BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS

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RECORD NO. 1985/37

MUNDARING GEOPHYSICAL OBSERVATORY

TWENTY-FIFTH YEAR 1983

by

P.J. GREGSON, E.P. PAULL, V.F. DENT, G. WOAD & B.J. PAGE

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CONTENTS

TABLES

FIGURES

SUMMARY

Basic programs in geomagnetism, ionspherics, and seismology continued at the Mundaring Geophysical Observatory during 1983. The main instruments were an Eschenhagen normal-run magnetograph, an IPS type 4B ionosonde, a Worldwide Standard Seismograph, and a Seismic Research Observatory.

Seismographs were operated at Ballidu, Kalgoorlie, Kellerberrin, Kununurra, Marble Bar, Meekatharra, Mundaring, Nanutarra, Narrogin, and Warburton. A regional seismograph was installed at Rocky Gully on 4 August.

The annual earthquake (ML > 2) list show details of 161 Western Australian earthquakes, 98 of which occured in the southwest seismic zone. More than 540 minor earthquakes (ML < 2.0) were recorded in the Southwest Seismic Zone.

Isoseismal maps were prepared for earthquakes that occurred near Cadoux on 26 January and Timor on 24 November.

1. INTRODUCTION

The Mundaring Geophysical Observatory opened on 18 March 1959, and now controls seismological recording at Ballidu, Kalgoorlie, Kellerberrin, Kununurra Marble Bar, Meekatharra, Mundaring, Nanutarra, Narrogin, Rocky Gully and Warburton; magnetic reocrding at Gnangara and ionspheric recording at Mundaring. The seismograph at Narrogin is a Seismic Research Observatory (SRO) and is operated in co-operation with the United States Geological Survey.

Descriptions of the observatory and an outline of activity there to the end of 1982 have been given in previous records (e.g. Gregson, 1983) and principal events in the observatory's history are given in the appendix.

As 1983 was the twenty-fifth year of operation, this report summarises some aspects of operation over the 25 years.

P.J. Gregson, E.P. Paull, V.F. Dent, G. Woad and B.J. Page have contributed to this report.

2. STAFF AND VISITORS

1983 observatory staff is listed in Table 1, and other personnel associated with the observatory's operations in Table 2. Staff absences, for reasons other than recreation leave are summarised in Table 3, and conferences attended and addresses given, in Table 4. P.J. Gregson was a member of the Geophysics Advisory Committee, Western Australian Institute of Technology and the seismological data base sub-committee of the Accreditation Technical Experts Natural Disasters (ATEND). Mr V.F. Dent (Science 2) was transferred from headquarters on 24 January 1983. Mr B.J. Page continued relief duties at Macquarie Island until 3 February 1983.

Messrs E. Paull and V.F. Dent assisted with the first order magnetic survey for 11 weeks (April, June and July) and 10 weeks (September- November) respectively.

Both technical officer positions were reclassified to Technical Officer Grade 2 (P/N 1685) and Senior Technical Officer Grade 1 (P/N 1684) on 20 January and 20 October respectively. Mr G. Woad acted in P/N 1684 from 28 November and Mr B.J. Page was promoted into P/N 1685 on 20 January.

Mr S. Soaki (Department of Lands and Surveys and National Resources, Tonga) was trained during July and August, in seismological observatory observatory practice, under the CCOP/SOPAC Tripartite Agreement SW Pacific.

Visitors to the observatory during 1983 are listed in Table 5.

1959-1983

Observatory staff during the 25 years of operation are listed in Table 6. The observatory has been the main training ground for Antarctic observatory personnel and they are listed in Table 7. In its early years of operation the observatory employed University students during their long vacation and they are listed in Table 8. Former staff, trainees and students currently employed by the Bureau of Mineral Resources are indicated in the Tables.

3. GEOMAGNETISM

An Eschenhagen 20mm/hr magnetograph operated continuously at Gnangara, recording the three components D, H and Z. The installation of an Elsec automatic digital magnetograph (ADM) commenced in the latter part of the year.

Eschenhagen magnetograph

The magnetograph operated satisfactorily throughout the year. Fifty five hours of record were lost owing to operator errors; total record loss was less than 1%. The Z trace ordinate increased abruptly by about four millimeters during orientation tests on 3 August. The H baseline value decreased by 4nT between two sets of control observations in October. The most probable time for the change was at 0800hrs on 25 October during a period of artificial disturbance. There were no other abrupt changes in either scale or base values during the year. As in previous years, the Z scale value drifted during the year. It changed from 5.4nT/mm in April to a peak in August of 6.36nT/mm; the drift reversed between August and November. Adopted scale and baseline values for 1983 are given in tables 12 and 13 respectively.

The standard deviations of the observed baseline and scale values were:

Element	Baseline value	Scale value
D	1.7nT (0.25 min)	-
H	0.9nT	0.01nT/mm
Z	1.3nT	0.03nT/mm

Values were similar to those obtained in previous years.

Eschenhagen magnetograph tests

Temperature coefficients. Values of qH = 0.0 nT/°C and qZ = 3.2 nT/°C derived from 1981 data and confirmed from 1982 and 1983 baseline plots were used throughout 1983.

The drift in Z scale value showed a good correlation with temperature. Least-squares analysis gave the following relation:

$SZ_0 = SZ - 0.05(t-20)$ nT/mm
where SZ_0 is the scale value at 20°C.

Orientation. Orientation tests were carried out on all variometers on 3 August. Results are given in Table 9 and were consistent with the previous tests carried out in July and November 1982.

Parallax. No tests were performed during 1983 and it was assumed that the parallax remained unchanged from previous years. During 1973 it had been found that the parallax on variation trace time-mark spots (but not on baseline spots or hour lines) was zero on all components. The parallax for other time-marks can be measured from the trace time-marks.

Scale values. A magnetograph calibrator MCO2 was used in conjunction with Helmholtz coils to determine H and Z scale values once weekly. The D scale value was determined on 3 August using the Helmholtz coils and was calculated as 1.10 min/mm (7.47 nT/mm).

Automatic digital magnetograph

Installation of an Elsec automatic digital magnetograph (ADM) commenced in the latter part of the year.

The magnetograph consists of an Elsec proton precession magnetometer with the detector head located in the centre of two mutually perpendicular Helmholtz coil pairs. The coil pairs are oriented so that the intersection of the coil planes is aligned with the mean magnetic field vector. When a bias current is applied individually to the two pairs of coils the magnetic fields produced will be at right angles to the mean declination and inclination, respectively. By successively applying and changing the direction of current through each pair of coils, deviations of declination (ΔD) and inclination (ΔI) from the mean values can be determined. These two values of ΔD and ΔI and the total force (F) are recorded once per minute on digital magnetic tape.

By the end of December the Helmholtz coils were installed and aligned and all the associated electronics and cabling installed. Excessive interference caused scattered readings at an unacceptable level. The interference was reduced considerably by providing better earthing to a number of units in the control console. However the proton magnetometer failed before an acceptable level was reached. The magnetometer should be repaired early in 1984 and it is hoped that routine recording will commence shortly after.

Magnetometers

Absolute observations for D,H, and Z values were made at weekly intervals. An Askania magnetometer (S/N 309319, circle 580135) was used throughout the year for D observations. A proton vector magnetometer (PVM B/5/Z) was used for combined observations of F and Z values (cancellation method). The PVM consisted of Elsec vector coils (set B), an MNS-2 proton-precession magnetometer (S/N 5) and sensor (S/N Z). H values were calculated from F and Z values.

Preliminary corrections used during the year were:

(a) PVM B/5/Z : H OnT, Z OnT
(b) Askania declinometer 509319 (circle 580135) : +0.5 minutes.

Comparisons. H comparisons were made through baseline values between the Gnangara PVM (pier NM) and QHM's (travelling standard QHM 460's, magnet survey QHM's 173, 305 & 306 and the Gnangara QHM 293) pier NE. The pier difference is negligible.

July 07 (Before Cocos/Christmas survey)

H.PVM B/5/Z - H.306 = -17.5nT (2 observations)

Mean H was 23300nT

July 22,27 (Before survey leg 5 - Meekatharra)

H.PVM B/5/Z - H.173 = -0.3 +/- 3nT (6 observations)

H.PVM B/5/Z - H.293 = -9.1 +/- 1.4nT (6 observations)

Mean H was 23300nT

7

August 1 (After Cocos/Christmas survey)

H.PVM B/5/Z - H.306 = -17.5 +/- 0.8nT (4 observations)

H.PVM B/5/Z - H.305 = 32.1 +/- 0.5nT (4 observations)

Mean H was 23290nT

October 4,11

H.PVM B/5/Z - H.460 = -0.8 +/- 0.2nT (6 observations)

H.PVM B/5/Z - H.461 = -0.9 +/- 0.2nT (6 observations)

H.PVM B/5/Z - H.462 = -1.3 +/- 0.2nT (6 observations)

Mean H was 23290nT

November/December

H.PVM B/5/Z - H.293 = -13.3 +/-1.1 nT (5 observations)

H.PVM B/5/Z - H.173 = -2.7 +/-1.6 nT (8 observations)

D comparsions were made through baseline value pier NE, between the Gnangara declinometer, magnetic survey Askania magnetometers 320 & 505, and DIM magnetometer 3207.

January 4, February 3

D.319 - D.3207 = -1.4 +/- 0.4' (11 observations)

July 22,27

D.319 - D.320 = -0.8 +/- 0.5' (5 observations)

August 1

D.319 - D.505 = -2.0 +/- 0.2' (4 observations)

F Comparisons were made between the Gnangara PPM and PPM's Austral 524 and 525 and Geometrics 1023. Differences were obtained by alternating PVM's on pier NM.

July 22, 27

F.5 (MNS2) - F.524 (Austral) = -1.1 +/- 3nT (25 observations)

F.5 (MNS2) - F.525 (Austral) = -0.5 +/- 2nT (25 observations)

The uncertainty in F differences is due to the scatter in Austral 524 and 525 readings.

November 22

F.5 (MNS2) - F.1023 (Geometrics) = -0.8nT (20 observations)

Reference Marks

Round of angle measurements between reference marks were made on 24 August. The relative angle between reference marks was the same as for 1982.

Accessory equipment

The Askania H visual variograph at Mundaring office was operated throughout the year with minor record losses.

A magnetic pulsations tape recorder previously operated at the Weir site for the University of Newcastle, was not operated during most of 1983 because of an equipment failure late in 1982. Operation recommenced on 14 December following the return of equipment from Newcastle.

First order magnetic survey

Mr E.P. Paull occupied the first order magnetic stations at McKay,Cooktown, Croydon, Mt Isa, Tennant Creek, Ayers Rock, Alice Springs, Daly Waters (18 April - 14 June), Christmas and Cocos Islands (11-27 July). V.F. Dent occupied stations at Geraldton (14-17 July), Southern Cross, Esperance, Eucla, Ceduna, Emu, Pt Lincoln, Woomera, Oodnadatta, Etadunna, Parafield, Tibooburra, Bourke, Wilcannia, Mildura, Warracknabeal and Portland (6 September - 9 November). The results will be reported separately.

Data reduction and publication

Magnetograms and reduction data were prepared in monthly batches about six weeks after the end of the month and sent to headquarters for reduction to mean hourly values.

Adopted scale values and baseline values are listed in Tables 12 and 13 respectively.

Monthly and annual mean values of H, D, Z, F and K-index for 1983 are listed in Table 10. The field values were derived from the five local quiet day each month by scaling a mean ordinate for each component from each magnetogram. The F value was calculated from H and Z values. Annual values and secular variation for all components since 1959 are shown in Table 11. Figure 1 shows the graphs of annual mean values 1919-1983. Apart from D, recent trends in secular variation continued during 1983 with H decreasing by 27nT, Z decreasing in magnitude by 16nT and the calculated mean value of F rising by 4nT during 1983. The mean value of D remained approximately the same as for 1982.

The routine distribution and publication of data is listed in Table 14. Components of K-index are stored on magnetic tape at headquarters.

Checked data for rapid variations, solar flare effects, and principal magnetic storms for 1982 were prepared for the IAGA Bulletin.

Requests for geomagnetic data attended to during the year are listed in Table 28.

9

4. IONOSPHERICS

A quarter-hourly sounding schedule was continued throughout the year using a model 4B ionosonde. Five minute soundings were made from 10 to 15 June to monitor effects caused by a solar eclipse. The ionosonde spare components and film were supplied by the Ionospheric Prediction Service (IPS), Department of Science and Technology.

Record loss was less than 3%, the main cause being an operator error in processing the film resulting in a week's record loss. A further week's film was faint but still readable, caused by poor developing. Other causes of record loss where the film jamming in the cassette and running out of film.

A problem of short trace and extra blank runs during February was overcome by installing a better earth spike and improving internal earthing. A recurrence of the problem in April was overcome by replacing the programmer. A lightning strike early in April resulted in prolonged over-voltage which burnt out the main power switch and cooling fan. A further lightning strike in August burnt out an insulator in the aerial balun resulting in low receiving sensitivity. This condition existed for three weeks before the insulator was replaced.

Data distribution and publication

The F2 layer critical freqency at each six hours UT and local noon were scaled. The six-hourly values were sent to IPS for distribution internationally and the monthly median of the noon values was telexed to the International Radio Consultative Committee (Geneva) for the determination of the index IF2. The weekly film was sent to IPS Hobart for scaling of the remaining parameters. Hourly values of all parameters are published in the IPS Series D and are distributed internationally. Ionograms are available on loan within Australia from IPS and internationally through the WDC-A.

5. SEISMOLOGY

Seismograph stations

Permanent seismograph stations were operated throughout 1983 at Ballidu (BAL), Kalgoorlie (KLG), Kellerberrin (KLB), Kununurra (KNA), Marble Bar (MBL), Meekatharra (MEK), Mundaring (MUN), Nanutarra (NAU), Narrogin (NWAO) and Warburton (WBN).

A station was installed at Rocky Gully (RKG) on 4 August and a local operator contracted to attend the equipment daily. Seismograms are posted to Mundaring three times a week.

An insensitive seismograph was operated in the Mundaring office.

The number of earthquakes reported from each station in 1983 were:

BAL 568; KLB 559; KLG 426; KNA 1037; MBL 688; MEK 1316;
MUN 915; NAU 790; NWAO 910; RKG 451 (5months); WBN 1356;
TOTAL: 8616

Figure 2 shows the increase in the annual total number of earthquakes reported to the United States Geological Survey by the observatory since 1959. The increase is related to the number of operating stations from one in 1959 to

eleven in 1983. The low numbers reported in 1978 and 1979 resulted from selected reporting in those years.

A summary of seismograph calibration data used during 1983 for all stations is given in Table 16.

Some of the EMI clocks used at the outstations have been in service for about 15 years. These clocks provide both time control and synchronous power to operate the seismographs. The faults developing with the clocks are becoming more numerous and frequent. To ensure reliable operation of outstations over the next few years it will be necessary to have more spare clocks on hand.

Descriptions of individual station operations during 1983 are given below and a summary of record losses in Table 15.

Ballidu (BAL). The station ran well. The majority of record loss occurred when someone or something switched off the DC power to the pre-amplifier at Ballidu. Wind induced noise has become a problem. This would probably be eliminated by moving the seismometer further away from trees and onto a granite outcrop.

Kellerberrin (KLB). This station also ran well. A fault in the pre-amplifier was responsible for the major portion of record loss.

Kalgoorlie (KLG). Very few problems were experienced during the year. Most record loss was caused by late or missed record changes. Noise on the record from the Mt Charlotte crusher has increased in both duration and intensity to the extent that it has become a problem. One solution would be to move the seismometer to a quiet site and telemeter the signal back to Kalgoorlie.

Kununurra (KNA). Failure of the recorder drive motor and problems with installing replacement motors were the main cause of record loss (15%) during the year. Recording during April and May were very spasmodic for this reason.

The long term operator retired in April. A spate of temporary operators between April and July experienced difficulty in routine operations including record fogging and processing, non-translation of the recording drum, records falling off the drums and time control. Routine operations improved from August when a permanent operator commenced duty.

The EMI clock failed on two occasions resulting in about 3% record loss. Minor problems were experienced with battery charging and radio reception. The alignment of the optics of the number 1 drum was improved during a maintenance visit in June. This enabled the vertical and north-south components to be returned to their original recording drums.

Marble Bar (MBL). The operator of several years experience was transfered in April. The new operator settled in after an initial period of operational problems. The major cause of record loss (6.7%) resulted from problems with the pre-amplifier (and VCO) at the remote site. The amplifier failed in August. Excessive trace drift occured following repair of the amplifier and it was not overcome till the amplifier was replaced in January 1984.

Meekatharra (MEK). This station ran very well. Late or missed record changes constituted the majority of record loss.

Mundaring (MUN). Only minor problems were experienced with the WWSSN seismograph. These were mainly associated with the strobe and programmer. Some variation in the sensitivity of photographic paper was experienced.

A fault in the station standby power plant voltage regulator caused the mains voltage to go abnormally high after an SEC failure. This resulted in a burnt out transformer supplying the supplementary recorder globes. The transformer was replaced with minimal record loss.

Two additional vertical components were added to the office insensitive seismograph and the response curves tailored to match the shape of a Wood-Anderson curve as closely as possible (see Figure 4). The resulting curves were within 10% of the Wood-Anderson curve for periods 0.1 to 1.0 seconds, equivalent to better than 0.05 in the Richter magnitude. Magnifications of the three components are 2800, 280 and 28. This gives a recording range of magnitude 3 to 7 for earthquakes in the southwest seismic zone. All three components are recorded on one helicorder at 30mm/min. Modifications were completed by 9 November.

System tests were made six times during the year and adjustments were made twice to the SP-Z seismometer free period.

Nanutarra (NAU). Instrumental problems were minimal at this station. A new calibration/amplifier rack was installed during a maintenance visit in March.

Excessive record was lost (21%) owing to poor performance of the operator in either not attending the seismograph daily or late attendance. In addition tardiness in despatching records resulted in delays in scaling and data transmission.

A new operator commenced in December.

Narrogin (NWAO). Record loss was minimal stemming mainly from Telecom line faults. No visits were made by personnel from the Albuquerque Seismological Laboratory.

Rocky Gully (RKG). A permanent short period vertical seismograph was installed on a farm at Rocky Gully on 4 August. Cultural noise proved to be a problem and the seismometer was moved further away from farm buildings onto a granite outcrop, on 12 December. This reduced the noise and allowed the gain to be doubled. Figure 3 and Table 16 show details of the response curve.

Main record losses were from power and pen failures. The battery charger malfunctioned delivering a high voltage which ruined the batteries resulting in no backup power. Two pens developed poor connections at the pen tips causing variable intensity recordings.

Warburton (WBN). This station ran well. The main problem was the backup power system. Record was lost whenever mains power failed. An inverter, installed during 1982, proved unreliable and was withdrawn from service. A new community power plant was installed during the year which greatly improved the continuity of the power supply and failures are no longer lengthy.

Network coverage

In a review of BMR activities in the field of earthquake seismology (Denham and others, 1981) the following recommendations were made regarding the capabilities of the national seismograph network.

To (i) locate continent-wide all Australian earthquakes with magnitudes greater than 4.0 on the Richter Scale;

(ii) locate all earthquakes with magnitude greater than 3.0 on the Richter Scale in the continent's most seismically active

and populous areas;

(iii) detect continent wide all earthquakes with magnitudes greater than 3.0 on the Richter Scale.

To locate an earthquake it needs to be recorded at three or more seismograph stations. Coverage capabilities of Western Australian stations at December 1983 are described below.

Western Australia. Figure 5 shows the three station coverage for earthquakes of Richter magnitude ML = 4. There is a good coverage for 80% of Western Australia. Figure 6 shows an 86% detection capability for earthquakes ML = 3. Table 18 indicates how the coverage has increased with the expansion of the network since 1964. Installation of two further stations one in the Fitzroy Crossing - Halls Creek area and the other at Forrest as recommended by Denham and others (1981) would increase the coverage to 100% for both locating ML = 4 and detecting ML = 3 earthquakes. These installations are programmed for late in the 1980's.

Southwest Seismic Zone. This zone is one of the most active in Australia and because of its proximity to Perth it requires special attention. Figure 7 shows a 90% three station coverage of the zone for earthquakes ML = 2. Figure 8 shows an 80% detection capability for earthquakes ML = 1. Table 19 indicates how the coverage has increased with the expansion of the network since 1976. The installation of a station at Morawa (programmed for 1984/85) will improve coverage in the northern end of the zone. At this stage it is not worth improving the deficiencies in coverage outlined in Table 19.

Accelerographs

Three MO2 accelerographs were operated in the Southwest Seismic Zone, two near Meckering and one near Cadoux. The latter was returned to the office in February as it was faulty and has not yet been repaired. The State Public Works Department (PWD) operated one MO2 at Kununurra and a Kinemetrics SMA-1 accelerograph at Mundaring Weir. Telecom operated three SMA-1 accelerographs in the Wellington St. Telephone Exchange, Perth. The Telecom instruments were serviced by Observatory Staff.

Two earthquakes in the southwest seismic zone triggered accelerographs. The ground accelerations recorded are summarised in Table 27.

Explosion seismology

During October the BMR Crustal Studies Group detonated large explosions at Koolyanobbing, Corrigin, Lake Magenta and New Norcia. They recorded the shock waves from these explosions and commercial quarry explosions (in particular Collie) along two perpendicular traverses from Koolyanobbing to Collie and New Norcia to Lake Magenta.

The permanent seismograph stations in the southwest recorded the shock waves from most of these explosions. Arrival times and ground amplitudes of various phases recorded are listed in Table 20. Shot times and locations provided by the group are listed in Table 21 together with the distances from the shots to the seismograph stations.

Analysis of the data from the survey will enable the group to determine crustal structure and velocities in the southwest which is essential if the exact location of earthquakes is to be determined.

Cadoux microearthquake survey

Sixteen seismograph tape recorders were operated in the Cadoux area on a square grid with approximately 4km spacings from 25 October to 2 November. Four additional tape recorders and the permanent station at Ballidu were evenly spaced on a circle 40km from Cadoux. These were operated from 27 October to 15 December. Station locations and equipment numbers are listed in Table 22 and shown in Figure 9.

Approximately 200 earthquakes were recorded during the week when all recorders were operating. Results of the analysis of the information recorded will be reported elsewhere.

Stress measurements

Seven sites in the southwest seismic zone were selected for hydrofracturing measurements. The BMR drilled the holes in September and made measurements in four of the holes in November/December.

Seismicity

Table 23 lists 161 earthquakes of magnitude ML = 2.0 or greater which occurred in Western Australia in 1983. A histogram comparing numbers of earthquakes located in Western Australia and those located in the Southwest Seismic Zone between 1959 and 1985 is shown in Figure 10. Epicentres of those with magnitude ML = 3 or greater are shown in Figure 11.

Table 25 lists 94 earthquakes of magnitude ML = 4.5 or greater which occurred in the region of Western Australia from 1887 - 1983.

Southwest Seismic Zone. During 1983 there were 98 earthquakes of ML > 2 located in the Southwest Seismic Zone (see Figure 12). Of these 57 occurred in the Cadoux area, the largest being ML = 4.8 on 26 January 1983. The remaining activity was scattered throughout the zone from Ballidu in the north, to Merridin in the east and Gnowangerup to the south. More than 540 minor earthquakes (ML < 2.0) were recorded in the zone and they are listed in Table 24.

Kununurra. During 1983 three small events occurred in the area, approximately 100km S of Kununurra. The area is of particular interest because of the Ord River Dam. All earthquakes that have been located in the area since routine recording commenced in 1963 until the end of 1983 are listed in Table 26 and shown in Figure 14.

Off-shore. The majority of the activity, outside the Southwest Seismic Zone, during 1983 was located off-shore. Earthquakes occurred off-shore from Wyndham (2) - 100km NW and 270km W; Broome (7) - 150km N to 360km W; Port Hedland (3) - 220km N to 220km W; Onslow - 450km NW; Dampier - 130km NNW; Carnarvon (4) - 115km NW to 190km SSW; Kalbarri (3) - 310km NW to 90km NW; Northampton - 550km WNW; Geraldton - 130km W; Dongara - 50km W; Fremantle - 370km W; Augusta - 500km SW and Israelite Bay - 170km E.

Other areas. Twenty nine earthquakes were located on land apart from the areas mentioned above. Those above magnitude ML = 4 were 80km N of Derby (ML = 4.2), Lake Tobin (ML = 4.1), 250km NNE Port Hedland (ML = 4.3) and 110km NE of Kalbarri (ML = 4.0).

Earthquake intensities and isoseismal maps

Isoseismal maps were prepared for two 1983 earthquakes from information received from the distribution of questionnaires.

26 January. (Fig 15). At 0116 UT (2.16pm local time) an earthquake of magnitude ML = 4.8 occurred near Cadoux in the south-west of Western Australia. The epicentre was 4 km north of the cadoux townsite. The intensity experienced in the Cadoux area was MM V with one isolated report of MM VI near the epicentre. The earthquake was felt over an area of 50,000 km and up to 200 km to the south-west. A number of isoseismal maps have been prepared for earthquakes in the Cadoux area since the large earthquake that occurred there in June 1979 (Everingham & others, 1982).

24 November. (Fig 16). Electric power and telephone services in parts of northern Australia were interupted by this earthquake which occurred in the Timor Sea about 650 km north-west of Darwin. The shock was strongly felt in the Indonesian Islands of Sumba, Flores, Timor and Alors but there were no reports of casualties (SEAN, 1983).

The earthquake occurred at 0530 UT and had a magnitude ML = 7.5. The maximum intensity reported in Australia was MM VI in Darwin where minor damage occurred. Strong shaking was experienced in northern towns eg Darwin, Wyndham, Kununurra, Derby and Katherine. Intensities of MMIV were experienced over an area of 300,000 km in Australia and up to 900 km from the epicentre.

The isoseismal map was prepared from responses to 200 felt report questionnaires distrbuted throughout northern Australia.

Effects of the earthquake were similar to those resulting from an earthquake on 29 October 1974 (Gregson & Gaull). It was felt in tall buildings in Perth as was the Indonesian earthquake of 19 August 1977 (Gregson & others, 1979).

Strain release

Strain release curves for a number of areas in the Southwest Seismic Zone are shown in Figures 17 to 20. Areas with dimensions of 0.4 degrees in latitude and longitude are defined in Figure 13 and are identified with the name of a major town in the area.

Strain release was determined for six-monthly periods over the 25 years from 1959 to 1983, using earthquakes of Richter magnitude (ML) greater than or equal to 2. The formula given by Richter (1958) was used to calculate strain release.

$$J = /E$$

$$E = 2.9 + 1.9\ ML - 0.024\ ML^2$$

where

J = strain release (Joules$^{1/2}$)

E = energy (Joules)

The curves show that approximately 80% of the strain released in the zone in the last 25 years has been released in the two areas Meckering and Cadoux. The Calingiri, Quairading and Brookton account for a further 15%.

The curves for the Meckering (Fig 17) and Cadoux (Fig 18) are significantly different. Only four earthquakes of magnitude ML > 4.5 have occurred in the Meckering area since the October 1968 earthquake (see Table 25) and these occured within two weeks of the main event. In contrast seven earthquakes (ML > 4.5) have occurred in the Cadoux area over the four years since the June 1979

earthquake.

The possible significance of these differences will be discussed elsewhere.

Major earthquake procedures

At the request of the State Emergency Services (SES), procedures were set up, which are to be followed after a major earthquake. These procedures are to ensure the SES is advised as early as possible of the location, magnitude and likely impact area of major earthquakes in Western Australia, in particular the south western area.

Figure 21 depicts these procedures. The local earthquake advisor (LEA) is a microprocessor unit being constructed by the BMR. When large amplitude, high frequency (>3Hz) shock-waves are detected from two or more of the three seismograph stations, Kelleberrin, Ballidu and Narrogin an alarm will trigger in the Mundaring office. At the same time the Universal Telephone Answering Service will be activated and officers of the SES and Observatory will be paged. The paging system and provision for its operational costs will be provided by the SES. Full implementation of the system has been delayed as the LEA was not ready for installation by the end of the year.

Data distribution, publication and requests

Preliminary phase data was telexed about five times a week (through the American Embassy, Canberra) to United States Geological Survey (USGS) who published the data together with preliminary earthquake locations in their Earthquake Data Reports (EDR). Monthly batches of preliminary phase data from all Western Australian stations were stored on the CSIRO Cyber computer in Canberra. This data was accessed by the Earthquake Seismology Group for distribution with data from other Australian stations. Final phase data was sent through headquarters (about fifteen months after the event) to the International Seismological Centre for publication.

During 1983 greater use was made of the computer terminal in handling the seismic data. Previously preliminary data was sent to Canberra on a cartridge. Once there, computer control statements had to be added by ADP personnel, who then put the date onto the computer. This was then checked by observatory personnel, who then advised MGO of any errors that they detected. The data is now put onto the computer through the terminal at Mundaring. The checking program is then run on the data, to pick up the more apparent errors, as was done previously in Canberra. A new stage has been added, where the data is then time sorted, and formatted in such a way that related phases are grouped together. This allows closer examination of group arrivals which are most likely to contain errors. Origin times are also computed when S phases are reported, and this has been found to expose errors which would otherwise have gone undetected.

Preliminary monthly lists of Western Australian earthquakes were distributed to 13 recipients. This reduced the number of day-to-day queries for data. Requests for seimological data attended to during the year are listed in Table 28. Narrogin SRO magnetic tapes were sent to headquarters for copying before being sent to Albuquerque Seismological Laboratory (ASL). This practise ceased at the end of February because the service of providing network day tapes by ASL made it unnecessary to hold copies of Narrogin tapes in Canberra. Narrogin tapes were sent to ASL via the U.S. Consulate (Perth). Mundaring WWSS seismograms were sent to the WDC-A for copying.

16

6 ACKNOWLEDGEMENTS

The assistance of the daily attendants listed in Table 2 and the co-operation of Australia Post for housing the seismograph at Marble Bar is hereby acknowledged. Remote seismometers and telemetry equipment were located on the properties of K. Quartermaine (Narrogin), V. Wright (Kellerberrin) and T. Malley (Ballidu). We also appreciate those listed in Table 22 for allowing seismograph tape recorders to be operated on their properties.

7. REFERENCES

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APPENDIX
PRINCIPAL EVENTS
MUNDARING GEOPHYSICAL OBSERVATORY 1957-1983

1957 May	Geomagnetic recording commenced at Gnangara (La Cour)
1959 Mar 18	Transfer of observatory from Watheroo to Mundaring
1959 Apr 03	Ionospheric recording commenced (Type 2 ionosonde)
1959 Jul 30	MUN seismograph recording commenced (Benioff)
1960 Mar-Oct	Atmospheric noise recording (for CSIRO)
1960 Apr 30	Eschenhagen normal magnetograph replaced La Cour at Gnangara
1960 May 01	Cossor ionosonde replaced type 2
1960 Jun 22	Absolute magnetic observations commenced in new absolute house
1962 Jun	WWSS system commenced recording at MUN
1963 Apr 19-Dec 17	GRV seismograph operation
1963 May 30-Dec 19	NGN seismograph operation
1964 Nov 06	KLG SP seismograph recording commenced
1965 Nov 29-1966 Aug 24	LVS seismograph operation
1965 Nov	KNA SP-Z seismograph recording commenced; operation intermittent till February 1972
1967 Feb	Fremantle Region Upper Mantle Project
1967 Oct 26	MEK SP-Z seismograph recording commenced
1968 Oct-Nov 26	Field seismograph operation at Meckering
1968 Nov 16-1971 Dec 31	AFMAG recording at Mundaring
1970 Jan 01	Routine analysis of KNA seismograms commenced
1970 Feb 26	IPS IIIE ionosonde replaced Cossor
1971 Feb 10-1972 Jul 31	KAA SP-Z seismograph operation
1971 Nov 30	Two MO2 accelerographs installed at Meckering
1972 Feb 29	KNA seismograph upgraded to 3 components
1972 Mar 01	MO2 accelerograph (PWD) installed at Kununurra
1972 Jun 27	Proton scalar magnetometer introduced for Z baseline control
1972 Oct 12-1975 Feb	MBT SP-Z seismograph recording
1972 Nov 16	MO2 accelerograph (PWD) at Kununurra
1973 Jan 31	Mobile SP-Z recording at various sites in SW seismic zone started
1973 Mar 01	MEK reduced to 3 component SP
1973 Mar 30	KLG reduced to SP-Z
1973 May 23	MUN 2 Wood Andersons installed
1973 May 25	MUN Benimore SP-Z withdrawn; Benioff SP-Z started
1974 Apr 01	Proton vector coils introduced for Z baseline control
1974 May 01	Proton vector coils introduced for H baseline control
1974 Jun 17-31	Riometer recording at Mundaring during solar eclipse
1974 Sep-1978 Jun	GLS SP-Z recording
1975 Jul 18-Nov 19	Earthtide recording at Mundaring
1975 Mar	Magnetic pulsation recording commenced at Mundaring
1975 Mar 19-Aug 15, Dec 18, 1981 Jul 20	SWV SP-Z recording
1975 Sep 02-1976 Feb 05	NWAO SP-Z recording
1976 Mar 27	NWAO Seismic Research Observatory commenced
1976 Jun	MBL SP-Z recording commenced
1976 Sep-1977 Nov 27	XMI SP-Z recording
1976 Oct	Special ionospheric sounding, solar eclipse (23 Oct)
1977 Nov 28	A third MO2 accelerograph installed at Meckering
1978 Feb	A fourth MO2 accelerograph installed at Meckering
1978 Jun 27	WBN SP-Z recording commenced
1980 Apr 19	NAU SP-Z recording commenced

1981 Aug 07-1982 Mar 27	BAL SP-Z recording
1981 Sep 23	KLB SP-Z recording commenced
1981 Nov 19-1982 Jun 27	Walpole SP-Z field recording
1982 Aug 26	BAL SP-Z recording commenced
1983 Aug 03	RKG SP-Z recording commenced

TABLE 1
OBSERVATORY STAFF 1983

Officer	Designation
P.J. Gregson	Geophysicist Class 3
E.P. Paull	Geophysicist Class 2
B.A. Gaull	Geophysicist Class 3 (to 7 Jan)
V.F. Dent	Geophysicist Class 2 (from 24 Jan)
G. Woad	Technical Officer Grade 2
	Acting Senior Tech. Off. Gr. 1 (from 28 Nov)
B.J. Page	Technical Officer Grade 2
M.A. Bousfield (Mrs)	Clerical Assistant Grade 3

TABLE 2
ASSOCIATED PERSONNEL 1983

Name	Nature of Duties
B. Carling	Daily attendant, Gnangara
P. Maddren	Daily attendant, Kalgoorlie (to Oct)
G. McLauchlan	Daily attendant, Kalgoorlie (from Oct)
R. Tatham	Daily attendant, Marble Bar (to 18 Apr)
D. Ardnt	Daily attendant, Marble Bar (from 18 Apr)
A. Riach	Daily attendant, Meekatharra
J. Roberts	Daily attendant, Kununurra (to Apr)
Various	Daily attendant, Kununurra (from Apr to Jun)
L. Makin	Daily attendant, Kununurra (from Jun)
M. Raven	Daily attendant, Nanutarra (to Nov)
L. Loque	Daily attendant, Nanutarra (from Dec)
J. Capps	Daily attendant, Warburton
S. Cameron	Daily attendant. Rocky Gully (from July)
Sunny Gardens	Ground maintenance (to Apr)
W. Briggs	Ground maintenance (from Apr)
M. Ferguson	Cleaning (to Feb)
L. Page	Cleaning (from Feb)

TABLE 3
OBSERVATORY STAFF ABSENCES 1983

Nature of absences	No. of man-days
Sick leave	49
Special leave	4
Furlough	25
Military leave	24
Attendance at outstations and field operations	47
Temporary transfer	129
Conferences and training	10
Total	288 *

* Clerical assistant relief was available for 16 days

a0

TABLE 4
CONFERENCES, ADDRESSES AND TRAINING, 1983

Officer	Date	Conference
P.J. Gregson	May 16 - 20	ANZAAS, Perth
V.F. Dent	May 16 - 20	ANZAAS, Perth
		Addresses
P.J. Gregson	Jun 07	Cunderdin Rotary Club, "Earthquakes"
E.P. Paull	Aug 15	Northam Rotary Club "Earthquakes"
		Committees
P.J. Gregson		Geophysics Advisory Committee, Western Australian Institute of Technology
P.J. Gregson		Seismological data base sub-committee of the Accreditation Technical Natural Disasters (ATEND)

TABLE 5
VISITORS

Visitor		Institution
H. Doyle		University of WA, Geology Department
K. Lambeck		Australian National University, Earth Sciences
D. Denham		Bureau of Mineral Resources
R. Tracy		
G. Ferrie		
J. Whatman		
R. Cherry		
R. Bracewell		
B. Drummond		
G. Jennings		
G. Thom		
J. McIntyre		
S. Soakai		Department Lands & Survey & National Resources , Tonga
H. Ishii		Observation Centre for Earthquake Prediction Tohuku University, Japan
D. Cole		Ionospheric Prediction Service
F. Pernet		Woodside Petroleum
M. Reklitis		
A. Kincar		Minister of Petroleum and Mineral Resources Saudia Arabia
N. Uren		Western Australian Institute of Technology
Geophysics students	12	
T. Cairnes		State Public Works Department
S. Evans		Marine Surveys, Cable & Wireless London
Scouts	36	Maida Vale
Students	90	Kalamunda Senior High School
	20	Spice Midland
	20	Spice Kalamunda
	20	Guildford Grammer School

21

TABLE 6
MUNDARING GEOPHYSICAL OBSERVATORY
PAST AND PRESENT STAFF 1959 - 1983

		Period
Observer-in-Charge		
P.M. McGregor	*	18 Mar 1959 to Nov 1966
I.B. Everingham		Nov 1966 to 05 Apr 1970
P.J. Gregson	*	06 Apr 1970 to
Geophysicists		
P.M. McGregor	*	18 Mar 1959 to Nov 1966
I.B. Everingham		18 Mar 1959 to 05 Apr 1970
A.D. Bowra		18 Mar 1959 to 21 Aug 1959
P.J. Gregson	*	21 Nov 1961 to 16 Oct 1962
		02 Oct 1964 to
G.S. Carrard		11 Mar 1963 to 20 Nov 1963
P.J. Brown-Copper		13 Feb 1964 to 16 Oct 1964
M.F. Barbetti		07 Mar 1967 to 14 Jul 1967
E.P. Paull	*	05 Feb 1968
R.S. Smith	*	22 Apr 1971 to 19 Aug 1976
M.J. Robertson		09 Feb 1972 to 31 Jul 1972
J.A. Major		01 Jul 1972 to 27 Jul 1972
J. Silich		29 Jul 1974 to 30 Sep 1974
B.A Gaull	*	27 Jan 1975 to 10 Jan 1983
V.F. Dent	*	24 Jan 1983
Technical Officers		
A.P. Parkes		18 Mar 1959 to 03 Jul 1970
G. Woad	*	27 Jul 1960
B.J. Page	*	27 Jan 1971
W.J. Byrne		06 Dec 1974 to 11 Dec 1974
W. Meyer		16 Jan 1980 to 11 Dec 1974
Clerical Assistants/Typists		
L.E Lee		25 May 1959 to 21 Apr 1961
D Muhlman		25 May 1959 to 18 Dec 1959
C.M. Read		08 Feb 1960 to 18 Dec 1959
J.I. Luhrs		19 Apr 1961 to 09 Mar 1962
J.D. Rayner		19 Jun 1961 to 01 Dec 1961
D.M. Belcher		07 Mar 1962 to 09 Sep 1964
T.D. Dunning		07 Sep 1964 to Sep 1969
Y.M. Moiler		19 Jan 1970 to 14 Mar 1981
M.A Bousfeild	*	28 Apr 1981
Assistants		
N. Keating		27 Apr 1959 to 14 Jul 1967
J.D. Cochrane		07 Aug 1967 to 22 Nov 1968
T.E. Creaser		16 Dec 1968 to 06 Jul 1979

* Officers currently employed by BMR.

TABLE 7
MUNDARING GEOPHYSICAL OBSERVATORY
ANTARCTIC TRAINEES 1959 -1983

Year		Trainee	Year		Trainee
1959		R.W. Merrick	1971		J. Silch
		C.H. van Erklens			M.I. McMullan
1960		W.H. Burch	1972	*	R.A Almond
1961	*	J.C. Branson		*	P.J. Hill
1962	*	R. Whitworth	1973		J.J. Walsh
	*	P.J. Gregson		*	P.J. Cameron
1963		J.R. Wilkie	1975		P.J. Wolter
	*	G.R. Small			P.R. Gidley
1964		R.J. Cooke	1976		K.D Wake-Dyster
		J.E. Haigh		*	M.J. Sexton
1965		F.J. Taylor	1977	*	P.M. Davies
		P. Towson	1980		A. Marks
1966	*	V.F. Dent	1981		R. Silberstein
		G. Hart			I. Ferguson
		J.A. Major	1982	*	R. Chechet
		J. Connelly			P. Lawrence
1967	*	R.S. Smith		*	P. Kelsey
1968	*	K.F. McCue			
1969		M.J. Robertson			
		J.R. Meath			
1970		J.J. Petkovic			
		M.J. McDowell			

* Officers currently employed by BMR.

TABLE 8
MUNDARING GEOPHYSICAL OBSERVATORY
VACATION STUDENTS 1959 - 1983

YEAR	STUDENT	YEAR	STUDENT
1958/59	C.G. Carton	1964/65	L.F. Quin
	D.A. McCallum		V.N.E. Robinson
	S. Jorna	1965/66	D.J. Edmiston
1959/60	M.J. Hodge	1966/67	G. Eichinski
	D.A. McCallum		R.M. Kerr
	C.G. Carton	1967/68*	A.S. Murray
1960/61	B.G. Mullumby		Rod S. Smith
	V.P. St.John	1968/69	P.E. Simmonds
1961/62	D. Andrich	1969/70	J. Murray
	V.P. St.John	*	L. Tilbury
1962/63	P.J. Brown-Cooper	1970/71	T. Pryor
	S.S.W. Hui	1971/72	T. Pryor
1963/64	C.J. Cosina	1972/73	T. Pryor
	S.S.W. Hui	1973/74	C. Blyth
		1974/75	R. Calver
		1975/76	C. Johnson

* Currently employed by B.M.R

TABLE 9
ORIENTATION TESTS 1983

Component	Reference	Magnet	Orientation	N pole
3 August				
H	23301nT	East	0.0°	---
D	3° 19.3'W	North	0.3°	West
Z	53727nT	North	0.5°	Up

TABLE 10
PRELIMINARY MONTHLY MEAN GEOMAGNETIC VALUES AND K-INDICES, 1983

Month	D(West)	H,nT	Z,nT	F,nT	K
January	3° 19.3'	23313	53719	58560	2.55
February	19.7	299	727	561	2.82
March	18.7	283	731	559	2.89
April	18.8	287	727	557	3.16
May	18.2	284	734	562	2.56
June	19.6	295	729	562	2.02
July	19.3	301	727	562	2.00
August	19.1	288	732	562	2.17
September	19.4	297	732	562	2.06
October	19.4	293	730	562	2.36
November	19.1	289	736	566	2.72
December	20.0	296	740	572	2.50
Mean	3° 19.3'	23294	53730	58562	2.48

TABLE 11

GEOMAGNETIC ANNUAL MEAN VALUES (AND SECULAR CHANGE) 1959-1983

Year	D	I	H,nT	X,nT	Y,nT	Z,nT	F,nT	Notes
	° '	° '						
1959	2 54.1	65 52.4	23954	23923	-1213	53482	58601	C
	(+0.6)	(+0.3)	(+ 5)	(+ 5)	(+ 3)	(+ 2)	(+ 1)	
1960	53.5	52.1	959	928	-1209	480	602	C
	(+0.2)	(-0.6)	(- 7)	(- 7)	(+ 2)	(-11)	(+ 7)	
1961	53.3	52.7	952	921	-1207	491	609	C
	(+0.5)	(-0.3)	(- 7)	(- 7)	(+ 4)	(+ 1)	(- 4)	
1962	52.8	53.0	945	914	-1203	490	605	C
	(+0.5)	(-0.9)	(-14)	(-13)	(+ 4)	(-13)	(+ 6)	
1963	52.3	54.1	931	901	-1199	503	611	C
	(+0.6)	(-0.5)	(-14)	(-14)	(+ 5)	(- 3)	(- 3)	
1964	51.7	54.6	917	887	-1194	506	608	C
	(0.0)	(-1.2)	(-10)	(-10)	(0)	(+ 6)	(- 9)	
1965	51.7	55.8	907	877	-1194	500	599	C
	(-0.9)	(-0.4)	(-17)	(-17)	(- 5)	(+ 1)	(- 8)	
1966	52.6	56.2	890	860	-1199	499	591	C
	(-1.6)	(-1.1)	(-21)	(-22)	(-10)	(0)	(- 9)	
1967	54.2	57.3	869	838	-1209	499	582	C
	(-3.4)	(-1.7)	(-23)	(-23)	(- 8)	(- 3)	(-14)	
1968	57.6	59.0	846	815	-1217	494	568	C
	(0.0)	(-0.6)	(-24)	(-25)	(-13)	(+ 7)	(-16)	
1969	57.6	59.6	822	790	-1230	487	552	C
	(-2.0)	(-1.4)	(-32)	(-32)	(-12)	(+13)	(-25)	
1970	59.6	66 01.0	790	758	-1242	474	527	C
	(-2.7)	(-1.0)	(-26)	(-28)	(-18)	(+15)	(-24)	
1971	3 02.3	02.0	764	730	-1260	459	503	C
	(-2.9)	(-2.0)	(-38)	(-38)	(-18)	(+ 5)	(-20)	
1972	05.2	04.0	726	692	-1278	454	483	C
	(-2.6)	(-2.2)	(-40)	(-41)	(-14)	(- 6)	(-11)	
1973	07.8	06.2	686	651	-1292	460	472	C
	(-2.1)	(-2.8)	(-44)	(-45)	(-12)	(-17)	(- 2)	
1974	09.9	09.0	642	606	-1304	477	470	C
	(-1.6)	(-2.3)	(-34)	(-35)	(-10)	(-19)	(+ 2)	
1975	11.5	11.3	608	571	-1314	496	474	C
	(-0.9)	(-2.9)	(-48)	(-41)	(- 4)	(-32)	(+12)	
1976	12.4	14.2	567	530	-1318	528	486	C
	(-0.8)	(-2.8)	(-49)	(-39)	(- 6)	(-29)	(+11)	
1977	13.6	17.0	528	491	-1324	557	497	C
	(-1.5)	(-2.5)	(-47)	(-48)	(- 8)	(-39)	(+17)	
1978	15.1	20.5	481	443	-1332	596	514	C
	(-0.6)	(-2.6)	(-37)	(-38)	(- 7)	(-28)	(+11)	
1979	16.5	23.1	444	405	-1339	624	525	C
	(-1.3)	(-2.6)	(-33)	(-35)	(- 7)	(-28)	(+11)	
1980	17.8	25.7	409	370	-1346	652	536	C
	(-2.1)	(-3.2)	(-45)	(-45)	(-12)	(-33)	(+14)	
1981	19.9	28.9	364	325	-1358	685	550	D
	(+0.4)	(-3.0)	(-43)	(-43)	(+ 5)	(-29)	(+ 8)	
1982	19.5	31.9	321	282	-1353	714	558	D
	(+0.2)	(-1.8)	(-27)	(-27)	(+ 3)	(-16)	(+ 4)	
1983	19.3	33.7	294	255	-1350	730	562	D

Notes: C Preliminary values = Mean daily values, 10 days
D Preliminary values = Mean daily values, 5 days

TABLE 12

ADOPTED SCALE VALUES, GNANGARA MAGNETOGRAPH 1983

Date from	UT h	m	Scale Value	Explanation
HORIZONTAL INTENSITY			So (nT/mm)	
Jan 01	00	00	2.44	
DECLINATION			SD (min/mm)	
Jan 01	00	00	1.09	
VERTICAL INTENSITY			SZ (nT/mm)	
Jan 01	00	00	5.84	
Feb 01	00	00	5.86	Drift due to temperature through
Mar 01	00	00	5.88	
Mar 11	00	00	5.90	
Mar 21	00	00	5.92	
Apr 01	00	00	5.94	
Apr 11	00	00	5.96	
Apr 12	00	00	5.98	
May 01	00	00	6.00	
May 05	00	00	6.02	
May 08	00	00	6.04	
May 11	00	00	6.06	
May 14	00	00	6.08	
May 17	00	00	6.10	
May 20	00	00	6.12	
May 23	00	00	6.14	
May 26	00	00	6.16	
May 29	00	00	6.18	
Jun 02	00	00	6.20	
Jun 05	00	00	6.22	
Jun 08	00	00	6.24	
Jun 11	00	00	6.26	
Jun 14	00	00	6.28	
Jun 17	00	00	6.30	
Jul 01	00	00	6.32	
Jul 06	00	00	6.34	
Jul 16	00	00	6.36	
Aug 03	05	00	6.34	
Aug 11	00	00	6.32	
Aug 21	00	00	6.30	
Sep 01	00	00	6.28	
Sep 11	00	00	6.26	
Sep 15	00	00	6.24	
Sep 19	00	00	6.22	
Sep 23	00	00	6.20	
Sep 27	00	00	6.18	
Oct 01	00	00	6.16	
Oct 05	00	00	6.14	
Oct 09	00	00	6.12	
Oct 13	00	00	6.10	
Oct 17	00	00	6.08	
Oct 21	00	00	6.06	
Oct 25	00	00	6.04	
Dec 11	00	00	6.02	
Dec 14	00	00	6.00	
Dec 17	00	00	5.98	
Dec 20	00	00	5.96	
Dec 23	00	00	5.94	
Dec 26	00	00	5.92	
Dec 29	00	00	5.90	

26

TABLE 13

ADOPTED BASELINE VALUES (UNCORRECTED) AT 20 C)

GNANGARA MAGNETOGRAPGH 1983

Date 1983	UT h	m	Baseline Value	Explanation
HORIZONTAL INTENSITY			BHs (nT)	
Jan 01	00	00	23240	
Feb 01	00	00	23241	
Mar 01	00	00	23240	
Jun 01	00	00	23241	
Jun 16	00	00	23242	
Jul 01	00	00	23243	
Jul 16	00	00	23244	
Oct 25	04	00	23241	
DECLINATION			BD (W)	
			o ,	
Jan 01	00	00	3 03.5	
Feb 16	00	00	3 03.4	
Mar 01	00	00	3 03.3	
Mar 16	00	00	3 03.2	
Jun 01	00	00	3 03.3	
Sep 01	00	00	3 03.4	
Oct 01	00	00	3 03.5	
VERTICAL INTENSITY			BZs (nT)	
Jan 01	00	00	53424	
Mar 01	00	00	53423	
Mar 21	00	00	53424	
Apr 01	00	00	53425	
Apr 11	00	00	53426	
Apr 21	00	00	53427	
May 01	00	00	53426	
May 11	00	00	53425	
May 21	00	00	53424	
Jun 01	00	00	53423	
Jun 11	00	00	53422	
Jun 26	00	00	53423	
Jul 01	00	00	53424	
Jul 06	00	00	53425	
Jul 11	00	00	53426	
Jul 16	00	00	53427	
Jul 21	00	00	53428	
Aug 03	05	00	53401	
Aug 08	00	00	53402	
Aug 12	00	00	53403	
Aug 16	00	00	53404	
Aug 20	00	00	53405	
Aug 24	00	00	53406	
Aug 28	00	00	53407	
Oct 01	00	00	53408	
Nov 01	00	00	53407	
Nov 16	00	00	53406	

TABLE 14
ROUTINE DISTRIBUTION OF GEOMAGNETIC DATA

Weekly K-indices

Carpentaria Exploration Pty Ltd, SA
Carpenraria Exploration Pty Ltd, Perth
Scintrex Pty Ltd, West Perth
Geopeko, Gorden NSW
Broken Hill Pty Ltd, Perth
Uranerz Australia Pty Ltd, Subiaco
Basic Aerosurveys Pty Ltd, Guildford
Aerodata McPhar Pty Ltd, Subiaco
Esso Minerals, Nedlands
Hamersley Exploration Pty Ltd, Tom
Seltrust Mining Co. Pty Ltd, Perth
Duval Mining Co. Australia Ltd, Perth

Monthly	K-indices	Rapid variations	Principal storms	Preliminary mean values	Magnetogram 16mm copy
BMR, Canberra	*1	*1	*1	*1	
IPS, Sydney	*	*			
WDC A, Washington	*	*	*		*
WDC C1, Denmark	*	*	*		
WDC C2, Kyoto	*	*	*		
Observatory de Elbo		*2			
Institute de Physiques du Globe	*				

Data published

1. Geophysical Observatory Report, Bureau of Mineral Resources, Geology and Geophysics

2. IAGA Bulletin, Geomagnetic data

TABLE 15
SEISMOGRAPH RECORD LOSS 1983

Recorders	MUN (WWSSN) SP-Z	SP-N	SP-E	LP-Z	LP-N	LP-E	MUN (SUP) Z	N	E	KNA Z	N	E
Late/no change										21	21	21
Paper fogging										24	24	24
Paper off drum/ reversed										26	26	26
Drum translation	67	67	67							177	177	177
Recorder failure										1290	1290	1290
DC power										174	174	174
AC power							17	17	17			
Clock										223	223	223
Recorder lamp	31	12	29				37		13	32		
Total hours	98	79	96	0	0	0	54	17	30	1967	1935	1935
Percentage	1.1	0.9	1.1	0	0	0	0.6	0.2	0.3	22.4	22.1	22.1

Visual Recorders	NWAO SP-Z	LP-Z	LP-N	LP-E	KLB	BAL	RKG	KLG	MEK	WBN	NAU	MBL
Late/no change			2		16	4		44	32	1	1908	
Pen translation	2				2	7		12	24			
Pen broke	12	12	2	4			73	8	26	10		55
Recorder failure												
Recorder amplifier									3			
DC power						64						
AC power	11	11	11	11	1	1	52	4		94		
Pre amplifier					133							585
Clock	8	8	8	8						6		
Line outage	41	41	41	41	31	24						
+/- 12V power												
Maintenance						12	8				10	
Total hours	74	72	640	74	183	112	133	68	82	111	1918	64
Percentage	0.8	0.8	0.7	0.8	2.1	1.3	3.7	0.8	0.9	1.3	21.9	7.9

29

TABLE 16
SEISMOGRAPH CALABRATION DATA 1983
MAGNIFICATION (x1000)

SHORT PERIOD PERIOD (Second) STATION	0.1	.15	0.2	.25	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1.0
BAL Z to 13 Jun	210	293	257	208	179	132	98	73	58	43	34	26
BAL Z fm 14 Jun	273	381	334	270	233	172	127	95	75	56	44	34
KLB Z	160	208	190	155	130	95	71	55	42	33	25	21
KLG Z		10	174	270	238	184	144	112	87	66	54	43
KNA Z	80	145	165	155	130	90	70	47	35	27	21	18
KNA N,E	25	32	34	34	32	27	22	18	15	12	10	7.8
MBL Z to 18 Jul	630	470	400	305	230	120	65	44	27	20	13	12
MBL Z fm 19 Jul	1260	940	800	610	460	240	130	88	54	40	26	24
MEK Z	449	452	402	348	305	236	192	156	126	98	75	60
MGO	2.60	3.03	2.98	2.97	2.97	2.87	2.59	2.25	1.89	1.70	1.40	1.11
MUN**Z,N,E	3	6	10	14.5	20	31	39	41	40	36	31	25
MUN HGZ	406	380	338	324	326	318	207	101	55	31	21	14
MUN WA	2.05		2.05		1.98	1.83	1.68	1.50	1.35	1.21	1.06	0.95
NAU Z		27	340		432	318	222	150	92	57	38	28
NWAO*Z	30	110	193	238	260	242	190	150	120	90	70	50
RKG Z fm 04 Aug	136	158	154	135	102	62	40	26	17	12	8	6
RKG Z fm 13 Dec	272	316	308	270	204	124	80	52	34	24	16	12
WBN Z	444		639		460	320	231	161	119	86	64	48

LONG PERIOD PERIOD (Second) STATION	8	9	10	15	20	25	30	40	50	60	80	100
MUN**Z,N,E	.31	.34	.36	.375	.34	.28	.25	.18	.14	.11	.08	.06
NWAO*Z,N,E	.32	.50	.82	2.3	4.1	5.0	5.0	4.0	3.3	2.0	1.0	.50

* Seimic Research Observatory
** World Standard Seismograph

30

TABLE 17
ROCKY GULLY SEISMOGRAPH STATION DETAILS

Code

RKG

Coordinates

Latitude	34° 34.19' S
Longitude	117° 00.62' E
Elevation	300 m
Foundation	Alluvium/granite

Parameters

Component	SP-Z
To	1.0s
Magnification	18K at 1.0s 380K at 0.15 (peak)
Recording speed	60mm/min

Instrumentation

Seismometer	Willmore Mk2
Pre-amplifier	Geotech 42/50
Recorder	Geotech RV301B
Recorder amplifier	Geotech AR311
Power and time	EMI clock

Installation date

3 August 1983

31

TABLE 18
SEISMIC COVERAGE OF WESTERN AUSTRALIA
PERCENTAGE AREA COVERED

For earthquakes		ML = 4						ML = 3
		Minimum number of stations recording earthquake						
Station		1	2	3	4	5	6	7	1
Installation Date									
MUN	Mar 1959	40							15
KLG	Nov 1964	50	35						25
MEK	Oct 1967	75	50	30					43
KNA	Jan 1970	90	50	30					51
MBL	Oct 1972	95	75	35	8				62
NWAO	Mar 1976	98	79	47	26	7			75
WBN	Jun 1978*	100	95	70	30	17	7		77
NAU	Apr 1980	100	100	80	40	25	110	7	86
Fitzroy Crossing									98
Forrest									100

* Tennant Creek (WRA), Alice Springs (ASP) and Manton Dam (MTN) used for earthquakes near the WA border and Kununurra

Three station coverage for earthquakes ML > 4 will increase with installations at:

Fitzroy Crossing

Rowley Shoals area	4%
Offshore north Kununurra	8%
	12%

An area (6%) up to 700 km off the north-west coast, west of Rowley Shoals will be covered by only 2 stations.

Forrest

Eucla area	4%
Offshore south Eucla-Esperence	4%
	8%

TABLE 19

SEISMIC COVERAGE OF SOUTHWEST SEISMIC ZONE

PERCENTAGE AREA COVERED

For earthquakes		ML = 2						ML = 1
Station		Minimum number of stations recording earthquake 1	2	3 (a)	3 (b)	4	5	1
Installation								
Date								
MUN	Mar 1959	15(c)						15
NWAO	Mar 1976	100	55					30
KLB	Sep 1981	100	80	60	25			45
BAL	Aug 1982	100	90	80(d)	40(d)	40		65
RKG	Aug 1983	100	100	85	65	160	30	80
Proposed (e)		100	100(f)	90	90	80	30	90(g)

Area of interest: 650 km x 160 km (100,000 sqkms)

Notes:

(a) Three stations ideally located for a good location.

(b) Includes areas where all 3 stations are on one side of the earthquake.

(c) Earthquakes located using azimuth and distance from MUN.

(d) Three station coverage of C. Naturaliste - C. Leeuwin area additional to southwest zone.

(e) Additional station proposed near Morawa 1984/1985.

(f) The 10% coverage by only 2 stations for earthquakes ML = 2 is the southern 50 kilometers of the zone, including Albany. Temporary instalation of a portable seismograph, as required, near Ongerup would overcome this deficiency.

(g) The 10% not covered for earthquakes ML = 1 is in the southeast corner of the zone. This deficiency would be overcome as for (f) above.

TABLE 20
YILGARN CRUSTAL SURVEY - PHASE DATA

EXPLOSION DATA
SHOT LOCATION CORRIGIN
Shot time UT

Arrival time UT
(Travel time s)
[Ground amplitude nm]

	KLB	NWAO	MUN	BAL	RKG
km	68.4	92.8	142.9	200.0	271.9
Phase					
P	46 25.3	not	46 36.9	46 45.0	46 56.1
	(10.9)	recording	(22.6)	(30.7)	(41.8)
	[8]		[4]	[0.6]	[4]
P			46 38.4	46 46.0	46 57.3
			(24.1)	(31.7)	(43.0)
			[7]	[3]	[4]
S	46 33.8		46 56.2	47 09.3	47 27.0
	(19.5)		(41.9)	(55.0)	(72.7)
	[11]		[9]	[3]	[23]
S				47 10.3	
				(56.0)	
				[5]	

29 September 1983 (01)
07 46 14.32

05 October 1983 (02)
00 50 45.18

km	68.4	92.7	142.7	199.9	271.9
P	50 56.2	51 00.5	51 07.7	51 15.6	51 26.8
	(11.0)	(15.3)	(22.5)	(30.4)	(41.6)
	[11]	[1.6]	[5]	[0.9]	[3]
P		51 00.9	51 09.3	51 16.6	51 28.1
		(15.7)	(24.1)	(31.2)	(42.9)
		[8]	[12]	[4]	[6]
S	51 05.9	51 10.8	51 25.2	51 40.1	51 57.8
	(20.7)	(25.6)	(40.0)	(54.9)	(72.6)
	[13]	[10]	[7]	[7]	[12]
S			51 26.8		
			(56.0)		
			[19]		

34

TABLE 20 (Contd)

12 October 1983	(03)				
01 08 01.64					
Stn	KLB	NWAO	MUN	BAL	RKG
km	68.3	92.9	142.8	199.9	
Phase					
p	08 12.9	08 17.1	08 24.8	08 32.2	
	(11.3)	(15.6)	(23.2)	(30.6)	
	[3]	[1]	[3]	[0.3]	
P		08 17.5	08 26.1	08 33.2	
		(15.9)	(24.5)	(31.6)	
		[5]	[4]	[1.5]	
S	08 21.3	08 28.6	08 43.8	08 33.2	
	(19.7)	(27.1)	(42.2)	(31.6)	
	[8]	[9]	[9]	[2]	
19 October 1983	(04)				
01 30 18.29					
km	68.4	92.8	142.7	199.8	272.0
Phase					
P	30 29.6	30 33.5	30 41.7	30 48.8	
	(11.3)	(15.2)	(23.4)	(30.5)	
	[8]	[1]	[4]	[0.6]	
P		30 33.9	30 43.0	30 49.8	
		(15.6)	(24.7)	(31.5)	
		[5]	[6]	[2]	
S	30 37.9	30 45.1	30 58.0	31 14.2	
	(19.6)	(26.8)	(39.7)	(55.9)	
	[11]	[10]	[4]	[7]	
S			31 00.0		
			(41.7)		
			[19]		

35

SHOT LOCATION KOOLYANOBBING

29 September 1983 (01)
07 00 00.75

Stn	KLB	KLG	BAL	NWAO	MUN	RKG	MEK
km	186.6	187.9	266.5	319.2	338.2	480.0	472.6
Phase							
P	00 30.2 (29.4) [5.3]	00 31.5 (30.8) [12]	00 39.0 (38.2) [10]	not recording	00 48.1 (47.4) [3]	01 06.5 (65.8) [3]	01 27.8 (87.0) [14]
P	00 31.3 (30.6) [69]		00 43.0 (42.2) [6]		00 52.1 (51.4) [6]		
P					00 56.0 (55.2) [7]		
S	00 51.2 (50.4) [12]	00 53.2 (52.4) [22]	01 13.9 (73.2) [20]		01 22.8 (82.0) [4]	01 54.9 (114.2) [6]	[14]
S	00 52.9 (52.2) [69]				01 31.5 (90.8) [6]		

05 October 1983 (02)
06 29 58.77

km	186.36	187.9	266.6	319.0	338.1	479.8	472.9
Phase							
P	30 29.2 (30.4) [3]	30 30.3 (31.5) [17]	30 38.1 (39.3) [6]	30 45.2 (46.4) [2]	30 47.2 (48.4) [6]		31 03.0 (64.2) [ ]
P	30 30.2 (31.4) [37]		30 42.1 (43.3) [4]		30 51.2 (52.4) [3]		
P					30 55.0 (56.2) [5]		
S	30 51.1 (52.3) [ ]	30 52.2 (53.4) [ ]	31 13.3 (74.5) [12]		31 21.9 (83.1) [3]		31 52.0 (113.2) [7]
S	30 52.2 (53.4) [37]	30 52.6 (53.8) [37]		31 28.3 (89.5) [5]	31 30.9 (92.3) [6]		

SHOT LOCATION LAKE MAGENTA
19 October 1983 (02)
05 50 00.40

Stn	NWAO	KLB	RKG	MUN
km	192.0	239.1	247.3	320.9
Phase				
P	50 31.2	50 38	50 38.7	
	(30.8)	(37.6)	(38.3)	
	[0.5]	[ ]	[1]	
S	50 53.7	51 04.1	51 08.1	51 27.5
	(53.3)	(63.7)	(67.7)	(87.1)
	[3]	[3]	[5]	[ ]
S	50 55.2			
	(54.8)			
	[8]			

SHOT LOCATION NEW NORCIA
12 October 1983 (01)
05 49 00.08

Stn	BAL	MUN	KLB	NWAO	RKG
km	60.3	110.1	157.0	234.2	404.1
Phase					
P	49 10.1	49 17.9	49 25.2	49 34.2	50 03.1
	(10.0)	(17.8)	(25.1)	(34.1)	(63.0)
	[16]	[21]	[5]	[1]	[2]
P			49 26.6		
			(26.5)		
			[11]		
S	49 17.2	49 30.2	49 44.3	50 04.2	
	(17.1)	(30.1)	(44.2)	(63.1)	
	[28]	[19]	[12]	[6]	
S			49 45.1		
			(45.0)		
			[13]		

19 October 1983 (02)
08 35 18.97

km	60.4	110.0
Phase		
P	35 28.9	35 37.0
	(8.8)	(18.0)
	[3]	[2]
S	35 36.1	35 49.1
	(17.1)	(30.1)
	[5]	[2]

TABLE 21
YILGARN CRUSTAL SURVEY
SHOT LOCATIONS

Shot		Latitude S	Longitude E	Elev m	Size Kg
		o '	o '		
Corrigin	01	32 11.52	117 42.30	285	800
	02	32 11.52	117 42.21	285	800
	03	32 11.47	117 42.29	285	800
	04	32 11.47	117 42.22	285	800
Koolyanobbing	01	30 47.15	119 29.35	330	800
	02	30 47.32	119 29.40	330	2800
Lake Magenta	01	33 19.96	119 14.26	340	800
	02	33 19.87	119 14.375	340	2800
New Norcia	01	30 59.29	116 15.46	240	2800
	02	30 59.37	116 15.47	240	800

TABLE 22
CADOUX MICROEARTHQUAKE SURVEY
STATION DATA

STN CODE	LOCATION	SET NO.	GRID REFERENCE mN	mE	LATITUDE S	LONGITUDE E
					o ' "	o ' "
200	Ballidu	00	6 613 958	471 930	30 36 23.4	116 42 25.8
201	Konnongorring	09	6 568 300	487 080	31 01 30.0	116 51 49.8
202	Koorda (Sth)	05	6 565 680	534 220	31 02 30.0	117 21 30.0
203	Koorda (Nth)	07	6 610 447	549 116	30 38 15.0	117 30 45.2
204	Kalannie	04	6 635 562	515 389	30 24 42.4	117 09 36.8
205	S. Booth	31	6 606 500	508 250	30 40 25.2	117 05 09.0
206	S. Booth	06	6 606 500	511 080	30 40 25.2	117 06 54.0
207	C. Mincherton	33	6 606 790	514 160	30 40 22.8	117 08 49.2
208	J. Kalaizic	02	6 605 880	517 290	30 40 45.0	117 10 45.0
209	C. Mincherton	08	6 603 280	508 380	30 42 10.0	117 05 13.2
210	C. Mincherton	24	6 603 220	511 380	30 42 13.2	117 07 06.0
211	C. Mincherton	27	6 602 880	514 280	30 42 24.0	117 08 55.8
212	F. Menz	29	6 603 620	516 830	30 42 00.0	117 10 30.0
213	C. Booth	30	6 601 200	508 810	30 43 18.0	117 05 28.8
214	H. McCashney	23	6 600 120	511 500	30 43 51.0	117 07 11.4
215	T. Kalaizic	32	6 600 790	514 660	30 43 32.4	117 09 10.8
216	J. Leggo	28	6 600 790	518 040	30 43 32.4	117 11 14.4
217	Shire	03	6 597 190	508 120	30 45 28.2	117 04 34.8
218	Shire	25	6 597 340	511 500	30 45 24.0	117 06 24.0
219	E. Cummings	22	6 597 390	514 470	30 45 22.8	117 09 01.8
220	R. Applegate	01	6 597 310	517 690	30 45 24.0	117 11 00.0
SPR	T. Kalaizic	--	6 601 070	515 390	30 43 22.6	117 09 34.5

38

TABLE 23

EARTHQUAKES IN THE REGION OF WESTERN AUSTRALIA 1983

DATE 1983	ORIGIN UT	LAT S (°)	LONG E (°)	DEP KM	MAG	LOCALITY	N	A
JAN 01	205202.9	32.10	117.18	10G	3.2 ML	22 KM WSW QUAIRADING	6	A
05	124909.7	30.71	117.14	10G	2.4 ML	6 KM NNE CADOUX	5	A
07	164522.6	30.83	117.10	10G	3.2 ML	7 KM S CADOUX	4	A
07	202124.9	30.83	117.10	10G	2.2 ML	7 KM S CADOUX	3	B
07	215540.5	30.83	117.10	10G	2.3 ML	7 KM S CADOUX	3	A
07	233053.5	30.83	117.10	10G	2.0 ML	7 KM S CADOUX	3	A
08	045300.0	16.45	121.50	10G	3.6 ML	180 KM NNW BROOME	5	D
09	190832.0	30.85	117.06	10G	2.0 ML	11 KM SSW CADOUX	3	A
09	194243	33.68	125.69	10G	3.0 ML	170 KM E ISRAELITE BAY	3	D
12	145733.0	16.40	120.10	37R	3.4 ML	280 KM NW BROOME	1	C
13	024725.0	16.40	120.10	37R	4.5 ML	280 KM NW BROOME	9	C
15	004533.8	30.71	117.14	10G	2.7 ML	6 KM NNE CADOUX	5	B
17	215729.0	32.32	125.23	10G	3.9 ML	20 KM W CAIGUNA	7	C
19	104454.9	32.21	117.14	10G	2.3 ML	22 KM NE BROOKTON	5	A
19	112512.5	33.82	118.10	5G	2.3 ML	16 KM NE GNOWANGERUP	3	B
19	123858.4	33.82	118.10	5G	2.0 ML	16 KM NE GNOWANGERUP	2	B
20	102808.3	33.82	118.10	5G	2.0 ML	16 KN NE GNOWANGERUP	3	B
20	135343.8	33.82	118.10	5G	2.5 ML	16 KM NE GNOWANGERUP	3	B
26	034902.9	30.73	117.13	10G	2.4 ML	4 KM N CADOUX	3	B
26	061615.4	30.73	117.13	10G	4.8 ML	4 KM N CADOUX	9	A
26	062605.4	30.73	117.13	10G	2.3 ML	4 KM N CADOUX	3	B
28	071457.8	30.71	117.12	10G	2.1 ML	6 KM N CADOUX	3	A
30	045000.0	30.72	117.11	10G	3.7 ML	5 KM N CADOUX	5	A
31	114036.5	33.82	118.10	5G	2.5 ML	16 KM NE GNOWANGERUP	3	B
FEB 01	112651.5	33.41	117.20	5	2.0 ML	16 KM SW WAGIN	3	B
01	150041.5	21.76	126.27	10G	3.5 ML	TOBIN LAKE	6	C
05	182151.2	33.82	118.10	5G	2.3 ML	16 KM NE GNOWANGERUP	3	B
08	194525.1	30.74	121.36	0G	2.5 ML	KALGOORLIE MINE COLLAPS	5	A
09	003728.7	30.71	117.14	10G	2.0 ML	6 KM NNE CADOUX	3	A
10	164355.7	30.71	117.14	10G	2.5 ML	6 KM NNE CADOUX	4	A
12	220323.2	33.41	117.73	10G	2.6 ML	10 MK S DUMBLEYUNG	4	B
22	194100.0	27.71	113.04	10G	2.5 ML	100 KM W KALBARRI	2	D
26	065912.0	30.74	121.36	0G	2.5 ML	KALGOORLIE MINE BLAST	3	A
MAR 07	210848.2				2.0 ML	220 KM FROM MEEKATHARRA	1	
10	010419.4	16.53	128.68	10G	2.0 ML	20 KM NE LISSADELL STN	2	B
12	040014.3	26.77	117.24	10G	2.9 ML	126 KM W MEEKATHARRA	6	C
13	165817.5	18.00	118.76	37R	3.5 ML	360 KM W BROOME	3	C
14	033004.2	16.53	128.68	10G	3.0 ML	20 KM NE LISSADELL STN	4	B
18	031340.8	30.65	117.13	10G	2.2 ML	12 KM N CADOUX	4	A
19	050641.0	38.00	112.04	10G	3.7 ML	500 KM SW AUGUSTA	5	D
19	151450.0	30.75	117.10	10G	2.0 ML	3 KM NW CADOUX	3	A
21	003316.5	28.67	113.28	10G	3.0 ML	130 KM W GERALDTON	2	D
27	081414.4	30.72	117.17	10G	2.1 ML	7 KM NE CADOUX	3	A
APR 03	224737.6	25.19	117.16	10G	2.9 ML	30 KM ESE LANDOR	4	B
05	045040.0	25.30	116.35	10G	3.4 ML	55 KM WSW OF LANDOR	5	C
06	193950	29.20	124.08	10G	2.5 ML	170 KM ESE LAVERTON	4	D
09	051935.7	29.29	114.38	37	3.2 ML	50 KM W DONGARA	3	C
11	050835.0	21.94	126.42	37	3.0 ML	35 KM E TOBIN LAKE	3	B
11	081304.0	30.88	117.11	10G	2.3 ML	12 KM S CADOUX	4	A

39

TABLE 23 (Contd)

DATE 1983	ORIGIN UT	LAT S (°)	LONG E (°)	DEP KM	MAG	LOCALITY	N	A
APR	16 185039.6	31.73	117.00	10G	2.4 ML	10 KM SSW MECKERING	4	B
	21 211817.4	18.09	118.97	37	4.3 ML	250 KM NNE PT HEDLAND	10	B
	24 082058	19.11	116.93	25	3.4 ML	220 KM NW PT HEDLAND	3	C
	24 091816.5	26.68	111.22	37	3.1 ML	310 KM NW KALBARRI	3	C
	26 061155.2	30.71	117.18	10G	2.0 ML	8 KM NE CADOUX	4	A
	26 071307.2	31.69	117.03	10G	2.1 ML	5 KM SSE MECKERING	4	A
	26 071318.5	31.69	117.03	10G	2.2 ML	5 KM SSE MECKERING	4	A
MAY	04 011533.5	29.59	124.56	10G	3.2 ML	170 KM NE CUNDEELEE	5	C
	04 070333.4	26.32	117.42	10G	2.2 ML	160 KM W MEEKATHARRA	2	C
	08 153350.5	31.17	117.26	10G	2.0 ML	10 KM W WYALKATCKEM	3	A
	10 221655	18.86	117.97	10G	3.0 ML	180 KM NW PT HEDLAND	3	D
	27 175915.5	30.73	117.16	10G	2.1 ML	8 KM NNE CADOUX	3	B
	31 213058.0	31.25	118.15	10G	2.2 ML	27 KM N MERREDIN	3	B
JUN	07 061612.5	15.22	123.61	10G	4.2 ML	270 KM W WYNDHAM	3	B
	07 101805	23.94	114.47	10G	3.0 ML	130 KM NNE CARNARVON	3	B
	11 230347.5	31.24	116.57	10G	2.0 ML	8 KM ENE BOLGART	3	A
	14 164614.0	18.14	119.60	37R	2.8 ML	280 KM W BROOME	3	C
	16 045457.3	30.70	117.11	10G	2.2 ML	7 KM N CADOUX	3	A
	16 072221.3	30.71	117.14	10G	2.2 ML	6 KM NNE CADOUX	3	A
	21 083651.1	30.69	117.17	10G	2.2 ML	10 KM NNE CADOUX	3	A
	25 033317.3	30.71	117.14	10G	2.0 ML	6 KM NNE CADOUX	3	A
	29 003331.4	31.35	118.32	10G	2.1 ML	16 KM NNE MERREDIN	3	B
	29 152442.0	18.87	122.65	10G	3.5 ML	110 KM SSE BROOME	7	B
JUL	01 171814.3	31.59	116.95	10G	2.0 ML	7 KM ENE MECKERING	5	A
	02 133056.0	31.28	118.26	5	2.6 ML	22 KM N MERREDIN	4	A
	03 043152.6	31.28	118.26	5	2.5 ML	22 KM N MERREDIN	4	A
	06 194112.6	32.65	122.29	10	3.0 ML	70 KM SE NORSEMAN	4	C
	10 174322.1	31.27	118.27	10G	2.2 ML	24 KM N MERREDIN	4	A
	10 185120.1	31.27	118.27	10G	2.5 ML	24 KM N MERREDIN	4	A
	15 170408.0	25.07	111.81	10G	4.0 ML	180 KM W CARNARVON	9	B
	16 222938.7	31.93	117.14	10G	2.1 ML	BALKULING	4	A
	22 024130.9	30.71	117.09	10G	2.6 ML	7 KM NNW CADOUX	4	A
	25 150311.0	28.54	122.85	10G	2.7 ML	45 KM ENE LAVERTON	5	B
	30 060457.0	31.93	117.14	10G	2.2 ML	6 KM NNE BALKULING	4	A
	30 16505407	31.93	117.14	10G	2.0 ML	6 KM NNE BALKULING	4	A
AUG	02 144330.6	33.90	117.91	10G	2.0 ML	10 KM NW GNOWANGERUP	3	C
	04 025525.3	31.28	118.26	10G	3.0 ML	22 KM N MERREDIN	5	B
	05 141144	31.52	111.93	10G	3.0 ML	400 KM W MUNDARING	6	C
	06 022717	26.27	112.52	10G	3.6 ML	190 KM SSW CARNARVON	4	C
	07 003836.5	30.75	117.11	10G	2.7 ML	4 KM NNW CADOUX	4	A
	07 102926.9	30.72	117.14	10G	2.0 ML	6 KM NNE CADOUX	3	A
	08 060327.4	30.80	117.13	10G	2.6 ML	3 KM S CADOUX	5	A
	08 071141.5	31.32	118.33	10G	2.0 ML	20 KM NNE MERREDIN	3	B
	08 225613	18.31	112.63	37G	3.4 ML	450 KM NW ONSLOW	2	D
	09 075754.4	16.56	128.53	10G	2.0 ML	12 KM N LISSADELL STN	2	C
	13 094134.0	30.29	117.80	10G	2.0 ML	18 KM NNW BEACON	4	B
	13 172020.5	26.48	132.42	10G	3.0 ML	MUSGRAVE RANGES, SA	2	D
	15 170410.1	30.81	117.07	10G	2.0 ML	7 KM SW CADOUX	3	A
	15 173646.6	30.76	117.10	10G	3.4 ML	2 KM W CADOUX FELT MMIV	4	A
	17 201635.5	31.77	116.90	10G	2.6 ML	18 KM NE YORK	6	A
	18 213020.9	30.64	117.13	10G	2.0 ML	14 KM N CADOUX	3	A

40

TABLE 23 (Contd)

DATE 1983	ORIGIN UT	LAT °S	LONG °E	DEP KM	MAG	LOCALITY	N	A
AUG 21	052755.9				2.8 ML	216 KM FROM MEEKATHARRA	1	
21	180436.4	30.88	117.14	10G	2.3 ML	12 KM SSE CADOUX	3	A
28	133836.0	31.29	118.31	10G	2.1 ML	21 KM N MERREDIN	3	B
28	190333.7	30.75	117.11	10G	2.2 ML	4 KM NNW CADOUX	3	B
29	073329.5	15.85	121.21	37R	3.6 ML	250 KM N BROOME	6	C
29	171954.5	30.82	117.08	10G	2.6 ML	7 KM SW CADOUX	4	A
31	072142.5	20.56	120.18	10G	3.8 ML	75 KM NNE MARBLE BAR	6	C
SEP 02	182228	23.99	113.03	10G	3.7 ML	115 KM NW CARNARVON	5	C
02	183534.2	30.67	117.14	10G	2.4 ML	10 KM N CADOUX	6	A
04	031258.3	30.87	117.15	10G	2.5 ML	11 KM SSE CADOUX	3	A
04	114751.4	30.87	117.15	10G	2.6 ML	11 KM SSE CADOUX	5	A
04	115600.1	30.87	117.15	10G	2.5 ML	11 KM SSE CADOUX	4	A
04	121259.0	30.87	117.15	10G	3.1 ML	11 KM SSE CADOUX	6	A
04	121357.9	30.87	117.15	10G	2.6 ML	11 KM SSE CADOUX	5	A
04	192744.1	30.74	117.12	10G	2.4 ML	3 KM N CADOUX	3	A
04	192838.1	30.74	117.12	10G	2.2 ML	3 KM N CADOUX	3	A
05	182344.8	30.70	117.14	10G	2.5 ML	7 KM N CADOUX	4	A
07	035118.3	30.67	117.18	10G	2.1 ML	12 KM NNE CADOUX	4	A
08	184611.3	16.94	126.22	10G	3.0 ML	300 KM WSW KUNUNURRA	4	C
12	070314.6	30.80	117.13	10G	2.2 ML	3 KM S CADOUX	3	A
13	115116.8	30.67	117.14	10G	2.4 ML	10 KM N CADOUX	3	A
13	220130.0	32.38	117.90	10G	2.2 ML	5 KM SE CORRIGIN	4	A
14	163801.8	30.67	117.14	10G	2.2 ML	10 KM N CADOUX	3	A
14	205132	11.29	130.32	10G	3.0 ML	BATHURST IS N.T.	3	C
15	071343.5	30.77	117.07	10G	2.4 ML	5 KM W CADOUX	4	A
16	141338.1	30.75	117.13	10G	2.4 ML	2 KM NNE CADOUX	4	A
17	144745.1	30.67	117.11	10G	2.3 ML	11 KM NNW CADOUX	4	A
19	120332.0	30.76	117.10	10G	2.5 ML	2 KM NW CADOUX	4	A
25	051601	21.80	126.27	37R	3.3 ML	TOBIN LAKE	5	B
26	121933	26.92	131.44	10G	3.5 ML	180 KM SSE AYERS ROCK	4	C
OCT 03	075125	25.01	112.94	10G	3.6 ML	70KM W CARNARVON	7	C
04	001240	24.14	130.25	10G	3.5 ML	370KM W ALICE SPRINGS	4	C
04	143028.3			10G	2.1 ML	215KM MEEKATHARRA	1	
12	192525	25.61	130.33	10G	3.8 ML	50KM SW MT OLGA	13	C
16	075714.0	32.23	117.39	10G	2.0 ML	40KM ENE BROOKTON	4	A
17	032234	10.92	125.81	37G	4.8 ML	TIMOR SEA	3	D
19	013717.0	30.80	117.13	10G	2.3 ML	4KM S CADOUX	3	A
20	182718.5	30.80	117.09	10G	2.4 ML	6KM SW CADOUX	4	A
24	005356	26.94	114.92	10G	4.0 ML	110KM NE KALBARRI	9	B
24	035454	26.94	114.92	10G	3.2 ML	110KM NE KALBARRI	3	B
24	133820			10G	3.2 ML	462KM KUNUNURRA	1	
25	091809.9	14.80	127.54	10G	2.1 ML	100KM NW WYNDHAM	2	D
25	132116			10G	2.9 ML	460KM KUNUNURRA	1	
25	145540.9	30.72	117.08	10G	2.0 ML	6KM NW CADOUX	3	A
25	230602.3	30.72	117.08	10G	2.4 ML	6KM NW CADOUX	5	A
27	185622.2	30.71	117.12	10G	2.1 ML	6KM N CADOUX	4	A
28	120119.4	20.59	120.70	10G	2.8 ML	120KM NE MARBLE BAR	3	C
30	010903	16.53	123.74	37R	4.2 ML	80KM N DERBY	9	C
31	062612.0	30.84	118.43	10G	2.0 ML	34KM ENE MUKINBUDIN	3	B

41

TABLE 23 (Contd)

DATE 1983	ORIGIN UT	LAT S (°)	LONG E (°)	DEP KM	MAG	LOCALITY	N	A
NOV	01 104627.8	18.32	118.34	37R	3.3 ML	220KM N PT HEDLAND	3	C
	01 105522.0	32.96	118.87	10G	2.2 ML	8KM NW LAKE BIDDY	4	C
	05 123417.4	30.74	116.54	10G	1.8 ML	21KM SW CADOUX	3	A
	11 182155	19.56	116.34	37R	3.5 ML	130KM NNW DAMPIER	5	C
	16 130020	25.55	113.66	10G	2.5 ML	70KM S CARNARVON	2	C
	22 143509.1	32.02	117.33	10G	2.0 ML	6KM W QUAIRADING	4	A
DEC	01 154505	21.96	126.45	10G	4.1 ML	TOBIN LAKE	0	B
	13 231041	28.19	114.11	10G	3.0 ML	50KM WNW NORTHHAMPTON	3	C
	14 020033.5	30.80	117.09	10F	2.3 ML	6KM SW CADOUX	3	B
	17 085320	27.09	113.48	10G	2.8 ML	90KM NW KALBARI	4	C
	18 151031	16.85	120.07	37R	3.8 ML	ROWLEY SHOALS	6	B
	19 145423.2	31.22	117.51	10G	2.1 ML	12KM SW WYALKATCHEM	4	A
	20 192305.4	30.61	116.78	5G	2.0 ML	7KM E BALLIDU	3	A
	21 181915	27.36	124.19	10G	2.7 ML	220KM NE LAVERTON	3	D
	25 030602	33.48	120.09	10G	3.0 ML	10KM N RAVENSTHORPE	5	D
	26 192643.1	30.62	116.76	5G	1.8 ML	2KM S BALLIDU	3	A
	27 062534.6	30.60	116.76	5G	2.2 ML	BALLIDU	3	A
	27 085315.8	30.60	116.76	5G	2.0 ML	BALLIDU	3	A

FOOTNOTES:

UT = Universal Time. Western Standard Time = UT + 8 hours.
Western Standard Summer Time = UT + 9 hours.

DEP = Depth of earthquake in kilometers.
G = Nominal depth.
R = Restrained depth.

MAG = Magnitude
ML = Richter magnitude

N = Number of stations that recorded the earthquake.

A = Accuracy of location.
A = +/- 0.05 degree
B = +/- 0.10 "
C = +/- 0.20 "
D = +/- 0.50 "

TABLE 24

MINOR EARTHQUAKES IN THE SOUTHWEST SEISMIC ZONE 1983

DATE 1983	TIME UT	MAG ML	LOCALITY	DATE 1983	TIME UT	MAG ML	LOCALITY
Jan 01	0747	1.5	Quairading	Feb 15	2023	1.7	Cadoux
	2116	1.1	Cadoux	16	2048	1.6	Cadoux
06	0040	1.0	Cadoux	20	0258	1.0	Cadoux
	1129	1.9	Meckering	20	1459	1.3	Northam
07	0359	1.7	Meckering	24	0824	1.1	Cadoux
08	0335	1.5	Cadoux	27	0400	1.3	Cadoux
09	1232	1.1	Cadoux		1258	1.1	Cadoux
	1555	1.3	Cadoux	Mar 01	0031	1.5	Cadoux
14	1724	1.3	Cadoux	03	1824	0.9	Meckering
15	2230	1.1	Cadoux	04	1411	1.5	Cadoux
	2236	1.1	Cadoux		2224	0.7	Cadoux
17	1724	1.7	Cadoux	05	1317	1.0	Cadoux
	2303	1.6	Cadoux		1649	0.9	Cadoux
	2339	1.3	Cadoux	07	0149	1.0	Cadoux
18	1022	0.9	Cadoux		0348	0.8	Cadoux
19	0324	1.6	Quairading		0601	0.9	Cadoux
20	0246	1.3	Cadoux		0931	1.2	Cadoux
21	0339	1.6	Cadoux		0933	0.7	Cadoux
23	0101	0.9	Cadoux	09	1625	1.3	Cadoux
	1320	1.4	Quairading	16	1232	1.4	Meckering
	1504	1.8	Cadoux	19	1329	1.3	Cadoux
	1512	1.2	Cadoux	20	1302	0.9	Cadoux
24	1336	1.8	Quairading	24	0814	1.2	Cadoux
26	0426	1.5	Cadoux		1630	1.0	Cadoux
	0634	1.2	Cadoux		1826	0.9	Meckering
	0642	0.9	Cadoux	28	0414	1.2	Cadoux
	0933	1.9	Cadoux	29	1300	0.4	Cadoux
	1132	1.2	Cadoux	Apr 01	2002	1.0	Cadoux
27	0236	1.4	Cadoux	02	1444	0.9	Cadoux
	0630	1.6	Cadoux	09	2223	1.3	Cadoux
	1233	1.6	Cadoux	11	0533	1.4	Cadoux
29	0603	1.7	Cadoux		1108	1.0	Cadoux
31	1144	1.0	Meckering		1109	1.3	Cadoux
Feb 01	0158	1.3	Cadoux		1110	0.4	Cadoux
	2018	1.4	Cadoux		1303	0.5	Cadoux
02	0032	1.1	Cadoux	12	1715	1.6	Cadoux
	0745	1.6	Cadoux		1742	1.0	Cadoux
	0901	1.2	Cadoux	13	0525	1.6	Meckering
05	0910	0.9	Cadoux		0608	1.8	Meckering
07	0853	1.6	Meckering	18	1745	1.0	Cadoux
10	0247	1.3	Cadoux	19	1938	1.2	Cadoux
	1355	1.1	Cadoux	20	1013	1.2	Brookton
12	0602	0.8	Cadoux	21	0041	1.6	Cadoux
14	0826	1.4	Meckering	22	0618	0.9	Cadoux
	1019	0.9	Cadoux		0832	0.7	Cadoux
	1104	1.1	Cadoux		0832	1.2	Cadoux
	1743	1.1	Cadoux		1354	0.7	Cadoux
15	1019	1.5	Cadoux		1613	1.4	Cadoux
	1239	1.1	Cadoux	23	1809	1.2	Cadoux
	1240	1.4	Cadoux		2135	1.9	Cadoux

49

TABLE 24 (Contd)

DATE 1983	TIME UT	MAG ML	LOCALITY	DATE 1983	TIME UT	MAG ML	LOCALITY
Apr 24	1506	1.0	Cadoux	Jun 08	2013	1.4	Cadoux
25	1157	1.5	Cadoux	09	0738	0.6	Cadoux
	1332	1.0	Ballidu	10	1052	0.6	Cadoux
26	0829	1.3	Meckering	12	1717	1.1	Cadoux
	1108	1.0	Cadoux		1718	1.2	Cadoux
	1156	0.9	Cadoux	13	0144	0.7	Cadoux
27	1021	1.2	Cadoux		1251	0.9	Cadoux
27	1759	1.5	Brookton West		2026	1.6	Cadoux
	1900	1.1	Cadoux	14	0814	1.3	Cadoux
28	0615	0.9	Ballidu	15	1231	0.9	Cadoux
May 01	0825	1.4	Meckering	16	0412	1.0	Bencubbin
04	1055	0.9	N of Ballidu		1354	1.4	Cadoux
06	1001	0.8	Meckering		1639	1.4	Cadoux
	1938	0.5	Ballidu	Jun 17	0146	1.2	Cadoux
	1402	1.0	Cadoux		1402	1.6	N of Merredin
08	1534	1.5	Dowerin	19	0233	1.0	Cadoux
09	0341	0.9	Cadoux		0925	0.8	Cadoux
	0408	1.4	Cadoux		0953	0.7	Cadoux
	0627	1.6	Cadoux		1703	0.7	Cadoux
	1018	1.4	Cadoux	20	0924	1.8	Cadoux
	1244	1.6	Cadoux		1706	1.0	Cadoux
10	0916	0.7	Cadoux		1707	1.0	Cadoux
	1300	1.3	Cadoux	21	0656	0.9	Cadoux
11	0043	0.6	Ballidu		2210	0.9	Cadoux
	2050	0.8	Dowerin	22	1520	0.9	Cadoux
12	1709	1.1	Cadoux		1644	0.5	Cadoux
	1915	1.4	Meckering	25	1942	1.0	Cadoux
15	0432	0.7	Cadoux	26	1216	1.0	Cadoux
	0933	1.0	Cadoux	28	0245	1.8	Cadoux
16	0026	1.0	Yorkrakine	29	0033	1.9	Meckering
	0411	1.4	Ballidu	30	0203	2.0	N of Merredin
	0413	0.9	Ballidu		0659	1.7	Cadoux
19	0437	1.0	Ballidu		1334	1.1	Cadoux
	0640	0.6	Ballidu	Jul 01	0302	1.7	N of Merredin
	0648	0.9	Ballidu		0822	0.7	Cadoux
20	0622	1.0	Yorkrakine		1718	1.8	Meckering
	1019	1.0	Cadoux		2213	1.5	Cadoux
21	0237	1.7	Cadoux	02	0234	1.9	N of Merredin
	0303	0.5	Cadoux		2156	1.5	N of Merredin
	1110	1.9	Cadoux	03	0502	1.8	N of Merredin
	1707	0.6	Cadoux	05	0333	1.7	?
28	0259	1.1	Cadoux	07	2045	1.2	Meckering
	2021	1.1	Cadoux	08	0011	1.7	Meckering
30	1547	1.3	Cadoux	09	0212	1.7	Cadoux
	2144	1.0	Cadoux		2256	1.2	Cadoux
Jun 01	2019	1.7	Cadoux	10	1320	1.5	Cadoux
04	0225	1.4	Cadoux	12	0756	1.6	N of Merredin
	1357	0.7	Cadoux		0857	1.3	N of Merredin
06	0305	0.6	Meckering		2335	1.5	N of Merredin
08	1435	1.5	Cadoux	15	0712	1.1	Ballidu

TABLE 24 (Contd)

DATE 1983	TIME UT	MAG ML	LOCALITY	DATE 1983	TIME UT	MAG ML	LOCALITY
Jul 15	0909		?	Aug 15	1902	1.2	Meckering
	1340	1.3	Cadoux		1935	1.1	Cadoux
	1843	0.8	?		1936	1.1	Cadoux
16	2229	1.8	Quairading	16	1434	1.2	Cadoux
17	1551	1.4	Meckering		1513	1.3	Cadoux
18	0541	1.4	Cadoux	17	0055	1.9	N of Merredin
20	0303	1.6	N of Merredin		0108	1.9	N of Merredin
22	1730	0.5	Cadoux		0230	1.8	N of Merredin
24	1817	1.2	Meckering		0409	1.5	N of Merredin
	0955	0.9	Cadoux	18	0853	1.9	Cadoux
25	2158	0.9	Cadoux		1702	1.3	Cadoux
	2313	1.3	Wongan Hills	20	1409	1.2	N of Ballidu
26	1552	1.2	Wongan Hills		1431	1.4	N of Ballidu
27	2313	1.1	Meckering	21	1113	1.7	Cadoux
28	1006	1.9	Wongan Hills	23	1639	1.3	Cadoux
29	1430	0.7	Cadoux		2045	1.2	Cadoux
	2307	1.4	Cadoux		2119	1.1	Cadoux
30	0605	1.9	Meckering		2152	1.6	Cadoux
	1332	1.1	Cadoux		2203	1.4	Cadoux
	1651	1.6	Meckering	24	0741	1.4	Cadoux
Aug 01	0952	1.1	Cadoux	25	0402	1.7	Cadoux
01	2131	1.2	Meckering		0513	1.5	Cadoux
03	1114	1.4	Cadoux		0556	1.4	Cadoux
	1603	1.2	Wongan Hills	26	0956	1.2	Cadoux
	1604	1.0	Wongan Hills		1116	0.6	Cadoux
	2113	0.6	Wongan Hills		1947	1.0	Cadoux
06	0642	1.0	Cadoux		1949	1.0	Cadoux
	1752	1.4	Cadoux	27	1050	1.7	Cadoux
	1759	1.6	Cadoux	28	0201	1.5	Cadoux
	1805	1.3	Cadoux		2100	1.6	Cadoux
07	1743	1.2	Cadoux	29	0155	1.0	Cadoux
08	0042	0.6	Cadoux		0858	1.5	Cadoux
	0712	1.7	N of Merredin		1307	1.3	Cadoux
	1157	1.3	N of Merredin		1354	0.9	Cadoux
09	0511	1.0	Cadoux	30	0016	1.5	Cadoux
	2117	1.2	Cadoux		0152	1.2	Cadoux
10	0403	0.9	Cadoux		1658		?
	1523	1.3	Cadoux		1659	1.5	Cadoux
	1821	1.9	Cadoux		1834	1.4	Cadoux
11	0039	1.4	Cadoux		2029	0.9	Cadoux
	0254	1.2	Cadoux		2343	1.5	Cadoux
	0344	1.6	Cadoux		2355	0.9	Cadoux
	0347	1.1	Cadoux	31	0012	0.9	Cadoux
	1410	1.6	Cadoux		0221	0.9	Cadoux
12	0130	1.4	Cadoux	Sep 04	0313	1.9	Cadoux
13	0941	1.7	Beacon		0747	1.3	Cadoux
14	1312	1.4	Cadoux		1217	1.4	Cadoux
15	0200	1.1	Cadoux		1226	1.5	Cadoux
	0418	1.2	Beacon		1254	1.3	Cadoux
	0458	0.9	?		1902	0.9	Cadoux

46

TABLE 24 (Contd)

DATE 1983	TIME UT	MAG ML	LOCALITY	DATE 1983	TIME UT	MAG ML	LOCALITY
Sep 05	1906	0.9	Cadoux	Sep 22	0520	1.0	Cadoux
	2009	1.0	Cadoux		1931		?
	2143	1.1	Cadoux		2023	0.9	Cadoux
	0143	1.2	Cadoux	23	2025		?
	0226	1.0	Cadoux	24	2215	1.7	Cadoux
	0233	1.0	Cadoux		2237	0.8	Cadoux
	0432	1.0	Cadoux	25	0459	1.0	Cadoux
	1847	1.7	Cadoux		2157	0.8	Meckering
06	0702	0.8	Cadoux	27	0754	1.1	Cadoux
	2115	1.4	Cadoux		1529	1.2	Cadoux
	2305	1.0	Cadoux		1838	1.0	Cadoux
07	1019	1.6	Cadoux		2020	1.7	Cadoux
	2009	0.9	Cadoux	28	0317	0.9	Cadoux
09	0430	1.8	Cadoux		1202	0.9	Cadoux
	0439	0.6	Cadoux		1247	1.2	Ballidu
	0801	0.6	Cadoux		1620	1.5	Cadoux
	1439	0.6	Cadoux		1945	1.5	Cadoux
	1616	0.6	Cadoux	29	0603	1.0	Cadoux
	1902	0.6	Cadoux		0631	1.1	Cadoux
10	2034	1.3	Meckering		1132		?
	2300	1.6	N of Merredin	30	1709	1.5	Cadoux
11	1340	0.8	Cadoux	Oct 03	1321	0.5	Cadoux
	1650	1.2	Cadoux		1959	1.5	Cadoux
13	1151	1.1	Cadoux		2340	1.1	Cadoux
	1330	1.0	Cadoux	04	0715	1.6	Cadoux
	1505	1.2	Cadoux		1056	0.7	Cadoux
	1512	1.0	Cadoux		1157	1.4	Cadoux
	2140	1.2	Cadoux	05	1432	1.3	Cadoux
	2201	1.2	?	06	0703	0.9	Cadoux
14	0023	0.7	Cadoux	07	0930	0.9	Cadoux
	1029	0.8	Cadoux		2026	0.5	Cadoux
	1055	0.7	Cadoux	08	0226	1.3	Cadoux
	1532	0.6	Cadoux	10	1414	1.5	Merredin
15	0326	1.1	Cadoux		2009	1.0	Meckering
16	1428	1.5	Cadoux	12	0050	0.9	Cadoux
17	0128	1.0	Cadoux		1006	1.3	Cadoux
	0129	0.9	Cadoux		1105	0.8	Cadoux
	1339	1.0	Cadoux	14	1428	0.9	Cadoux
	1351	1.3	Cadoux		1750	1.1	Cadoux
18	1347	1.3	Cadoux	15	0500	0.9	Cadoux
	1954	1.4	Cadoux		0924	0.9	Narrogin
	2340	1.1	Cadoux		1004		?
19	0725	1.2	Cadoux		1130	0.9	Cadoux
20	0215	0.7	Cadoux		2104	1.0	Cadoux
	1710	0.8	Cadoux	16	0700	1.5	Cadoux
21	0212	0.9	Cadoux		1045	1.6	Brookton
	0324	1.4	Cadoux		1523	1.5	Cadoux
	0723	1.7	Cadoux		1827	0.9	Cadoux
	0739	1.2	Cadoux		2157	1.2	N of Ballidu
	1650	0.6	Cadoux	17	1532	0.9	Cadoux

46

TABLE 24 (Contd)

DATE 1983	TIME UT	MAG ML	LOCALITY	DATE 1983	TIME UT	MAG ML	LOCALITY
Oct 18	0939	0. 9	N of Ballidu	Nov 04	1047	0.7	Cadoux
	2241	1.5	Cadoux		1516	0.6	Cadoux
19	0018	1.7	Koorda	05	1234	1.8	SW of Cadoux
	0536	1.5	Merredin		2341	1.8	Cadoux
	0945	0.8	Cadoux	06	0437	1.0	Cadoux
	1237	1.3	Cadoux		1635	1.0	Cadoux
20	0308	0.6	Cadoux	07	1335	1.0	Cadoux
	0745	0.7	Cadoux		1804	0.9	Cadoux
	1704	1.6	Cadoux		1833	1.4	Cadoux
	2309	1.5	Cadoux	08	0348	1.0	Cadoux
22	1416	1.0	Cadoux		1552	0.9	Cadoux
	1431	1.0	Cadoux	09	0008	1.1	N of Ballidu
	1601	1.0	Cadoux		0032	1.0	Cadoux
	2107	1.0	Cadoux		0210	0.7	Cadoux
	2227	1.1	Cadoux		1131	1.3	Cadoux
	2328	0.9	Koorda		1213	1.8	Meckering
23	0254	0.9	Cadoux		1227	1.5	N of Ballidu
	0726	1.3	Cadoux		1459	0.7	Cadoux
	0756	0.6	Cadoux	10	0710	0.7	Cadoux
	0840	0.5	Cadoux	12	0635	0.6	Cadoux
	0947	0.7	Cadoux		1032	1.2	Cadoux
24	0220	0.8	Cadoux		1035	0.8	Cadoux
	0803	0.8	Koorda		2225	1.5	Cadoux
25	1010	0.7	Cadoux		2351	0.1	Ballidu
	1247	1.4	Cadoux	13	0956	0.5	Cadoux
	1457	1.1	Cadoux		1314	0.7	Cadoux
26	0009	1.3	Cadoux	14	0635	1.2	?
	1503	1.0	Cadoux	16	1338	1.3	Meckering
	2320	1.0	Cadoux	18	0125	1.0	Cadoux
27	0736	0.5	Cadoux		2316	1.5	Cadoux
	1329	0.5	Cadoux	19	0257	0.6	Cadoux
	1355	0.5	Cadoux		1302	0.7	Cadoux
28	0034	1.1	Cadoux	21	2216	1.4	Cadoux
	1146	0.9	Cadoux	22	1430	1.8	Merredin
	2105	1.7	Cadoux	23	0536	1.0	Cadoux
	2225	1.3	E of Bencubbin	25	0423	1.9	Cadoux
29	0216	1.1	Cadoux	28	2138	1.5	Merredin
	1109	0.5	Cadoux	29	0212	1.2	Merredin
	1635	0.8	Cadoux	Dec 02	0006	1.8	Cadoux
	1900	0.6	Cadoux	03	1148	1.6	Cadoux
30	0648	1.5	Cadoux	05	0210	1.4	Cadoux
	1235	1.1	Cadoux	06	1447	1.2	Cadoux
	1749		N of Ballidu	07	2211	0.8	Cadoux
	1755	0.9	Cadoux	12	0718	0.7	Cadoux
	1942	1.5	Cadoux	13	0742	1.6	Brookton
31	0919	0.8	Cadoux	14	0200	2 +	Cadoux
Nov 01	1158	1.8	?		1510	0.9	Cadoux
	1212	1.0	?	15	1828	0.7	Cadoux
04	0853	1.0	Cadoux	16	0220	1.8	Cadoux
	1014	0.7	Cadoux		0542	0.6	Cadoux

TABLE 24 (Contd)

DATE 1983	TIME UT	MAG ML	LOCALITY	DATE 1983	TIME UT	MAG ML	LOCALITY
Dec 16	1515	1.1	Cadoux	Dec 23	1134	0.9	Cadoux
	1809	1.1	Cadoux	24	0330	1.6	Cadoux
	2058	0.5	Cadoux		0856	0.7	Cadoux
17	1352	1.7	Cadoux		1000	0.7	Cadoux
	1410	1.0	Cadoux		1613	1.8	Cadoux
	2206	1.4	Cadoux	26	0726	0.7	Cadoux
18	1536	0.9	Cadoux		0728	1.5	Cadoux
	1856	1.6	Cadoux		1311	1.7	Cadoux
	2107	1.3	Cadoux		2144	1.3	Ballidu
19	2024	1.8	Cadoux		2152	0.2	Ballidu
20	0551	1.0	Cadoux		2201	0.3	Ballidu
	1631	1.2	Ballidu	27	0455	1.3	Ballidu
	1923	2.0	Ballidu		0625	1.4	Ballidu
	1926	0.8	Ballidu		0853	1.3	Ballidu
21	0127	1.0	Cadoux		0917	1.0	Ballidu
	0207	1.1	Cadoux	30	0902	1.5	Cadoux
	0318	1.3	Cadoux		1113	0.7	Cadoux
	0706	0.9	Cadoux		1546	1.1	Cadoux
	0750		?		1611	1.1	Ballidu
	0905	0.4	Ballidu		1707	0.4	Ballidu
	1423	1.2	Cadoux	31	0223	1.2	Cadoux
22	0715	0.9	Cadoux		0226	1.1	Cadoux
	0817	0.4	Ballidu		0404	1.3	Cadoux
	1525	0.7	Cadoux		0417	1.7	Cadoux
	2309	1.3	Cadoux				

TABLE 25

WESTERN AUSTRALIAN EARTHQUAKES ML > 4.5 1887-1983

DATE	ORIGIN UT	LAT S (°)	LONG E (°)	MAG	LOCALITY
1873 Dec 15	0400	27	128	(6.2)ML	Barrow Range
1885 Jan 06	1400	29	114	(6.2)ML	Geraldton
1906 Nov 19	071841	19.1	111.8	(7.6)ML	Indian Ocean
1920 Feb 08	052430	35	111	(6.3)ML	Indian Ocean
Jul 07	195540	20.0	111.0		
1929 Aug 16	212823.4	16.99	120.66	(6.3)ML	Indian Ocean
1934 Jul 12	142427.2	14.8	112.3	(6.3)ML	Indian Ocean
1937 Jul 05	165908	12.0	111.5		
1941 Apr 29	013541	26.8	116.1	7.2 ML	Meeberrie
1946 Apr 19	2113	33.5	114.5	5.7 ML	Yallingup
Sep 17	1512	32.5	116.9	4.5 ML	Pingelly
1949 Mar 13	123519	12.5	106.5		
May 02	1000	30.9	116.4	5.1 ML	Yericoin
1952 Mar 11	0609	31.3	116.5	5.1 ML	Bolgart
1955 Apr 29	0914	30.9	116.4	4.7 ML	Yericoin
Aug 29	0609	30.7	116.4	5.3 ML	Gabalong
Aug 30	1352	30.7	116.4	5.8 ML	Gagalong
Aug 30	1407	30.7	116.4	4.7 ML	Gabalong
Aug 30	1656	30.7	116.4	4.6 ML	Gabalong
1956 Feb 24	0627	30.9	116.4	4.5 ML	Yericoin
Apr 05	2313	30.9	116.4	4.5 ML	Yericoin
1958 Mar 20	0303	32.3	117.2	4.8 ML	Yericoin
1959 Nov 27	062522	25.8	116.2	4.8 ML	100km SW Landor
1960 Jun 04	185516			4.6 ML	1680km from MUN
1961 Jun 18	161358	20.1	119.3	6.3 ML	80km ENE Pt Hedland
Aug 23	180133	18.5	119.0	5.4 ML	150km NNE Pt Hedland
1962 Jan 08	005535			4.6 ML	750km E MUN
Apr 21	123430			4.6 ML	1550km N MUN
Sep 03	190949			4.6 ML	760km N MUN
1963 Jan 18	054918	32.2	117.2	4.9 ML	25km NE Brookton
Feb 26	141019	22.2	121.2	4.6 ML	200km SE Marble Bar
1964 Jan 06	153122			4.6 ML	1350km from MUN
Mar 23	224116.1	17.71	123.16	6.3 ML	100km E Broome
May 18	101752	17.5	121.0	4.5 ML	140km WNW Broome
1965 May 19	021347	25.0	112.1	6.1 ML	
Jun 15	061601	19.6	106.3	5.3 ML	
Sep 10	122401	18.1	122.2	5.1 ML	80km S Broome
Oct 11	040727	26.9	110.5	4.5 ML	400km SW Carnarvon
1966 Apr 30	032458	16.9	121.0	4.7 ML	170km NW Broome
1968 Oct 14	025850.3	31.62	116.98	6.9 ML	Meckering
Oct 14	040907.5	31.60	117.01	4.6 ML	Meckering
Oct 15	033007.0	31.68	117.03	5.7 ML	Meckering
Oct 21	153259.2	31.61	117.09	4.6 ML	Meckering
Oct 26	042230.2	31.67	117.03	4.9 ML	Meckering
1970 Mar 10	171511.2	31.11	116.47	6.0 ML	Calingiri
Mar 24	103517.6	23.05	126.61	6.7 ML	Lake McKay
1972 Oct 21	023342.8	24.88	115.55	5.2 ML	Gascoyne region
1974 Sep 30	033219.0	30.3	112.8	5.0 ML	220km SW Geraldton
1976 Oct 29	060448.2	31.64	117.0	4.7 ML	Meckering
1977 Apr 10	101844.0	30.51	122.92	4.6 ML	130km E Kalgoorlie
May 15	191607.6	35.0	117.95	4.5 ML	Albany
Nov 17	175632.0	30.59	123.67	4.6 ML	30km NE Cundeelee

49

TABLE 25 (Contd)

DATE	ORIGIN UT	LAT S	LONG E	MAG	LOCALITY
1977 Dec 30	100937.0	25.16	117.08	4.9 ML	200km NW Meekatharra
1978 May 01	034252.5	23.64	115.59	5.7 ML	220km NE Carnarvon
May 06	195219.6	19.55	126.56	6.0 ML	110km SE Christmas Creek
Aug 31	003547.6	21.98	126.54	4.6 ML	45km E Tobin Lake
Dec 12	065136	22.02	126.43	4.7 ML	35km E Lake Tobin
Dec 15	141046	26.14	111.57	4.6 ML	160km W Dirk Hartog Is.
1979 Jan 24	183139	38.05	112.56	4.5 ML	550km SW Albany
Apr 22	210615.6	16.81	120.50	5.7 ML	260km NW Broome
Apr 23	051210.8	16.60	120.27	7.3 ML	260km NW Broome
Apr 24	030902	16.70	120.45	4.6 ML	35km E Lake Tobin
Apr 24	231438	26.25	127.57	4.5 ML	250km SSW Warburton
Apr 25	221357.4	16.94	120.48	6.1 ML	260km NW Broome
Apr 27	201439.4	16.78	120.50	5.7 ML	210km NW Broome
May 09	021826	16.70	120.45	4.7 ML	260km NW Broome
Jun 01	215402.9	30.83	117.17	5.2 ML	7km SE Cadoux
Jun 01	094801.0	30.83	117.15	6.2 ML	7km SSE Cadoux
Jun 03	074534.5	30.77	117.17	5.3 ML	4km E Cadoux
Jun 07	064516.1	30.81	117.16	5.5 ML	5km SE Cadoux
Jul 14	094056.6	18.42	122.82	5.8 ML	50km NNE Broome
Jul 16	204941.5	17.21	127.09	4.9 ML	150km NW Halls Creek
Aug 12	104124.0	19.94	114.61	4.5 ML	120km NW Barrow Island
Oct 11	040411.7	30.79	117.15	4.8 ML	3km SE Cadoux
Oct 21	204609.4	18.62	120.45	4.8 ML	210km NW Broome
Oct 31	140726.3	20.63	114.43	4.5 ML	100km W Barrow Island
1980 Jan 23	022928	22.95	107.14	4.5 ML	700km WNW Carnarvon
Mar 15	070950	18.62	121.64	4.7 ML	100km SW Broome
Apr 19	074438.6	19.08	113.45	4.7 ML	330km NW Onslow
Dec 08	001207.8	32.12	114.11	5.2 ML	150km W Fremantle
Dec 10	043505.6	30.75	117.15	5.0 ML	4km NNE Cadoux
1981 Jan 01	090016.0	17.42	122.74	5.0 ML	80km NE Broome
Apr 07	201558.7	30.77	117.21	4.5 ML	8km E Cadoux
Dec 06	014048.1	22.78	114.17	4.5 ML	70km S Learmonth
Dec 08	113328.5	14.76	129.51	4.8 ML	135km NE Kununurra
1982 Jan 01	063633	16.68	120.21	4.7 ML	Rowley Shoals
Feb 06	152439.5	30.88	117.15	4.9 ML	12km SSE Cadoux
Feb 13	082700.0	22.00	126.60	5.3 ML	50km E Tobin Lake
Jun 16	151326.4	18.05	118.47	4.5 ML	60km S Rowley Shoals
Oct 03	170044	22.09	115.85	5.0 ML	60km NE Nanutarra
Nov 03	024032.0	20.53	120.48	5.2 ML	105km NE Marble Bar
Dec 07	144003.0	16.88	120.25	4.5 ML	240km Nw Broome
1983 Jan 13	024725.0	16.40	120.10	4.5 ML	280km NW Broome
Jan 26	061615.4	30.73	117.13	4.8 ML	4km N Cadoux

50

TABLE 26

EARTHQUAKES IN THE KUNUNURRA REGION 1963 - 1983

DATA SOURCE	DATE YR	MO	DY	ORIGIN UT HR	MN	SEC	LAT °S	LONG °E	DEPTH KM	MAGNITUDE	N
IBE	63	08	27	19	15	43.	16.600	128.600	33	5.2 MB	7
ISC	68	01	08	05	43	53.3	16.620	128.560	18	4.4 MB	7
MUN	72	05	28	13	59	36.0	16.500	128.600	0	3.0 ML	3
MUN	73	01	07	18	18	49.0	16.600	128.550	10	2.4 ML	1
MUN	73	04	25	15	27	08.6	16.300	128.200	10	2.1 ML	3
MUN	73	05	11	23	20	31.6	16.600	128.500	10	1.7 ML	1
MUN	73	05	30	08	54	07.8	16.700	128.200	10	2.3 ML	1
MUN	73	09	24	20	29	26.9	16.600	128.600	10	2.4 ML	1
MUN	74	03	08	12	00	06.4	17.200	128.500		2.7 ML	1
MUN	74	05	08	01	49	48.1	16.200	128.700		2.0 ML	1
MUN	74	07	14	11	32	32.8	16.200	128.700		1.8 ML	1
MUN	74	08	01	18	15	05.7	16.200	129.000		1.0 ML	1
MUN	74	08	07	16	51	05.6	16.100	128.900		1.9 ML	1
MUN	74	09	07	08	00	16.	16.600	128.500		1.9 ML	1
MUN	74	09	15	04	51	32.6	16.300	128.600		1.7 ML	1
MUN	74	09	21	16	05	15.9	16.600	128.900		2.2 ML	1
MUN	74	09	26	16	38	01.8	17.240	128.130		3.7 ML	9
MUN	75	01	06	09	00	23.3	16.180	128.900		2.9 ML	1
MUN	75	02	20	17	03	19.8	16.200	128.800		1.6 ML	1
MUN	75	03	30	02	10	50.5	16.200	129.500		2.9 ML	1
MUN	75	04	13	10	38	31.0	16.050	128.700		2.0 ML	1
MUN	75	04	18	14	45	51.8	16.040	128.640		2.6 ML	1
MUN	75	05	06	01	49	01.4	16.600	128.800		2.0 ML	1
MUN	75	05	06	06	57	51.5	16.600	128.800		2.0 ML	1
MUN	75	08	05	11	27	55.6	16.450	127.420		3.7 ML	9
MUN	75	10	10	06	20	45.6	16.500	128.300		2.4 ML	1
MUN	76	03	28	07	35	34.9	17.000	127.600		2.7 ML	1
MUN	76	03	29	01	26	03.4	16.900	127.700		2.7 ML	1
MUN	76	04	12	15	24	27.0	16.400	128.100		2.2 ML	1
MUN	76	05	21	05	43	31.7	16.450	128.250		2.5 ML	1
MUN	76	05	21	05	48	13.4	16.500	128.200		2.0 ML	1
MUN	76	09	14	14	15	12.9	16.400	128.000		2.1 ML	1
GS	76	09	27	02	17	49.4	16.745	128.731		2.0 ML	5
MUN	76	10	10	12	18	12.2	16.560	128.420		2.4 ML	1
MUN	76	11	07	03	47	27.6	16.050	128.820		4.5 ML	7
MUN	76	11	07	09	58	19.6	16.020	128.640		2.0 ML	2
MUN	76	11	10	05	27	42.6	16.020	128.640		2.1 ML	1
MUN	76	11	20	08	18	18.8	16.020	128.640		2.5 ML	1
MUN	76	12	04	20	27	13.	17.100	128.100		3.0 ML	1
MUN	77	02	26	05	49	53.2	16.500	128.360		2.7 ML	1
MUN	77	02	26	06	03	05.0	16.500	128.360		2.4 ML	1
MUN	77	04	06	01	22	42.8	16.530	129.050		2.3 ML	1
MUN	77	04	06	22	06	03.2	16.530	129.050		2.3 ML	1
MUN	77	04	06	22	07	36.0	16.530	129.050		2.1 ML	1
MUN	77	07	27	21	09	59.4	16.870	128.520		3.4 ML	0
MUN	78	02	13	06	14	22.2	16.500	128.660		2.5 ML	1
MUN	78	02	15	23	23	48.6	16.500	128.660		2.0 ML	1
MUN	78	03	06	01	59	20.	17.980	127.260		2.8 ML	4
MUN	78	03	18	06	14	49.5	16.050	128.780		2.0 ML	1
MUN	78	03	18	07	11	32.	16.050	128.780		1.4 ML	1
BMR	79	05	23	10	56	46.5	15.350	129.590	0	2.7 ML	5
BMR	79	07	16	20	39	40.8	16.950	127.010	10	4.9 ML	10

51

TABLE 26 (Cont)

DATA SOURCE	DATE YR MO DY	ORIGIN UT HR MN SEC	LAT °S	LONG °E	DEPTH KM	MAGNITUDE	N
BMR	79 07 16	20 39 40.8	16.950	127.010	10	4.9 ML	10
MUN	79 10 26	02 56 05.5	16.460	128.570		3.1 ML	3
MUN	80 02 18	12 47 17.9	15.850	128.480		1.4 ML	1
MUN	80 07 14	01 17 09.1	16.240	128.650	10	1.8 ML	2
MUN	80 07 16	06 55 29.2	16.240	128.650		2.0 ML	2
MUN	80 07 19	05 15 07.0	16.530	128.630		2.4 ML	2
MUN	80 07 26	06 41 41.2	16.880	128.370	19	2.8 ML	3
MUN	80 07 26	21 03 26.9	16.880	128.370	19	2.0 ML	1
MUN	80 08 01	18 24 10.8	16.440	128.710	37	2.7 ML	3
MUN	80 12 05	08 41 15.8	16.650	128.370		2.8 ML	2
MUN	81 11 06	20 51 09.4	17.610	127.360	10	2.8 ML	2
MUN	81 11 11	05 59 36.7	16.020	128.710	10	2.2 ML	2
MUN	81 12 06	12 55 26.3	16.820	128.730	10	3.0 ML	1
MUN	81 12 12	23 38 15.8	17.020	128.860	10	2.4 ML	3
MUN	82 01 13	08 37 06.9	15.770	127.910	10	2.2 ML	2
MUN	83 03 10	01 04 19.4	16.530	128.680	10	2.0 ML	2
MUN	83 03 14	03 30 04.2	16.530	128.680	10	3.0 ML	4
MUN	83 08 09	07 57 54.4	16.560	128.530	10	2.0 ML	2

52

TABLE 27

ACCELEROGRAM DATA 1983

YR	MN	DY	UT	LAT	LONG	ML	LOC	H/E	COM	T(S)	ACC	R	DUR
83	04	26	0713	31.69	117.03	2.2	ME-M	7/6	SZ	0.015	2.8		
									N	0.015	11.8	13.5	9.0
									E	0.015	6.0		
83	07	01	1718	31.59	116.95	2.0	ME-M	17/16	SZ	0.018	4.9		
									N	0.021	25.5	34.4	8.0
									E	0.021	22.5		

KEY TO ACCELEROGRAM DATA

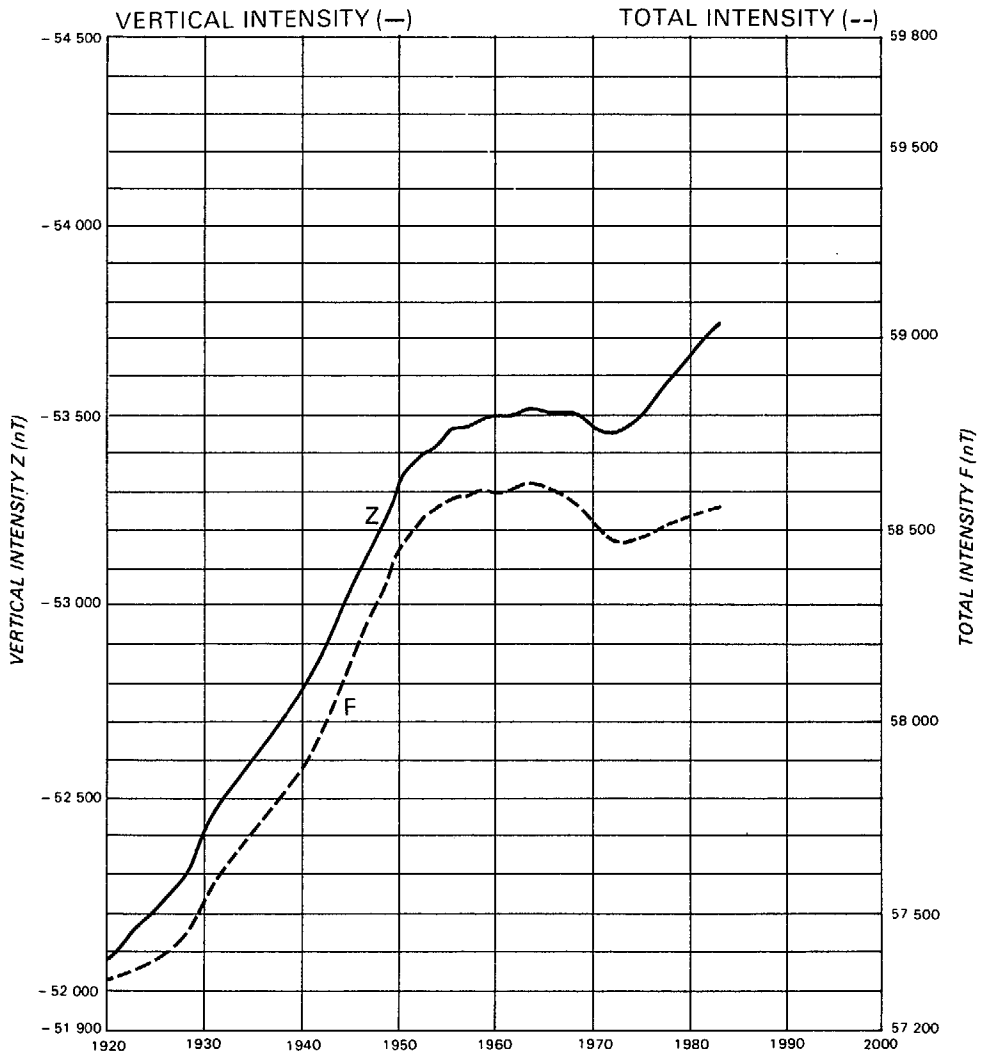
YR = YEAR
MN = MONTH
DY = DAY
UT = UNIVERSAL TIME
LAT = LATITUDE (DEGREES SOUTH)
LONG = LONGITUDE (DEGREES EAST)
ML = RICHTER MAGNITUDE
LOC = ACCELEROGRAPH LOCATION
H/E = HYPOCENTRAL DISTANCE / EPICENTRAL DISTANCE
COM = COMPONENT
T(S) = GROUND PERIOD IN SECONDS
ACC = PEAK GROUND ACCELERATION IN CENTIMETRES PER SECOND SQUARED
R = RESULTANT ACCELERATION IN CENTIMETRES PER SECOND SQUARED
DUR = DURATION IN SECONDS WHILE GROUND ACCELERATION REMAINED ABOVE 0.5 CENTIMETRES PER SECOND SQUARED

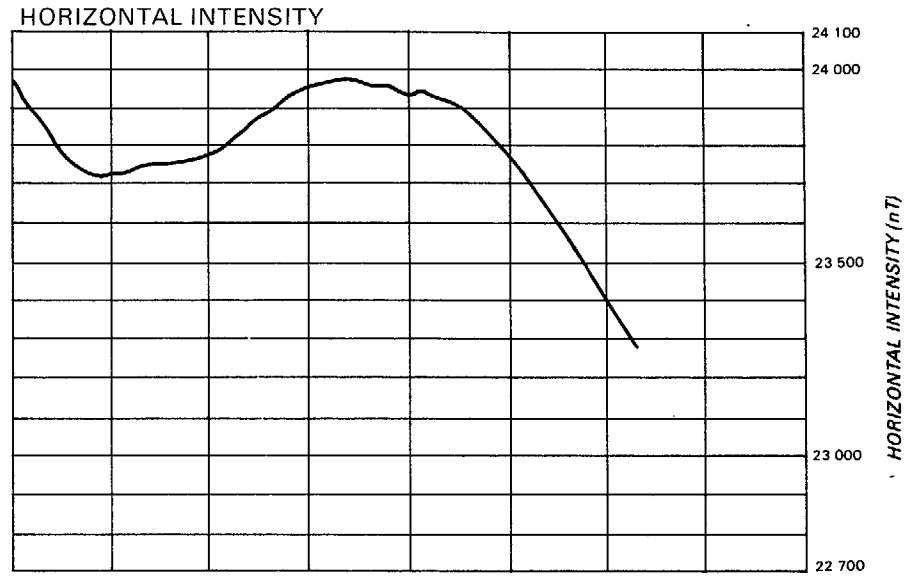
53

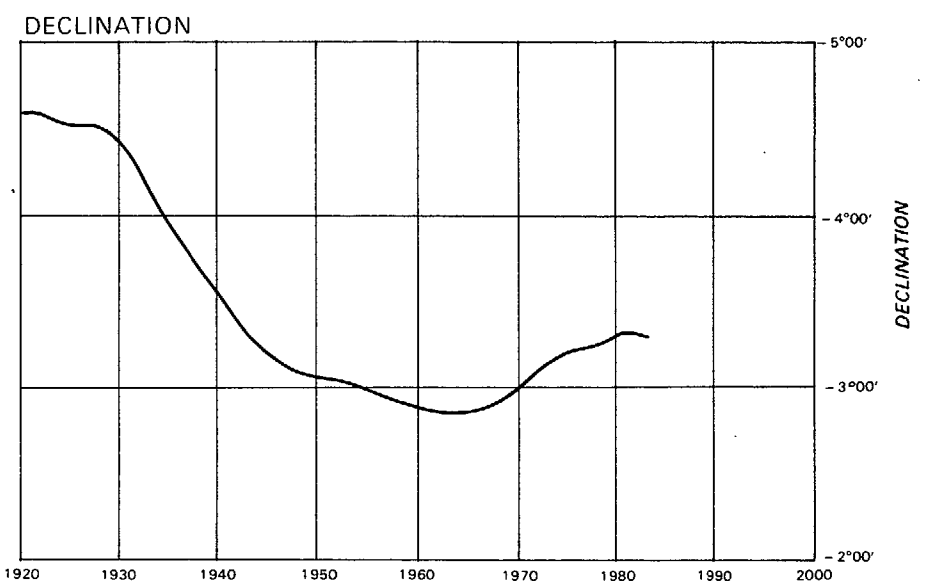
TABLE 28
EQUESTS FOR DATA 1983

Institution	Type of data	No
Bureau of Meteorology	Magnetic declination map	1
Goldfields Exploration	" "	1
Lands & Survey	" "	1
Dept. of Aviation	" "	1
Satellite Positioning Service	" "	1
Research School of Earth Sciences, ANU	Magnetogram copies	92
Ionospheric Prediction Service	" "	2
Academia Sinia China	" "	7
Jacia	" "	1
Universaid Nacional de Tucuman, Argentina	Mean hourly values H,D,Z 1975	1
University of WA (Medical Dept.)	K-Indices (5 year period)	1
Various	Magnetic field values	84
World Data Centre - A	Seismogram copies	12
Lamont-Doherty Geological Observatory	" "	7
Earthquake Research Institute, Tokyo	" "	31
World Data Centre - A	" "	6
BMR - P.M. McGregor	" "	4
Meteorological Research Institute, Japan	" "	6
Geophysical Institute, Tohoku University Japan	" "	6
BMR - D. Denham	" "	11
Disaster Prevention Research Institute, Japan	" "	6
University of California	" "	10
Pennsylvania State University	" "	10
BMR - D. Denham	" "	15
BMR - B. Gaull	" "	3
W.W. Ullinger & Partners, Consultants	Earthquake data-Kukerin area	1
Stewart & Wrightson Insurance Brokers	" list 1873-1982	1
Stewart & Wrightson Insurance Brokers	Risk map	1
W.W. Ullinger & Partners, Consultants	Isoseismal maps	5
Various Insurance Companies	Earthquake information	70

54



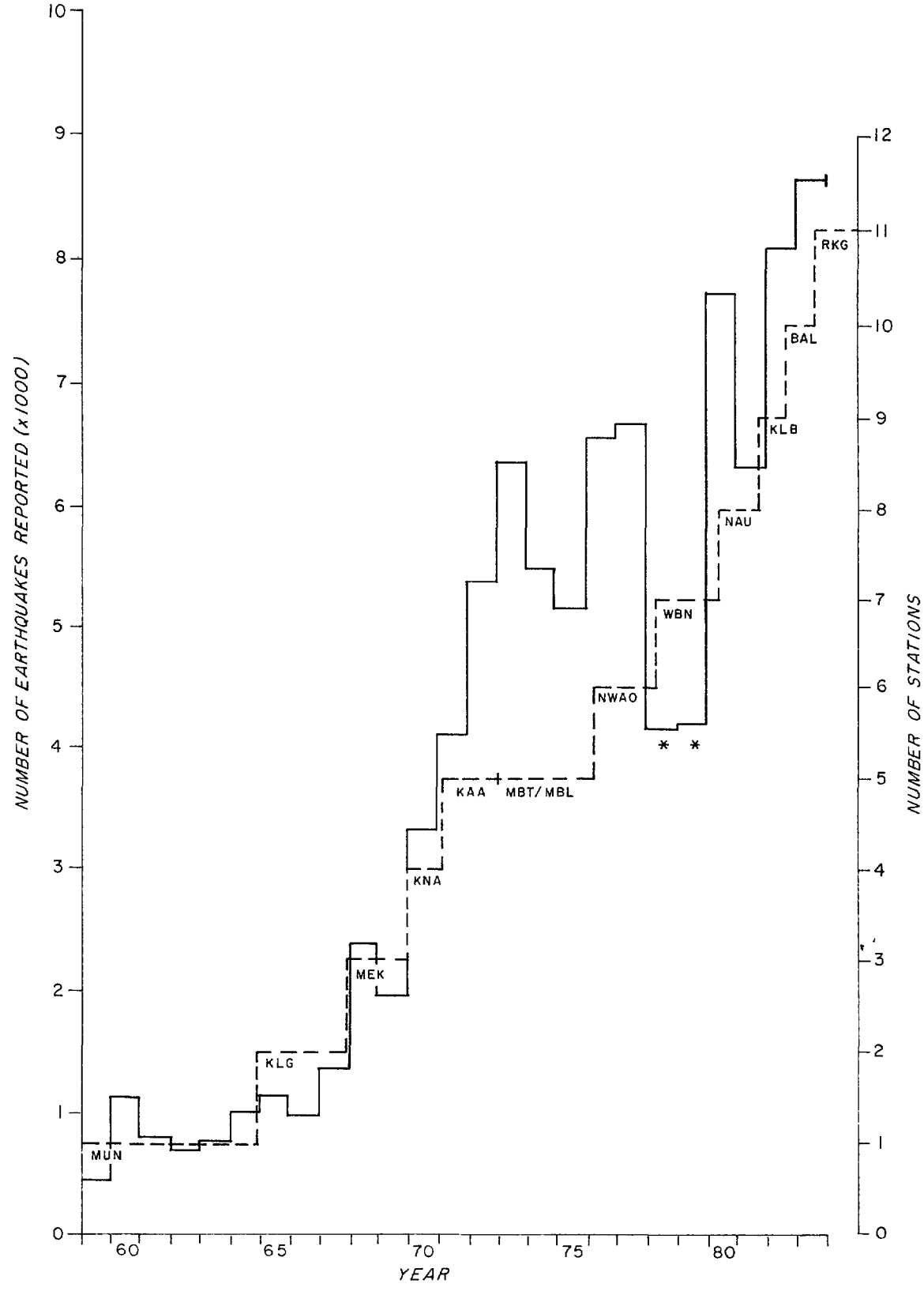




Values before 1959 are Watheroo values adjusted to Gnangara by application of station differences: GNA–WAT = D: –14.3′; H: –918 nT; Z: – 1256 nT (D scale is equal to H, Z and F scale in nT)

24/H50/2

Fig. 1 Geomagnetic Annual mean values at Gnangara 1919 — 1983



Earthquakes

Stations in operation

* Selected reporting resulted in reduced numbers

Fig. 2 Total number of earthquakes reported from Western Australian stations 1959–1983

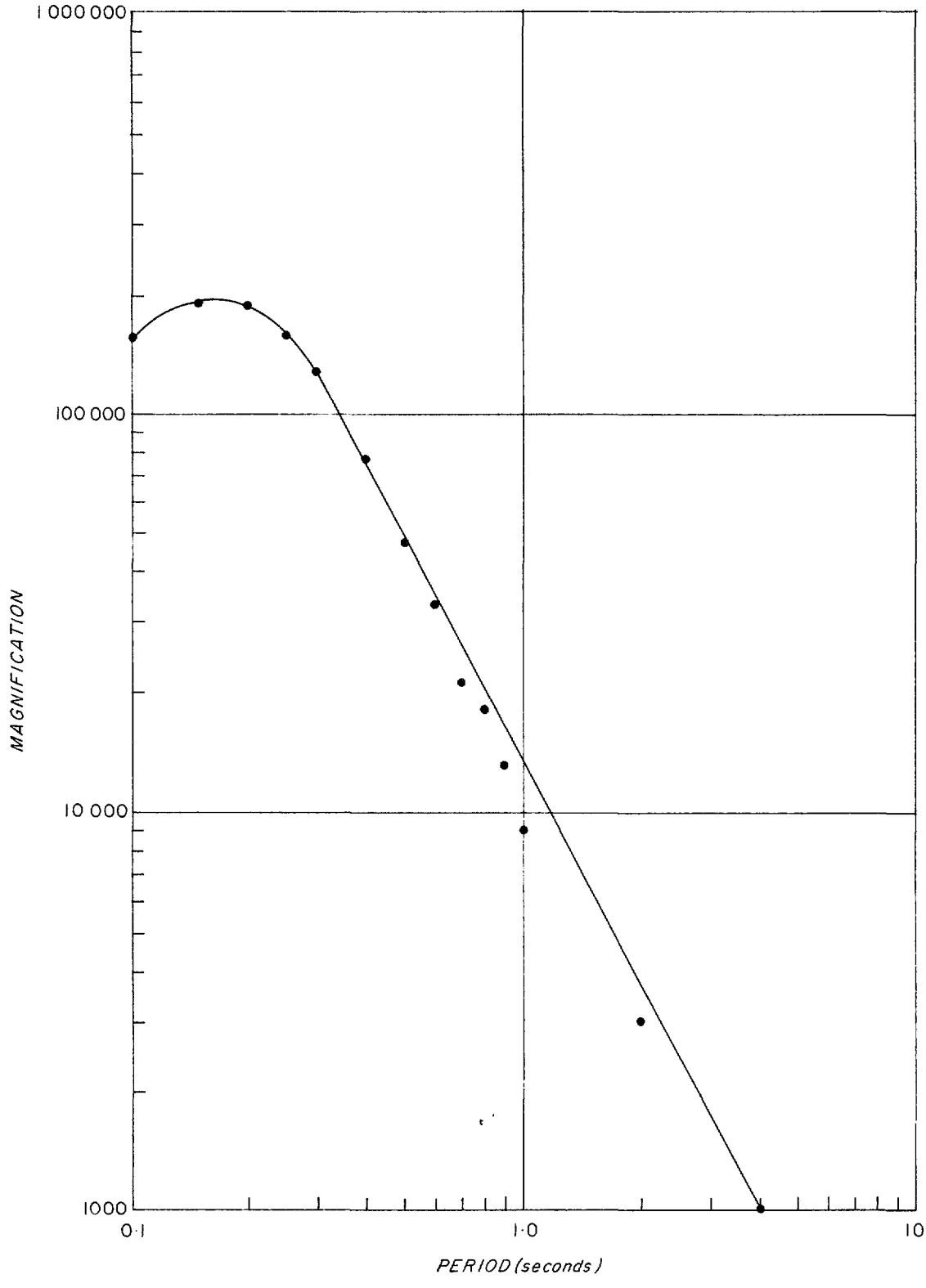


Fig. 3 Calibration curve Rocky Gully seismograph 1983

BMR Record 1985/37

24/WA/35 57

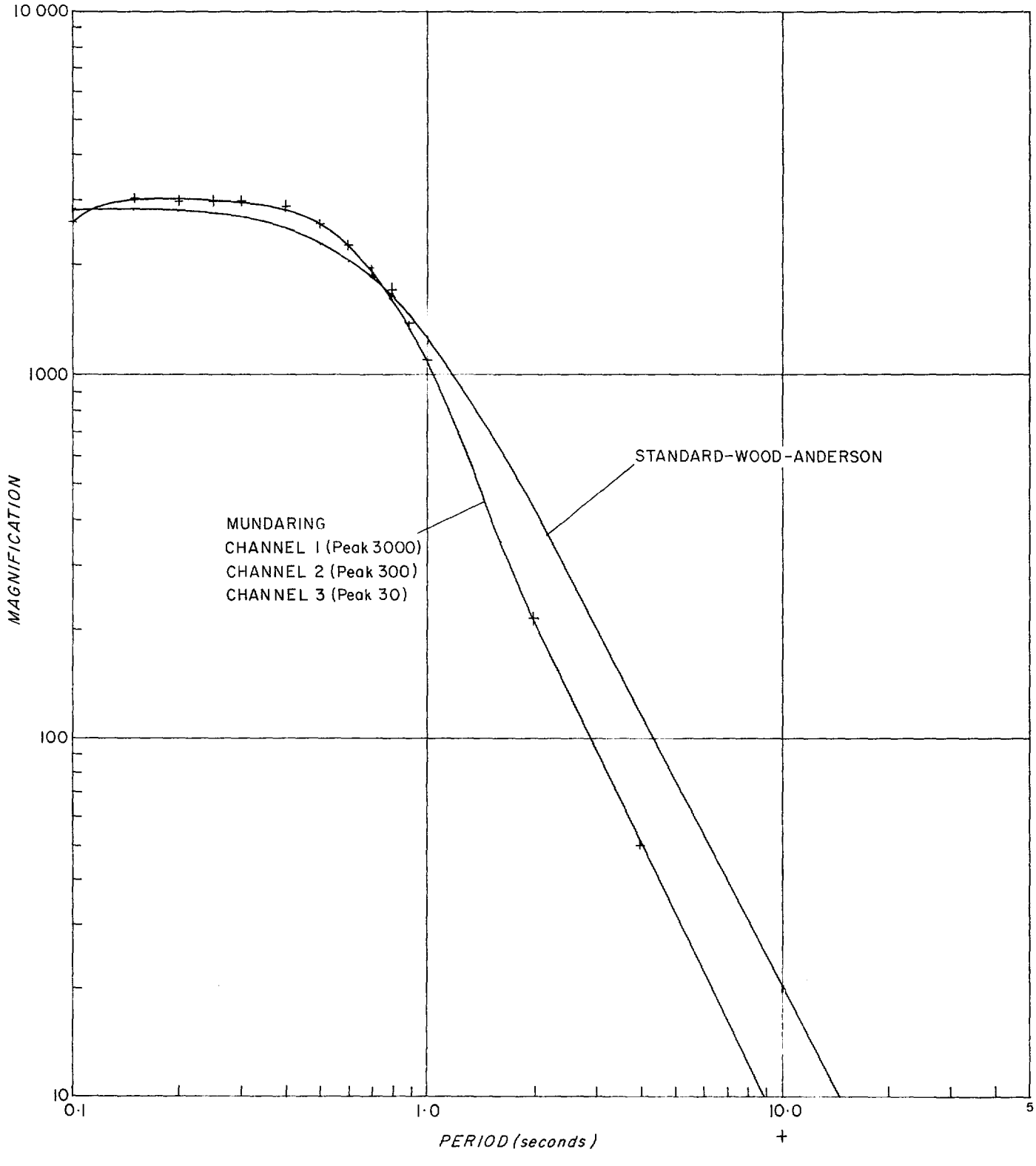


Fig. 4 Calibration curve, Mundaring insensitive seismograph from 9 Nov. 1983

BMR Record 1985/37

24/WA/36

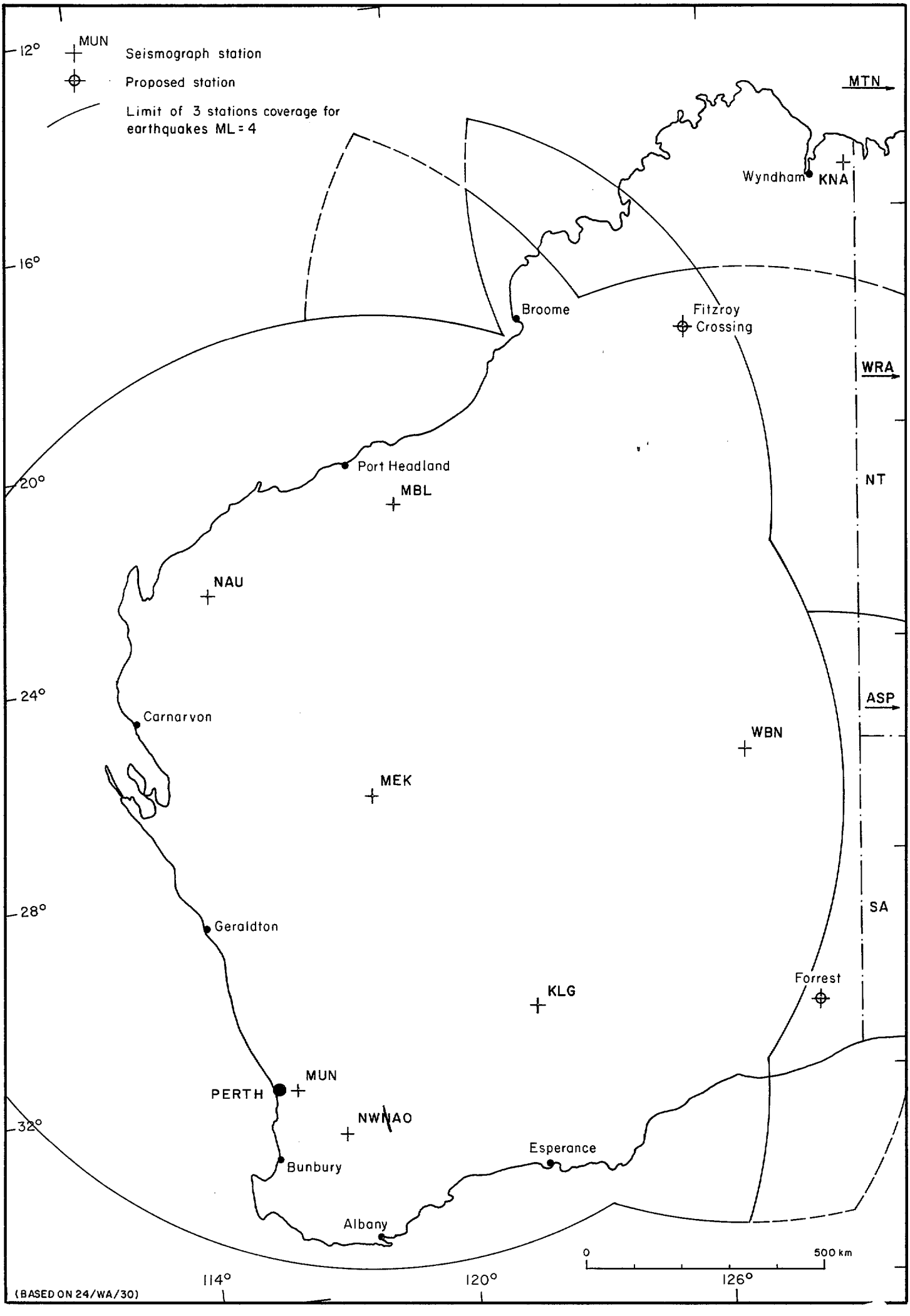


Fig. 5 Seismic coverage of Western Australia earthquakes ML = 4

24/WA/37

BMR Record 1985/37

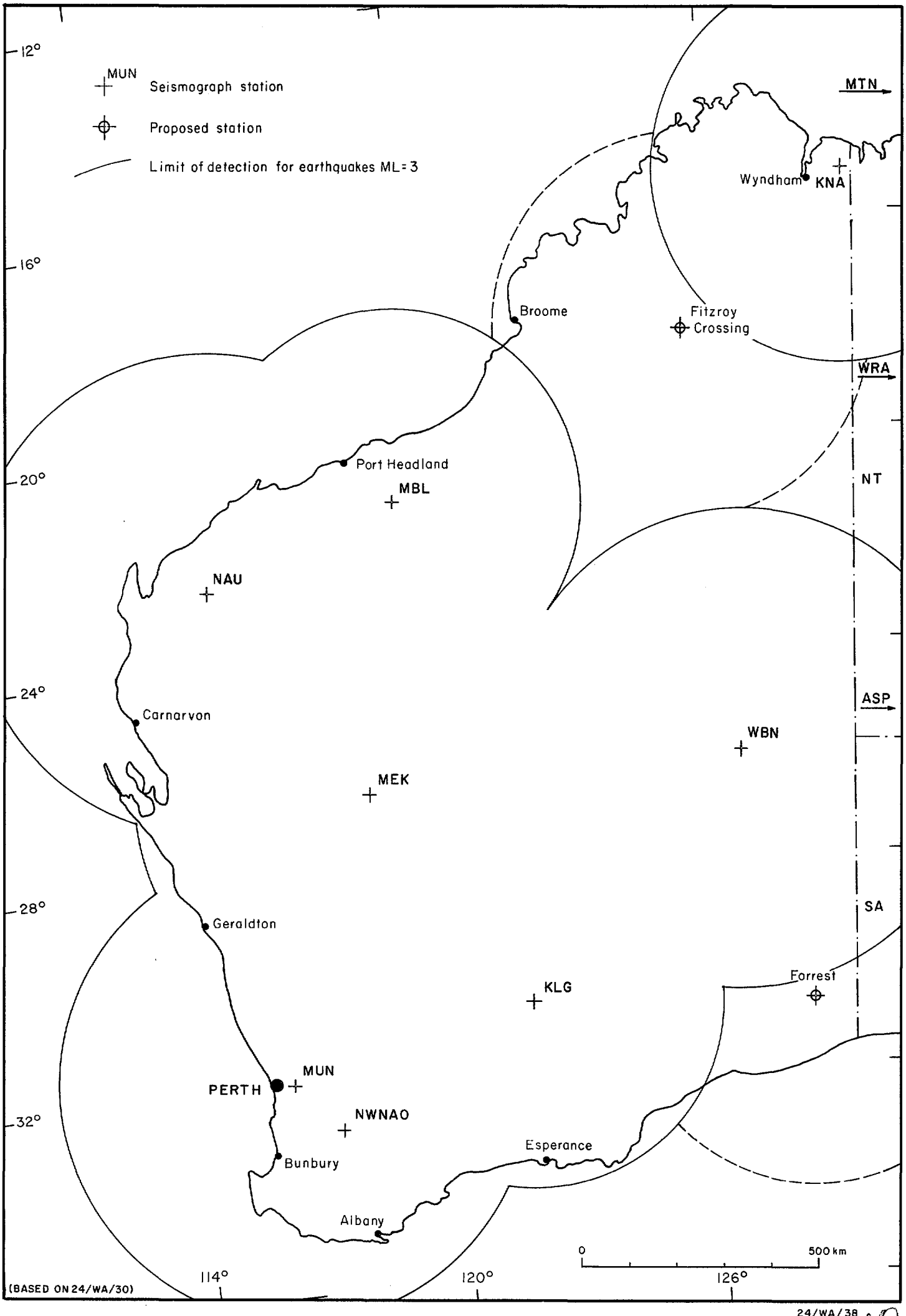


Fig.6 Seismic coverage of Western Australia earthquakes ML=3 1983

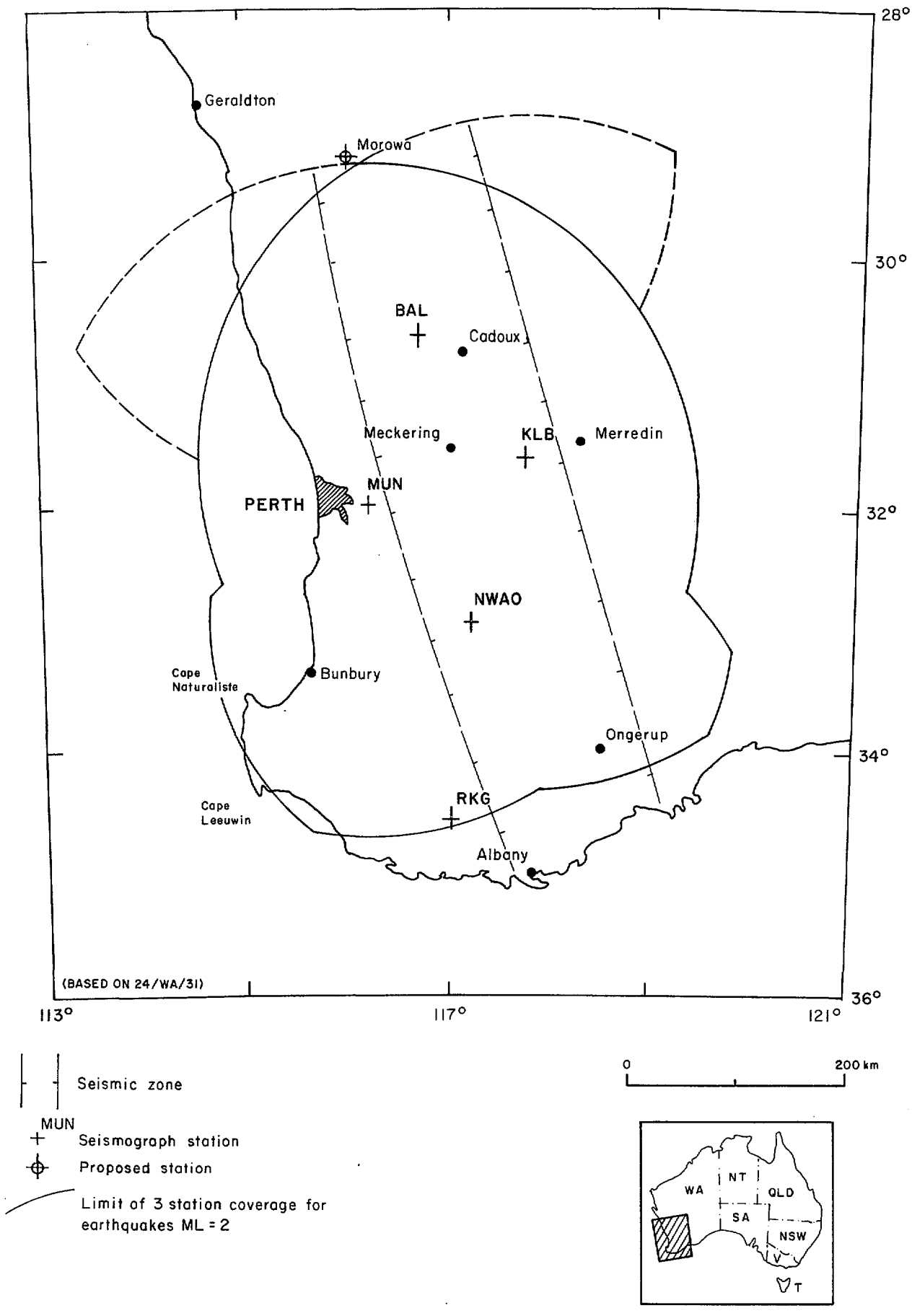


Fig. 7 Seismic coverage southwest seismic zone earthquakes ML=2 1983

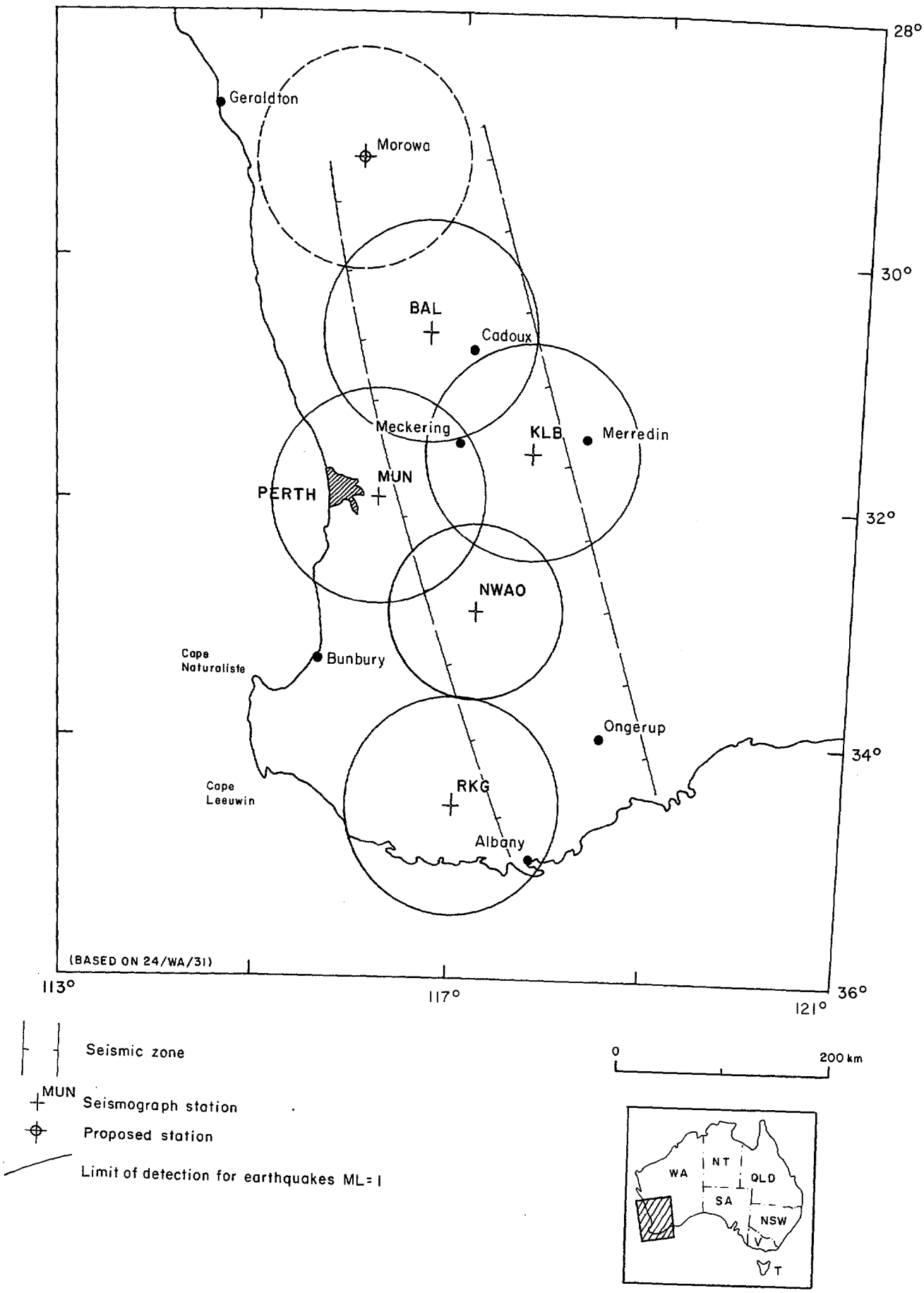
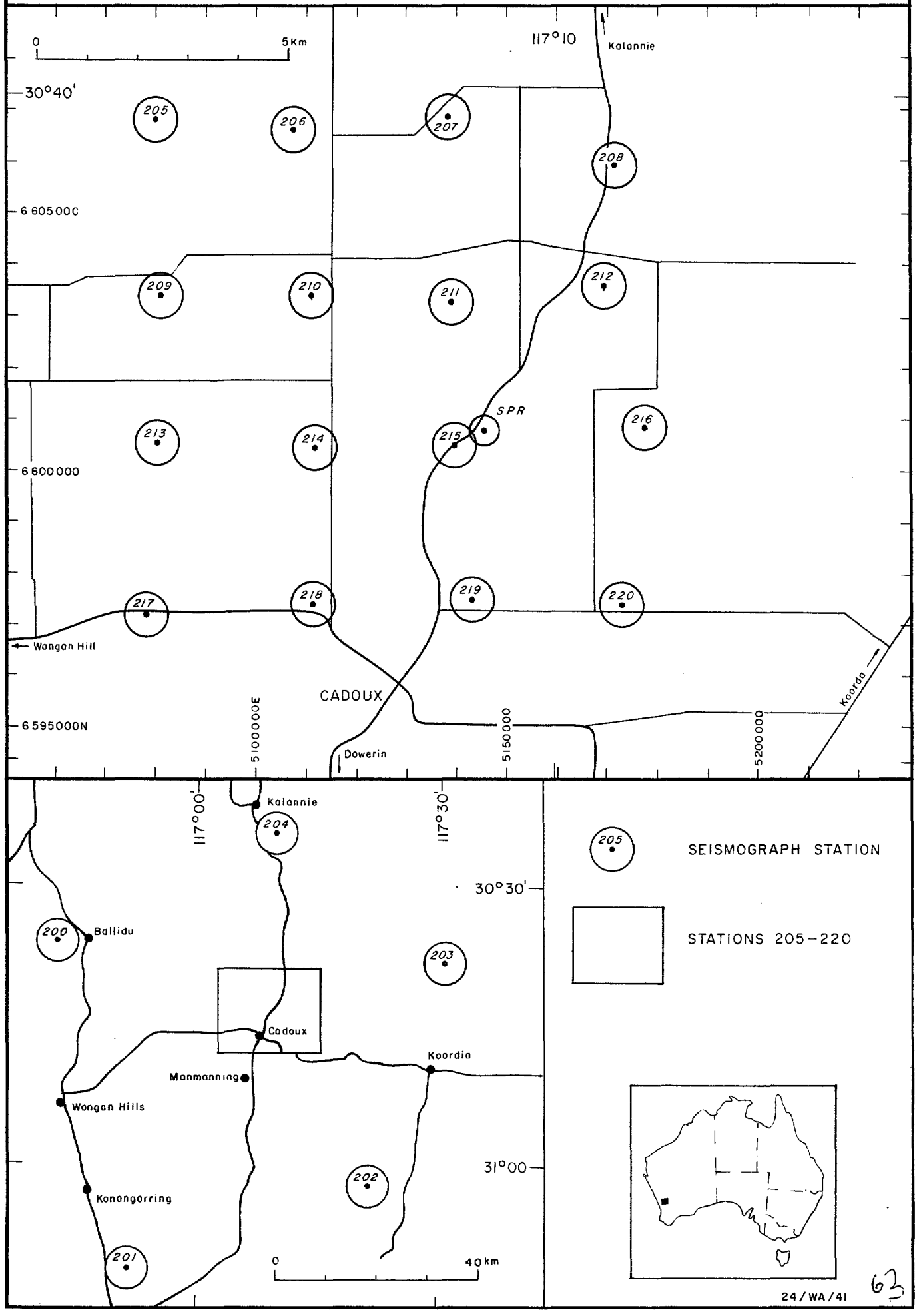


Fig. 8 Seismic coverage southwest seismic zone earthquakes ML=1 1983

Fig. 9 CADOUX MICROEARTHQUAKES STATION LOCATIONS



BMR Record 1985/37

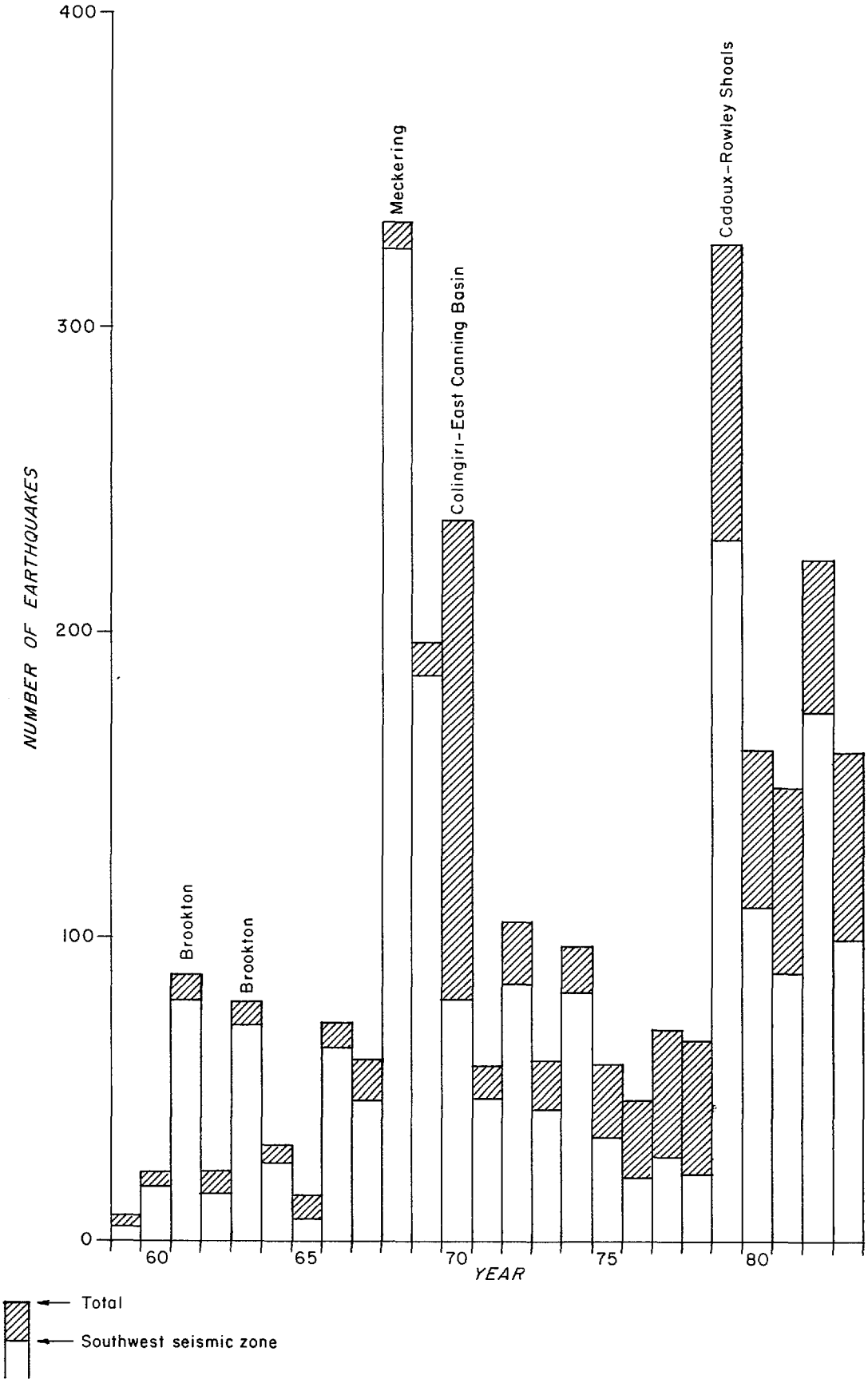


Fig. 10 Number of Western Australian earthquakes (ML≥2) 1959-1983

64

24/WA/42

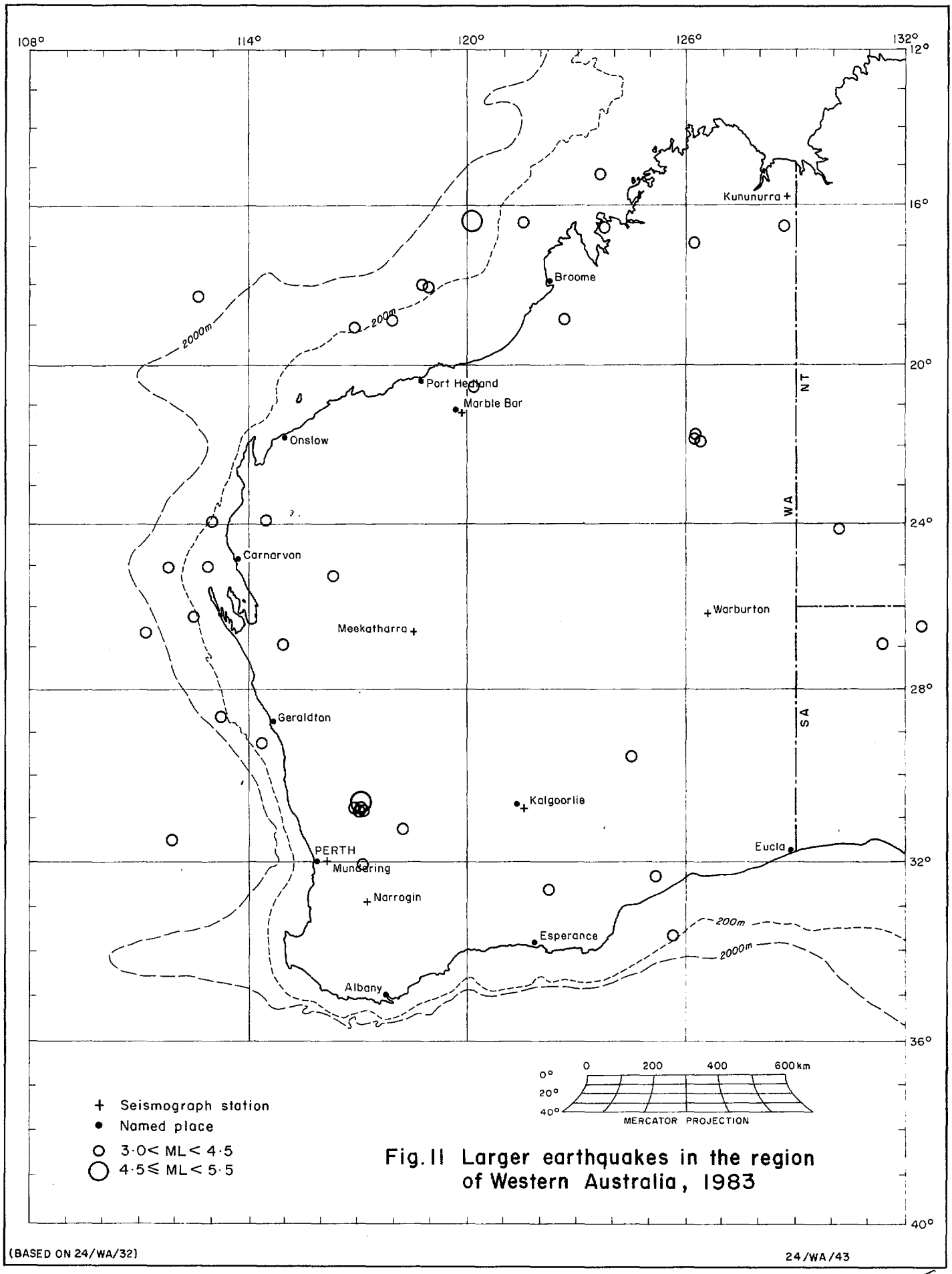


Fig. 11 Larger earthquakes in the region of Western Australia, 1983

(BASED ON 24/WA/32)

24/WA/43

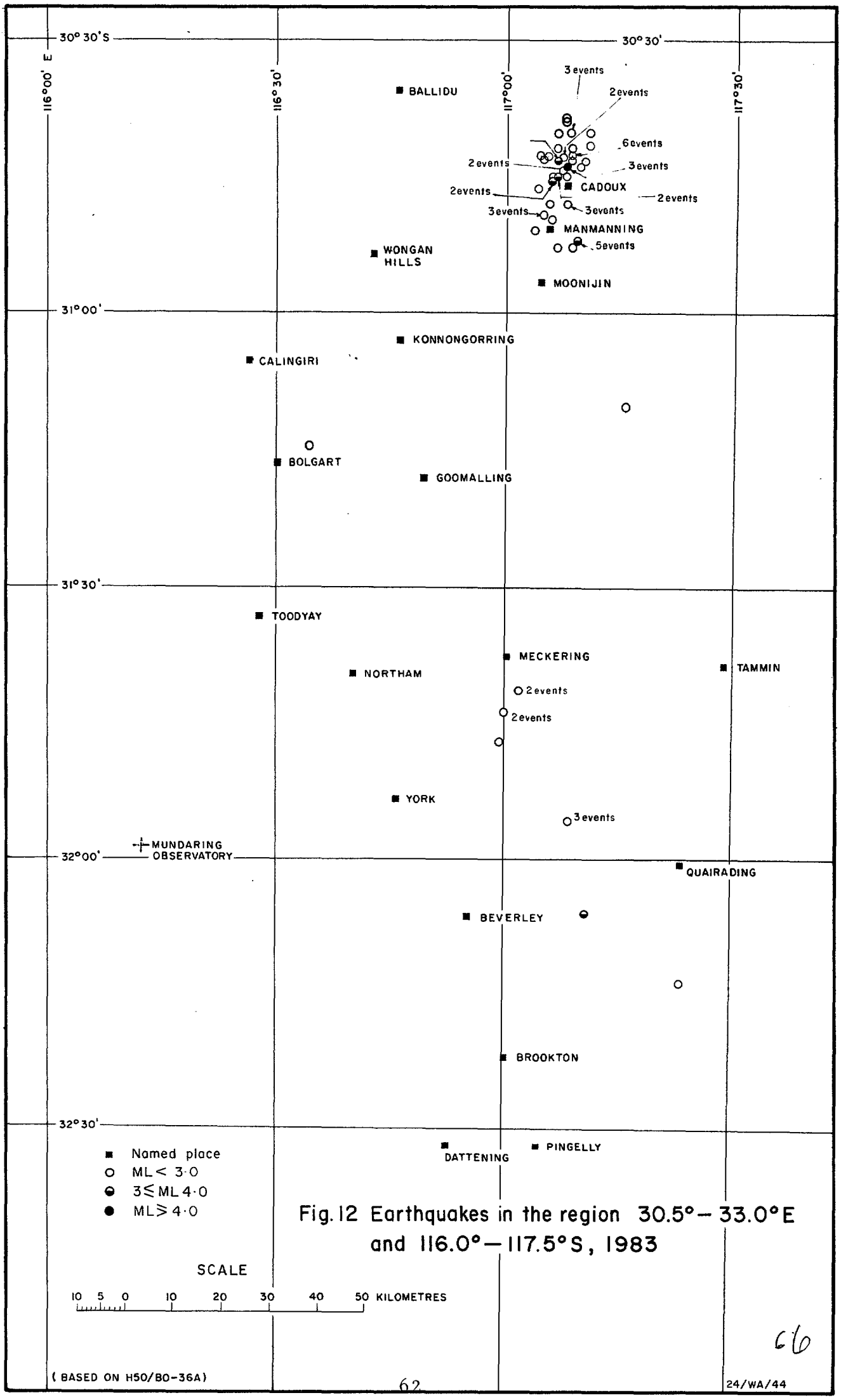
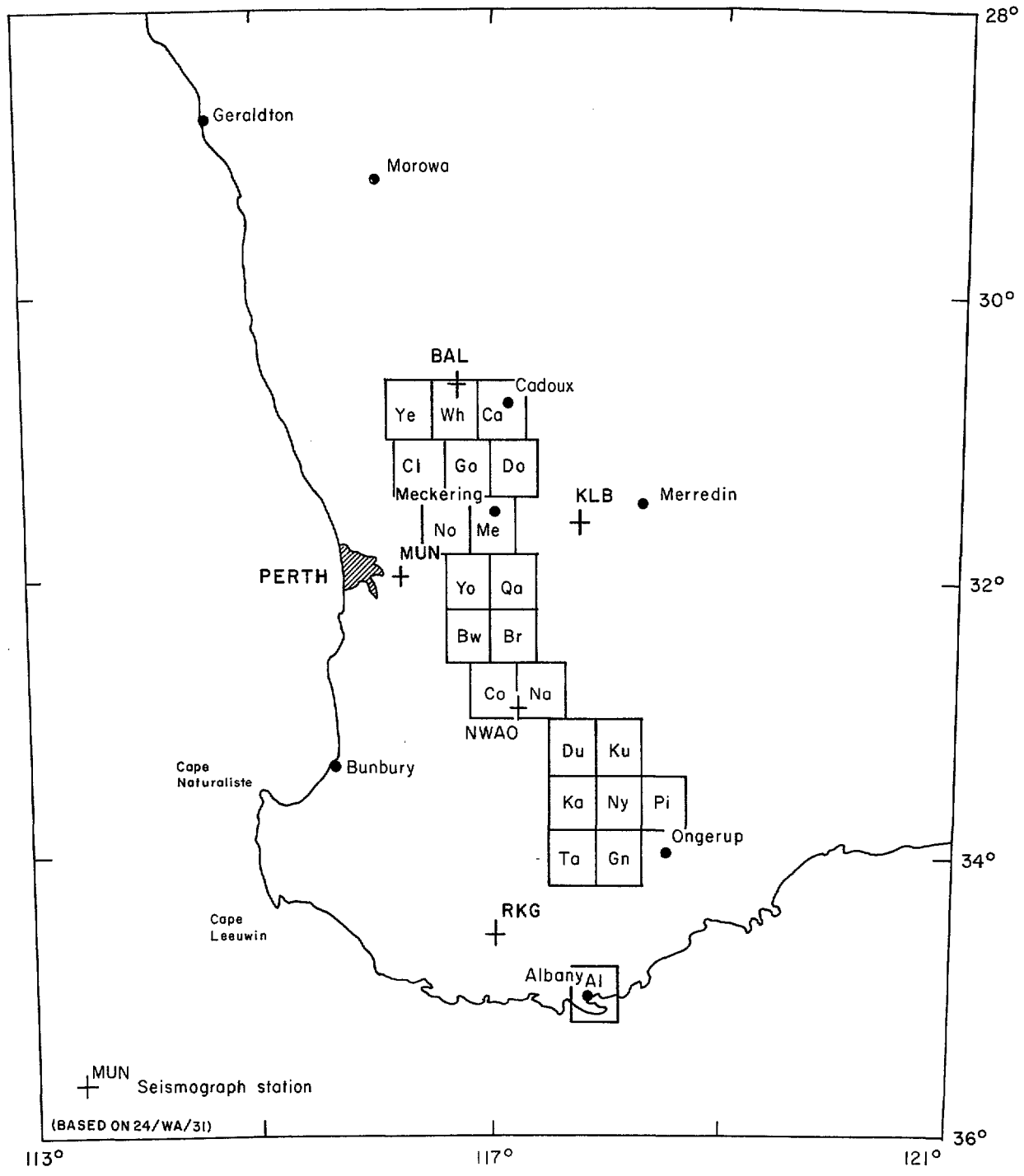
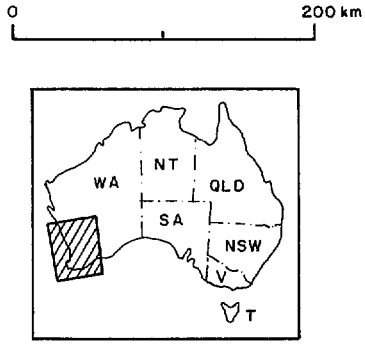


Fig. 12 Earthquakes in the region 30.5° – 33.0° E and 116.0° – 117.5° S, 1983



Al	Albany	Gn	Gnowaangerup	Ta	Tambellup
Br	Brookton	Go	Goomalling	Wh	Wongan Hills
Bw	Brookton west	Ka	Katanning	Ye	Yericoin
Ca	Cadoux	Ku	Kukerin	Yo	York
Cl	Calingiri	Me	Meckering	Na	Narrogin
Co	Congelin	Ny	Nyabing	No	Northam
Do	Dowerin	Pi	Pingrup		
Du	Dumbleyung	Qu	Quairading		



24/WA/45

Fig. 13 Southwest seismic zone – Localities

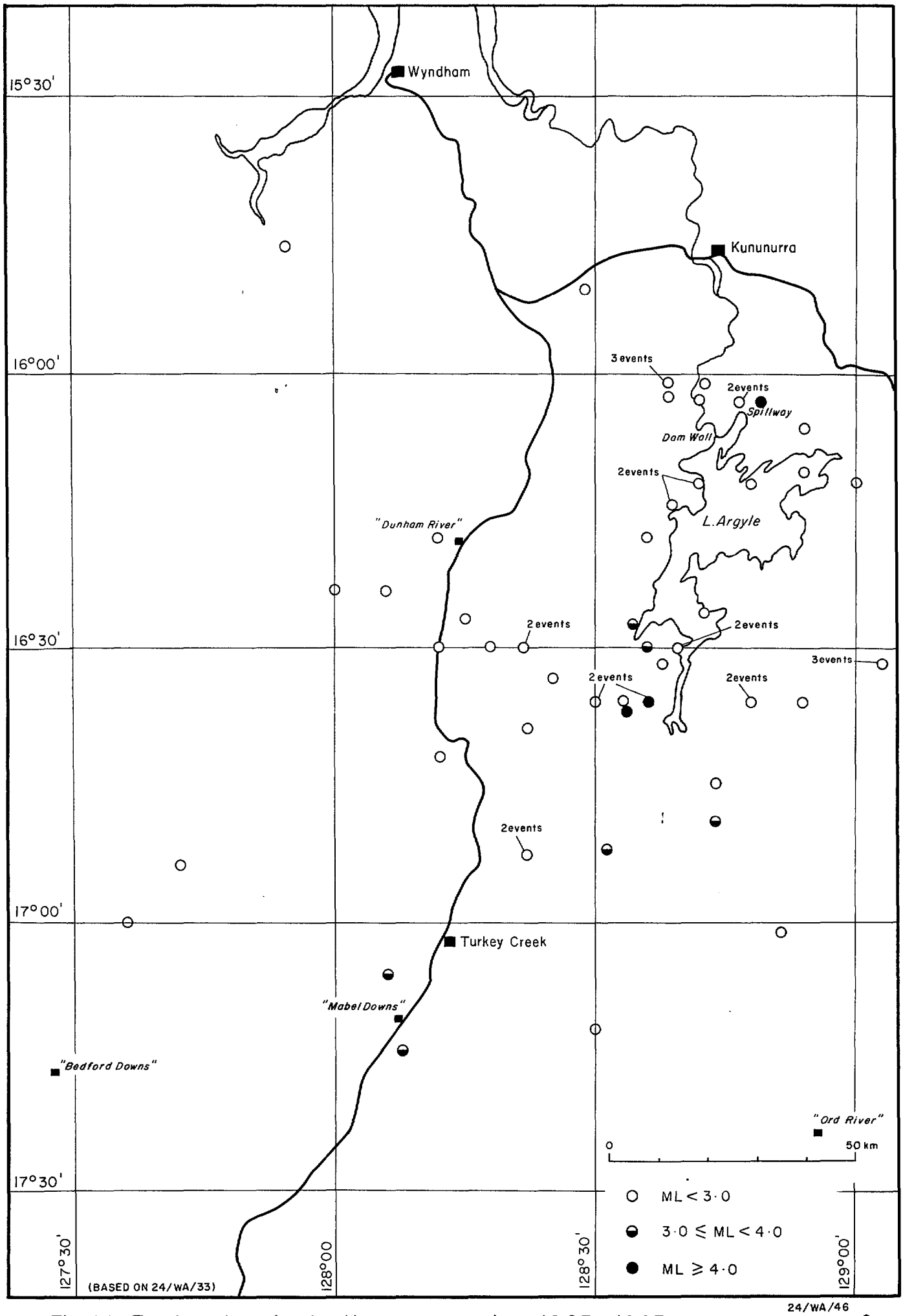
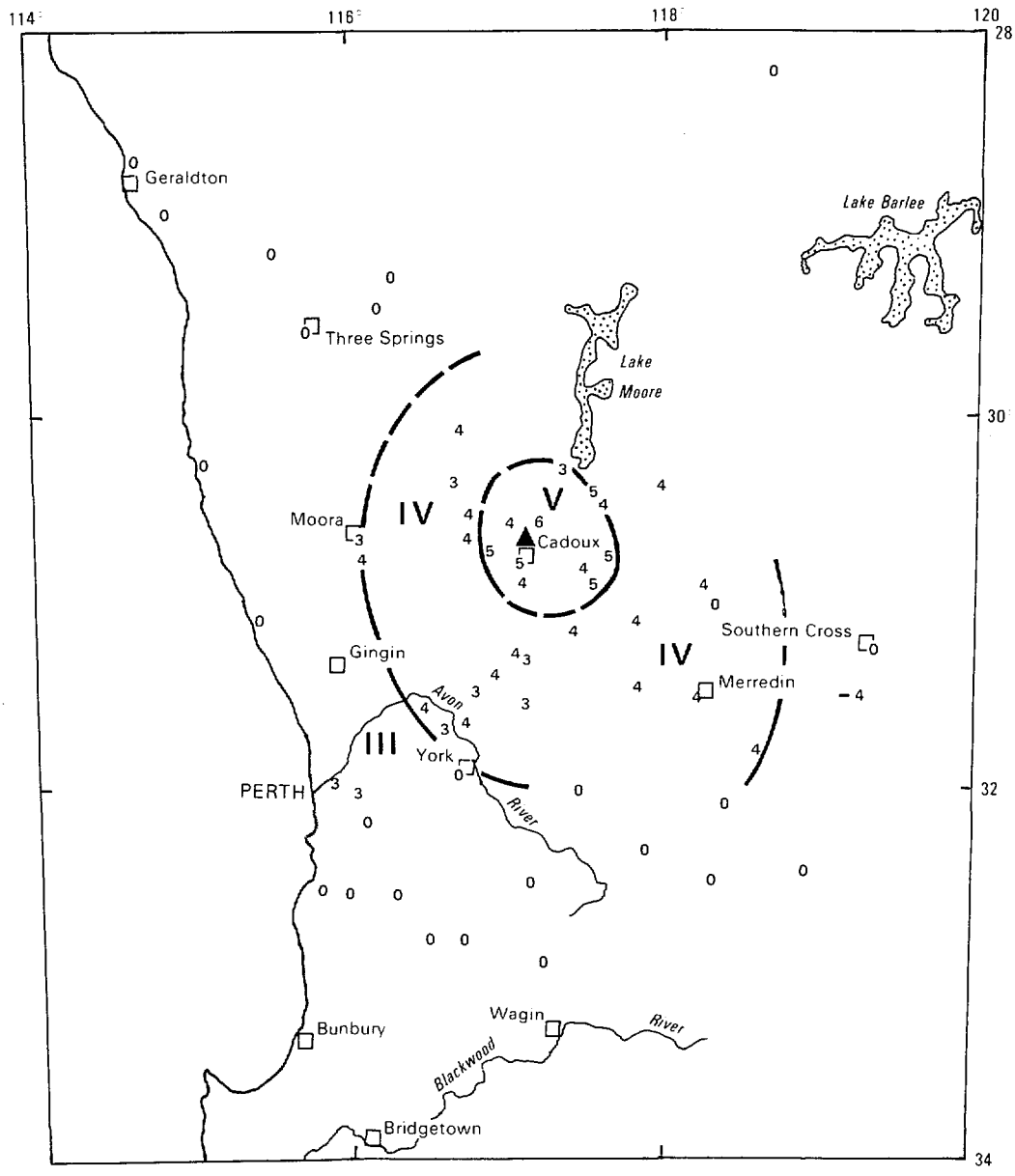


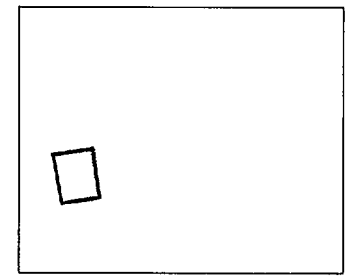
Fig. 14 Earthquakes in the Kununurra region 1963–1983

ISOSEISMAL MAP OF THE CADOUX EARTHQUAKE, WESTERN AUSTRALIA, 26 JANUARY 1983



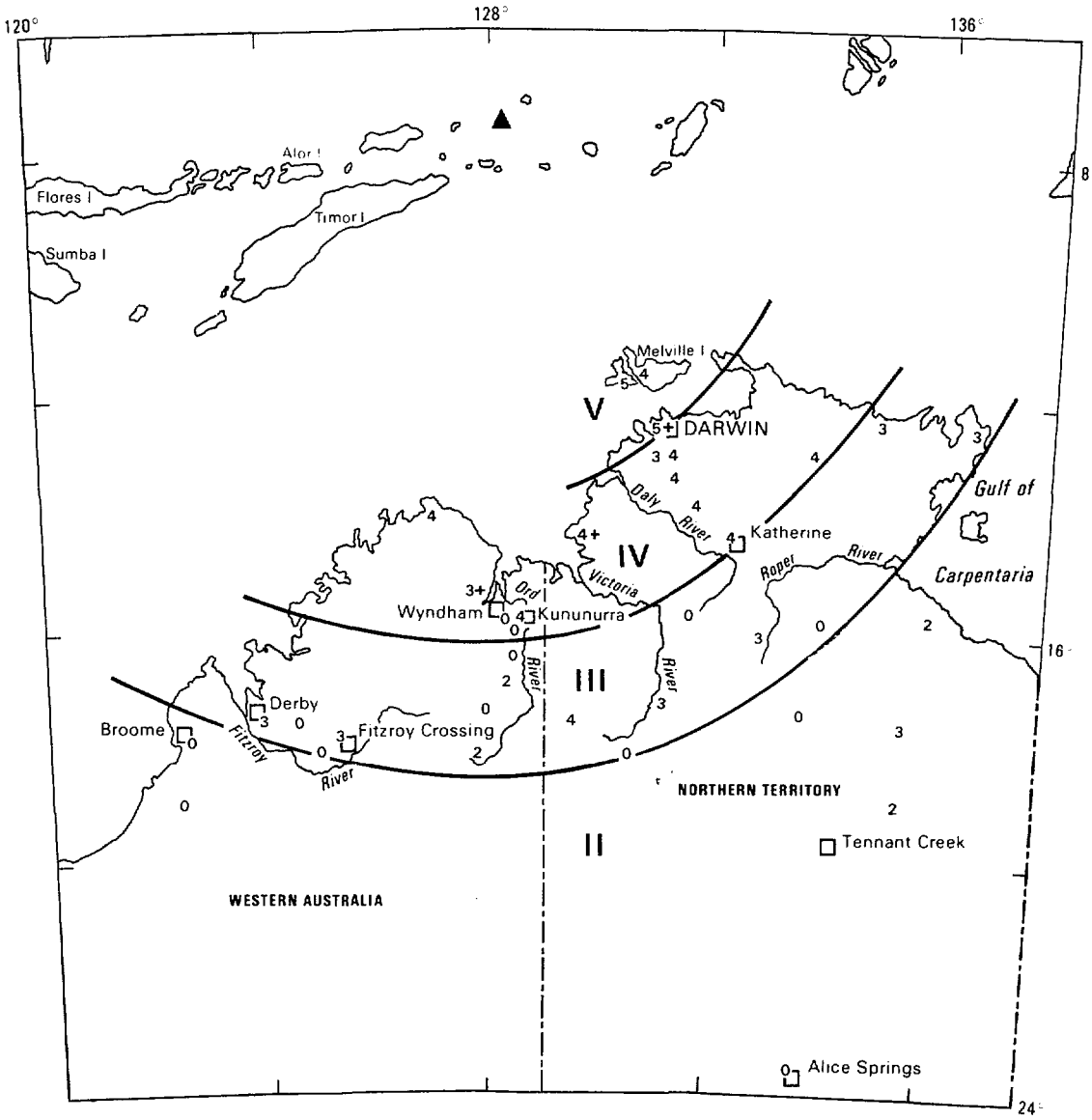
DATE : 26 JANUARY 1983
TIME : 06:16:15.4 UT
MAGNITUDE : 4.8 ML (MUN), 5.1 MB
EPICENTRE : 30.73°S 117.13°E
DEPTH : 10 km

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



24 WA 69

ISOSEISMAL MAP OF THE TIMOR EARTHQUAKE, 24 NOVEMBER 1983



DATE : 24 NOVEMBER 1983
TIME : 05:30:34.2 UT
MAGNITUDE : 7.5 ML (MUN), 6.4 MB, 7.1 MS (GS)
EPICENTRE : 7.57°S 128.19°E
DEPTH : 180km

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

70
24/09/193

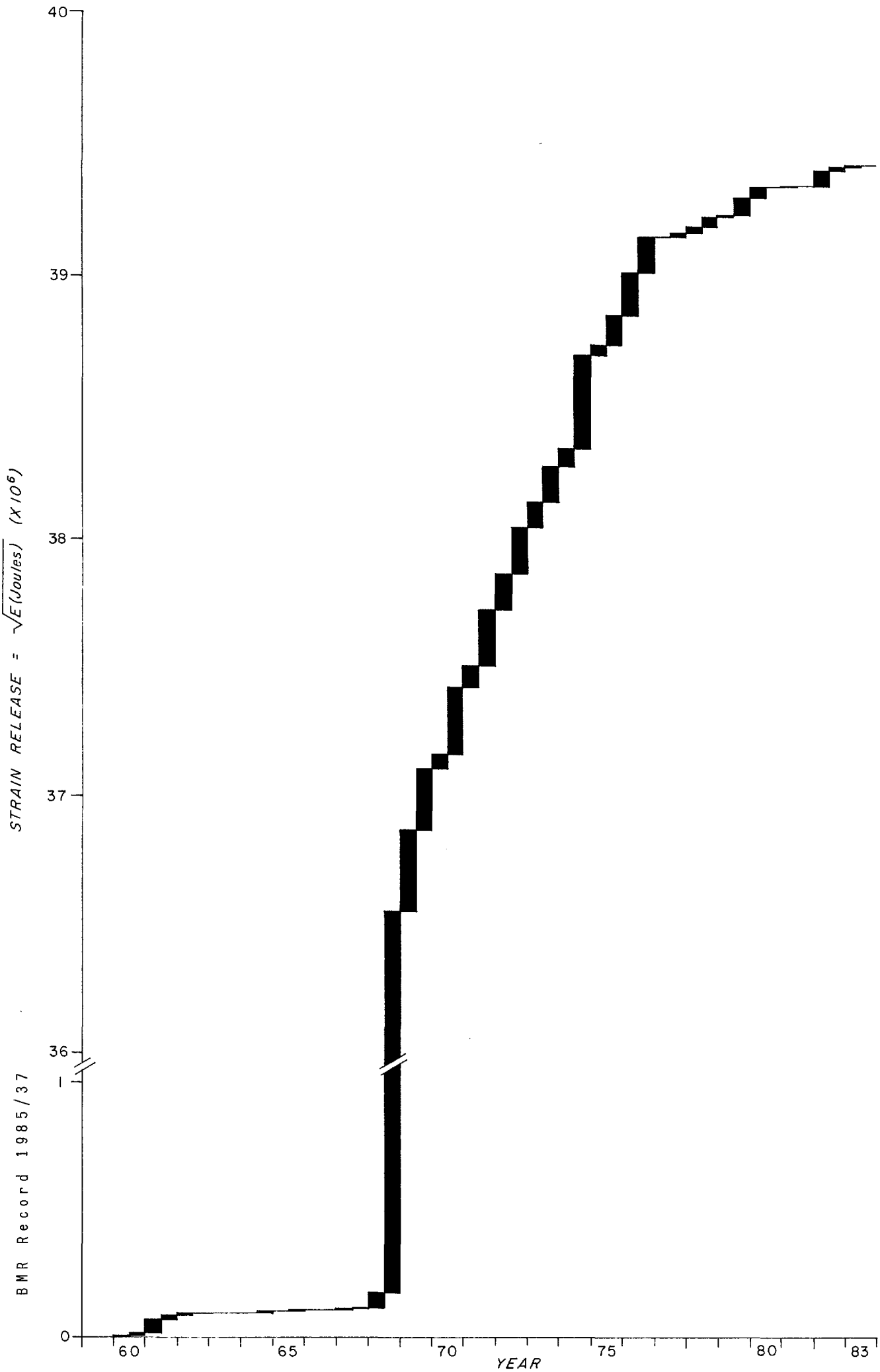


Fig. 17 Strain release - Meckering 1959–1983

24/WA/47 7

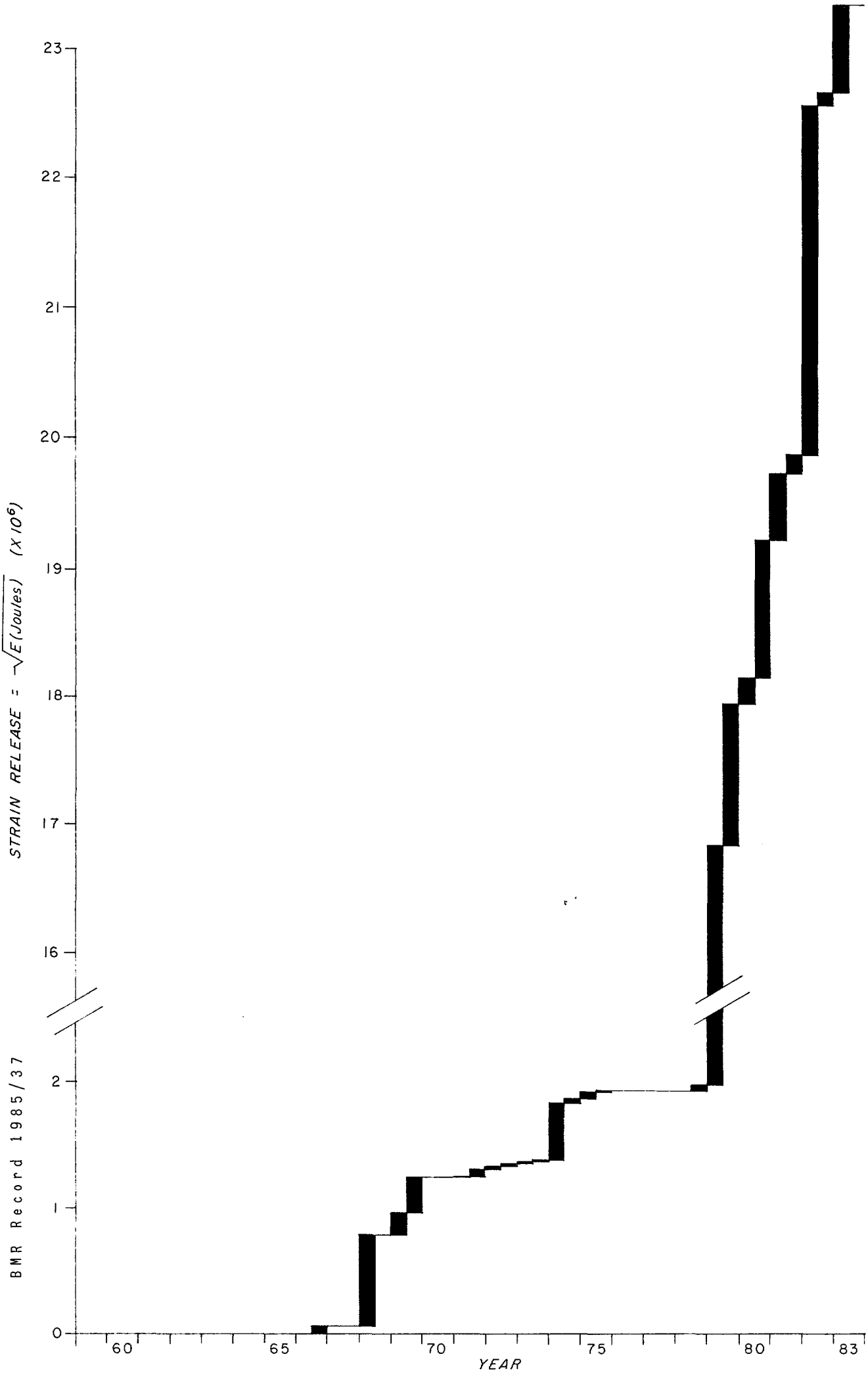


Fig. 18 Strain release - Cadoux 1959-1983

24/WA/48

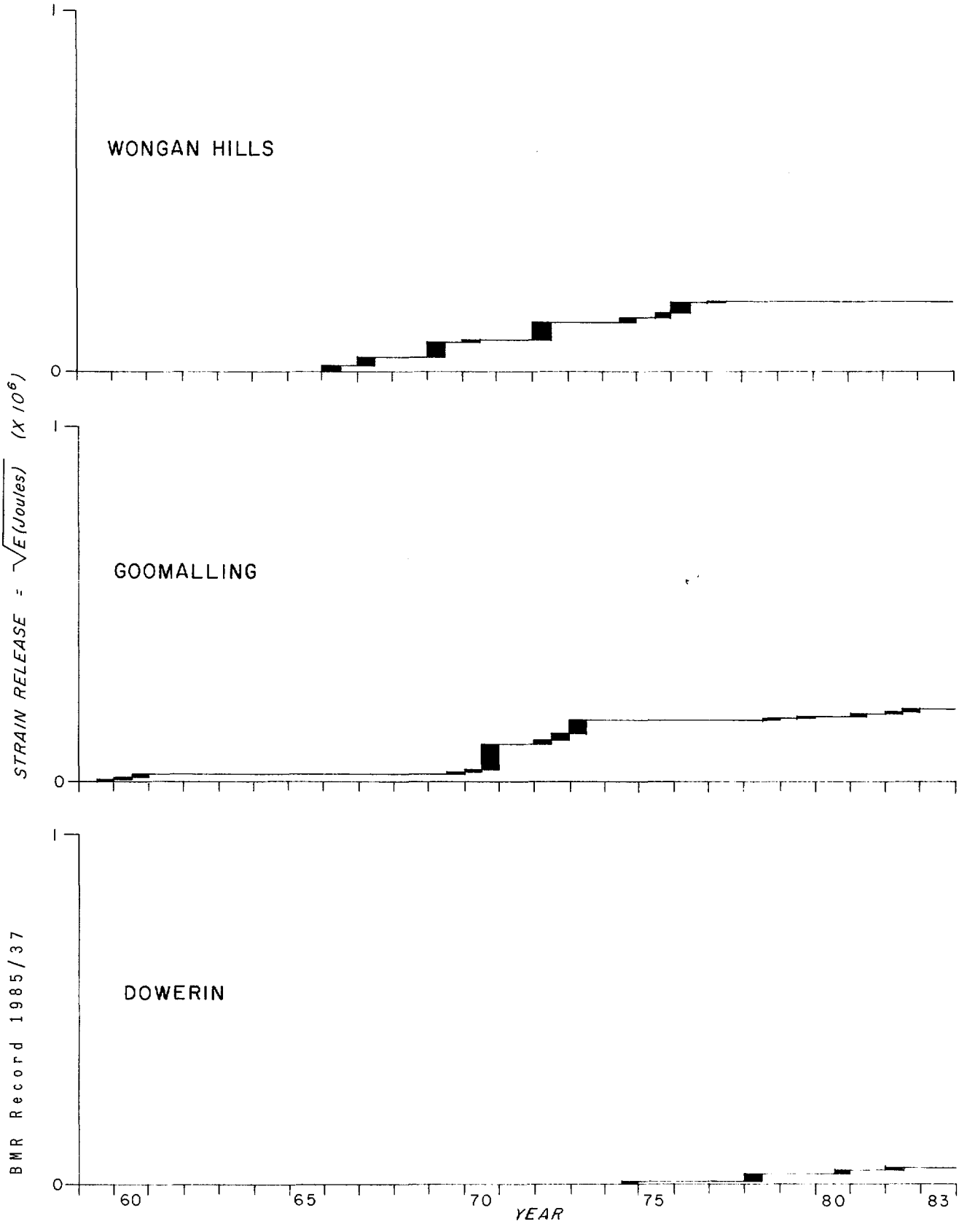


Fig. 19(A) Strain release - Southwest seismic zone (north) 1959-1983

24/WA/49 73

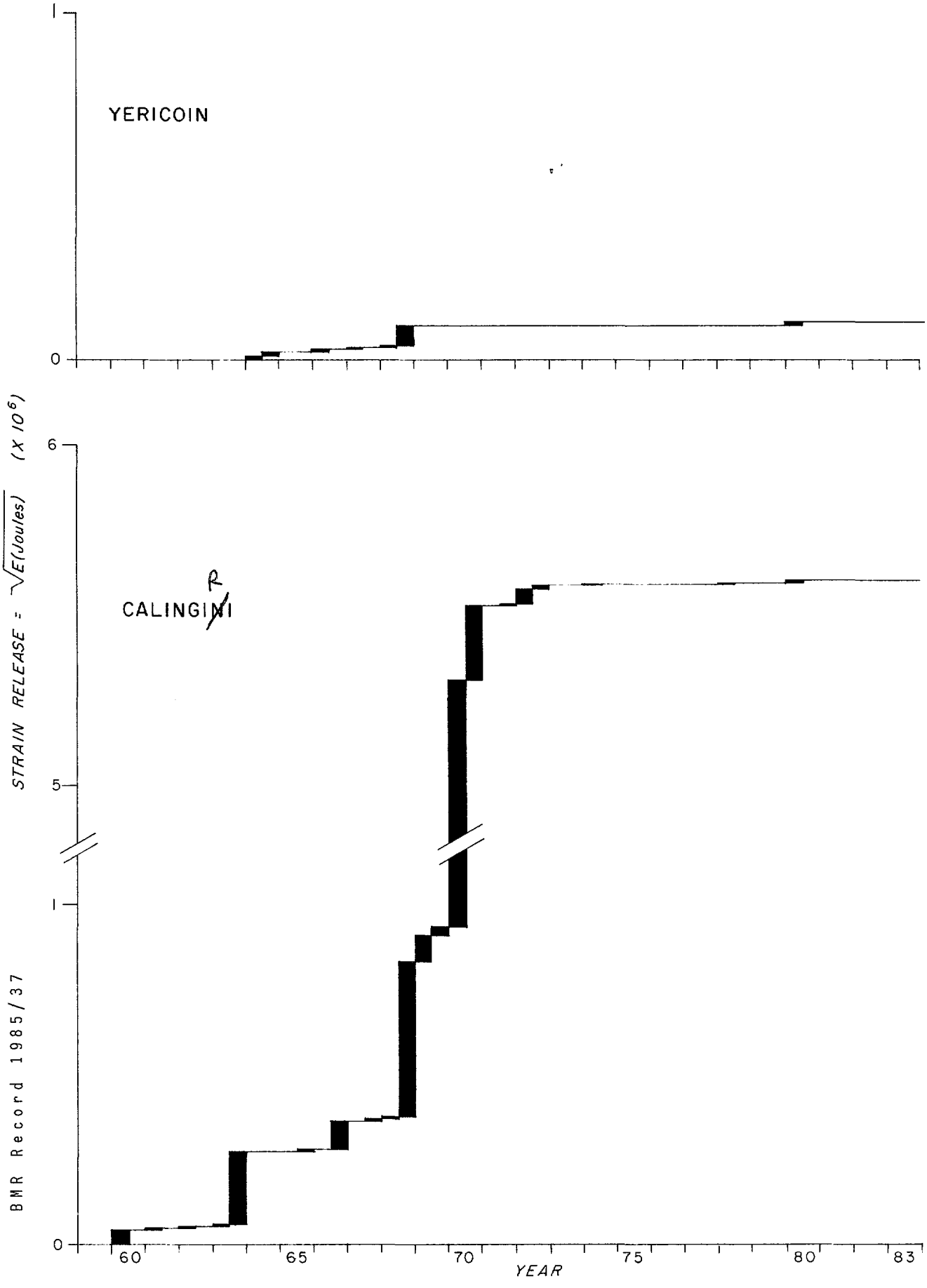


Fig. 19 (B) Strain release - Southwest seismic zone (north) 1959–1983

24/WA/[illegible] 24

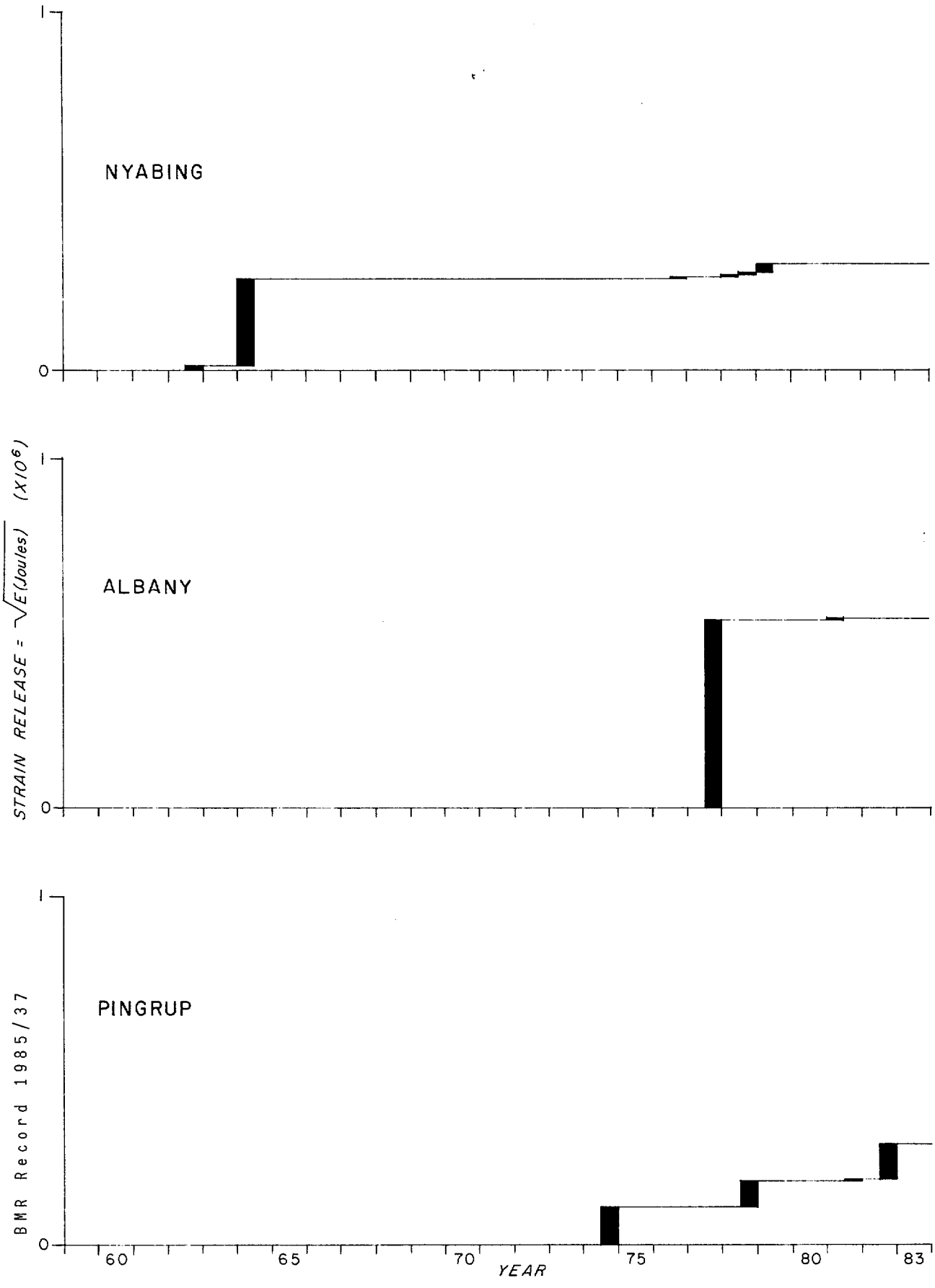
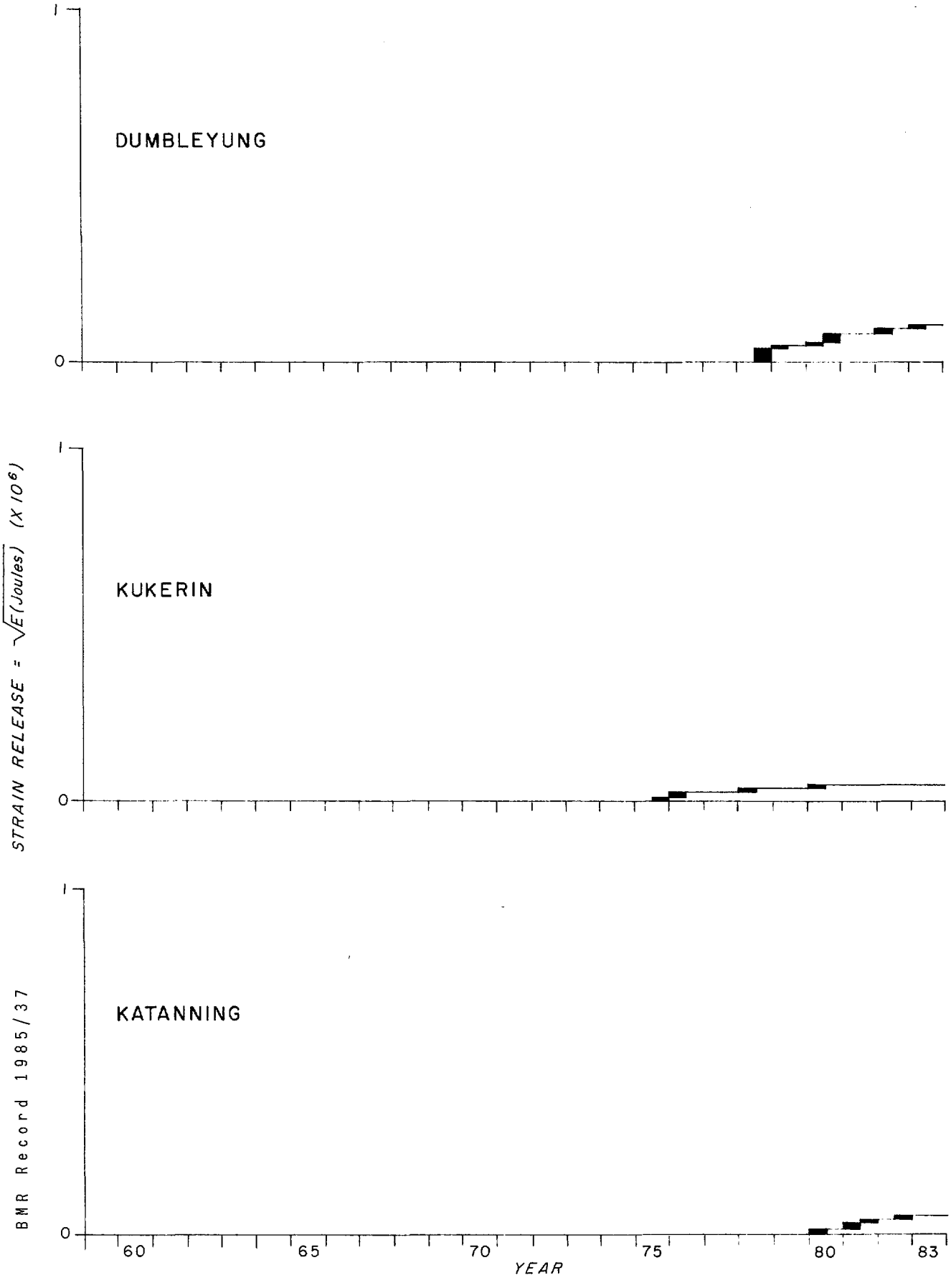


Fig. 20(A) Strain release - Southwest seismic zone (south) 1959 - 1983

75

24/WA/3



24/WA/52

Fig. 20(B) Strain release - Southwest seismic zone (south) 1959-1983 76

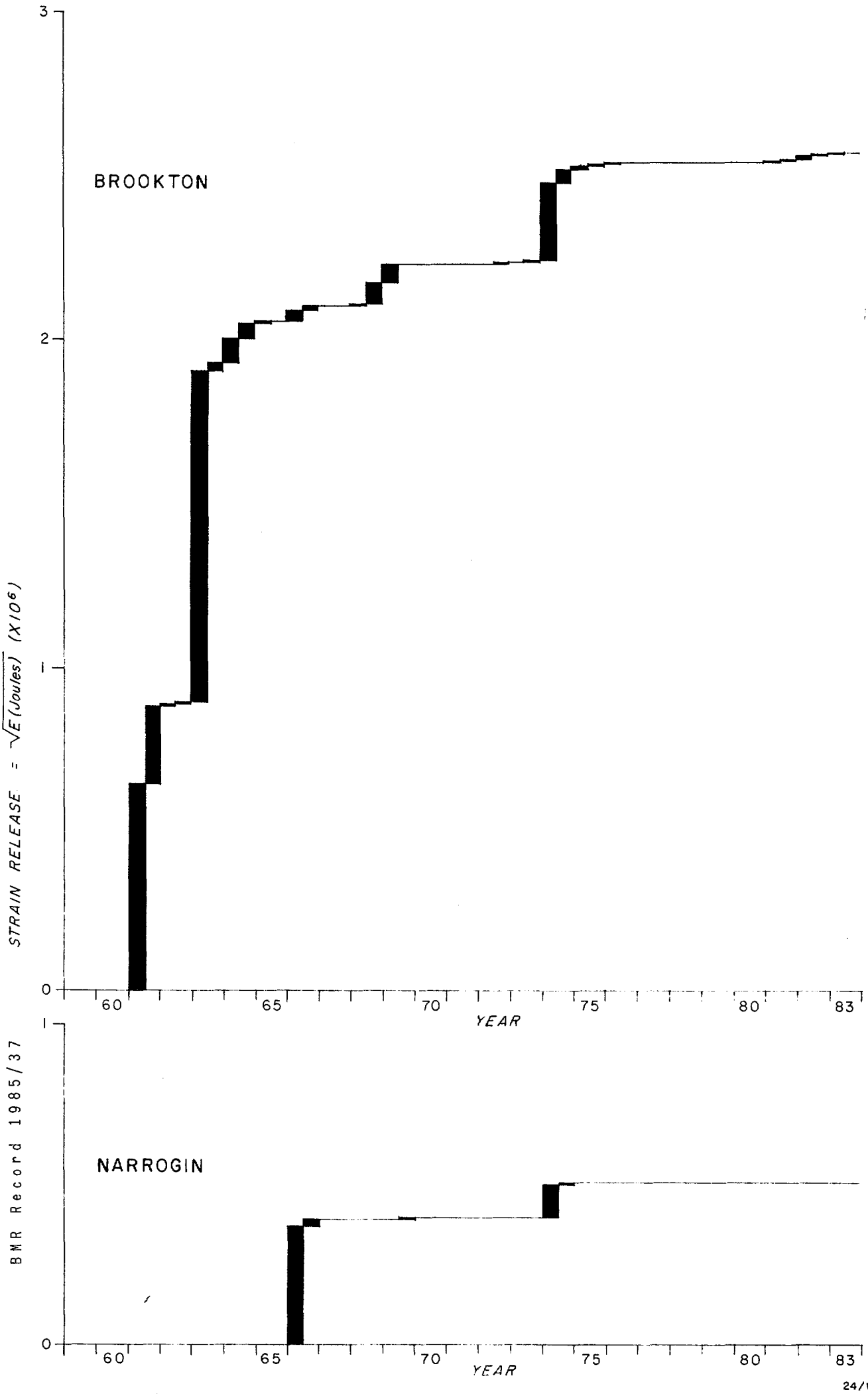
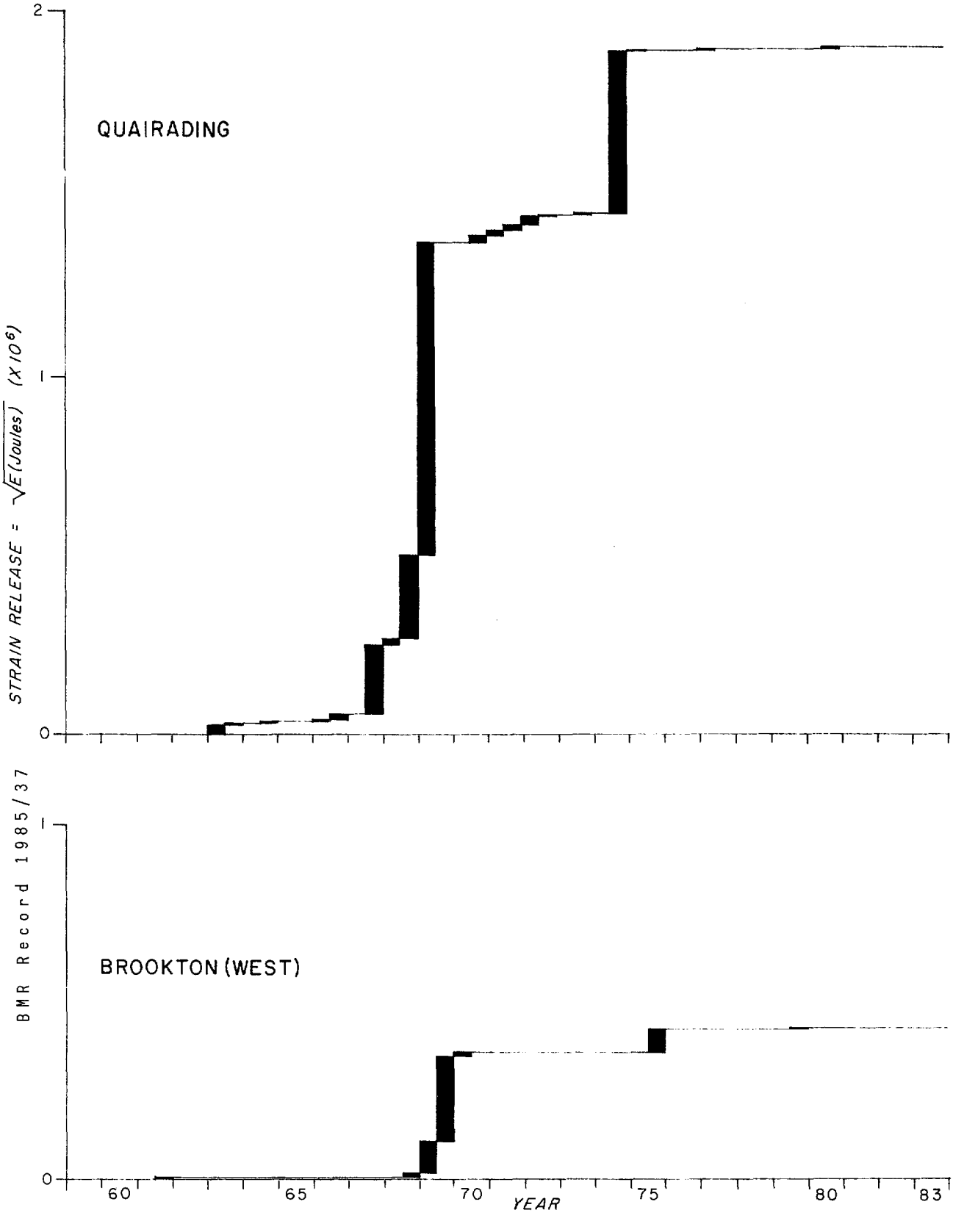


Fig. 20(C) Strain release - Southwest seismic zone (south) 1959-1983

24/W 53



24/WA/54

Fig. 20(D) Strain release - Southwest seismic zone (south) 1959–1983

74

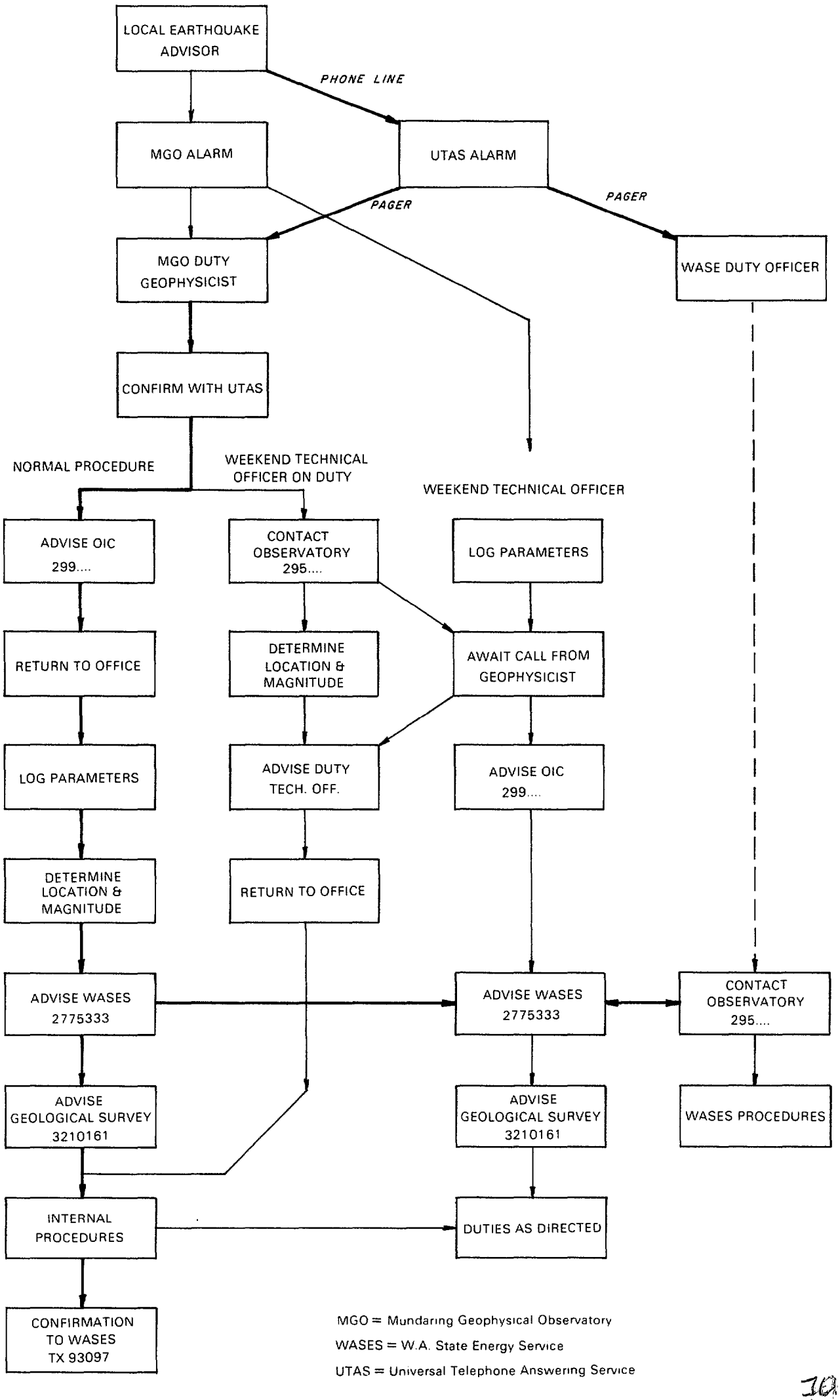


Fig. 21 Major earthquake procedures