of world (7); magnetic models (7); geoid heights (8); IGRF (46); base maps (1); station plots (2); contours (12); profiles (4); track maps (4); grids (5); Metalliferous: resistivity curves (2); graphs (16); seismic station plots (2); track maps (21); shot-point plots (3); well locations (7); graphs (5); Gravity: Bouguer anomaly contours (180); station plots (76); Magneto-tellurics graphs (84); Regional Gravity: station plots (628); Bouguer anomaly contours (304); height control (1); Drawing Office: map grids (2); display samples (8.25 hours); Australian coastline (1); contours, Geological D.O. (3); Miscellaneous: CSIRO (12.25 hours); DCA (0.75); test program (17.85); system tests (10.33); demonstration (2.80), time lost due to faults (8.33); miscellaneous time lost (5.13); System down: (63.00).

Map editing and map and photo services (A. Crowder, D. Park, I. Perkovic). Map editing continued to occupy one draftsman full time. Maps and photos were ordered and supplied to meet the Branch's requirements. The Observatory Group was assisted in the pre-planning of flight paths and marking of stations on aerial photographs in connexion with the third-order regional magnetic survey.

5. REPORTS, MAPS, LECTURES, COURSES, OVERSEAS VISITS

Listed in the following pages are BMR publications issued in 1975, BMR publications in preparation, papers published in outside journals, BMR Records issued and in preparation, addresses delivered at meetings and conferences, courses attended, overseas visits made, and geophysical maps released. The period covered by the lists is 1 Nov 1974 to 31 October 1975.

BMR PUBLICATIONS

Bulletins and Reports issued in 1975

Bulletin 152	HAIGH, J.E. & SMITH, M.J.	Standard curves for interpretation of magnetic anomalies due to thin, finite dykes.
Report 175	HARRISON, P.L., ANFILOFF, W. & MOSS, F.J.	Galilee Basin seismic and gravity survey, Qld 1971.
Report 176	I.B. EVERINGHAM	Seismological report on the Madang earthquake of 31 October 1971 and aftershocks.
Report 177	WIEBENGA, W.A. POLAK, E.J., ANDREW, J.T.G., WAINWRIGHT, M. & KEVI, L.	Burdekin delta underground water investigation, North Queensland, 1962-63.
Report 178	RIPPER, I.D.	Earthquake focal mechanisms in the New Guinea/Solomon Islands region to 1963.
Report 179	MUTTER, J.C.	A structural analysis of the Gulf of Papua and northwest Coral Sea region.

Bulletins and Reports in preparation or in press

Bulletin 164	DENHAM, D. (Co-ordinator)	Symposium on seismicity and earthquake risk in Eastern Australia Canberra, Dec 1964.
Bulletin 173	PARKINSON, W.D. (now at Univ. Tas)	Analysis of the geomagnetic diurnal variation during the International Geophysical Year.

Bulletin	EXON, N. & WILLCOX, J.B.	The regional geology of the Exmouth Plateau off north-western Australia.
Bulletin	MATHUR, S.P., MOSS, F.J., & BRANSON, J.C.	Seismic and gravity investigations along the Geotraverse, WA 1969.
Report 180	EVERINGHAM, I.B.	Catalogue of tsunamis, Papua New Guinea.
Report 182	REES, J.E., & TAYLOR, R.J.	Tottenham detailed aeromagnetic survey, NSW, 1971.
Report 183	BRANSON, J.C., MOSS, F.J., & TAYLOR, F.J.	Deep crustal reflection seismic survey, Mildura, Vic, and Broken Hill, NSW, 1968.
Report 184	DENHAM, D.	An analysis of strong-motion accelerograms from Yonki, Papua New Guinea, 1967-72.
Report 185	DOWNIE, D.N.	Digital data acquisition system in geophysical survey aircraft VH-BMG.
Report 187	YOUNG, G.A. & SHELLEY, E.P.	Amadeus Basin airborne magnetic and radiometric survey, NT, 1965.
Report 192	RIPPER, I.D.	Some earthquake focal mechanisms in the New Guinea/ Solomon Islands region, 1969-71.
Report 197	FRASER, A.R.	Reconnaissance gravity survey of the southwest of Western Australia, 1969.
Report 198	FRASER, A.R.	Reconnaissance gravity survey of the northwest of Western Australia, 1969.
Report 199	FRASER, A.R.	Reconnaissance gravity survey, WA, 1971-72.
Report 200	PETTIFER, G.R. & FRASER, A.R.	Reconnaissance helicopter gravity survey, SA, 1970.
Report	CAMERON, P.J., & PETKOVIC, P.	Naturaliste Plateau: sediment distribution and structure
Report	DENHAM, D.	Catalogue of earthquake focal mechanisms for the western Pacific and Indonesian region 1960-1972.

Report	DENHAM, D., ALEXANDER, L.G. & WORONTNICKI, G.	Proposals for measurements of rock stress in Western Australia.
Report	EVERINGHAM, I.B.	Seismicity of the New Guinea/ Solomon Islands region 1969.
Report	HARRISON, P.L., ZADOROZNYJ, I. & MATHUR, S.P.	Officer Basin seismic, gravity, magnetic and radiometric survey, WA, 1972.
Report	JONGSMA, D.	Macquarie Island and the Macquarie Ridge complex.
Report	JONGSMA, D.	The islands of the Queensland Plateau.
Report	JONGSMA, D.	Reefs on the Marion Plateau.
Report	JONGSMA, D.	Mellish Reef, Frederick Reef, Keuu Reef, Wreck Reef and Cato Island.
Report	JONGSMA, D.	Christmas Island and the Christmas Rise.
Report	JONGSMA, D.	The Cocos Islands and the Cocos Rise.
Report	MOSS, F.J. & JONES, P.	Ngalia Basin seismic survey, NT, 1967-1969.
Report	MUTTER, J.C.	The relation between basin evolution and marginal plateau subsidence in the Coral Sea. (Abstract for publication in CCOP/SOPAC Technical Bulletin No. 2).
Report	PINCHIN, J., JONGSMA, D., & PETKOVIC, J.J.	Seabed margins and resources potential of Macquarie Ridge, and Lord Howe Rise. (Confidential record).
Report	RIPPER, I.D.	Earthquake focal mechanisms and tectonics of the New Guinea/Solomon Islands region.
Report	WILLCOX, J.B.	The Great Australian Bight: regional interpretation of the gravity and magnetic fields and seismic profiles.

Contributions to BMR Journal (1976)

McEWIN, A.J., UNDERWOOD, R. (Hydro Electric Commission of Tasmania) & DENHAM, D. — Earthquake risk in Australia.

SPIES, B.R. — Experience with the transient electromagnetic method in Australia.

EXTERNAL PUBLICATIONS

ANGUS-LEPPAN, P.V., (Univ. NSW) BOMFORD, A.G. (Div. Nat Map), DOOLEY, J.C., & MATHER, R.S. (Univ NSW) — Geodesy in Australia - National Report for 1971-74. Australian Academy of Science

CONNELLY, J.B. — Magnetic and gravity modelling in the Bismarck Sea (summary). ASEG Bull. 1975, 6, 2/3, 52.

CONNELLY, J.B. — Tectonic development of the Bismarck Sea based on magnetic and gravity modelling. Geophys. J.R. astrono. Soc.

DENHAM, D. — Distribution of underthrust lithospheric slabs and focal mechanisms - Papua New Guinea and Solomon Islands region, Bull. Aust. Soc. Explor. Geophys., v. 6, no. 2/3., 78-79. (1975)

DENHAM, D., CLEARY, J.R., (ANU) GREGSON, P.J., SUTTON, D.J., (Univ Adelaide) & UNDERWOOD, R., (Tas HEC) — Australian earthquakes (1897-1972), Search, v. 6, no. 1-2, 34-37. (1975)

EVERINGHAM, I.B., — Large earthquakes in the New Guinea/Solomon Islands area 1873-1972. Tectonophysics, 23, p 323.

EVERINGHAM, I.B. — Faulting associated with the major Solomon Sea earthquakes of 14 and 16 July, 1971. J. geol. Soc. Aust., 22, 61-9.

FINLAYSON, D.M. — Crustal variations in the Solomon - Papua New Guinea region based on seismic investigations (summary). ASEG Bull., 1975, 6, 2/3, 61.

FINLAYSON, D.M., CULL, J.P., & DRUMMOND, B.J., 1974 — Upper mantle structure from the trans-Australia seismic survey (TASS) and other seismic refraction data. J. geol. Soc. Aust. 21, p 447.

FINLAYSON, D.M., DRUMMOND, B.J., COLLINS, C.D.N., & CONNELLY, J.B. — Crustal structure under the Mount Lamington region of Papua New Guinea. In, Volcanism in Australasia ed. R.W. Johnson, Elsevier, in press.

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1974/27	FRASER, A.R.	Reconnaissance helicopter gravity survey of the Northwest of Western Australia, 1969.
1974/43	PIEUCHOT, M. (CGG)	Poole Range seismic survey, 1962.
1974/88	PETTIFER, G.R. & FRASER, A.R.	Reconnaissance helicopter gravity survey, S.A., 1970.
1974/89	DAVIES, J.S.	Southern Georgina Basin seismic survey, Northern Territory and Queensland, 1965.
1974/115	McMULLAN, M.W.	Macquarie Island Geophysical Observatory Annual Report, 1972.
1974/116	MUTTER, J.C.	Geophysical results from the Coral Sea.
1974/125	MOSS, F.J.	Overseas visit to Mexico and USA, 18 October to 24 November 1973.
1974/126	SPIES, B.R.	Dual loop configuration of the transient electromagnetic method.
1974/130	PETTIFER, G.	The International Atomic Energy Agency Symposium: Isotope techniques in groundwater hydrology, Vienna March 1974.
1974/132	DOLAN, B., & MICHAIL, F.N.	Sturt Island sand and gravel deposits: seismic refraction survey, ACT 1974.
1974/133	BRANSON, J.C.	Overseas visit: Third Indonesia Petroleum Convention, Jakarta, June 1974.
1974/134	POLAK, E.J., & RAMSAY, D.	Goulburn Valley dipole-dipole resistivity survey Vic., 1974.
1974/135	SAMPATH, N. & OGILVY, R.	Cloncurry area geophysical survey Qld 1972.
1974/136	BRANSON, J.C.	Continental margin survey: Eastern Tasmania.

1974/137	HORSFALL, K.	Cooktown, Hann River and Rutland plains airborne magnetic and radiometric survey, Qld 1974.
1974/140	SHIRLEY, J.E. & ZADOROZNYJ, I.	Reconnaissance helicopter gravity survey North Queensland, 1966.
1974/142	CHENON, C. (I.F.P.)	Notes on seismic reflection testing.
1974/146	BRANSON, J.C., & TURPIE, A.	Sediments and structures of the Australian continental slope bordering the Indian Ocean.
1974/147	WILLCOX, J.B.	Geophysical results from the Great Australian Bight.
1974/152	SPIES, B.R.	Transient electromagnetic model studies 1973.
1974/155	TILBURY, L.A.	Continental margin survey: pre-survey report, western Tasmania and eastern Great Australian Bight.
1974/156	SHELLEY, E.P.	Recontoured magnetic data from part of 1960 airborne survey of the Tennant Creek area.
1974/157	SCHWING, E.H. (I.F.P. & MOSS, F.J.	Experimental seismic survey using explosives for comparison with a 'Vibroseis' survey in the Otway & Sydney Basins, 1965 & 1966.
1974/160	NEUMANN, F.J.G.	BMR gravity surveys, Gippsland Basin, Vic, 1948-61.
1974/164	WILKES, P.	Results of radiometric surveys in the Alligator River and Cobourg Peninsula area of the NT.
1974/166	MICHAIL, F.N.	Mary River area geophysical survey NT 1972.
1974/168	MATHUR, S.P. & ABBS, G.L.	Explosives tests for comparison of seismic efficiency of molanite, TNT, and anzite blue, Victoria, March 1974.
1974/170	PINCHIN, J. & HUDSPETH, J.	The Queensland Trough: some recent geophysical results and its petroleum potential.
1974/171	HONE, I.G.	Ground geophysical survey Tennant Creek 1972.
1974/173	ALLEN, J.C. & WALDRON, A.W.	Reconnaissance helicopter gravity survey, Qld, 1964: Compilation and recomputation of data.

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1974/175	ANFILOFF, W.	Evaluation of radio positioning equipment for helicopter gravity surveys.
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1974/181	FLAVELLE, A.J.	Canning Basin gravity surveys, 1953-62.
1974/187	BRANSON, J.C. & MATHUR, S.P.	East Otway Basin seismic survey, Victoria, 1967.
1974/190	MICHAIL, F.N. & HONE, I.G.	Tuggeranong sewer pipeline seismic refraction survey ACT 1974.
1974/192	PINCHIN, J.	Geophysical survey over the continental margin of part of east and west Africa.
1974/193	RIPPER, I.D., & GAULL, B.A.	Port Moresby Geophysical Observatory annual report 1973.
1975/7	WELLMAN, P.	Gravity trends and the growth of Australia.
1975/10	ZADOROZNYJ, I.	Melbourne area gravity survey, 1975; preview report.
1975/15	PETTIFER, G.R. & KEREC, L.	Goulburn Valley gravity survey operational report, Victoria, 1973.
1975/20	MATHUR, S.P., MOSS, F.J. & BAUER, J.A.	Long term program proposals for land seismic investigations by BMR.
1975/24	DOOLEY, J.C.	Preliminary gravity measurements on crustal movements survey markers PNG 1973.
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1975/32	GARNETT, R.A.P.	Seismic reflection profiles across the Timor Trough.
1975/37	MUTTER, J.C. TILBURY, L.A. et al.	Abstracts of papers presented at the Southwest Pacific Symposium, Feb. 1975.
1975/41	HARRISON, P.L.	Structure contour maps of the base of the Rolling Downs Group and the base of the Eromanga Basin sequence, Northern Eromanga Basin, Qld, 1974.

1975/42	WELLMAN, P.	Visit to International Gravity Commission meeting in Paris, Recent Crustal Movements Symposium in Zurich and to Ottawa and Moscow, August-September 1974.
1975/47	RIPPER, I.D.	Anomalous aspects of PNG seismicity.
1975/48	WELLMAN, P.	Operational report on the Soviet gravity tie, Port Moresby - Hobart 1974.
1975/50	SMALL, G.R. & ZEITLHOFER, A.	Stephens Creek seismograph installation 1974.
1975/52	TAYLOR, F.J.	Broken Hill power station vibration measurements, 1973.
1975/60	GARNETT, R.	Continental margins survey; satellite fix processing methods.
1975/71	FINLAYSON, D.M. et al.	Seismic investigation of the Papuan Ultramafic Belt 1973.
1975/72	FINLAYSON, D.M. et al.	Crustal structure under the Mount Lamington region PNG.
1975/74	TUCKER, D.H.	Cloncurry regional and Prospector detailed airborne magnetic and radiometric survey Qld, 1973.
1975/75	RAMSAY, D.C.	Mount Stromlo to Higgins reservoir bulk supply main, tunnel section, seismic refraction survey, Mount Stromlo, ACT 1975.
1975/76	RAMSAY, D.C.	Molonglo Parkway, Black Mountain, ACT: additional seismic survey, 1974.
1975/85	ANFILOFF, W.	Automatic density profiling across 2-dimensional topography.
1975/103	COOKE, R.J.S.	Australian Calibration Line gravity survey 1971.
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1975/114	JONES, J.A., KENNEDY, K.M., SMITH, E.R., & TURPIE, A.	BMR marine program: a report by a BMR committee on forward marine program.

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1974/167	SPIES, B.	Transient electromagnetic field tests NT & Qld, 1972.
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1975/2	KERR, D.	The effects of finite magnetometer band-width on a point source aeromagnetic anomaly.
1975/59	COOKE, R.S.J.	Reconnaissance gravity observations near Mawson and Prince Charles Mountains Antarctica.
1975/89	HORSFALL, K., & WILKES, P.G.	Airborne magnetic and radiometric survey of the Cobourg Peninsula, Alligator River and Mount Evelyn (pt) 1:250 000 Sheet areas NT, 1971-2.
1975/98	BRIGGS, I.C.	A program to contour using minimum curvature.
1975/101	HOGAN, A.H. & JACOBSON, E.P.	Geophysical results from the northwestern Australian continental margin.
1975/104	C.G.G.	Marine geophysical survey of the continental margins of Australia, Gulf of Papua and Bismarck Sea, 1970-1973. Systems performance.
1975/105	WHITWORTH, R., BROWN, F.W., & GRACE, J.K.	Preview report on marine geophysical survey No. 24 (magnetic), northwest continental shelf, 1975 (Division of National Mapping, contract No. 5).
1975/108	PETTIFER, G.R., POLAK, E.J., & TAYLOR, F.J.	Albury/Wodonga geophysical survey 1975.
1975/110	PETKOVIC, P.,	Test of VLF navigation equipment March 1974.
1975/112	FRASER, A.R.	Report on attendance at the 44th Annual conference of the Society of Exploration Geophysicists, Dallas, Texas, 10-14 November and visits to companies and institutions in Dallas, Houston, Tucson, Salt Lake City and San Francisco, U.S.A.

1975/115	TILBURY, L.A.	Geophysical results from the Gulf of Papua and Bismarck Sea.
1975/116	MUTTER, J.C.	Magnetometer shore stations for the continental margin survey, 1970-73.
1975/119	FINLAYSON, D.M.	Report on visits to geophysical institutions in USA, Canada and UK, March-May 1974.
1975/121	DOOLEY, J.C.	Two-dimensional interpolation of irregularly spaced data using polynomial splines.
1975/122	DOLAN, B.H.	Westernport seismic profiling survey, Victoria, 1973.
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1975/125	DOLAN, B.H.	SEC Power station sites offshore seismic profiling, Western Port Bay, Vic 1973.
1975/126	WELLMAN, P., & McCRACKEN, H.	Gravity measurements at crustal movements survey markers PNG, and along the ACL 1975.
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1975/133	POLAK, E.J.	Visit to Hong Kong, Japan, USA, Canada, England and Poland 1974.
1975/136	RAMSAY, D.C.	Ryan sewer tunnel geophysical investigation, ACT, 1974.
1975/140	ALMOND, R.	Mawson Geophysical Observatory annual report 1973.
1975/141	HILLMAN, P.J.	Modification of the Press-Ewing long-period seismometer to compensate for the effects of changes in temperature.
1975/142	MUTTER, J.C.	International scientification workshop on the geology, mineral resources and geophysics of the South Pacific: notes compiled in preparation for workshop discussions.

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1975/144	MULDER, J.H.	Manufacture and test of radar reflection buoys for marine surveys.
1975/145	MICHAIL, F.N., & TAYLOR, F.J.	Googong pumping station site, pipeline and access road seismic refraction surveys NSW, 1974-75.
1975/146	MANN, P.E., & DOLAN, B.H.	Concorde vibration measurements NT, 1974.
1975/150	DOLAN, B.H.	Development of a high resolution seismic profiling system for shallow water 1971-72.
1975/151	COMPAGNIE GENERALE DE GEOPHYSIQUE	Geophysical surveys of the continental margins of Australia, Gulf of Papua and the Bismarck Sea: Operations and Techniques 1970-1973.
1975/152	COMPAGNIE GENERALE DE GEOPHYSIQUE	Geophysical surveys of the continental margins of Australia, Gulf of Papua and the Bismarck Sea: Data quality.
1975/155	WYATT, B.	Aeromagnetic survey of Perenjori, Ninghan, Bencubbin and the eastern part of Moora 1:250 000 Sheet areas WA, 1972.
1975/156	BENNETT, D., & POLAK, E.J.	Googong pipeline route - rippability study 1975.
1975/158	EXON, N., WILLCOX, B.J., & PETKOVIC, P.	Preliminary report on the regional geology of the Exmouth Plateau (Confidential).

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BULLOCK, P.W.B.	Tennant Creek area gravity and magnetic survey NT, 1973.
HONE, I.G.	Transient electromagnetic survey, Elura Prospect, Cobar, NSW, 1974.
HONE, I.G., & MAJOR, J.A.	Mary River area geophysicsl survey, NT, 1973.
MAJOR, J.A.	Rum Jungle area gravity survey, NT, 1974.
OGILVY, R.D. & MUTTON, A.J.	Alligator River area ground and airborne geophysical surveys, NT, 1974.

OGILVY, R.D.	Geophysical test survey, Elura Prospect, Cobar, NSW, 1974.
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SAMPATH, N.	Cloncurry area geophysical survey, Qld, 1973.
WRONSKI, E.G.	Alligator River area test gravity survey, NT, 1972-73.
YOUNG, G.A.	Drill hole and transient electromagnetic test surveys, Woodlawn deposit, NSW, 1973.
DOWNIE, D.N.	Tallangatta, Wangaratta and Bendigo airborne magnetic and radiometric survey, Vic.
LAMBOURN, S.S.	Airborne survey of the south Eucla Basin, 1972-73.
TAYLOR, R.J.	Detailed airborne magnetic and radiometric survey of the Arltunga Nappe, NT, 1972.
TAYLOR, R.J. & REES, J.E.	Victoria River Basin aeromagnetic survey, NT, 1966-68.
WYATT, B.W.	Glenburgh (part), Robinson Range, Peak Hill, Nabberu and Stanley aeromagnetic survey, WA, 1972.

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ANFILOFF, W.	Barometric levelling test survey using precision aneroid barometers, Mark 2, type M2336/A - Serial Nos. 260, 261, 262, 263, 264 & 265, ACT, 1973.
ANFILOFF, W.	Arltunga Nappe detailed gravity survey, NT, 1973.
ANFILOFF, W.	Kalgoorlie detailed gravity survey - interpretation report.
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BROWN, F.W., & DAVIES, J.S.	Magnetotelluric equipment and survey proposals.
BROWN, F.W., & WATTS, M.D.	North Eromanga Basin semi-detailed gravity survey, Qld, 1967.
CHENON, C.	Symmetrical grouping of geophones.
DARBY, F.	Geological interpretation of the Bouguer anomalies of the Surat and Dalby 1:250 000 areas, Qld.

FRASER, A.R.	Detailed gravity survey, southwest Western Australia, 1970 - Operational Report.
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HARRISON, P.L.	Compilation of some geophysical and geological information in the northwest Eromanga Basin, NT and Qld.
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MATHUR, S.P.	Probable crustal structure in central Australia.
MOSS, F.J.	Deep crustal reflection sounding surveys in Australia.
MOSS, F.J.	Laserscan optical data processing.
MOSS, F.J. et al.	Gosses Bluff geological and geophysical studies.
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MOSS, F.J., HARRISON, P.L. & JONES, P.	Airborne seismic survey, PNG, 1970.
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JONGSMA, D.	A review of marine geophysical investigations over the Lord Howe Rise and Norfolk Ridge.
MUTTER, J.C. & WHITWORTH, R.	A proposal to update the marine data acquisition system.
PETKOVIC, P.	Corrections for the ship's influence upon Continental Margin Survey magnetic data.
PETKOVIC, P.	Geophysical results from the southwestern Australian continental margin.
WATT, C.J.	Magnetic jumps in BMR marine magnetic surveys.

WHITWORTH, R.	Overseas visit: Unites States and Japan, March to May, 1975.
WILLCOX, J.B.	Exmouth Plateau, depth and thickness maps.
WILLCOX, J.B. & EXON, N.F.	A preliminary report on the regional geology of the Exmouth Plateau.

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CAMERON, P.J.	Mawson Geophysical Observatory annual report, 1974.
GAULL, B.A.	Attenuation of seismic energy in PNG.
McGREGOR, P.M., & RIPPER, I.D.	Notes on earthquake magnitude scales.
McGREGOR, P.M., & ZEITHOFER, A.	The Manton telemetry seismograph station, NT, 1972.
McMULLAN, M.W., & ZEITLHOFER, A.	Cooney seismograph installation, NSW, 1974
PFISTER, D.	Earth-noise tests at the earth-tide recording site Broken Hill, NSW, 1975.
RIPPER, I.D., GAULL, B.A., & SHERD, S.N.	Port Moresby Geophysical Observatory annual report, 1974.
ROBERTSON, M.J.M., & ZEITLHOFER, A.	Giles seismograph installation, WA, 1974.
SILICH, J.J.	Mawson Geophysical Observatory annual report, 1972.
FINLAYSON, D.M.	East Papua crustal survey, Oct-Dec 1973: Operational report.

Geophysical Services Section

BENNETT, D., GOLDSMITH, R., & POLAK, E.J.	Murrumbidgee No. 3 Bridge seismic refraction survey, ACT, 1975.
BISHOP, I.D., POLAK, E.J., & POUNDER, M.	Geophysical investigation for groundwater, Daru, PNG, 1972.
BRISCOE, G., & RAMSAY, D.C.	Belconnen Town Centre, geological and geophysical survey, 1975.
HORSFALL, C.L., MacDOWELL, M., & PETTIFER, G.R.	Cape York groundwater resistivity survey, 1974.
TAYLOR, F.J., WHITELEY, R.J., & POLLARD, P.C.	Windorah geophysical survey, Qld, 1969.

ADDRESSES TO MEETINGS AND CONFERENCES

BARLOW, B.C. - The measurement of tidal deviations of the vertical at Armidale, NSW. Third Series of Research Seminars in Geodesy, the Univ. of NSW, Sydney June-July 1975.

BROWN, F.W. - Application of geophysics in exploration of the Australian continental margin. International training course in minerals exploration, Canberra, September 1975.

CONNELLY, J.B. - Magnetic and gravity modelling in the Bismarck Sea. SW Pacific Symposium, Sydney, Feb. 1975.

COUTTS, D.A. - Use of a Soviet-built tilt table for laboratory calibration of quartz-type gravity meters. ANZAAS Science Technology Conference, Adelaide 17-20 August 1975.

DENHAM, D. - The tectonic significance of earthquakes. Victoria Branch of the Australian Institute of Physics, Latrobe University, 19 June 1975.

DENHAM, D. - Distribution of underthrust lithospheric slabs and focal mechanisms - Papua New Guinea and Solomon Islands region. SW Pacific Symposium, Sydney, Feb. 1975.

DOOLEY, J.C. - Evidence from deep reflections for the structure of the Australian crust. Commission for Controlled Source Seismology, Paris, Aug. 1975.

DOOLEY, J.C. - Two-dimensional interpolation of irregularly spaced data using polynomial splines. Symposium on Analysis, Processing, and Interpretation of Geophysical Data. XVI General Assembly of IUGG, Grenoble, Sept. 1975.

FINLAYSON, D.M. - Crustal variations in the Solomon - Papua - New Guinea region based on seismic investigations. SW Pacific Symposium, Sydney, Feb. 1975.

GAUL, B.A. - Accelerograph recordings of the Musa earthquake 16 September 1972. South Pacific Regional Conference on Earthquake Engineering, Wellington, 13-15 May 1975.

GAUL, B.A., & SHEARD, S.N. - Seismicity. Idubada Technical College students, Port Moresby, April 1975.

HONE, I.G. - A selection of results obtained at Woodlawn by the Bureau of Mineral Resources. Geological Society of Australia Symposium on the geology and geophysics of the Woodlawn prospect, NSW. Macquarie University, Sydney, 17 October 1975.

MUTTER, J.C. - Basin evolution and marginal plateau subsidence in the Coral Sea. SW Pacific Symposium, Sydney, Feb. 1975.

MUTTER, J.C. - The Coral Sea Plateau. BMR Synposium, Canberra, April 1975.

PINCHIN, J. & HUDSPETH, J.W. - The Queensland Trough: some recent geophysical results and its petroleum potential. APEA conference, Surfers Paradise, March 1975. (Reported in Oil & Gas Journal v. 73, 31, 4 Aug. 1975; published in APEA Journal 1975).

RIPPER, I.D. - Seismicity and earthquake focal mechanisms in the New Guinea/Solomon Islands region. Southwest Pacific Workshop Symposium, Sydney, February 1975.

TILBURY, L.A. - Lineations in the Bismarck Sea. S.W. Pacific Symposium, Sydney, Feb. 1975.

TILBURY, L.A. - Lineations in the Bismarck Sea. BMR Symposium, April 1975.

WHITWORTH, R. - Problems in secular variations in the Australian region. Zmuda memorial conference on geomagnetic field models, Denver, USA, March 1975.

WOAD, G. - The Seismological Research Observatory. ANZAAS Science Technology Conference, Adelaide, 17-20 August 1975.

YOUNG, G.A. - Airborne and ground geophysical methods used by BMR to assist metalliferous mineral exploration. Australian Development Assistance Agency, International Training Course in Mineral Exploration Administration - Canberra, September 1975.

ZADOROZNYJ, I. - Eastern Australia helicopter gravity survey, 1973-74. BMR Symposium Canberra, April 1975.

OVERSEAS VISITS AND CONFERENCES

DOOLEY, J.C.	France, USSR, Sweden, UK: including attendance at XVI Assembly of IUGG, Grenoble, and Commission for Controlled Source Seismology, Paris. Aug-October, 1975.
MATHUR, S.	USA: Basic principles of seismic stratigraphy (Denver); New seismic interpreter (Houston); 45th Conference of SEG. Oct, 1975.

MUTTER, J.	Fiji: Workshop on geology, geophysics and mineral resources of south Pacific (CCOP/ SOPAC) Aug-Sep, 1975.
WHITWORTH, R.	USA, Japan: including attendance at Zmuda Memorial Conference, Colorado Springs. (IAGA). March-May, 1975.

TRAINING COURSES

External

BENNETT, D.	Fifth underground-water school (AMF). Jul 1975.
BROWN, F.W.	Management in Data Processing Projects (CDC). Oct 1975.
DEVENISH, B.	15th National Convention IREE. Aug 1975.
FRASER, A.R.	Ore genesis and mineral exploration (AMF). Nov 1975.
FUATA, P.	Fifth underground-water school (AMF). Jul 1975.
GRACE, J.	Undersea technology (AMF). Aug/Sep 1975.
HOGAN, A.	Seismic waves in fluid saturated rocks (ASEG). Aug 1975.
HORSFALL, C.	Fifth underground-water school (AMF). Aug 1975.
HSU, H.D.	Management in data processing projects (CDC). Oct 1975.
JOHNSTON, C.	Seismic waves in fluid-saturated rocks (ASEG). Aug 1975.
LIU, B.	15th National Convention IREE. Aug 1975.
PETTIFER, G.	Seminar on groundwater geophysics (AMF). Sep 1975.
PAGE, B.J.	Logic principles (ATC). Apr 1975.
POLAK, E.J.	Seminar on groundwater geophysics (AMF). Sep 1975.
RAMSAY, D.C.	Undersea technology (AMF). Aug 1975.
REES, J.	Interpretation of airborne magnetic surveys (AMF). Jul 1975.
SMITH, R.S.	Seismic Research Observatory (USGS). May/ Jul 1975.

TILBURY, L.	Interpretation of airborne magnetic surveys (AMF). Jul 1975.
WOAD, G.	Seismic Research Observatory (USGS). Jan/Mar 1975.

Internal

BARRETT, K.	ADP appreciation. Apr 1975. Introduction to ADP. Jun 1975.
BENNETT, D.G.	Rock mechanics. Jun 1975.
BROWN, F.W.	Interviewing techniques. Jul 1975.
BULLOCK, P.	Man management (seminar). Jul/Aug 1975.
BURHOP, W.	Introduction to ADP. Jun 1975.
CLEMENTS, F.	Report writing. May 1975.
DENHAM, D.	Interviewing techniques. Jul 1975.
DEVENISH, B.	Man management (seminar). Oct 1975.
GERULA, J.	" " " " "
GREENWOOD, W.	Basic Fortran. Jun/Jul 1975.
HAMILTON, B.	Interviewing techniques. Jul 1975.
HOLDEN, B.	Induction. Feb 1975.
HORSFALL, C.L.	Rock mechanics. Jun 1975.
HORSFALL, K.	Basic Fortran. Jun/Jul 1975.
KARNER, G.	Graduate conference. Oct 1975.
KEREC, L.	Report writing. May 1975.
KIMBER, T.	" " " "
MAJOR, J.A.	ADP appreciation. Apr 1975.
" "	Report writing. May 1975.
MANN, P.E.	Man management (seminar). Oct 1975.
POLAK, E.J.	Basic Fortran. Jun/Jul 1975.
RAMSAY, D.C.	Rock mechanics. Jun 1975.
RAYNER-SHARPE, J.	Induction. Aug 1975.
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SAMPATH, N.	Man management (seminar). Oct 1975.
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MAPS PRINTED AND RELEASED

Aeromagnetic maps printed

Survey	Year	Type	(Scale) x 1000	Map Name
Western Australia	1972	A	(250)	Bencubbin, Glenburgh, Moora, Nabberu, Ninghan, Peak Hill, Perenjori, Robinson Range, Stanley
Western Australia	1972-73	A	(250)	Corrigin, Kellerberrin, Perth, Pinjarra

A: aeromagnetic results only.

Preliminary aeromagnetic/radiometric maps released

Survey	Year	Type	(Scale) x 1000	Map Name
Cloncurry		A	(100)	Cloncurry
NSW		A	(500)	Deniliquin, Hay, Jerilderie, Narrandera
Victoria		A	(500)	Hamilton, Horsham
Prospector		A	(100)	Prospector 1:100 000
Georgetown		A	(100)	Georgetown
Victoria	1974	A	(250)	Ballarat, St Arnaud
Carpentaria Basin	1973-74	A	(250)	Cooktown, Ebagoola, Hann River, Holroyd, Rutland Plains
Wagga	1973-74	A/R	(250)	Canberra, Wagga Wagga

A/R: aeromagnetic and radiometric results.

Proposed preliminary data release (Nov-Dec 75)

Survey	Year	Type	(Scale) x 1000	Map Name
Victoria	1974	A/R	(250)	Ballarat
Victoria	1974	R	(250)	St Arnaud
South Australia	1975	A/R	(250 & 100)	Whyalla, Lincoln, Maitland

Bouguer anomaly maps

Maps for the fifty-eight 1:250 000 Sheet areas covered by the 1973-74 contract helicopter gravity survey of south-eastern Australia were released.

Ana Branch	Ivanhoe	Queenscliff	SJ 55-14
Bairnsdale	Jerilderie	Renmark	SJ 55-15
Ballarat	Mallacoota	St Arnaud	SK 55-1
Balranald	Manara	Sale	SK 55-2
Bathurst	Melbourne	Swan Hill	SK 55-3
Bega	Menindee	Sydney	SK 55-6
Bendigo	Mildura	Tallangatta	SK 55-7
Broken Hill	Milparinka	Urisino	SK 55-9
Cargelligo	Narrandera	Wagga Wagga	SK 55-10
Cobham Lake	Narromine	Wangaratta	SK 55-11
Colac	Nymagee	Warburton	SK 55-14
Deniliquin	Ouyen	Warragul	SK 55-15
Forbes	Pinnaroo	White Cliffs	
Hamilton	Pooncarie	Wilcannia	
Horsham	Portland	Wollongong	