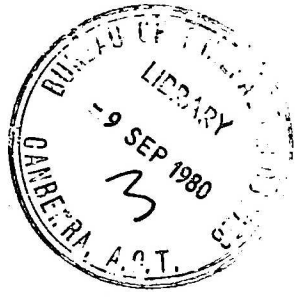

BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS

RECORD

Record 1980/51

MUNDARING GEOPHYSICAL OBSERVATORY

ANNUAL REPORT 1979

by

P.J. Gregson

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SUMMARY

Basic programs in geomagnetism, ionospherics, and seismology continued at the Mundaring Geophysical Observatory during 1979. 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 Mundaring, Swan View, Narrogin, Kalgoorlie, Meekatharra, Marble Bar, Warburton, and Kununurra.

The annual earthquake lists show details of 326 Western Australian earthquakes. Large earthquakes occurred 260 km northwest of Broome on 23 April, and at Cadoux on 2 June. The latter caused extensive damage in the area. Of the earthquakes listed, 231 occurred in the Cadoux area.

Isoseismal maps for two Cadoux earthquakes (2 June and 11 October) were prepared.

1. INTRODUCTION

The Mundaring Geophysical Observatory opened on 18 March 1959, and now controls seismological recording at Mundaring, Swan View, Narrogin, Kalgoorlie, Meekatharra, Marble Bar, Kunnunurra, and Warburton and magnetic recording at Gnangara and ionospheric 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 1979 have been given in previous records (e.g. Gregson, 1980) and principal events in the observatory's history are given in the Appendix. Discussion of non-routine projects is brief, as details will be reported separately.

2. STAFF AND VISITORS

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, conferences attended and addresses given, in Table 4.

Mr T.E. Creaser (Assistant Grade 1) retired on 6 July. He was not replaced because of the BMR staff ceiling. Mr B. Gaull (Science Class 1) was temporarily transferred to headquarters on 27 August in preparation for Antarctic duty in 1980. Although alternative arrangements were made for most of the duties carried out by the Assistant, the two vacancies placed a strain on the remaining staff and restricted the observatory's program considerably.

Both technical officers lodged Regulation 6 appeals for the upgrading of their classifications. They were interviewed by the Public Service Board in August and September, with no result forthcoming by 31 December.

Three months' training in seismological observatory practice was given to Mr J. Soetardjo from the Indonesian Meteorological and Geophysical Institute. The training was undertaken as part of a UNESCO Fellowship study program.

Visitors to the observatory during 1979 are listed in Table 5.

3. GEOMAGNETISM

Normal magnetograph

The Eschenhagen 20 mm/hr magnetograph continued to operate at Gnangara. Record loss during the year was minor (0.5%), resulting from fogging when the hour lamp stayed on (32 hours) and an extended mains power failure (17 hours).

The recording trace became faint in February for several days. Cleaning the lamp current control potentiometer rectified the fault.

The Z baseline value decreased by 5 nT in September for no apparent reason. No other unexplained changes in baseline or scale values occurred during 1979.

As in previous years, the Z scale value drifted during the year. It changed from 5.70 nT/mm in April to reach a peak in July of 6.12 nT/mm. The drift reversed during October and November.

The H ordinate trace was increased by about 30 mm on 10 July in order to reduce the time for which the H ordinate was negative. The Cadoux earthquake on 2 June increased the H ordinate trace by about 1 mm.

Adjustments on 28 November to increase the intensity of the D baseline were only partially successful. The D baseline trace shifted by about 10 mm, reducing the D ordinate.

The standard deviation of the observed baselines and scale values were:

Element	Baseline value	Scale value
D	0.21 min	-
H	1.4 nT	0.01 nT/mm
Z	1.4 nT	0.04 nT/mm

These were similar to the standard deviations obtained for 1978 data.

Magnetograph tests

Temperature coefficients. Values of qH = 0.0 nT/^{o}C and qZ = 2.4 nT/^{o}C derived from 1978 data were used throughout 1979.

Orientation. Orientation tests were carried out on all variometers. In the case of the H variometer, tests were made before and after the adjustment to the H ordinate trace of 10 July. Orientations of the recording magnets in the mean magnetic fields were:

3 July	H:	E 0.6^{o} S
10 July	H:	E 0.1^{o} S (after adjustment)
3 July	D:	N 0.3^{o} W
3 July	Z:	N 0.0^{o}

The values are similar to the results attained in previous years.

Parallax. No tests were performed during 1979 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 MC02 was used in conjunction with Helmholtz coils to determine H and Z scale values once weekly. The unit failed twice during the year and several integrated circuits required replacing.

Magnetometers

Control observations for D, H, and Z values were made at weekly intervals. An Askania magnetometer (S/N 309319) was used throughout the year for D observations. A proton vector magnetometer was used for combined observations of H and Z values. Until 17 July PVM B/116/B was used. This

comprised an Elsec vector coil set B, Elsec proton-precession magnetometer (S/N 116), and sensor head B. The Elsec magnetometer and sensor head were replaced on 17 July with an MNS-2 proton-precession magnetometer (S/N 5) and sensor head. The latter magnetometer is capable of reading to 0.1 nT compared with 1 nT for the Elsec. The resulting combination PVM B/5/Z was used for the remainder of the year.

Comparisons. Comparisons were made between the two PVM sets B/116/B and B/5/Z on 8, 10, 11, and 29 May. Measurements of H and Z were compared by alternating instruments on the NM pier. F comparisons were also made by using both NM and NW piers and alternating magnetometers.

The mean differences for all observations are shown below. Differences on each day showed considerable scatter as indicated in brackets.

H. B/116/B - H. B/5/Z = 1.0 nT (-0.2 to 1.8; 16 observations)
Z. B/116/B - Z. B/5/Z = -1.6 nT (-3.3 to 0.9; 16 observations)
F. B/116/B - F. B/5/Z = -0.1 nT (-1.9 to 1.9; 64 observations)
F. NW pier - F. NM pier = -0.5 nT (64 observations)

An examination of the MNS-2 sensor head showed that the terminal strip was magnetic. This was replaced with a non-magnetic strip and observations were repeated on 26 June and 3 July. Mean differences were:

H. B/116/B - H. B/5/Z = 0.3 nT (8 observations)
Z. B/116/B - Z. B/5/Z = -0.8 nT (8 observations)
F. B/116/B - F. B/5/Z = -1.8 nT (16 observations)
F. NW pier - F. NM pier = -0.1 nT (16 observations)

The observations showed that the orientation of the sensor head in the vector coils was significant and therefore the same orientation should be used for all observations. Observations using the MNS-2 magnetometer showed less scatter than for the Elsec magnetometer.

Preliminary corrections used during the year were:

(a) PVM B/116/B: H nil, Z nil.
(b) Askania declinometer 509319 (circle 508135): +0.5 minutes.
(c) PVM B/5/Z: H nil, Z nil.

Accessory equipment

The Askania horizontal-intensity visual recorder at Mundaring office was operated throughout the year with minor record losses.

Magnetic pulsation tape recording equipment was operated at the Weir site for the University of Newcastle. Apart from minor losses, recording was continuous.

First-order magnetic survey

First-order magnetic observations were made by observatory staff at Christmas Island and Cocos Island in June. The Australian survey office determined azimuth of reference marks at the Albany and Augusta magnetic stations. Results are reported elsewhere.

Date reduction and publication

As in previous years, mean hourly value reduction data were prepared in monthly batches about three months after recording. Magnetograms and reduction data were sent to headquarters when requested to determine hourly values. From September, reduction data were prepared within a few weeks after the end of each month so that data could be used for the Magsat program.

Monthly and annual mean values of H, D, Z, F, and K-index at Gnangara for 1979 are listed in Table 6. The values were derived from the ten local quiet days of 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 for all components since 1969 are shown in Table 7. Recent trends in secular variation continued with H decreasing by 37 nT, D becoming more westerly by 1.4 minutes, and Z increasing in magnitude by 28 nT. The calculated mean value of F rose by 11 nT during 1979.

The distribution and publication of data continued as for 1978 (Gregson, 1980, Table 10), weekly K-indices being sent to two further recipients. Rapid variation and principal magnetic storm data for 1978 were prepared for the IAGA Bulletin.

Requests for geomagnetic data attended to during the year are listed in Table 15.

4. IONOSPHERICS

Equipment

The model IIIE Ionosonde which had been in service since 1970 was replaced with an IPS type 4B ionosonde on 16 January. The new ionosonde is a compact, largely solid state, swept-frequency, pulse instrument, designed for routine vertical incidence sounding of the ionosphere. It employs a digital frequency synthesiser and digital programming control, signal processing, and display techniques. Recording is on 16 mm film which is changed weekly. The ionosonde and spare components were supplied by the Ionospheric Prediction Service (IPS), Department of Science. The quarter-hourly sounding schedule was continued throughout the year.

During installation of the ionosonde, a switch on the synthesiser unit was incorrectly left on the single-frequency position. This was not noticed until 20 February. During that period a continuous power signal of 1 MHz was radiated, resulting in deterioration of the final stage amplifier valves. These were replaced.

The monitor scope power supply failed in November as a result of a faulty transformer. The complete unit was replaced by IPS.

Retardation of the signal at critical frequencies at certain times of day resulted in some loss of data. Modifications proposed by IPS to the automatic gain control circuitry were made in September. This reduced the loss of data but the problem still remains. It may be necessary to install an automatic gain change for day and night soundings.

The film cassette is of poor design, and inexperience by the operators in handling the film and loading cassettes was the major cause of record loss during the first half of the year. Unless carefully loaded, the film jammed in the cassette. There was no indication of this until the film was unloaded, sometimes a week later. A small inspection hole was drilled in the cassette so that the rotation of film spools could be checked routinely. This enabled detection within 24 hours of the film jamming.

Data distribution and publications

From 1 January scaling of ionograms by Mundaring staff was reduced to five values a day, i.e. the F2 layer critical frequency every six hours UT and at local noon. The weekly film was sent to IPS Sydney for scaling of the remaining parameters. Distribution and publication continued as previously (for details see Gregson (1976).

5. SEISMOLOGY

Seismograph stations

Permanent seismograph stations were operated throughout 1979 at Mundaring (MUN), Kalgoorlie (KLG), Meekatharra (MEK), Kununurra (KNA), Marble Bar (MBL), Swan View (SWV), Warburton (WBN), and Narrogin (NWAO). Field seismographs were operated in the southwest seismic zone.

An insensitive seismograph was installed in the Mundaring office in December. The peak magnification of the seismograph is about 50 at 0.1s. This was installed because of the difficulty in obtaining accurate magnitudes for large earthquakes which occur in the southwest seismic zone. The calibration curve is shown in Figure 3.

The number of events reported from each station in 1979 was:

MUN 579; SWV 137; NWAO 630; KLG 221; MEK 624; MBL 1062;
KNA 782; WBN 152. TOTAL 4187.

A summary of all record losses from the permanent seismograph stations is given in Table 8. Record losses from all stations, with the exception of Kalgoorlie and Marble Bar, were greater than for 1978. Reasons are discussed under individual station headings.

Mundaring. The WWSS seismograph continued to be reliable. Twelve days of record were lost during maintenance and calibration tests made by a team from the Albuquerque Seismological Laboratory in January. The free period and damping of the SP-Z and SP-NS galvanometers were out of tolerance limits and the galvanometers were replaced. One of the connectors and the shield of the cable between the seismometer and galvanometer of the LP-NS

component had been reversed at an earlier date. Although this fault had no effect on the seismograph, the connections were rewired correctly.

The LP-EW seismometer magnet/coil assembly was dismantled, cleaned, and re-aligned in March, as it appeared that the seismometer was jamming.

The bearing on the LP recorder failed in July, resulting in two days of LP record loss before the bearings could be replaced.

The supplementary recorder operated satisfactorily throughout the year.

Swan View. The seismograph was out of service for 26 days when the AS330 pre-amplifier was being repaired, and 11 days while some of the equipment was used at other stations.

Narrogin. Faults with the SRO during the year were numerous and are summarised below:

(a) The systems controller at the remote end failed on 11 January with the result that no data were being returned to the recording system at Mundaring. Replacement components were not available until 11 February. The unit failed again on 19 February, but this fault was rectified by reseating the newly installed components.

(b) Tape unit 1 failed on 23 May. Although the seismograph continued to record satisfactorily it meant that there was no spare tape recording unit. A replacement magnetic tape interface board did not correct the fault and a replacement data electronics board sent from Albuquerque Seismological Laboratory (ASL) for the tape unit was faulty. The problem was rectified when a new data electronics board was installed on 3 September. The tape unit failed again on 5 November and was still unserviceable at the end of the year.

(c) The "Beginning of day" message and automatic daily calibration failed in August as a result of the program not detecting 00.00 hours. Thorough cleaning of the clock eliminated the fault.

(d) The inverter at the remote end failed on 20 July. This was fixed by replacing the drive board on 22 August.

(e) The 5V power supply at the remote end failed on 28 October and a temporary supply was installed. The replacement power supply from ASL was installed on 22 November.

(f) Damage to the main magnetic program tape prevented the program being reloaded from 25 December. This was not diagnosed until 2 January 1980 when supplementary tapes were used to load the program.

(g) Lightning activity at Narrogin in February caused the failure of an equaliser unit at the Narrogin Telecom exchange. State Energy Commission mains power also failed for an extended period, resulting in the 24V batteries going flat.

Minor faults included:

(h) Failure of the tape recorder arm sense lamp.

(i) Incorrect helicorder clutch tightness.

(j) Helicorder translation wires falling off (several occasions).

(k) Mains power failure at the remote end as a result of the breakdown of lightning arrestors on the mains input.

New anti-aliasing filters were installed on the three LP components in January and a new Kinemetrics radio was installed in August. Thirty centimetres of water was removed from the vaultlet in August.

Maintenance visits to the station by personnel from the Albuquerque Seismological Laboratory were made in January, February, and August.

Kalgoorlie. This seismograph operated with little loss of record throughout the year. A modified DC charger, DC distribution panel, and relay unit were installed in October.

Meekatharra. This seismograph operated with little loss of record throughout the year. The recorder clutch was serviced and the standby batteries were replaced in February. A modified charger and relay unit were installed in December.

Marble Bar. The major problems at Marble Bar were associated with power supplies. The town 250V main supply was unreliable for considerable periods in April and May, resulting in about four days' record loss. Lightning damaged the regulator in the remote power supply, and with poor charging rates from the solar cells due to lengthy overcast periods and a faulty 12V battery, a total of nearly seven days' record was lost. The late or non-attendance of the operator resulted in a total of six days' record loss. This was an improvement on the previous year but could still be improved.

A modified battery charger and relay unit were installed in December.

Kununurra. Failures of the recorder motor, EMI clock, and 24V batteries were the main reasons for increased record loss during 1979.

Warburton. Operational problems continued throughout the year. Although most of the equipment problems were fairly minor, they resulted in considerable amounts of record loss. The equipment problems were compounded by inexperienced operators, poor reporting of fault symptoms, and poor communication. On numerous occasions there was no response to queries from the observatory. There were several relief operators throughout the year when the normal operator was away from Warburton.

Visits to the station by observatory staff were made in February and August. On the latter occasions, a modified charger, DC distribution panel, and relay unit were installed.

Field stations. Three field seismographs were operated in the Meckering area until 21 July when one was transferred to Burakin (25 km north of Cadoux). Operation of the Burakin and one of the Meckering seismographs ceased on 2 August so that repairs could be made to the equipment. Seismograph details are given in Table 12.

Accelerographs

Six MO2 accelerographs were operated throughout the year apart from short periods when two instruments required maintenance in the office. Four instruments were located in the Meckering area and the other two were operated by the State Public Works Department (PWD) at Kununurra. The PWD also operated a Kinemetrics SMA-1 accelerograph at Mundaring Weir. Location details are given in Table 13.

Three earthquakes on 23 January, 2 June, and 27 November, which occurred in the southwest seismic zone, triggered accelerographs. The maximum ground accelerations recorded are summarised in Table 14.

Seismicity

Tables 10 and 11 list 230 earthquakes which occurred in the Cadoux area during 1979. Table 9 lists 99 earthquakes of magnitude ML = 2.0 or greater which occurred in Western Australia other than the Cadoux area in 1979. Of these, only 18 occurred in the southwest seismic zone.

Epicentres were determined graphically using Western Australian stations and, where applicable, other Australian stations. Depths were assigned wherever possible.

Figures 1 and 2 show epicentres of Western Australian earthquakes with magnitude ML = 3 or greater (mB = 4.0 or greater) and those in the southwest seismic zone respectively.

Southwest seismic zone. A major earthquake occurred on 2 June 1979 near the small town of Cadoux. Only one person was injured, but the cost of damage in the town and surrounding district exceeded $4m. Preliminary results show that the earthquake had a Richter magnitude of 6.2 and occurred at 09h 48m 01s UT, at latitude 30.83°S, longitude 117.15°E, and at a depth

of 15 km. The maximum Modified Mercalli intensity observed was IX. The surface of the earth fractured in a zone 14 km long. The Australian Survey Office made surveys in the Cadoux area of both vertical and horizontal ground displacements following the earthquake. A preliminary report was prepared by Gregson & Paull (1979). A more detailed report will be presented later.

Activity in the rest of the zone was at about the same level as for 1978 and was widespread from Perenjori in the north to Nyabing in the south. One small event occurred 50 km west of Cape Naturaliste.

Rowley Shoals. A magnitude ML = 7.3 earthquake occurred on 23 April, 260 km northwest of Broome. The maximum intensity felt in Western Australia was MM IV at Broome, Derby, and Port Hedland. The earthquake was felt in some of the taller buildings in Perth, 1650 km away. Tide recordings along the coast of Western Australia showed no unusual sea-level fluctuations. Two foreshocks and 29 aftershocks, ranging in magnitude from 3.3 to 6.1, occurred between April 22 and October 25.

Kununurra. Only two earthquakes occurred in the area within 200 km of Kununurra compared with seven in 1978. The largest, ML = 3.1, occurred on 26 October, 82 km south of Kununurra.

Other areas. Earthquakes also occurred in other regions throughout the State. Those with magnitude above ML = 4 were - 550 km SW Albany (4.5); 120 km E Warburton (4.5); 230 km N Point Sampson (2 events, 4.1); 150 km NE Halls Creek (4.9); 120 km W and 100 km W Barrow Island (2 events, 4.5); and 60 km from Marble Bar (4.2) (Fig. 1).

Earthquake intensities

Seven hundred intensity questionnaires were distributed for the magnitude ML = 6.2 earthquake of 2 June and an isoseismal map was prepared from the 75% returned (Fig. 4). The maximum intensity reported was MM IX and the radius of the isoseismal for intensity IV was about 400 km. By comparison, the magnitude 4.8 earthquake of 11 October had a maximum MM intensity of V, and the radius of the IV isoseismal was 130 km (Fig. 5). One hundred questionnaires were distributed for this earthquake.

Insufficient data were available to draw an isoseismal map for the magnitude ML = 7.3 earthquake of 23 April. Intensities of IV were experienced in Port Hedland, 450 km from the epicentre.

Data distribution and publication

The distribution of data continued as for 1978 (Gregson, 1980). Requests for seismological data attended to during the year are listed in Table 15.

6. ACKNOWLEDGEMENTS

The assistance of the daily attendants listed in Table 2, the co-operation of Australia Post for housing the Marble Bar seismograph and assistance of the Australian Survey Office for surveys at Albany, Augusta, and Cadoux are acknowledged. The operation of seismographs during the year in the Meckering-Cadoux areas by Mr N. Richardson, Mrs F. Morrell, Mr W. Thompson, and Mrs J. McKenzie is appreciated.

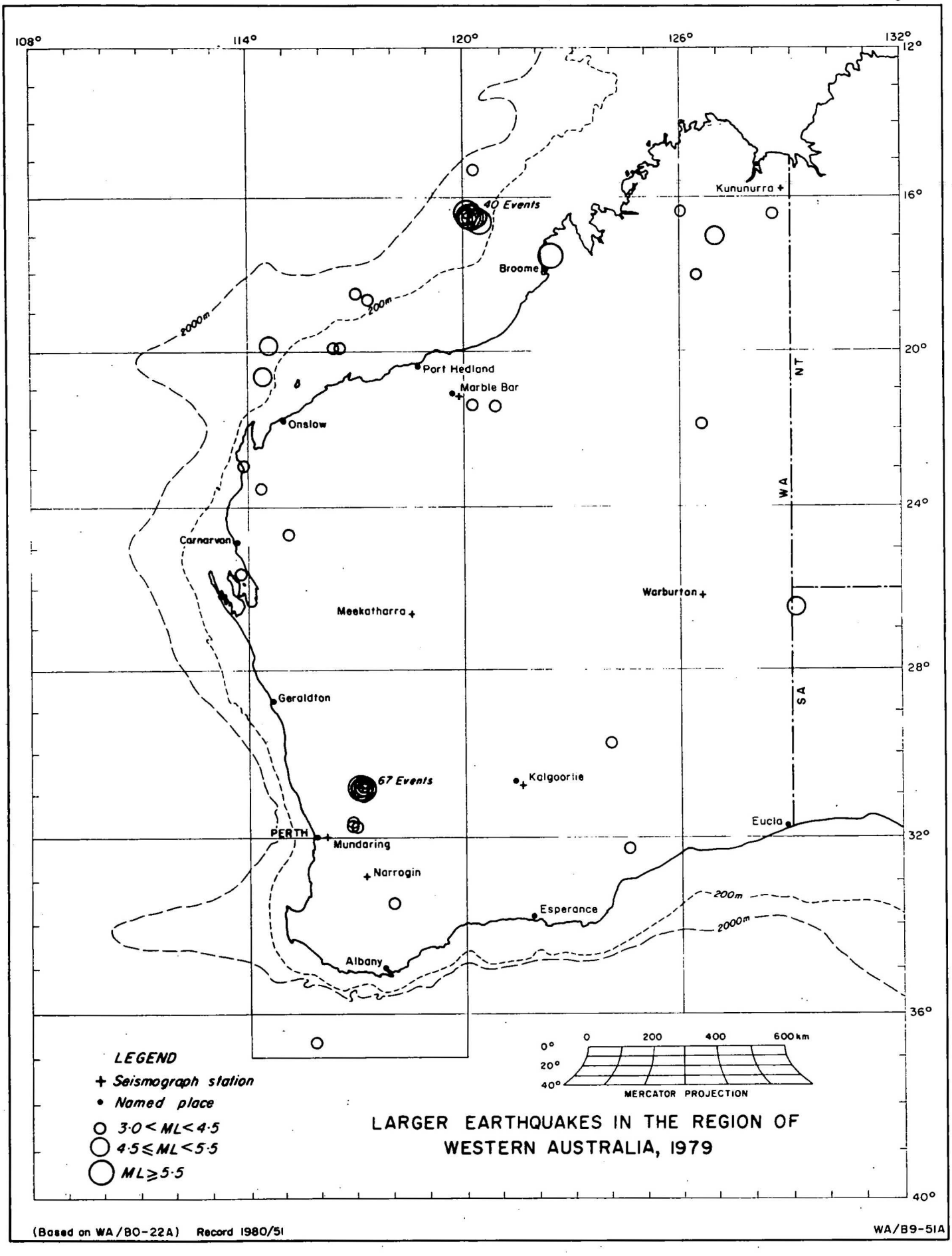
7. REFERENCES

GREGSON, P.J., (1976) - Mundaring Geophysical Observatory Annual Report 1975. Bureau of Mineral Resources, Australia, Record 1976/48

GREGSON, P.J., (1980) - Mundaring Geophysical Observatory Annual Report 1978. Bureau of Mineral Resources, Australia, Record 1980/40.

GREGSON, P.J., & PAUL, E.P., (1979) - Preliminary report on the Cadoux earthquake Western Australia, 2 June 1979. Bureau of Mineral Resources, Australia, Report 215; Microform MF100.

Fig.1

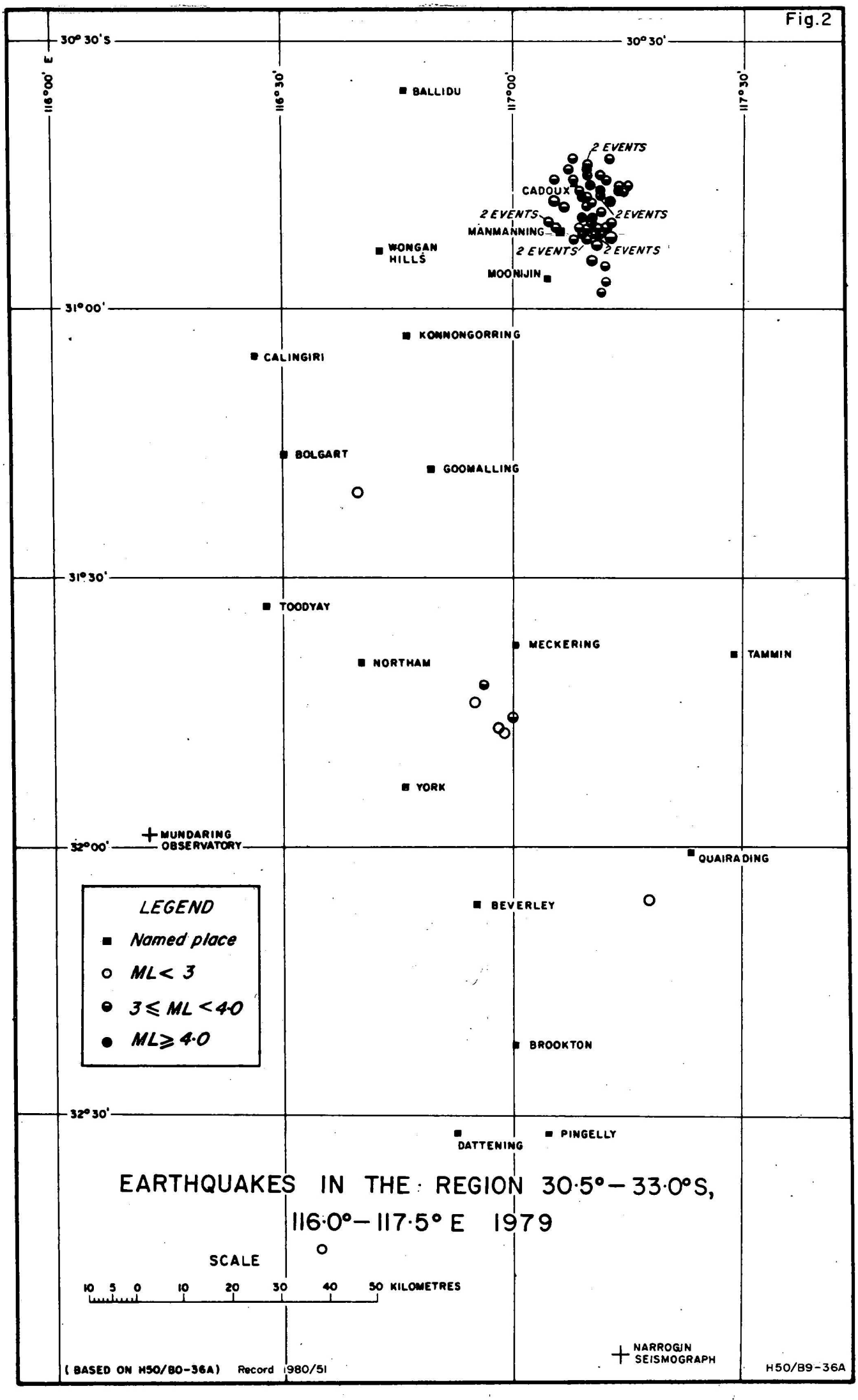


LARGER EARTHQUAKES IN THE REGION OF WESTERN AUSTRALIA, 1979

(Based on WA/80-22A) Record 1980/51

WA/89-51A

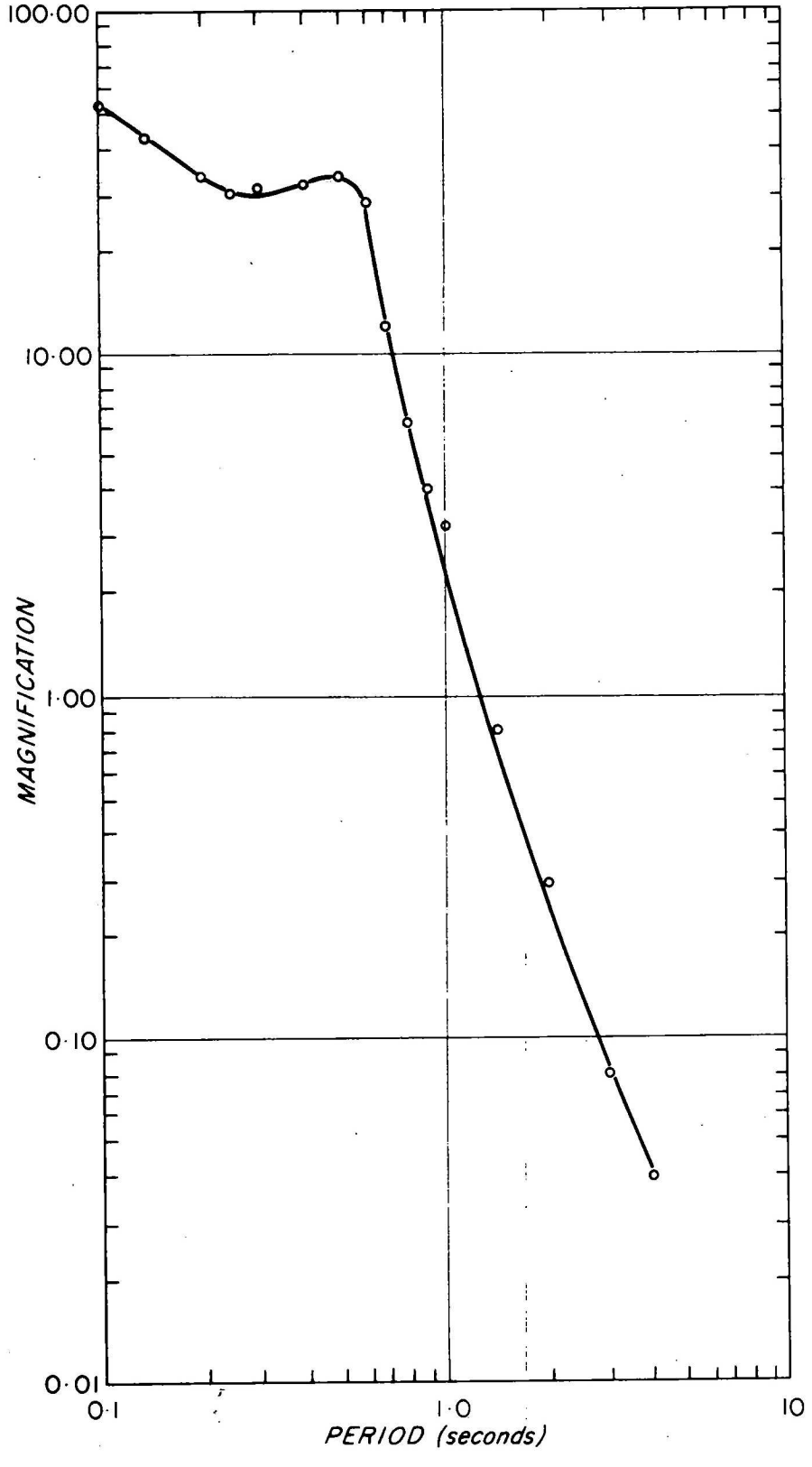
Fig.2



EARTHQUAKES IN THE REGION 30·5°–33·0°S, 116·0°–117·5° E 1979

(BASED ON H50/80-36A) Record 1980/51

H50/89-36A



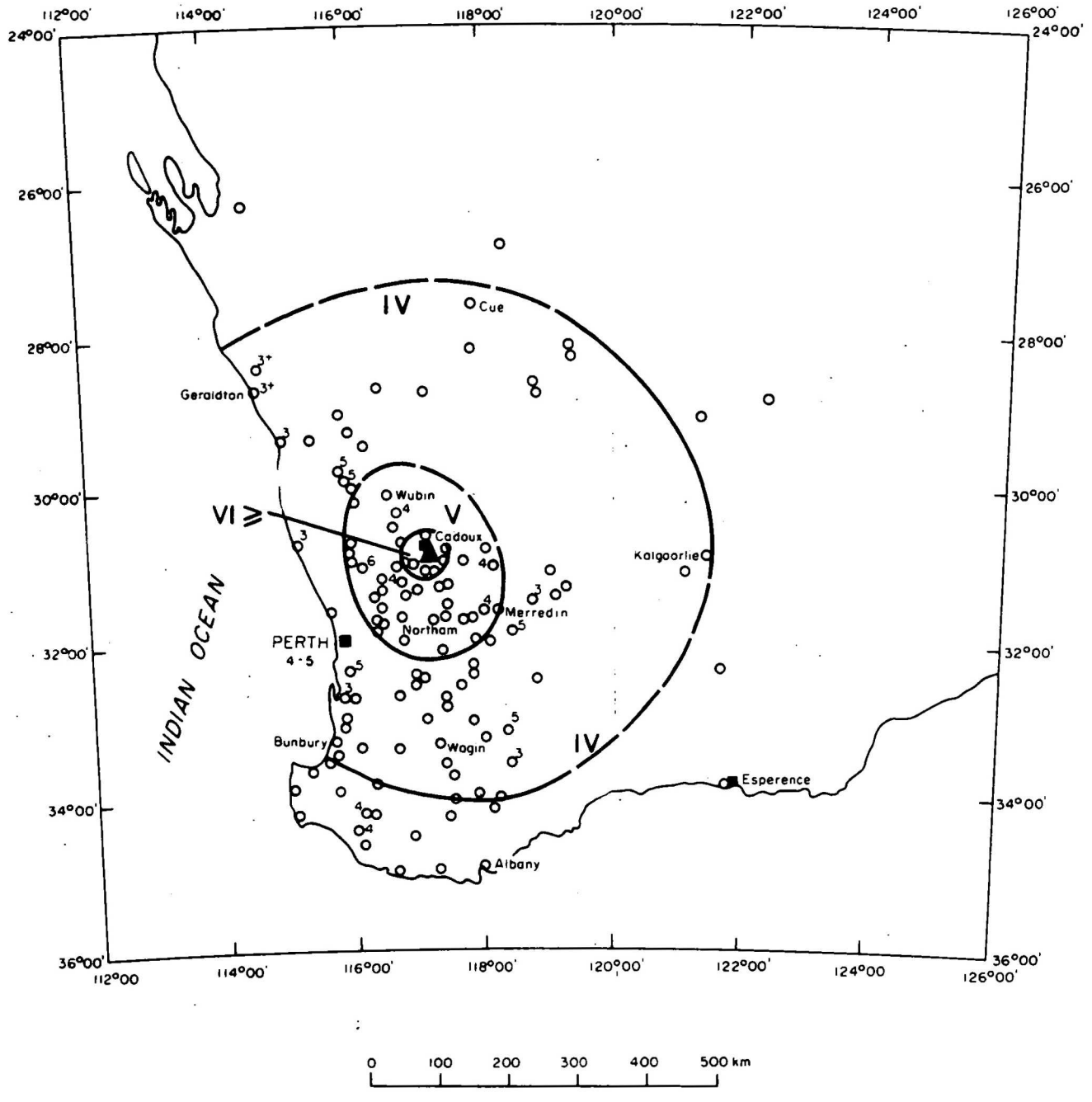
CALIBRATION CURVE MUNDARING SEISMOGRAPH

FROM DECEMBER 1979

MUN SP - Z INSENSITIVE

Fig.4

ISOSEISMAL MAP OF THE CADOUX EARTHQUAKE, WA 2 JUNE 1979



DATE : 2 JUNE 1979

TIME : 09·48·01·1 UT

MAGNITUDE : 6·2 ML (MUN), MB 6·3, MS 6·4

EPICENTRE : 38·83°S 117·15°E

DEPTH : 13 km

▲ EPICENTRE

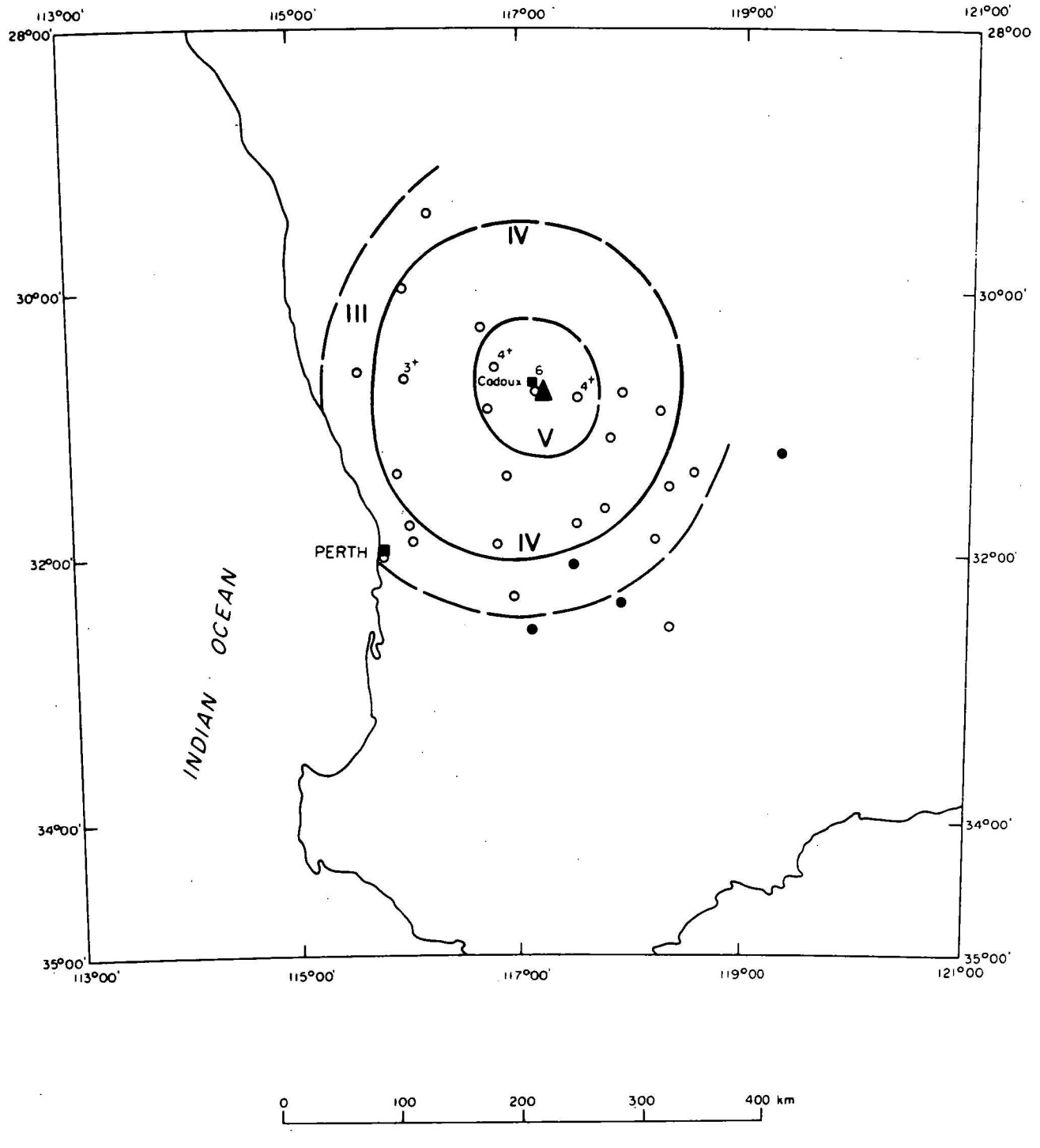
o EARTHQUAKE WAS FELT

IV ZONE INTENSITY DESIGNATION (mm)

Small figure beside open circle indicates intensity is different from zone designation

Fig.5

ISOSEISMAL MAP OF THE CADOUX EARTHQUAKE, WA 11 OCTOBER 1979



DATE : 11 OCTOBER 1979
TIME : 04 : 04 : 11·7 UT
MAGNITUDE : 4·8 ML (MUN), 5·0 MB
EPICENTRE : 30·79°S 117·15°E
DEPTH : 15 km

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

Small figure beside open circle indicates intensity is different from zone designation

APPENDIX

PRINCIPAL EVENTS

MUNDARING GEOPHYSICAL OBSERVATORY 1957-1979

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 operation 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 Feb 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 M02 accelerographs installed at Meckering.
1972, Feb 29	KNA seismograph upgraded to 3 components.
1972, Mar 01	M02 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	M02 accelerograph (PWD) installed at Kununurra.
1973, Jan 31	Mobile SP-Z recording at various sites in SW seismic zone started.
1973, Mar 30	KLG - reduced to SP-Z.
1973, May 01	MEK - increased to 3-component SP.
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 19-Aug 15, Dec 18	SWV - SP-Z recording.
1975, Sep 02-1976, Feb 05	NWA - 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.

TABLE 1

OBSERVATORY STAFF 1979

Officer	Designation
P.J. Gregson	Geophysicist Class 3
E.P. Paull	Geophysicist Class 2
B.A. Gaull	Geophysicist Class 1 (temporary transfer to HQ, 27 Aug)
G. Woad	Technical Officer Grade 2
B.J. Page	Technical Officer Grade 1
Y.M. Moiler (Mrs)	Clerical Assistant Grade 3
T.E. Creaser	Assistant Grade 1 (retired, 6 Jul)

TABLE 2

ASSOCIATED PERSONNEL 1979

Name	Nature of duties
B. Carling	Daily attendant, Gnangara
P. Maddren	Daily attendant, Kalgoorlie
B. Harvey	Daily attendant, Meekatharra
J. Bailey	Daily attendant, Marble Bar (until 10 Jul)
R. Tatham	Daily attendant, Marble Bar (from 11 Jul)
J. Roberts	Daily attendant, Kununurra
S. Steen	Daily attendant, Warburton
F. Morrell	Seismograph operator, Meckering

TABLE 3

OBSERVATORY STAFF ABSENCES 1979

Nature of absence	No. of man-days
Sick leave	51
Special leave	2
Furlough	63
Military leave	24
Attendance at outstations and field operations	42
First Order Magnetic Survey	7
Temporary transfer	86
Conferences and training	22
	297

TABLE 4

CONFERENCES, ADDRESSES AND TRAINING, 1979

Officer	Date	Address/Conference
P.J. Gregson	Jan, 22-26	Attended ANZAAS, Auckland, NZ
	Jan, 29-30	Visited DSIR Observatory, Wellington, NZ
	Feb, 01-02	Visited headquarters, Canberra
E.P. Paull	Jun, 26	Addressed Roleystone Ratepayers - Earthquakes
P.J. Gregson	Oct, 18	Addressed States' Emergency Services - Earthquake risk
P.J. Gregson	Oct, 19	Attended Seismic Sub-committee of Accreditation Technical Experts Natural Disasters (ATEND), committee of the State Emergency Service
E.P. Paull	Dec, 03-14	International Union Geodesy & Geophysics, Canberra; presented paper - Cadoux earthquake
P.J. Gregson	Dec, 04	Addressed Shires from Calingiri and surrounding districts - Earthquake risk
P.J. Gregson	Dec, 11	Attended Advisory Committee, West Australian Institute of Technology

TABLE 5

VISITORS 1979

Visitor	Institution
Mr G. Dushaw	Albuquerque Seismological Laboratory
Mr T. Shields	Albuquerque Seismological Laboratory
Mr B. Brizzell	Albuquerque Seismological Laboratory
Dr. B. Forgen	Ionospheric Prediction Service
Mr Cornelius	Ionospheric Prediction Service
Dr N. Pavlenkova	Institute of Earth Physics, Moscow
Dr S. Boldyrev	Institute of Earth Physics, Moscow
Dr G. Udintsev	Institute of Earth Physics, Moscow
Dr V. Lugovenna	Institute of Earth Physics, Moscow
Mr B. Johnson	Macquarie University
Mr R. Tatham	Marble Bar seismograph operator
Mr H. Peglar	Geology Department, WAIT
Mr J. Denny	State Public Works Department
Mr T. Cairns	State Public Works Department
Mr F. Pitman	State Public Works Department
Mr N. Daetwyler	State Geological Survey
Dr J. Lewis	State Geological Survey
Mr M. Gettings	U.S. Geological Survey Mission
Mr T. Herzfeld	MLA, Mundaring
Mr G. Spriggs	MLA, Darling Ranges
Mr M. Nanovich	MLA, Whitford
Mr R. Pike	MLC, State Parliament
Mr G. Masters	MLC, State Parliament
Mr B. Drummond	Bureau of Mineral Resources, Canberra
Dr S. Mather	Bureau of Mineral Resources, Canberra
Mr D. Fortescue	Representative, Building Products
Mr Pitt	State Energy Commission
Mr B. Tanner	State Energy Commission
Mr J. Scott	Maunsell and Partners
Mr B. Smith	Golder Associates, USA
Mr B. Hoffman	Golder Associates, USA
Mr D. Giles	Public Service Office, Perth
Mr R. Cooke	Australian Survey Office, Perth
Mr B. Gilligan	Australian Survey Office, Perth
Dr G. Berz	Munich Re-insurance Co, Munich
Mr B. O'Brien	Munich Re-insurance Co, Munich

Visitor	Institution
Mr B. Kenyon	Department Administrative Services, Perth
Mr T. Cox	Department Administrative Services, Perth
Dr Y. Stus	Institute of Automation & Electrometry, Siberian Branch of Academy of Sciences
Dr E. Ralish	Institute of Automation & Electrometry, Siberian Branch of Academy of Sciences
Dr T. Tarassiuk	Institute of Automation & Electrometry, Siberian Branch of Academy of Sciences
Dr E. Arnantox	Institute of Automation & Electrometry, Siberian Branch of Academy of Sciences
Students	Darlington Primary School
Students	Ravensthorpe High School

TABLE 6

PRELIMINARY MONTHLY MEAN GEOMAGNETIC VALUES AND K-INDICES

1979

Month	D(West)	H, nT	Z, nT	F, nT	K
January	3° 16.3'	23459	53613	58521	2.86
February	16.2	461	616	524	2.48
March	16.1	451	618	522	2.57
April	16.4	448	622	525	2.82
May	15.0	451	620	524	2.29
June	16.3	446	620	522	1.95
July	16.6	445	622	523	1.90
August	16.6	433	626	522	2.30
September	16.8	429	626	521	2.22
October	17.3	431	632	527	2.16
November	17.2	432	640	535	2.09
December	17.6	439	637	535	2.08
Mean	3° 16.5	23444	53624	58525	2.31

TABLE 7

GEOMAGNETIC ANNUAL MEAN VALUES 1969-1979

Year	D	I	H, nT	X, nT	Y, nT	Z, nT	F, nT	Notes
1969	-2°57.6'	-65°59.6'	23822	23790	-1230	-53487	58552	2B
1970	59.6	-66°01.0'	790	758	-1242	474	527	2B
1971	-3°02.3	02.0	764	730	-1260	459	503	2B
1972	05.2	04.0	726	692	-1278	454	483	2C
1973	07.8	06.2	686	651	-1292	460	472	2C
1974	09.9	09.0	642	606	-1304	477	470	2C
1975	11.5	11.3	608	571	-1314	496	474	2C
1976	12.4	14.2	567	530	-1318	528	486	2C
1977	13.6	17.0	528	491	-1324	557	497	2C
1978	15.1	20.5	481	443	-1332	596	514	2C
1979	16.5	23.1	444	405	-1339	624	525	2C
1969-1979	-1.89	-2.35	-37.8	-38.5	-10.9	13.7	-2.7	
1969-1974	-2.46	-1.88	-36.0	-36.8	-14.8	-2.0	-16.4	
1974-1979	-1.32	-2.82	39.6	-40.2	-7.0	-29.4	11.0	

Notes: 2. Preliminary values B. Mean hourly values, 5 IQ days
C. Mean daily values, 10 days

TABLE 8

1979 SEISMOGRAPH RECORD LOSSES IN HOURS

	MUN WWSSN						MUN SUP			NWAO								KNA			
	SP			LP			SP			SP	LP							SP			
Causes	Z	N	E	Z	N	E	Z	N	E	Z	Z	N	E	SWV	KLG	MEK	MBL	Z	N	E	WEN
OPERATOR																					
Late change															20	29	139	52	52	52	118
Drum not reset															21						24
Paper reversed							24	24	24									6	6	6	
Paper fogged				23	23	23	32	32	24									30	30	30	
POWER FAILURES																					
Mains							7	7	7	30	30	30	30		3	3	99				1
Battery DC														15			157	87	87	87	
RECORDER																					
Lamp down			12				22	21										56			
Recorder				50	50	50			5			2			13		145	126	126	126	12
Seismometer jammed						120															
CONTROL EQUIPMENT																					
EMI																		58	58	58	
PS112																	86				
AS330														624							
Computer										144	144	144	144								
Systems controller										534	534	534	534								
Equipment elsewhere														267							
LINE FAILURE										9	9	9	9				27				
MAINTENANCE	290	290	290	288	288	386				55	55	71	71				2				
MISCELLANEOUS										170	170	170	170				11	12	12	12	2760
TOTAL	290	290	302	361	361	579	85	84	60	942	942	960	958	906	57	32	666	427	371	371	2915
Percentage	3.3	3.3	3.4	4.1	4.1	6.6	1.0	1.0	0.7	10.8	10.8	11.0	10.9	10.3	0.7	0.4	7.6	4.9	4.2	4.2	33.3%
Mean percentage			4.2					0.9				10.9							4.5		

TABLE 9

WESTERN AUSTRALIAN EARTHQUAKES 1979

(Excluding the Cadoux area - See Tables 10 & 11)

Date 1979	Origin Time U.T.	Lat. °S	Long °E	Depth km	ML(MUN)	mB(MUN)	Remarks	No. of Stations
Jan 09	11 55 04.9	33.95	117.99		2.3		Gnowangerup, felt MM IV.	2
17	17 31 28	22.95	113.85	(70)	3.4		120 km SSW Exmouth	3
24	18 31 39	38.05	112.56		4.5		550 km SW Albany	5
24	21 49 15.0	31.07	115.69	25	2.9		32 km W Mogumber.	4
Feb 03	15 23 04.1	30.72	117.75	15	2.4		14 km NW Bencubbin	5
07	22 48 00.0	21.42	120.85		3.9		100 km ESE Marble Bar	3
Mar 19	19 44 26.9	(21.1)	(119.8)		2.2		20 km from Marble Bar	2
26	00 14 27.7	16.35	126.07		3.2		10 km W Mt. Elizabeth	2
31	04 45 44.9	18.04	127.03		3.5		70 km WNW Halls Creek	6
Apr 10	18 11 17.5	33.40	117.76	5	2.5		4 km S Dumbleyung	3
22	21 06 12.3	16.55	120.24	37	5.7		260 km NW Broome	8
22	21 21 33	**			3.4		260 km NW Broome	1
23	05 45 08.3	16.47	120.21	37	7.3		260 km NW Broome, felt MM IV	11
23	06 03 38	**			4.2		260 km NW Broome	2
23	06 43 22.0	**			3.4		260 km NW Broome	2
23	07 05 57	**			3.3		260 km NW Broome	2
23	07 22 42.6	**			3.3		260 km NW Broome	2
23	09 29 46.3	**			3.9		260 km NW Broome	2
23	11 48 51.3	**			3.3		260 km NW Broome	2
23	12 07 48.5	**			3.6		260 km NW Broome	2
23	13 00 15.5	**			4.1		260 km NW Broome	2
23	13 02 21.6	**			4.3		260 km NW Broome	3

Date 1979	Origin Time U.T.	Lat. °S	Long. °E	Depth km	ML(MUN)	mB(MUN)	Remarks	No. of Stations
Apr 24	00 35 15.3	**			3.7		260 km NW Broome	2
24	03 09 02.0	**			4.6		260 km NW Broome	3
24	13 31 04.8	**			3.3		260 km NW Broome	2
24	23 14 37.8	26.50	129.13		4.5		120 km E Warburton	8
24	17 47 11.5				2.8		Near NW Cape or Great Victorian Desert	2
25	06 56 36.6	33.52	118.02	7	3.2		12 km WNW Nyabing	5
25	15 44 14.2	**			3.4		260 km NW Broome	2
25	22 13 59.6	16.63	120.40	37	6.1		260 km NW Broome	8
25	22 39 06.2	**			4.4		260 km NW Broome	2
27	06 07 33.7	**			3.6		260 km NW Broome	1
27	08 27 15.7	**			4.4		260 km NW Broome	1
27	20 14 38.8	16.43	120.16	37	5.7		270 km NW Broome	7
28	22 28 38.7	**			4.1		260 km NW Broome	3
29	06 33 35.7	31.69	117.09		2.1		10 km SW Meckering	6
30	04 00 48.2	**			3.9		260 km NW Broome	2
May 01	21 21 05.7	**			3.8		260 km NW Broome	2
02	06 26 14.8	**			3.3		260 km NW Broome	3
05	18 52 07.7	**			3.8		260 km NW Broome	2
07	06 17 00.2	**			3.5		260 km NW Broome	2
09	02 18 25.9	16.55	120.21	37	4.7		260 km NW Broome	8
09	09 30 48.1	18.55	117.05	37	4.1		230 km N Pt Sampson	3
16	01 35 09.8	**			4.1		260 km NW Broome	2
16	11 50 36.2	**			4.1		260 km NW Broome	2
17	19 31 38.8	**			3.3		260 km NW Broome	2
23	10 56 46.9	15.41	129.71		2.7		110 km WNW Kununurra	3

Date 1979	Origin Time U.T.	Lat. °S	Long. °E	Depth km	ML(MUN)	mB(MUN)	Remarks	No. of Stations
May 25	08 10 19.9	32.75	116.58	5	2.6		12 km NE Boddington	3
26	04 18 06.0	18.66	117.34	37	4.1		210 km N Pt Sampson	4
Jun 10	20 14 40.0	24.72	115.15	(16)	3.7		35 km N Gascoyne Junction	4
10	22 26 35.3				3.2		106 km from Marble Bar	2
17	15 48 05.0	15.33	120.27	37	3.7		350 km NW Broome	4
18	20 15 21.7	29.74	124.04	10	3.9		270 km ENE Kalgoorlie	5
20	01 11 13.6				2.9		4 km from Kalgoorlier (Rockburst)	1
26	19 13 00	31.79	124.19	(10)	2.6		80 km NNW Balladonia	3
27	10 46 10.6	**			3.2		260 km NW Broome	1
27	15 45 43.2	19.94	116.60	(10)	3.2		80 km N Dampier	3
28	06 48 30.4	23.51	114.40	(10)	3.3		265 km NNE Carnarvon	2
29	00 49 15.4	**			3.9		260 km NW Broome	2
Jul 08	10 11 02.6	**			3.7		260 km NW Broome	2
11	22 14 53.2	31.70	116.94	19	3.3		12 km SW Meckering	6
14	09 40 50.0	17.53	122.45	19	5.8		50 km NNE Broome, felt MM IV	5
16	20 39 41.6	17.02	127.00	15	4.9		150 km NW Halls Creek, felt Halls Creek MM IV	6
17	17 27 53.8	25.60	113.79	(10)	3.4		Shark Bay region	2
21	17 28 48.6	26.79	120.94	(10)	2.6		75 km ESE Wiluna	3
25	19 06 43.7	32.26	121.72	(10)	2.9		10 km SW Norseman	4
26	12 27 08.7	31.29	117.62	(10)	2.5		10 km NNE Yorkrakine, felt	3
26	17 34 42.0				3.3		64 km from Marble Bar	2
Aug 09	06 17 18.7	33.52	114.41		2.5		50 km W Cape Naturaliste	3
12	10 41 24.0	19.94	114.61	37	4.5		120 km NW Barrow Island	7
17	08 06 53.0	21.89	126.59	19	3.5		50 km E Lake Tobin	6
20	15 54 34.0	32.30	124.52	(10)	3.2		65 km ENE Balladonia	5

Date 1979	Origin Time U.T.	Lat. °S	Long. °E	Depth km	ML(MUN)	mB(MUN)	Remarks	No of Stations
Sept 02	15 10 09.6	31.34	116.66		2.0		15 km WSW Goomalling	3
06	15 07 31.5	36.60	115.81		3.1		260 km SW Albany	4
11	02 05 32.0	21.44	120.22	5	4.2		60 km SE Marble Bar	7
20	17 21 05.5	32.57	116.86		2.0		20 km W Pingelly	3
21	20 17 52				2.4		225 km from Meekatharra (Meeberrie)	1
23	03 44 34.0	16.50	120.11	37	4.0		260 km NW Broome	7
25	09 24 01.4	16.42	120.11	37	3.5		240 km NW Broome	5
Oct 06	06 51 59.4	29.55	116.26		2.5		12 km S Perenjori	3
21	20 46 06.7	16.55	120.25	37	4.8		260 km NW Broome	7
21	22 55 31.6	**			3.5		260 km NW Broome	2
26	02 56 05.5	16.46	128.57		3.1		82 km S Kununurra	3
31	14 07 26.3	20.63	114.43	37	4.5		100 km W Barrow Island	6
Nov 09	20 41 01.5	33.98	117.86		2.1		6 km W Gnowangerup	3
10	04 28 02.6				3.0		(565 km from Meekatharra) (408 km from Marble Bar)	2
27	06 39 41.6	31.73	116.92	10	3.0		15 km SW Meckering, felt Meckering MM IV	5
Dec 08	10 27 40.7	31.79	116.98	12	2.6		18 km S Meckering	3
08	12 48 35.3	31.76	117.00	19	3.1		15 km S Meckering	5
14	22 13 11.5	19.97	116.42		3.4		80 km NNW Dampier	3
15	14 09 07.4				3.1		307 km from Kununurra	1
17	13 36 07.4	31.78	116.97		2.6		18 km S Meckering	2
21	06 03 10.3	31.00	117.28	19	2.8		20 km NNW Wyalkatchem	5
30	10 25 05.5	33.35	116.86		2.4		12 km E Darkan	3
30	01 45 58.5	32.1	117.3		2.0		10 km S Quairading	3

** Earthquake in the vicinity of the event of 23 April (i.e. 16.57°S, 120.21°E)

TABLE 10

EARTHQUAKES IN THE CADOUX REGION, 1979

MAGNITUDE ML > 2.9

Date 1979	Origin Time U.T.	Lat. °S	Long °E	Depth km	ML(MUN)	mB(MUN)	Remarks
Mar 13	07 29 42.1	30.85	117.20	16	3.9		12 km SE Cadoux, felt MM III
14	23 45 46.8	30.88	117.18	12	3.7		13 km SSE Cadoux, felt MM IV
14	23 49 04.6	30.88	117.18	12	3.2		13 km SSE Cadoux, felt MM III
15	17 34 45.7	30.88	117.18	12	3.1		13 km SSE Cadoux
Apr 06	21 47 23.5	30.80	117.09	12	3.0		5 km SW Cadoux
May 10	19 33 16.8	30.91	117.17	8	3.1		16 km SSE Cadoux
Jun 01	21 54 02.9	30.83	117.17	17	5.2		7 km SE Cadoux, felt MM VI
01	22 38 28.9	30.86	117.15	12	3.3		10 km SSE Cadoux
02	01 34 55.4	30.85	117.16	10	3.8		10 km SSE Cadoux
02	02 13 35.3	30.85	117.14	16	3.4		10 km S Cadoux
02	02 13 50	30.85	117.14	16	3.4		10 km S Cadoux
02	03 11 51.3	30.87	117.16	8	3.0		12 km SSE Cadoux
02	09 48 01.0	30.83	117.15	15	6.2		7 km SSE Cadoux, felt MM IX
02	10 00 17.8	-	-	-	3.7		Cadoux area
02	10 05 31.9	-	-	-	3.3		Cadoux area
02	10 09 21.9	-	-	-	3.0		Cadoux area
02	10 16 52.9	-	-	-	3.4		Cadoux area
02	10 33 11.9	-	-	-	3.0		Cadoux area
02	10 37 21.8	-	-	-	3.6		Cadoux area
02	10 40 53.7	-	-	-	3.6		Cadoux area
02	10 44 22.8	-	-	-	3.3		Cadoux area
02	11 04 57.2	30.80	117.21	13	4.1		8 km ESE Cadoux
02	11 36 09.6	-	-	-	3.3		Cadoux area

Date 1979	Origin Time U.T.	Lat. °S	Long. °E	Depth km	ML(MUN)	mB(MUN)	Remarks
Jun 02	11 47 52.8	30.78	117.24	7	3.8		10 km E Cadoux
02	12 27 28.0	30.72	117.13	10	3.4		5 km N Cadoux
02	17 08 54.6	30.79	117.16	13	3.7		4 km ESE Cadoux
02	17 30 39.8	-	-	-	3.5		Cadoux area
02	19 24 44.9	30.77	117.25	17	3.4		12 km E Cadoux
02	20 08 31.0	30.80	117.21	4	3.2		8 km ESE Cadoux
02	21 00 30.9	30.77	117.23	13	3.3		9 km E Cadoux
02	21 28 49.5	30.76	117.20	4	3.0		7 km E Cadoux
03	04 21 33.0	30.87	117.13	15	3.1		11 km S Cadoux
03	07 45 34.5	30.77	117.17	10	5.3		4 km E Cadoux, felt MM VI
03	20 54 13.4	30.78	117.14	14	3.5		1 km E Cadoux
04	04 13 16.3	30.84	117.21	12	3.3		10 km SE Cadoux
04	06 03 30.3	30.81	117.11	6	3.1		5 km S Cadoux
04	14 30 41.4	30.86	117.19	(10)	3.1		12 km SE Cadoux
04	16 27 03.3	30.75	117.16	(10)	3.0		3 km ENE Cadoux
05	00 23 10.3	-	-	-	3.3		Cadoux area
05	10 25 36.5	30.85	117.18	7	3.1		10 km SSE Cadoux
05	11 33 32.5	30.86	117.18	7	3.0		11 km SSE Cadoux
06	05 04 29.5	30.84	117.16	12	3.3		7 km SSE Cadoux
06	06 17 32.9	30.78	117.23	12	3.1		10 km E Cadoux
06	17 36 53.1	30.73	117.16	14	3.5		5 km NE Cadoux
07	06 45 16.1	30.81	117.16	12	5.5		5 km SE Cadoux
07	22 33 30.4	30.73	117.16	9	4.0		5 km NE Cadoux
10	18 24 52.6	30.78	117.19	12	4.3		6 km E Cadoux, felt MM V
12	02 23 15.0	30.86	117.18	(10)	3.1		12 km SSE Cadoux

Date 1979	Origin Time U.T.	Lat. °S	Long. °E	Depth km	ML(MUN)	mB(MUN)	Remarks
Jun 12	22 15 10.9	30.87	117.16	13	3.1		12 km SSE Cadoux
14	21 31 43.1	30.85	117.09	13	3.5		10 km SSW Cadoux
15	16 18 54.9	30.87	117.13	19	3.1		11 km S Cadoux
18	05 03 49.2	30.79	117.19	11	3.1		7 km ESE Cadoux
22	19 53 49.4	30.84	117.08	23	3.4		9 km SSW Cadoux
25	11 40 51.3	30.84	117.08	15	3.3		9 km SSW Cadoux
27	01 58 51.0	30.80	117.17	5	3.0		5 km SE Cadoux
Jul 16	23 50 35.3	30.75	117.19	3	3.1		5 km ENE Cadoux
Aug 07	00 20 40.0	30.76	117.13	(0)	3.0		Cadoux
23	21 36 49.2	30.76	117.09	19	3.0		3 km W Cadoux
26	07 00 43.3	30.79	117.19	4	3.1		6 km ESE Cadoux
Sept 10	09 51 07.4	30.72	117.21	13	3.3		8 km SSE Cadoux
21	10 49 31.9	30.74	117.12	12	3.1		3 km N Cadoux
Oct 11	04 04 11.7	30.79	117.15	15	4.8		3 km SE Cadoux, felt MM V
Dec 11	02 50 57.1	30.97	117.19	12	3.1		23 km SE Cadoux
17	09 54 03.9	30.95	117.20	12	3.9		21 km SSE Cadoux
20	19 47 42.7	30.82	117.19	12	3.3		8 km SE Cadoux
20	20 14 08.1	30.92	117.20	18	3.4		18 km SSE Cadoux
26	18 41 15.4	30.74	117.16	3	3.0		5 km NE Cadoux

TABLE 11

EARTHQUAKES IN THE CADOUX REGION, 1979

MAGNITUDE 1.9 < ML < 3.0

Date 1979	Origin Time U.T.	ML(MUN)	Date 1979	Origin Time U.T.	ML(MUN
Mar 09	07 34 57.7	2.4	Jun 02	12 59 50.1	2.4
13	08 28 48.6	2.2	02	13 00 26.3	2.6
15	03 14 55.1	2.3	02	14 18 21.8	2.3
15	05 57 48.0	2.1	02	14 51 43.5	2.4
16	09 38 27.0	2.2	02	15 48 20.0	2.4
Apr 03	16 20 45.4	2.1	02	16 11 33.1	2.4
Jun 01	22 06 02.2	2.1	02	17 19 46.8	2.8
01	22 11 42.6	2.2	02	17 47 26.9	2.5
01	22 16 07.9	2.3	02	18 10 23.0	2.3
01	22 22 09.4	2.7	02	18 12 00.9	2.4
01	22 38 38.4	2.4	02	18 53 50.7	2.5
02	00 27 34.0	2.0	02	19 21 34.6	2.2
02	00 27 47.2	2.7	02	19 47 34.1	2.3
02	00 50 50.4	2.7	02	19 48 48.7	2.2
02	01 46 50.4	2.6	02	21 35 25.9	2.9
02	07 19 58.1	2.3	02	22 10 12.9	2.5
02	12 11 22.0	2.2	02	22 15 12.9	2.6
02	12 20 15.5	2.5	02	22 26 12.6	2.4
02	12 31 42.9	2.6	02	22 26 32.6	2.7
02	12 38 11.7	2.5	02	23 22 23.2	2.2

Date 1979	Origin Time U.T.	ML(MUN)	Date 1979	Origin Time U.T.	ML(MUN)
Jun 03	00 01 57.5	2.4	Jun 04	13 31 51.8	2.7
03	01 19 44.0	2.3	04	14 14 03.9	2.7
03	03 01 23.0	2.4	04	14 16 13.8	2.8
03	03 07 29.3	2.5	04	19 39 30.5	2.0
03	03 20 42.6	2.4	05	01 26 18.0	2.6
03	03 36 16.8	2.3	05	04 51 19.7	2.4
03	03 57 25.8	2.4	05	06 57 13.1	2.3
03	09 54 40.7	2.9	05	09 00 31.5	2.3
03	11 11 09.9	2.8	05	13 35 02.9	2.4
03	11 12 54.4	2.3	05	18 57 45.3	2.7
03	15 20 58.0	2.4	05	19 26 21.1	2.9
03	16 34 08.9	2.2	06	00 43 27.7	2.3
03	17 13 57.9	2.8	06	06 09 58.3	2.4
03	19 17 39.3	2.8	06	18 19 28.3	2.1
04	02 26 02.2	2.9	06	23 03 58.2	2.1
04	02 46 42.7	2.7	07	00 59 38.8	2.4
04	03 52 39.7	2.8	07	07 03 13.3	2.4
04	06 24 17.7	2.6	07	07 47 40.9	2.4
04	09 22 14.8	2.1	07	14 41 49.6	2.4
04	12 58 38.4	2.5	07	16 59 23.2	2.6

Date 1979	Origin Time U.T.	ML(MUN)	Date 1979	Origin Time U.T.	ML(MUN)
Jun 07	23 18 13.1	2.5	Jun 20	21 37 17.1	2.4
07	23 38 10.8	2.4	21	11 59 59.1	2.0
08	00 28 33.3	2.7	21	17 56 20.1	2.0
08	09 48 02.3	2.5	22	07 28 26.7	2.4
08	13 08 40.4	2.5	23	10 01 04.2	2.2
08	16 44 49.5	2.0	24	00 28 53.6	2.5
10	01 20 53.6	2.4	25	07 02 14.6	2.1
11	11 56 48.8	2.3	25	11 16 20.6	2.7
12	12 58 21.5	2.3	25	20 11 40.9	2.4
12	22 25 31.9	2.1	30	18 42 29.1	2.1
13	10 34 04.6	2.2	Jul 03	00 32 54.3	2.0
13	11 38 33.9	2.7	04	01 44 22.5	2.1
15	05 19 07.9	2.3	05	11 01 34.5	2.4
15	23 24 25.3	2.7	08	03 09 20.7	2.1
16	14 35 02.6	2.3	12	19 25 57.5	2.7
17	03 27 44.1	2.1	17	18 27 52.3	2.5
18	08 54 24.1	2.5	19	02 06 25.2	2.3
19	19 21 28.5	2.8	22	15 14 58.9	2.7
19	23 21 43.1	2.3	26	07 55 48.6	2.9
			26	12 27 08.9	2.5

Date 1979	Origin Time U.T.	ML(MUN)		Date 1979	Origin Time U.T.	ML(MUN)	
Jul 28	05 34 42.0	2.1		Sept 15	13 13 24.2	2.0	
28	12 07 21.8	2.1		20	13 26 54.8	2.4	
Aug 02	08 10 27.9	2.0		Oct 02	02 22 42.6	2.0	
04	20 01 24.0	2.1		06	11 22 54.3	2.3	
06	16 48 16.1	2.0		17	09 38 33.2	2.1	
06	17 13 08.8	2.9	30.80°S, 117.13°E, h=15 km 3 km S Cadoux	23	06 30 14.3	2.4	30.84°S, 116.99°E h=11 km
07	14 06 27.4	2.1		27	18 10 06.8	2.3	
08	02 02 40.5	2.3		Nov 02	11 23 07.6	2.1	
08	07 06 01.9	2.0		03	16 58 23.5	2.0	
08	07 07 37.5	2.0		10	15 33 55.2	2.0	
12	23 05 16.6	2.0		13	02 24 14.0	2.1	
14	08 28 21.3	2.3		14	18 26 14.1	2.5	
15	12 46 37.8	2.8		15	11 29 44.1	2.0	
19	03 29 27.5	2.0		22	22 37 11.5	2.6	
20	04 51 44.6	2.3		Dec 10	07 31 22.3	2.5	
28	07 16 56.6	2.5		11	04 44 07.1	2.5	
29	21 11 37.5	2.0		11	05 02 33.1	2.1	
Sep 08	11 18 07.3	2.9	30.79°S, 117.21°E, h=3 km 8 km E Cadoux	12	06 37 52.2	2.1	
				17	10 35 48.0	2.1	
10	05 58 06.9	2.2		17	10 36 05.1	2.3	
13	17 47 52.6	2.3		21	05 57 40.3	2.5	
				21	06 03 10.3	2.8	
				26	16 09 03.5	2.6	
				29	17 13 27.0	2.3	
				31	17 35 37.5	2.5	

TABLE 12

FIELD SEISMOGRAPH DETAILS

Meckering (McKenzie's farm)	
Equipment	Transportable 70mm film recorder
Co-ordinates	Latitude 31.716°S Longitude 116.968°E
Dates of operation	28 Nov 1977 to 2 Aug 1979
Meckering (Richardson's farm)	
Equipment	Sprengnether MEQ 800
Co-ordinates	Latitude 31.608°S Longitude 117.002°E
Dates of operation	6 Dec 1977 to 21 Jun 1979
Meckering (Morrell's farm)	
Equipment	Sprengnether MEQ 800
Co-ordinates	Latitude 31.659°S Longitude 117.089°E
Dates of operation	5 July 1978 (continuing)
Burakin	
Equipment	Sprengnether MEQ 800
Co-ordinates	Latitude 30.494°S Longitude 117.127°E
Date of operation	23 Jun 1979 to 2 Aug 1979

TABLE 13

WESTERN AUSTRALIAN ACCELEROGRAPHS

Station and ownership	Co-ordinates and date installed	Elevation	Foundation
Meckering (Kelly) (BMR)	31.694°S, 116.982°E 30 November 1971	200	Alluvium over Precambrian granite
Meckering (Springbett) (BMR)	31.813°S, 116.958°E 16 November 1973	220	Alluvium over Precambrian granite
Meckering (Richardson) (BMR)	31.608°S, 117.002°E 28 November 1977	220	Alluvium over Precambrian granite
Meckering (Morrell) (BMR)	31.659°S, 117.089°E	220	Alluvium over Precambrian granite
Ord River Dam (PWD)	16.113°S, 128.738°E 1 March 1972	120	Rock fill 3m clay, core 90m, quartzite
Ord River Abutment (PWD)	16.113°S, 128.737°E 16 November 1972	60	Phyllite
Mundaring Weir (PWD)	31.967°S, 116.167°E 1979	350	Concrete dam 42m

BMR: Bureau of Mineral Resources, Mundaring Geophysical Observatory

PWD: Public Works Department, W.A.

TABLE 14

ACCELEROGRAM DATA, 1979

Date 1979	Time U.T.	ML	Site	Distance km	Comp.	Period s	Peak Acceleration m/s^2
Jan 23	22 23 34	1.3	Kelleys	3	Z	0.03	0.009
					N	0.02	0.035
					E	0.02	0.013
Jun 02	09 48 01	6.2	Morrells	90	Z	0.14	0.20
					N	0.06	0.10
					E	0.06	0.20
			Mundaring Weir	120	Z	0.1	0.19
					N	0.04	0.10
					E	0.1	0.39
Nov 27	06 39 42	3.0	Kellys	7	Z	0.06	0.44
					N	0.04	0.86
					E	0.04	0.88
			Morrells	18	Z	0.02	0.06
					N	0.02	0.29
					E	0.02	0.24

TABLE 15

REQUESTS FOR DATA

Institution	Type of data	No.
Earthquake Research Institute, University of Tokyo	Seismogram copies	10
Geological Research Division, University of Tokyo	Seismogram copies	46
Lamont-Doherty Geological Observatory	Seismogram copies	12
Institute of Physics of the Earth, Strassbourg	Seismogram copies	126
Port Moresby Observatory	Seismogram copies	120
World Data Centre A	Seismogram copies	30
Californian Institute of Technology	Seismogram copies	12
I.B. Everingham, BMR, Canberra	Seismogram copies	30
Institute of Physics of the Globe	Seismogram copies	35
Stanford University	Seismogram copies	6
Western Mining Corporation	Earthquake risk map	
Geological Survey of W.A.	Earthquake risk map	
Lands Dept (W.A.)	Earthquake risk map	
State Energy Commission	Earthquake risk map	
Public Works Dept (W.A.)	Earthquake data lists	
National Mutual Insurance Co	Earthquake data 1978, 79	
Geological Survey of W.A.	Cadoux earthquake lists	
Royal Insurance Co.	Cadoux earthquake lists	
University of Tasmania	Isoseismal data	
Institute of Earth Physics, Moscow	Magnetogram copies	40
Schlumberger Sesco	Declination map	
Various sources	Magnetic field values Earthquake information	