Report 273

Australian seismological report 1982

Compiled by Peter J. Gregson & David Denham

Bureau of Mineral Resources, Geology & Geophysics

Department of Resources & Energy

BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS

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AUSTRALIAN SEISMOLOGICAL REPORT 1982

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Peter J. Gregson & David Denham

(Division of Geophysics)

AUSTRALIAN GOVERNMENT PUBLISHING SERVICE
CANBERRA 1986

DEPARTMENT OF RESOURCES & ENERGY

Minister: Senator The Hon. Gareth Evans
Secretary: A.J. Woods, AO

BUREAU OF MINERAL RESOURCES, GEOLOGY & GEOPHYSICS

Director: R.W.R. Rutland

Published for the Bureau of Mineral Resources, Geology and Geophysics by the Australian Government Publishing Service.

ISBN 0 644 05363 1

ISSN 0084-7100

This Report was edited by K.H. Wolf. Line drawings by BMR Geophysical Drawing Office.

Printed by Graphic Services Pty Ltd, Northfield SA 5085

Contributors

Contributors to this publication are listed below according to the information furnished or service performed:

Hypocentres and magnitudes

D. Denham, BMR, Canberra, ACT
G. Gibson, Preston (now Phillip) Institute of Technology, Bundoora Vic
P.J. Gregson, BMR, Mundaring Geophysical Observatory, Mundaring, WA
C. Krayshek, Research School of Earth Sciences, Australian National University, Canberra ACT
R. MacDougal, University of Adelaide, Adelaide, SA
R. Nation, University of Adelaide, Adelaide, SA
National Earthquake Information Service, US Geological Survey, Boulder, USA
E.P. Paull, BMR, Mundaring Geophysical Observatory, Mundaring, WA
J. Pongratz, University of Tasmania, Hobart, Tas
J.M.W. Rynn, University of Queensland, Brisbane, Qld
R.S. Smith, BMR, Canberra, ACT
J.P. Webb, University of Queensland, Brisbane, Qld
J. Weekes, Research School of Earth Sciences, Australian National University, Canberra, ACT
International Seismological Centre (ISC), Newbury, UK

Intensities

D. Denham and R.S. Smith, BMR, Canberra, ACT
P.J. Gregson, BMR, Mundaring Geophysical Observatory, Mundaring, WA
G. Gibson, Preston (now Phillip) Institute of Technology, Bundoora, Vic
J.M.W. Rynn, University of Queensland, Brisbane, Qld

Network operations (by institution)

Australian National University, ACT (CAN)
Bureau of Mineral Resources, Geology and Geophysics, Canberra, ACT (BMR) and Mundaring, WA (MUN)
Preston (now Phillip) Institute of Technology, Bundoora, Vic (PIT)
Geological Survey of Queensland (GSQ)
Riverview College, Sydney, NSW (RIV)
University of Adelaide, SA (ADE)
University of Queensland, Qld (QLD)
University of Tasmania, Tas (TAU)
Western Australian Public Works Department, Perth, WA (PWD)

Strong Motion data

P.J. Gregson, BMR, Mundaring Geophysical Observatory, Mundaring, WA
G. Gibson, Phillip Institute of Technology, Vic

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ABSTRACT

The level of seismicity in Australia during 1982 was about the same as for 1981. Of the 117 earthquakes of magnitude 3.0 or greater that were located during the year, four had magnitudes of 5.0 or greater. The largest was the Wonnangatta earthquake of 21 November with a magnitude of 5.5 ML, which was felt over a wide area of Central Victoria. The others, all in Western Australia, were located at Tobin Lake, 100 km northeast of Marble Bar, and Red Hill, with magnitudes of 5.3, 5.2 and 5.0, respectively.

Isoseismal maps have been produced for the Inverell, West Wyalong - 2 (NSW), Glen Innes - 3 (NSW), Corryong (Vic), Wonnangatta (Vic) and Cadoux - 2 (WA) earthquakes. Intensities of VI on the Modified Mercalli Scale were reported from the Cadoux and Wonnangatta earthquakes.

Twenty-seven recordings were obtained from strong-motion accelerographs in Western Australia. The maximum acceleration was 77 cm/s^2 at a site near Meckering from a magnitude 2.8 earthquake which took place approximately 2 km from the accelerograph. Two accelerograms were obtained in Victoria from the Wonnangatta earthquake.

On a world scale the largest earthquake during 1982 occurred south of the Tongan Islands. It had a surface-wave magnitude of 7.7 and generated a local tsunami with a maximum peak-to-peak amplitude of about 15 cm. The most destructive earthquake took place in Yemen on 13 December when at least 2800 people were reported killed from a magnitude 6.0 earthquake in the Western Arabian Peninsula.

INTRODUCTION

This Report provides information on all earthquakes of Richter magnitude 3 or greater that were reported in the Australian region during 1982. It is the third of an annual series to be compiled by the Bureau of Mineral Resources, Geology and Geophysics (BMR) using data provided by various seismological agencies in Australia. Its purpose is to provide information on Australian earthquakes for studying seismic risk and answering inquiries from scientists and the general public.

The Report comprises four main sections: 'Australian earthquakes', containing a summary of the 1982 seismicity and brief descriptions of the more important earthquakes; 'Network operations', providing details of the seismographs that operated in Australia during 1982; 'Strong-motion seismograph data' which contains the results of the accelerograph network; and 'Principal World Earthquakes 1982' listing the largest and most damaging earthquakes that took place during 1982.

Throughout the Report we refer to magnitudes of earthquakes and intensities caused by earthquakes. These terms are defined below.

Magnitudes

The magnitude of an earthquake is a measure of its size and is related to the energy released at its focus. The magnitude scale is logarithmic; thus a magnitude 6 earthquake produces ground amplitudes 10 times as large, and an energy release about 30 times as large as a magnitude 5 earthquake.

A rule-of-thumb relation between magnitude and energy is

$$\log E = 4.8 + 1.5M,$$

where E is in Joules.

A shock of magnitude 2 is the smallest normally felt by humans, and earthquakes of magnitude 5 or more can cause major damage if they are shallow and close to buildings.

Several magnitude scales are in common usage. Those used in this report are defined below.

Richter magnitude (ML)

$$ML = \log A - \log Ao$$

as defined by Richter (1958, p. 340), where A is the maximum trace amplitude in millimetres on a standard Wood-Anderson seismogram and log Ao is a standard value given as a function of distance (0-600km). Richter's reference earthquake of ML = 3.0 produces a trace amplitude of 1mm, 100 km from the epicentre.

If standard Wood-Anderson instruments (Anderson & Wood, 1925) are not available, an equivalent Richter magnitude can be determined by correcting for the differences in magnification (see Willmore, 1979, para. 3.1.1).

Surface-wave magnitude (MS)

The surface-wave magnitude is normally applicable only to shallow earthquakes in the distance range 20-160 degrees, and in the period range $T = 20 \pm 3$s. When these conditions hold, MS values are calculated from the IASPEI (1967) formula:

$$MS = \log (A/T) + 1.66\ \Delta + 3.3,$$

where A is the ground amplitude in micrometers, T in seconds and Δ the epicentral distance in degrees (see Båth, 1981).

Body-wave magnitude (mb)

$$mb = \log (A/T) + Q\ (\Delta, h),$$

where A is the maximum mean-to-peak ground amplitude in microns of the P, PP, or S-wave trains, T the corresponding wave-period (seconds) and Q (Δ, h) a depth/distance factor. The Q factors were derived by Gutenberg (1945) and are given by Richter (1958, pages 688-689).

Duration magnitude (MD)

$$MD = a \log t + b\Delta + c,$$

where t is the length of the earthquake coda in seconds, Δ the distance from the epicentre and a, b and c are constants for a particular recording station.

Seismic moment magnitude (Mw)

$$Mw = (\log Mo/1.5) - 6.0(N\text{-}m),$$

where Mo is the seismic moment based on the physics of the earthquake source.

$$Mo = \mu AD,$$

where μ is the rigidity, A is the surface area displaced, and D is the average displacement on that surface. This magnitude scale was proposed by Kanamori (1978).

Magnitude from isoseismals (MRp)

In some cases where reliable magnitude values could not be determined instrumentally (from seismograms), it was possible to calculate magnitudes from macroseismic data. In these cases McCue's (1980) formula was used:

$$M(Rp) = 1.01 \ln(Rp) + 0.13,$$

where Rp is the radius of perceptibility in kilometres of the MM(III) isoseismal. Magnitudes found by this method should be treated as approximate values which may be revised as a result of additional research.

Further information on magnitudes is available in McGregor & Ripper (1976), Båth (1981), and Denham (1982).

Intensity

Intensity, as applied to earthquakes, represents a quantity determined from the effects on people, buildings, and the Earth's surface. In this report we use the Modified Mercalli Scale (MM) as presented by Eiby (1966) for New Zealand conditions and listed in the Appendix. Essentially the MM scale is a subjective assessment of how severely the earthquake was felt and the damage that was caused at a particular place. Some earthquakes are large enough to be felt over a wide area and an isoseismal map can be prepared. These maps indicate in detail the extent of the shaking. They are prepared mainly from information compiled from questionnaire canvasses, newspaper reports, and personal interviews and inspections.

During 1982 ten earthquakes were large enough for isoseismal maps to be prepared. These are shown in Figs 3 to 14.

AUSTRALIAN EARTHQUAKES, 1982

The level of earthquake activity in the Australian region during 1982 was about the same as in 1981 (Denham & Gregson, 1985) when it was below average. Figure 1 shows the distribution of all known earthquakes having a magnitude of 3 or greater that occurred during 1982 and Fig. 2 the distribution of magnitude 4 and greater earthquakes for 1873-1981. Table 1 lists the hypocentral parameters for the 1982 earthquakes.

The Southwest Seismic Zone remained one of the most active parts of

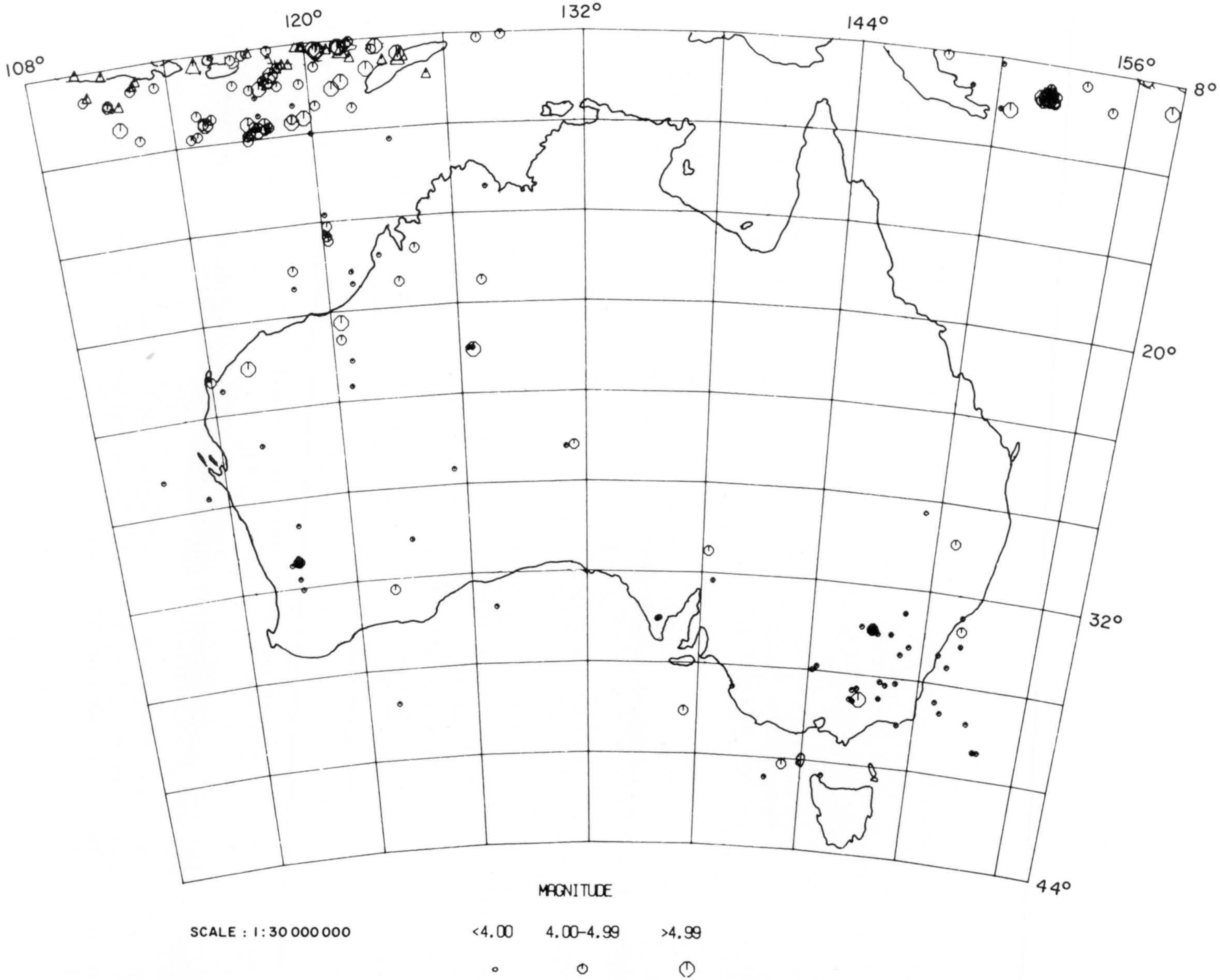


Fig. 1. Australian earthquakes 1982.

24/A/82

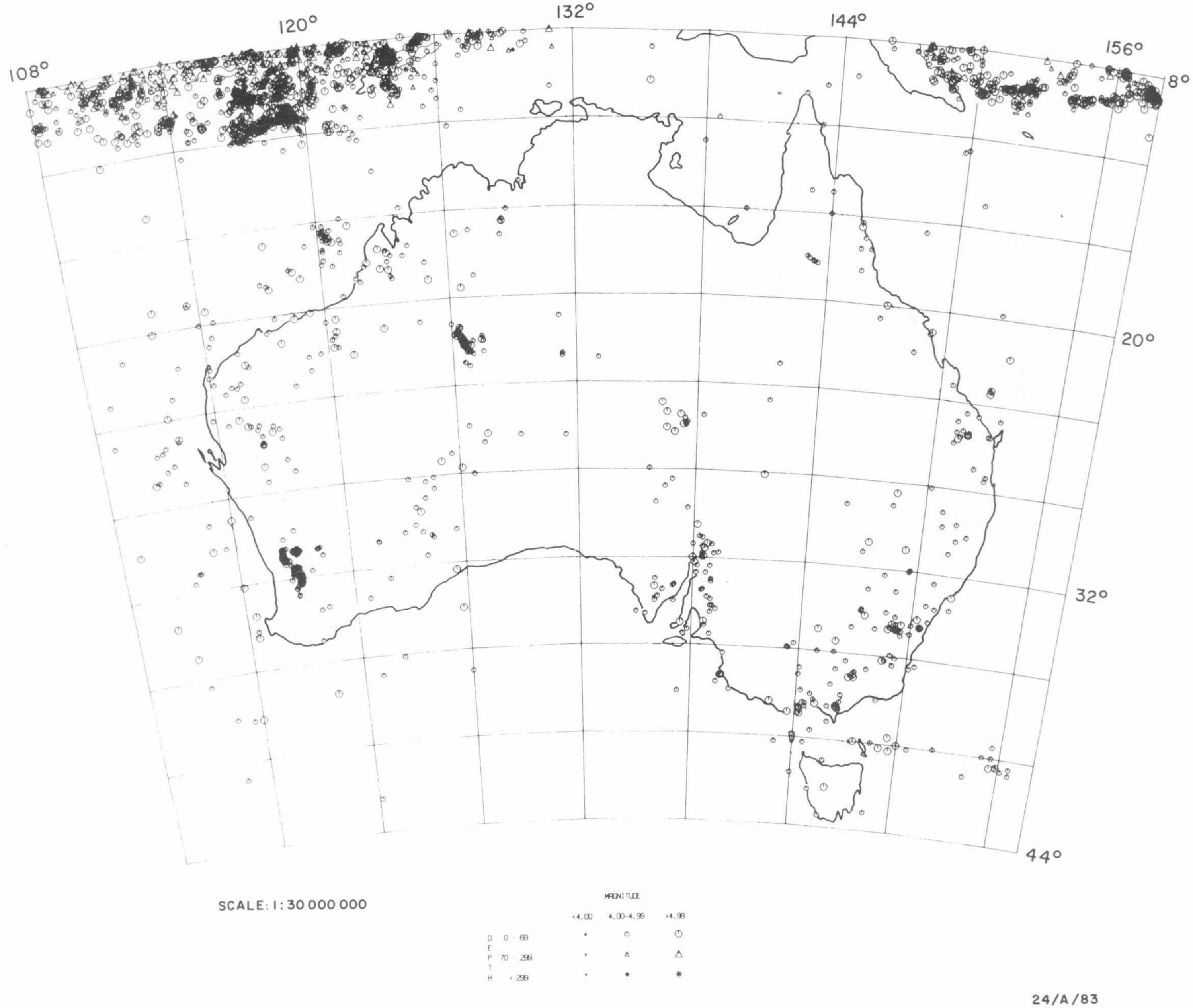


Fig. 2. Australian earthquakes 1873-1981.

Australia and 164 earthquakes were located there during 1982. Of these 117 occurred in the Cadoux area, the largest with magnitude 4.9 ML and four others greater than 4.

The Pilbara area was the most active area in Western Australia outside the Southwest Seismic Zone. Seven earthquakes of magnitude greater than 3 occurred in the Broome, Port Hedland and Marble Bar areas, the largest of magnitude 5.0 ML was located 80 km NE of Marble Bar.

South Australia was seismically quiet during 1982. Only five earthquakes were located with magnitudes of 3 or greater.

In eastern Australia the level of seismic activity was close to average. The largest earthquake occurred near Wonnongatta and had a magnitude of 5.5 ML. It was felt in Melbourne and an isoseismal map is shown in Fig. 12. Elsewhere in eastern Australia significant earthquakes took place near Inverell, Wyalong, Glen Innes (NSW) and Corryong (Vic). Brief descriptions of these earthquakes and others for which isoseismal maps were prepared are given below.

Cadoux

Shortly after midday local time on 24 January 1982, an earthquake of magnitude ML 4.4 occurred 15km south of Cadoux in Western Australia.

The earthquake was felt over an area of 20 000 km^2, but no damage was reported. The highest intensity was MMV reported from the townsite of Cadoux. Intensity MMIV was felt over an area of radius 45km.

The response to felt-report questionnaires was poor, presumably because the earthquake was not widely felt. The isoseismal map based on about 50 returns (Gregson, 1985) is shown in Fig. 3.

Several other earthquakes from the same location were felt, the two largest on 23 January at 2.02am (local time) ML 3.8, and 26 January 7.12am (local time) ML 4.4, produced isolated reports of intensity MMV.

Cadoux

Many people in the vicinity of Cadoux were woken by severe shaking caused by an earthquake which occurred shortly before midnight, local time, on 6 February 1982. The magnitude of the earthquake was ML 4.9 and it was located 12km SSE of Cadoux, near the epicentral region of earthquakes that took place in January 1982.

Slight damage occurred near Cadoux. Walls were cracked, water tanks leaked and small objects broke by falling from shelves. The maximum intensity reported was MMVI.

The isoseismal map, prepared from felt-report questionnaires, indicates that the earthquake was felt over an area of 90 000 km^2, with intensities of MMIV being experienced up to 110 km from the epicentre. The outer boundaries of the lower isoseismals are not well defined because the majority of the population were asleep (Gregson, 1985).

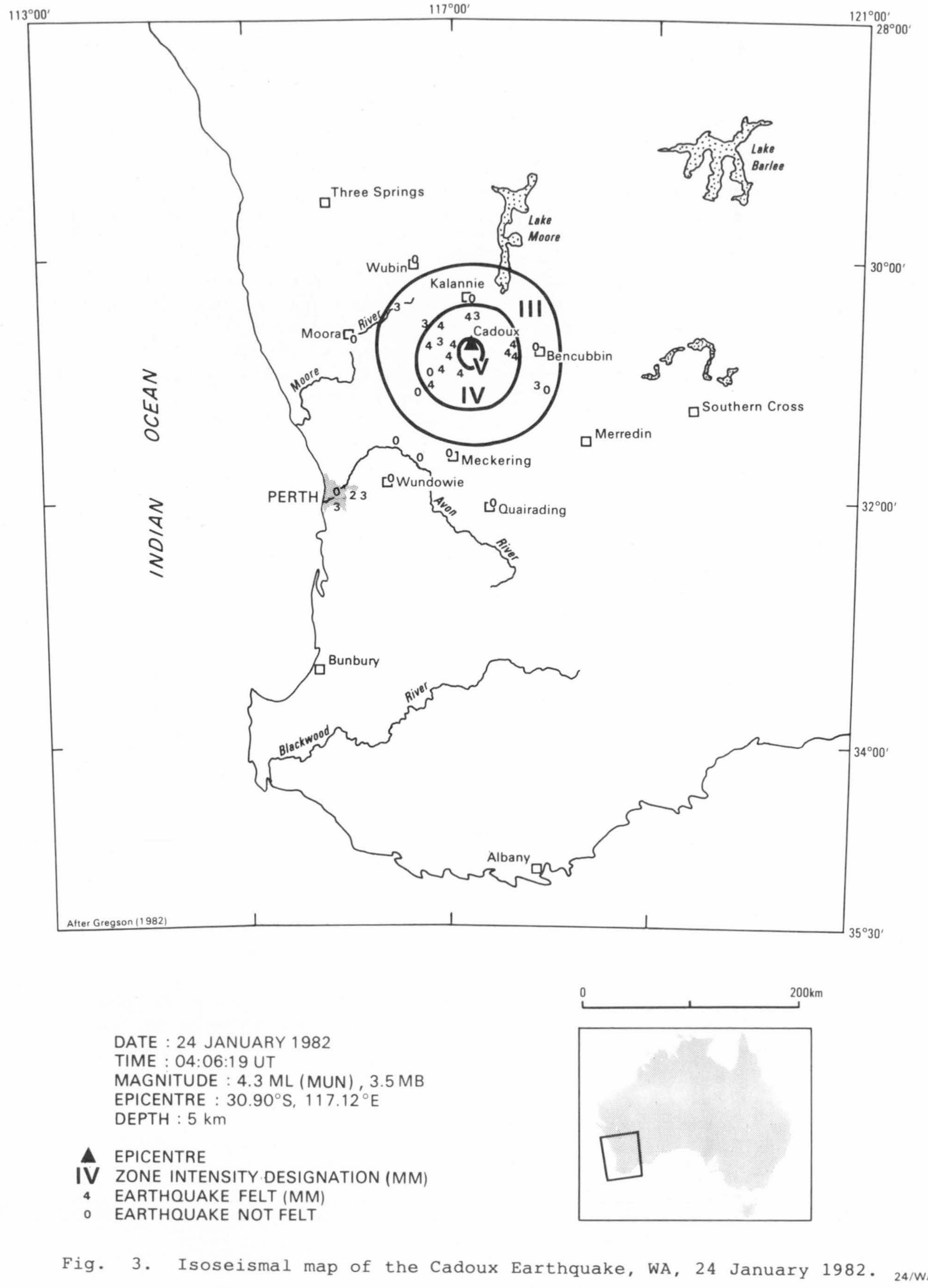


Fig. 3. Isoseismal map of the Cadoux Earthquake, WA, 24 January 1982. 24/WA/25

The earthquake was described by residents of Cadoux as the strongest since the series of earthquakes in June 1979.

Members of the Mundaring Geophysical Observatory visited the Cadoux area to interview residents and determine the extent of the higher intensities. Intensities of MMVI were experienced at only three farm houses over an area of about 8 km^2 located just to the west of the epicentre as determined by the observatory. Intensities of MMV were experienced over an area exceeding 1 000 km^2.

Isoseismal maps are shown in Figs 4 and 5.

A second earthquake of magnitude ML 4.6 occurred six minutes later. Resulting intensities were about one degree lower than for the main event.

Inverell

At about 10:01 UT on 4 March 1982 (9.01pm local Eastern Standard Summer time), the Inverell district in northeastern NSW experienced an earthquake (Rynn and Lynam, 1984). Analyses of instrumental recordings revealed that in fact two earthquakes of almost the same magnitude had occurred within about 90 seconds. It was apparent that the second was the larger of the two. In respect of the felt-reports, it is not considered possible to distinguish which of the two events is responsible for the reported effects; one would expect these to be related to the larger of the two. For this reason, the isoseismal data are analysed in terms of a single event related to a "double earthquake".

For the isoseismal survey undertaken by the University of Queensland, 161 earthquake questionnaires were received of which 116 reported having felt the effects of the earthquakes. Of these reports 65 were received from the town of Inverell (51 positive) and 96 from the surrounding district (65 positive). The felt-area covered about 6 500 km^2 with the maximum intensity MM5 assigned to reports from two homesteads 5 to 10km south of Elsmore (objects on shelves and furniture moved).

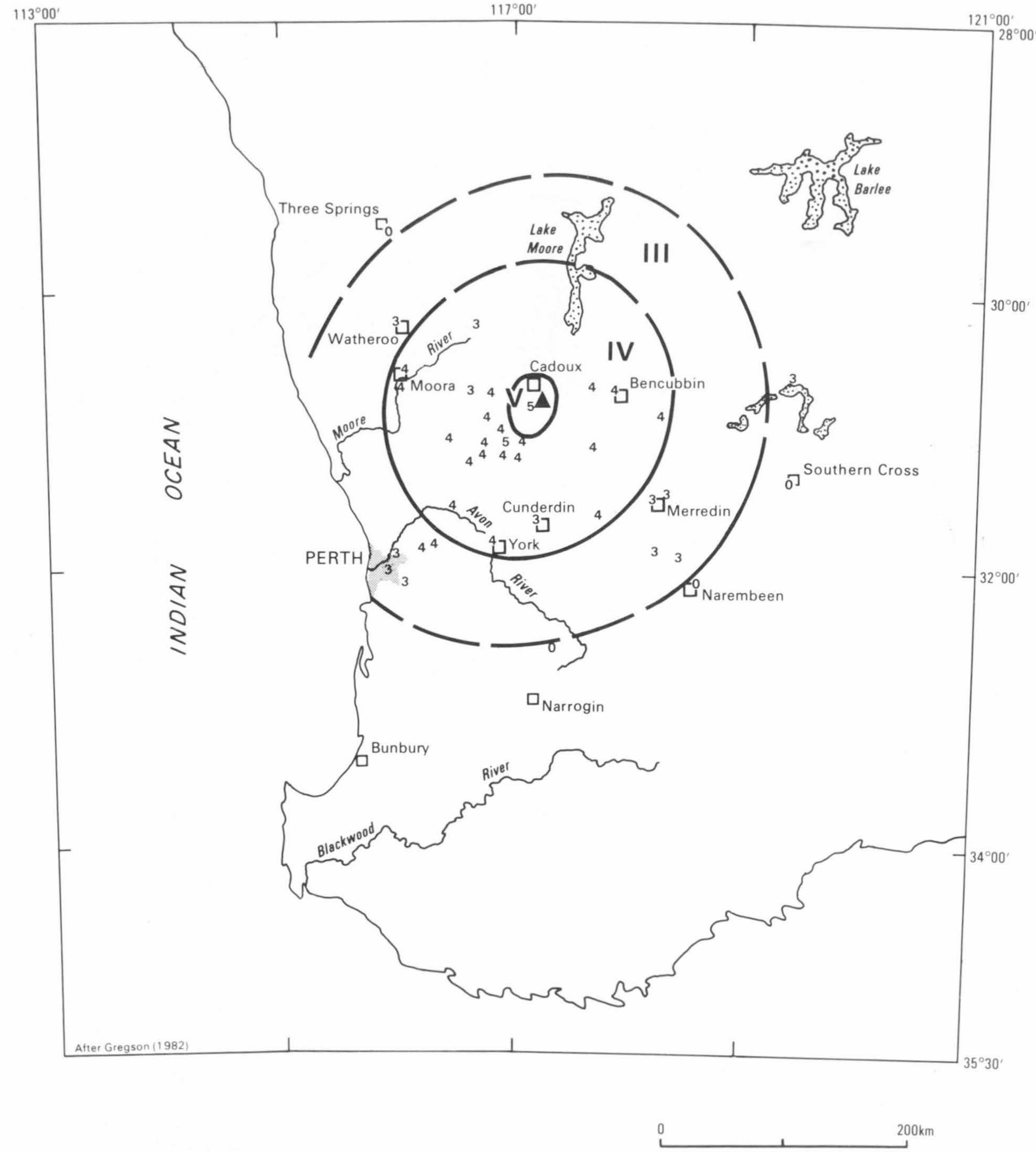
Reports of damage in the town of Inverell and a subsequent insurance claim were also reported. The isoseismal map is shown in Fig. 6.

A detailed survey was undertaken with the assistance of the local radio station 2 Hz and high schools in the town. 65 reports were received of which 51 reported the effects of the earthquake.

The most affected areas appeared to be in the western parts of Inverell, where the average assigned intensity was MM4 (windows, doors, etc rattling). There were, however, several isolated cases where higher shaking levels were reported. These ranged from small objects being displaced from shelves (assigned MM5) to cracks in concrete slabs (MM6).

Instrumental magnitudes were calculated from RIV (Riverview College Observatory) and the Wivenhoe Dam (southeastern Queensland) network, yielding average values of ML(RIV) = 4.0, 4.3 and ML(WIV) = 3.4, 3.5, respectively for the two events. A magnitude of ML(I) = 3.9 was computed from the isoseismal data (using the radius of the MM = 3 isoseismal).

Foreshocks: Twenty foreshocks are known to have occurred (data from both



DATE : 6 FEBRUARY 1982
TIME : 15:24:38.4
MAGNITUDE : 4.9 ML(MUN), 4.7 MB
EPICENTRE : 30.88°S 117.15°E
DEPTH : 7 km

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

Fig. 4. Isoseismal map of the Cadoux Earthquake, WA, 6 February 1982. 24/WA/26

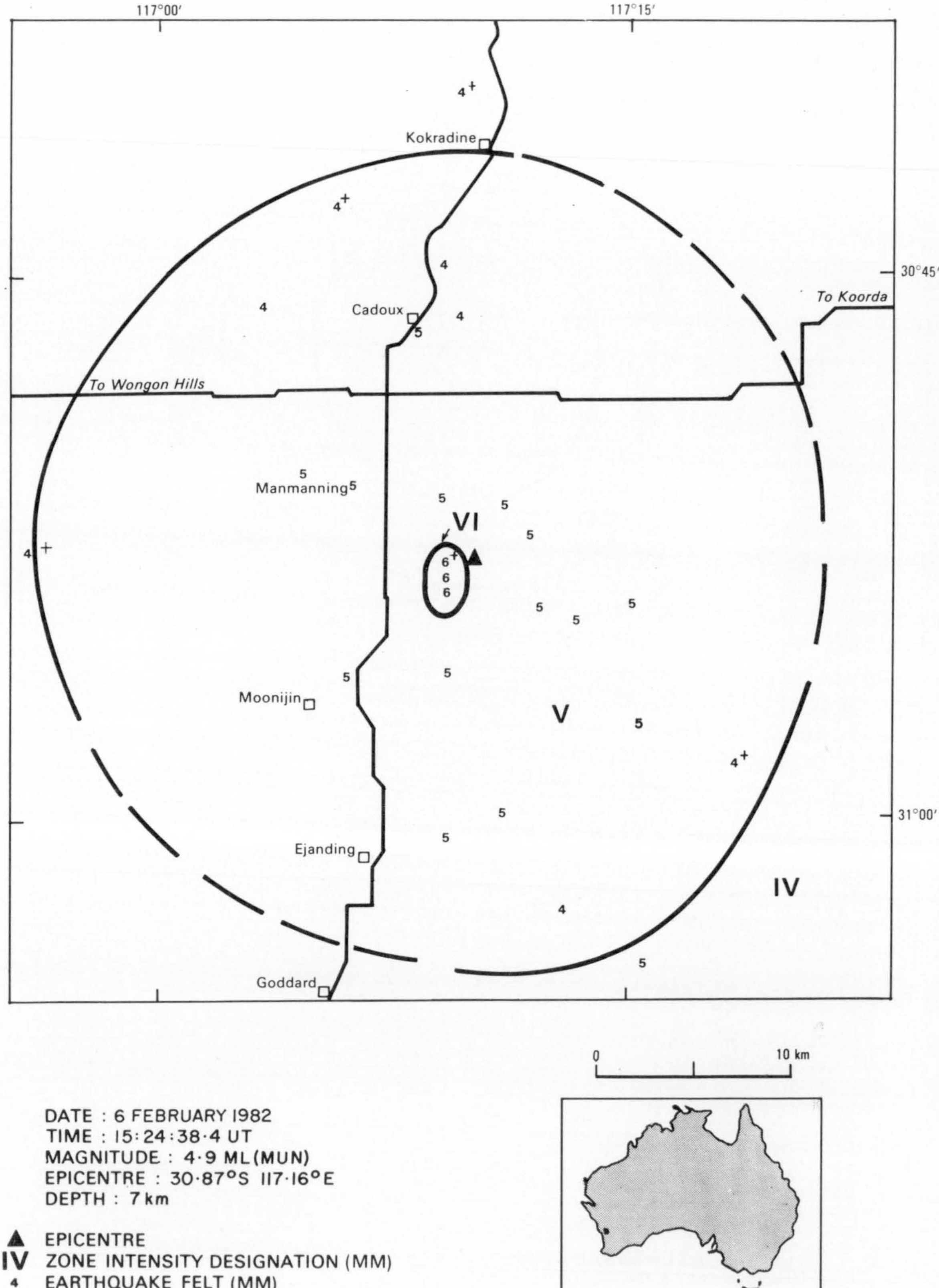


Fig. 5. Isoseismal map of the Cadoux Earthquake, WA, near epicentre (see Fig. 4), 6 February 1982.

24/H50/8

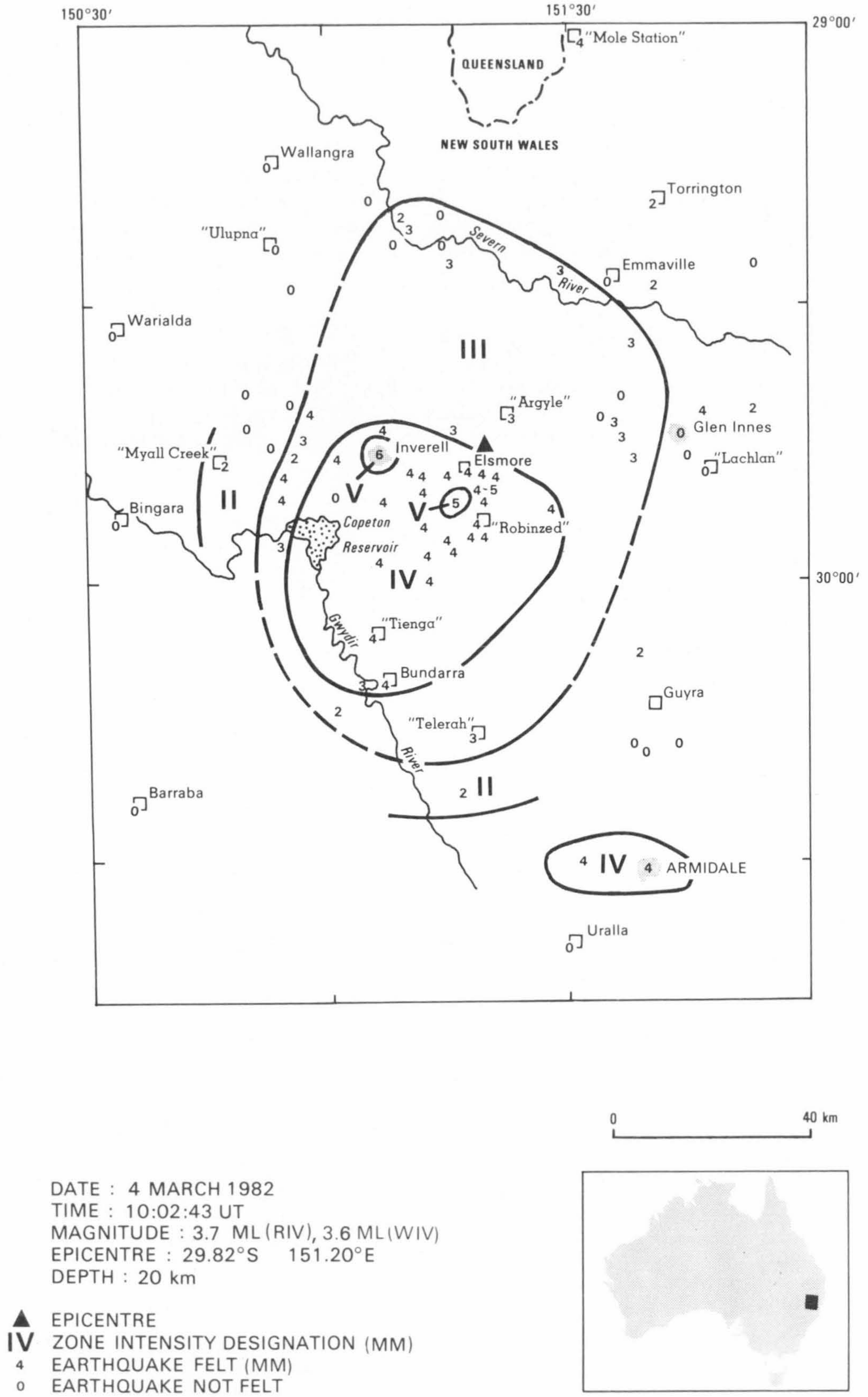


Fig. 6. Isoseismal map of the Inverell earthquake, NSW, 4 March 1982. 24/H56/6

felt-reports and Cooney Observatory seismograms) in a period of 12 days prior to the main shocks. The maximum intensity reported was MM = 4.

Aftershocks: Thirty aftershocks occurred up till 30 March 1982. There appears to be two groups in time: one group occurring within 24 hours of the main shock and the other on the 29 and 30 March. The epicentres of this later group appear to be 10 to 20km WSW of that for the main shocks. The maximum intensity for the aftershock was MM4.

Corryong

The Corryong earthquake took place in a sparsely populated region of northern Victoria and the spatial distribution of felt reports with respect to the epicentre is poor. The radius of perceptibility was about 40km and the maximum reported shaking was only MM4. The map shown in Fig. 7 was based on 30 data points.

West Wyalong

A remarkable feature of this earthquake on 20 May 1982 is the limited area in which it was felt, considering the magnitude of the earthquake, and the associated rapid attenuation of intensity with distance from the epicentre (Denham & others, 1984).

Although generally the isoseismals are not well-defined, in the area from Wyalong to the western outskirts of West Wyalong there was clearly a decline in intensity from MMVI to MMIV over the space of about 5km. This trend was also noticable in other directions from Wyalong.

The final choice of epicentre was influenced by the macroseismic data. The computed solution produced an epicentre in the MMIII intensity zone. A shift of some 11km to the northwest provided an epicentre which more closely correlated with felt intensities whilst still remaining within the standard-error ellipse of the solution. The isoseismal map is shown in Fig. 8.

Glen Innes

At 03:13 UT on 8 June 1982 (1.13pm local time), a small region just west of Glen Innes experienced an earthquake (Rynn and Lynam, 1984). Of the 22 earthquake questionnaires obtained, 10 reported effects from the earthquake. The affected area covered about 250 km^2 with a maximum intensity of MM4-5 assigned to reports from "Truro" homestead about 16km northwest of Glen Innes. An instrumental magnitude of ML(WIV) = 2.5 was calculated from the Wivenhoe Dam Network (southeastern Queensland) seismograms. From the isoseismal data a magnitude ML(I) = 2.5 was obtained.

The epicentre plotted on the map (Fig. 9) is offset from the region where the highest intensities were experienced; but it was determined instrumently and the errors involved are probably at least plus or minus 10km. A series of 12 events on the previous day were recorded on the COO seismogram. These could be considered as foreshocks. In the twelve hours following the main shock, eight aftershocks were recorded at COO, two of which were felt in the Glen Innes area with MM = 3.

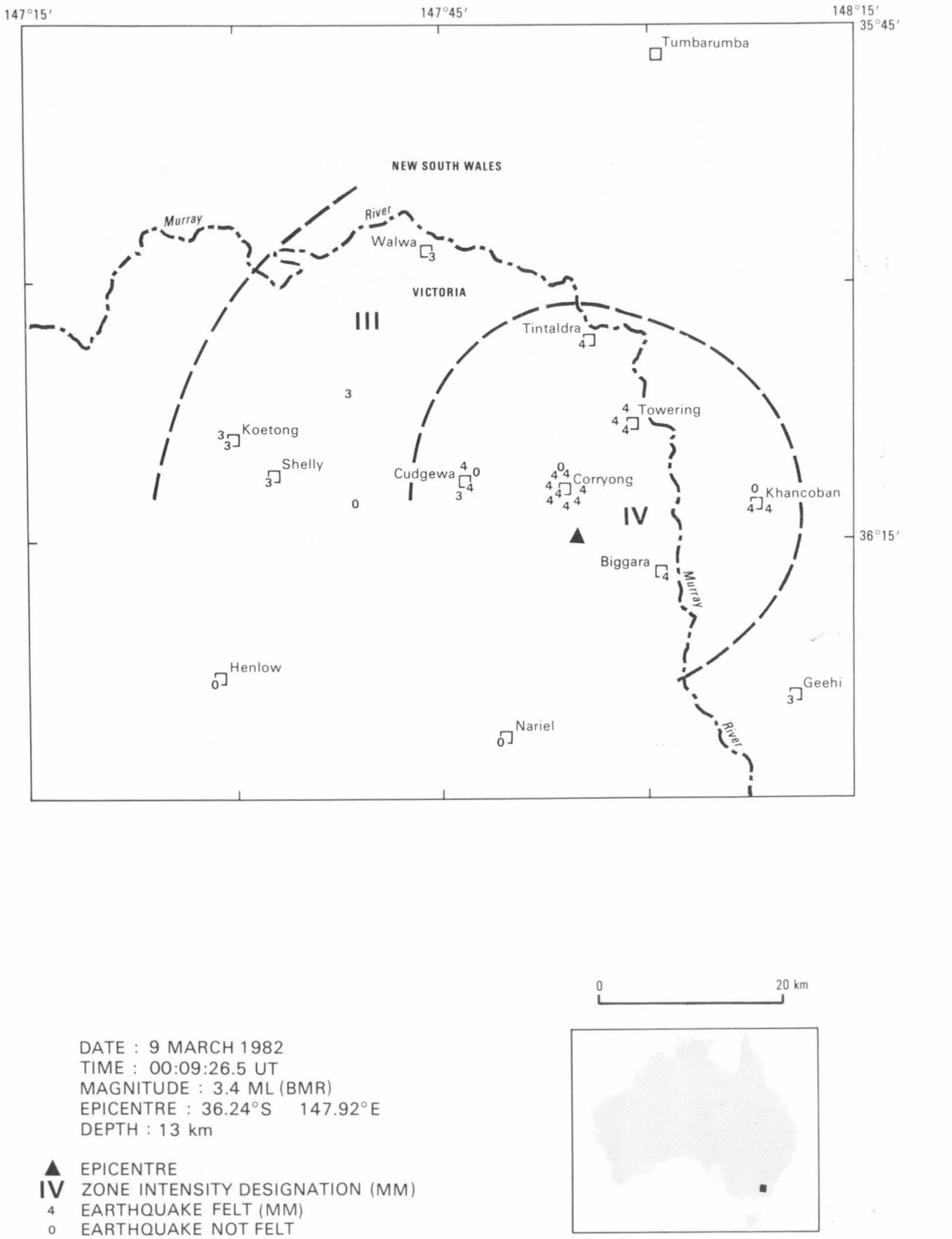


Fig. 7. Isoseismal map of the Corryong Earthquake, Vic, 9 March 1982. 24/I55/11

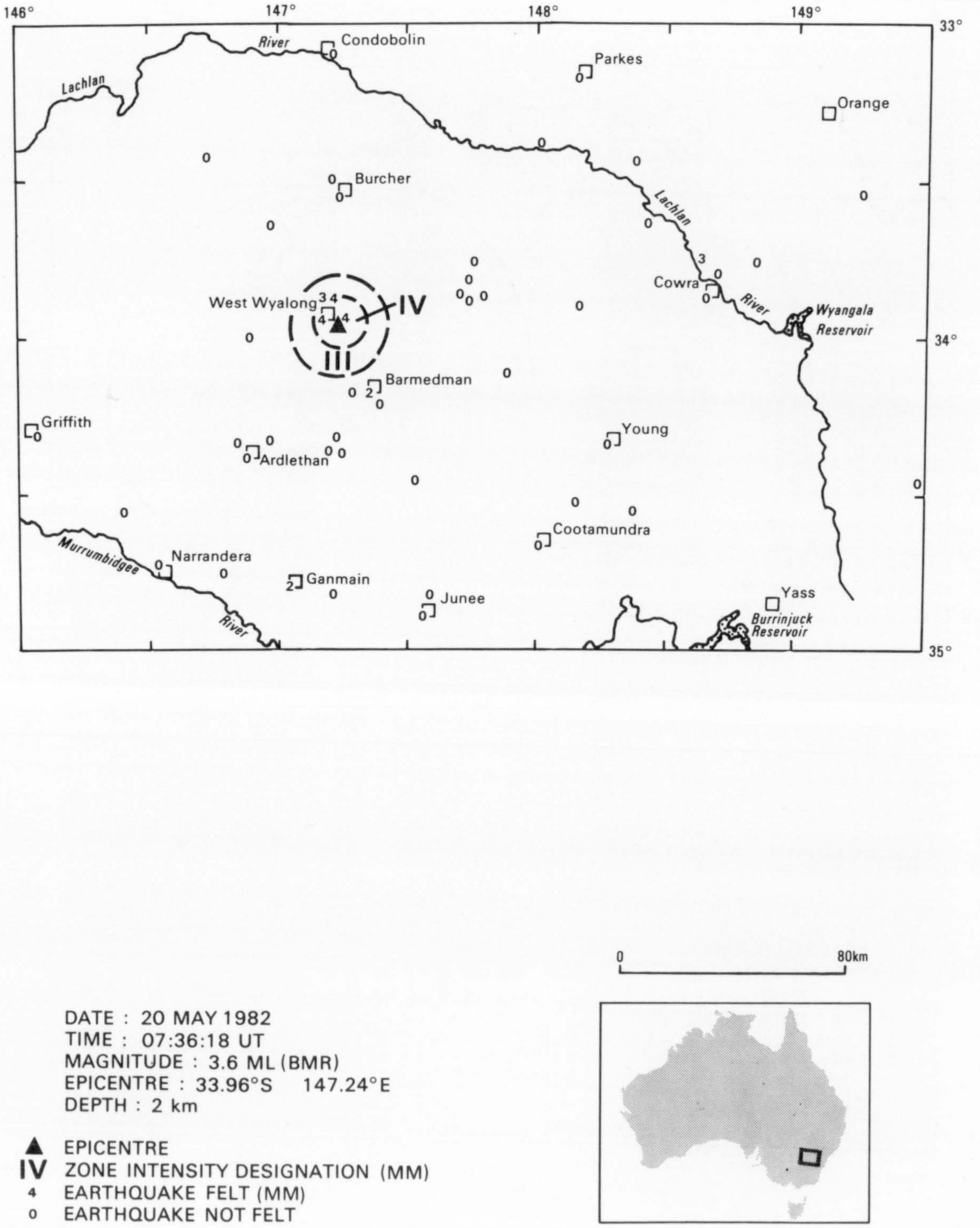
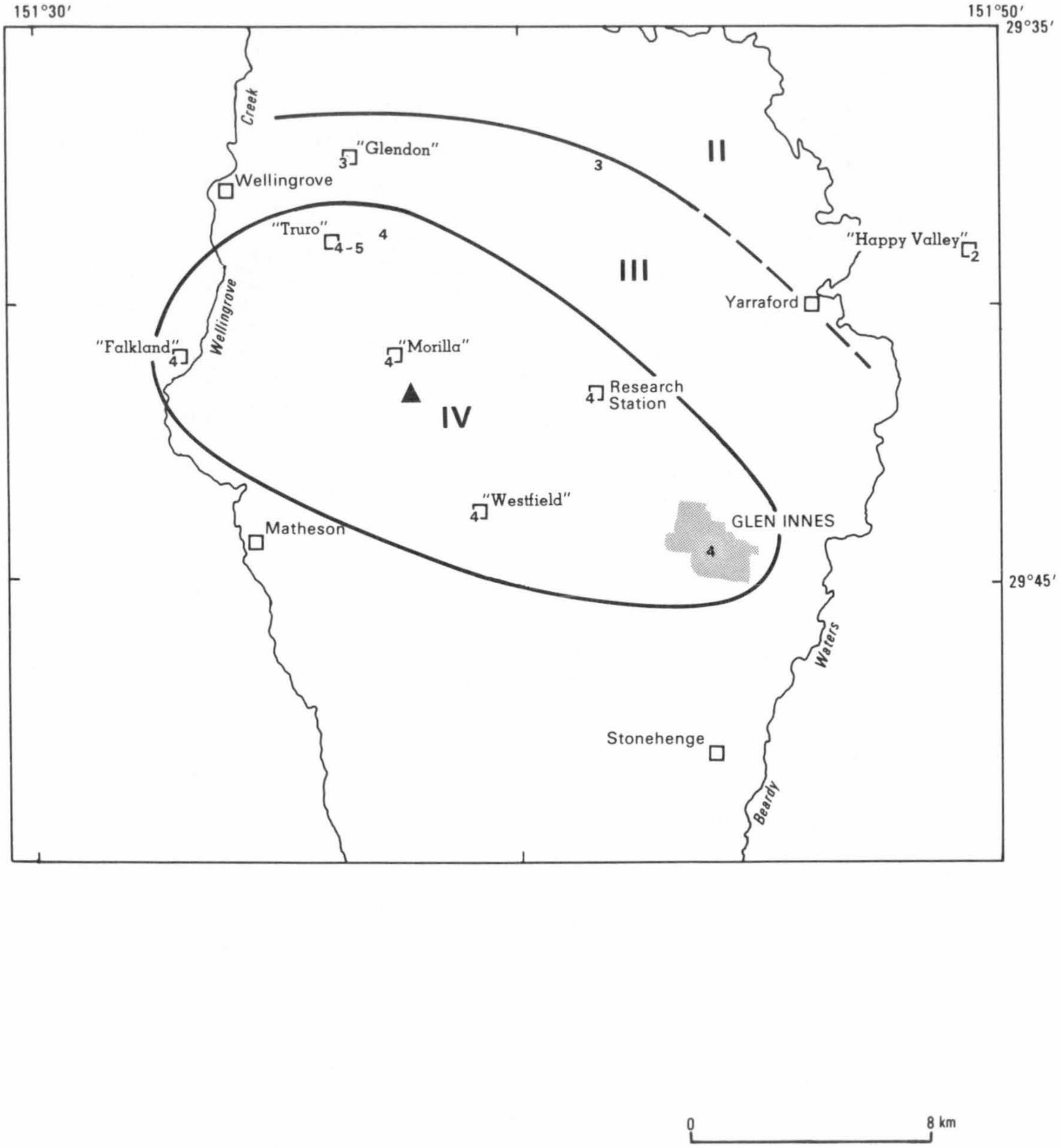


Fig. 8. Isoseismal map of the West Wyalong Earthquake, NSW, 20 May 1982 24/I55/10



DATE : 8 JUNE 1982
TIME : 03:13:23.72 UT
MAGNITUDE : 2.9 ML (WIV), 2.5 ML I)
EPICENTRE : 29.66°S 151.63°E
DEPTH : Crustal

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

Fig. 9. Isoseismal map of the Glen Innes Earthquake, NSW, 8 June 1982. 24/H56/5

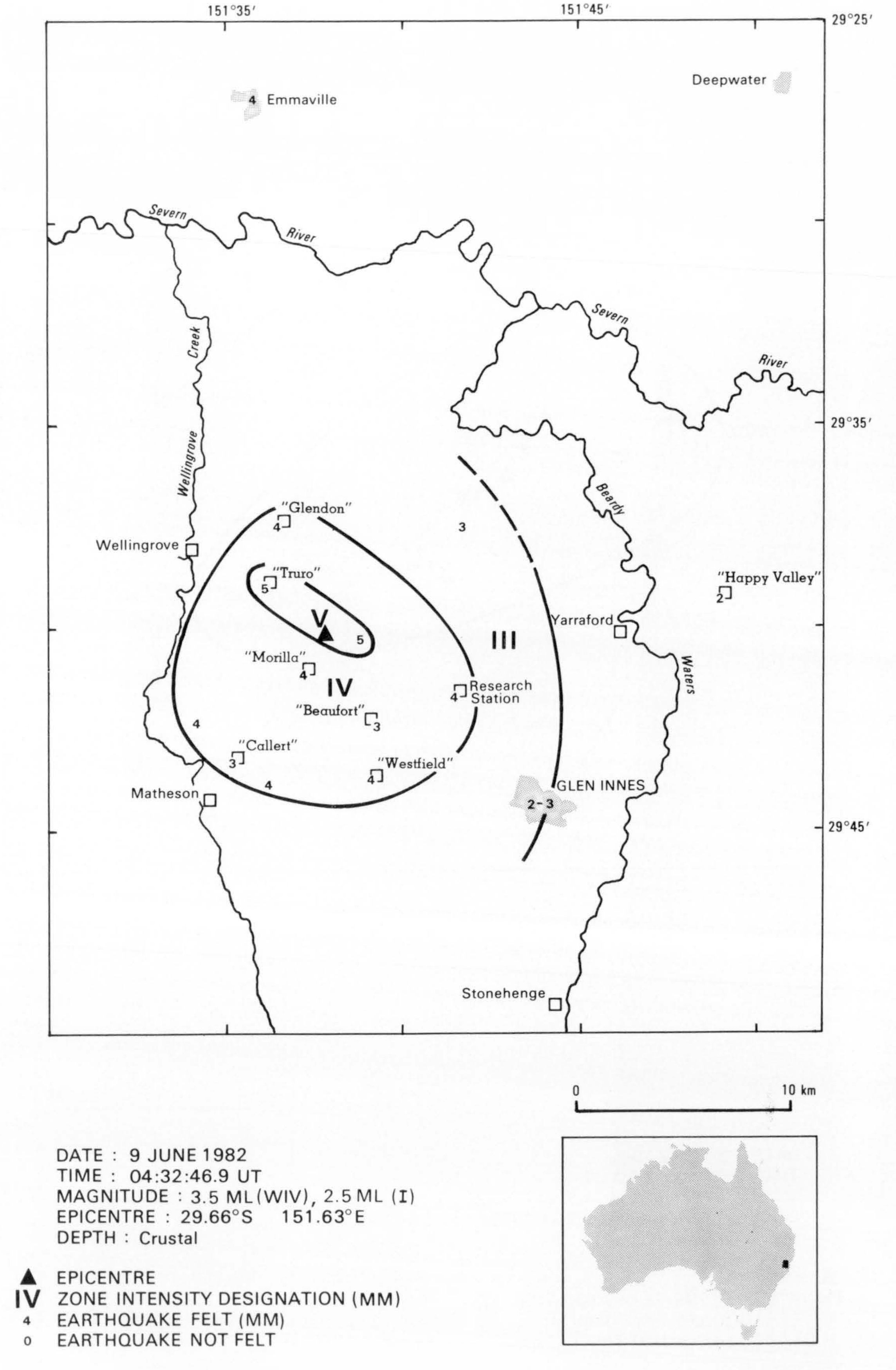


Fig. 10. Isoseismal map of the Glen Innes Earthquake, NSW, 9 June 1982. 24/H56-6/3

Glen Innes

At 04:32 UT on 9 June 1982 (2.32pm local time) a small region just west of Glen Innes experienced an earthquake (Rynn and Lynam, 1984). From an isoseismal survey, 26 earthquake questionnaires were obtained of which 14 reported felt effects from the earthquake. The affected area covered about 200 km^2 with a maximum intensity of MM5 assigned to a small area 10 to 15km northwest of Glen Innes (where small objects and furnishings were displaced). An instrumental magnitude ML(WIV) = 3.2 was calculated from the Wivenhoe Dam Network (southeastern Queensland) seismograms. A magnitude ML(I) = 2.5 was calculated from the isoseismal data. The isoseismal map is shown in Fig. 10.

A series of 20 aftershocks recorded at COO were associated with this event, of which three were reported as MMII-III.

This earthquake is very similar to the one of 8 June 1982. It is possible that the event on 9 June 1982 is the "main" shock of the whole two day sequence with that of the 8 June 1982 being the major foreshock.

Glen Innes

At 09:02 UT on 5 July 1982 (7.02pm local time) a small earthquake was felt in the Glen Innes area (Rynn and Lynam, 1984). The region affected coincided with that referred to as the Wellington Rumbles area by Rynn and Lynam (1982) about 10km west of Glen Innes town. Six felt reports were received. The maximum assigned intensity values was MM4. An instrumental magnitude of ML(WIV) = 1.6 was calculated for the Wivenhoe Dam Network (southeastern Queensland) seismograms. From the isoseismal data a magnitude ML(I) = 1.8 was obtained. The isoseismal map is shown in Fig. 11.

As in the cases of the previous earthquakes of 8 and 9 June 1982 in the same area, small earthquakes both prior to and following this event were recorded at Cooney; four considered as foreshocks and two as aftershocks; these latter two being reported as MMII-III.

Wonnangatta

The earthquake was widely felt throughout eastern Victoria and southeastern New South Wales. The most distant report (275km) was from the fifth floor of a block of flats in Canberra where a motion typical of MMI was experienced.

Production of the Wonnangatta isoseismal map (Fig. 12) was made very difficult by the remoteness of the epicentral region. Very few people live within 35km of the epicentre and there are no sizeable towns closer than about 60km. Staff from the Phillip Institute of Technology (PIT) interviewed most people within the epicentral region and a random sample at locations out to 100km. BMR distributed 300 questionnaires to Post Offices in southeastern Australia to determine the extent of the felt area. These data were combined to prepare the isoseismal map.

Intensities of V (MM) were felt in the epicentral region and intensities of IV were experienced in most of eastern Victoria. One surprising feature was the relatively low intensities felt immediately east and north of the epicentre. Despite wide questioning of the local population at Mount Hotham, Harrietville, Mount Beauty, Tawonga and Bright, only one report exceeding V

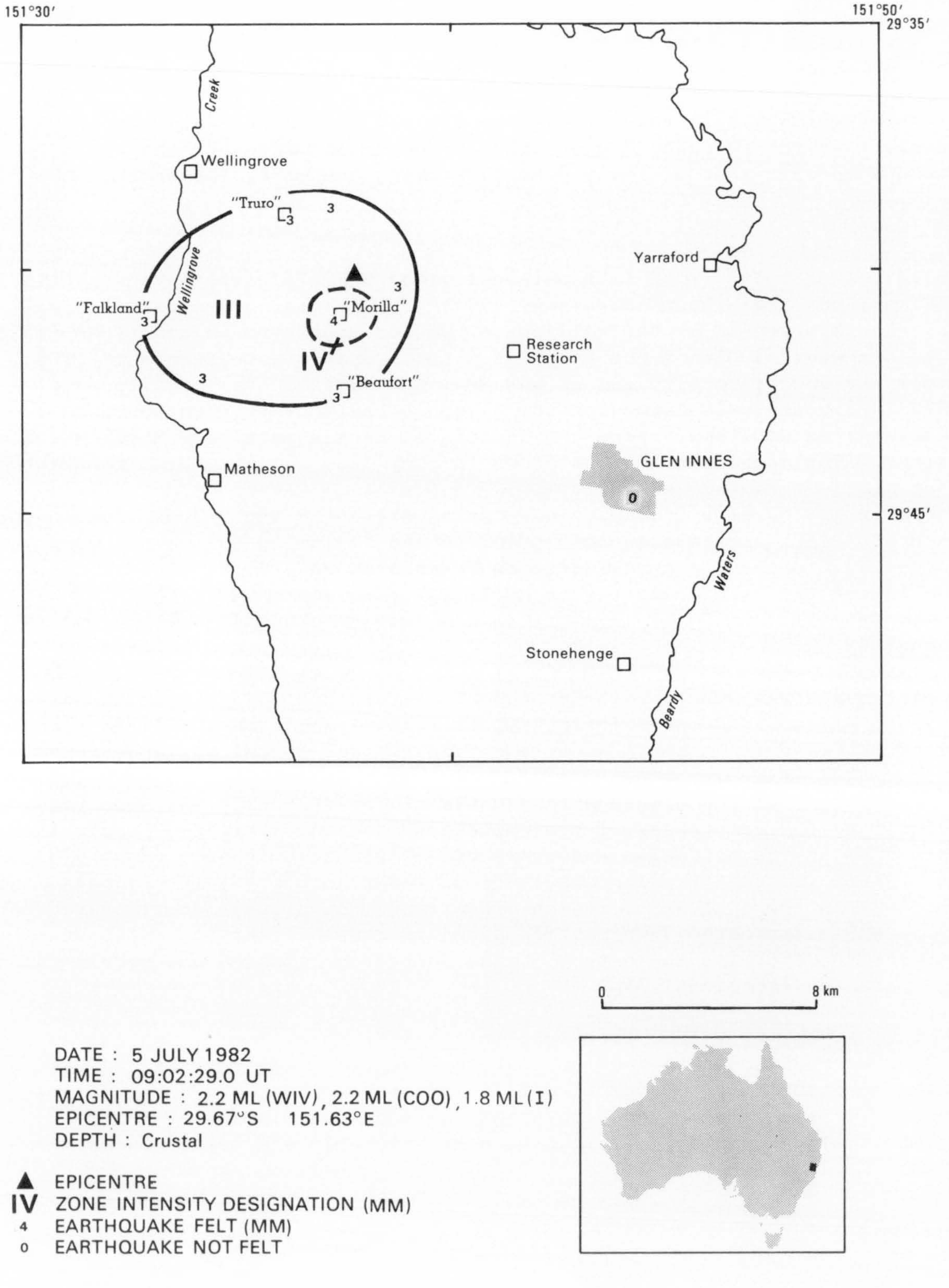


Fig. 11. Isoseismal map of the Glen Innes Earthquake, NSW, 5 July 1982. 24/H56-6/1

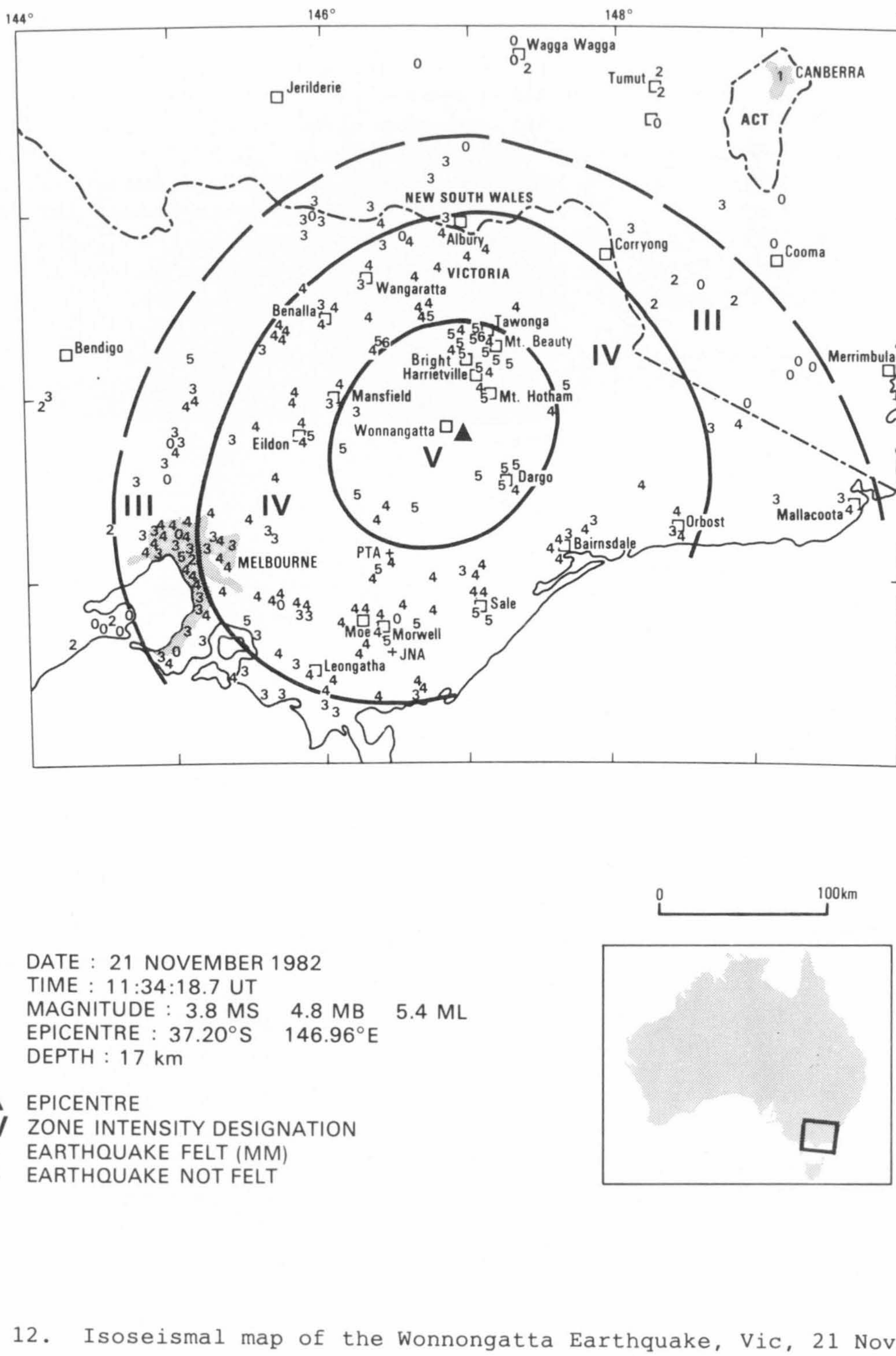


Fig. 12. Isoseismal map of the Wonnongatta Earthquake, Vic, 21 November 1982.

was found in these areas. In contrast, intensities of V were experienced at distances over 100km west and southwest of the epicentre.

The Melbourne metropolitan area, which is about 180km from the epicentre, experienced intensities from III-IV. This contrasts with the 1966 Mount Hotham earthquake, which had an almost identical magnitude but was felt only at a very few places in Melbourne (Underwood, R., 1967; Everingham & others, 1982).

A number of questionnaire returns and newspaper reports suggested that the earthquake could have caused minor damage to some houses in the Eildon-Mansfield Moe-Morwell area. However, an inspection by PIT staff in these areas discovered damage consistent with MMVI (damage to buildings of weak construction) and the possibility remains that most of this damage was caused by subsidence resulting from the 1982 drought and that the damage was only discovered when the shock prompted people to examine their buildings. Normally an intensity of at least VI is required to produce damage in buildings of inferior quality.

Strong ground motion from the main earthquake was recorded at sites PIT, PAT and JEN, which are shown as small +'s on the map (Fig. 12). The maximum recorded accelerations at these stations were 22, 160 and 75 mm/s^2, respectively (Denham & others, 1985).

West Wyalong

This earthquake occurred at 11.11 a.m. daylight saving time on November 26th (Denham & others, 1984). It was the largest of a series of earthquakes in the region in 1982; some residents reported having felt "over 20" tremors before and after the main event.

Approximately 80 reports of the earthquake were collected from questionnaires and by BMR staff who visited the area, and from these data the isoseismal maps composed (Figs 13&14). About half of the respondents confirmed that they had felt the shock.

There was extensive, though minor damage in Wyalong, West Wyalong and neighbouring regions. In Wyalong, every report received indicated cracking of internal or external walls, or both. In some stores, stock was in disarray and a shop awning had partially collapsed. According to these effects the maximum intensity assigned was MMVI.

The extent of the felt area was confined to a mean radius of about 35km with the exception of few isolated reports; the most distant being 120km away to the west of Narrandera.

NETWORK OPERATIONS

Figure 15 shows the locations of all the stations that operated continuously during 1982. Three new stations were commissioned during the year: Cobar in New South Wales, Pegleg in Victoria, and Ballidu in Western Australia. Table 2 gives the co-ordinates of the stations and indicates the type of seismograph in operation.

Regional epicentres were located by the main operating institutions

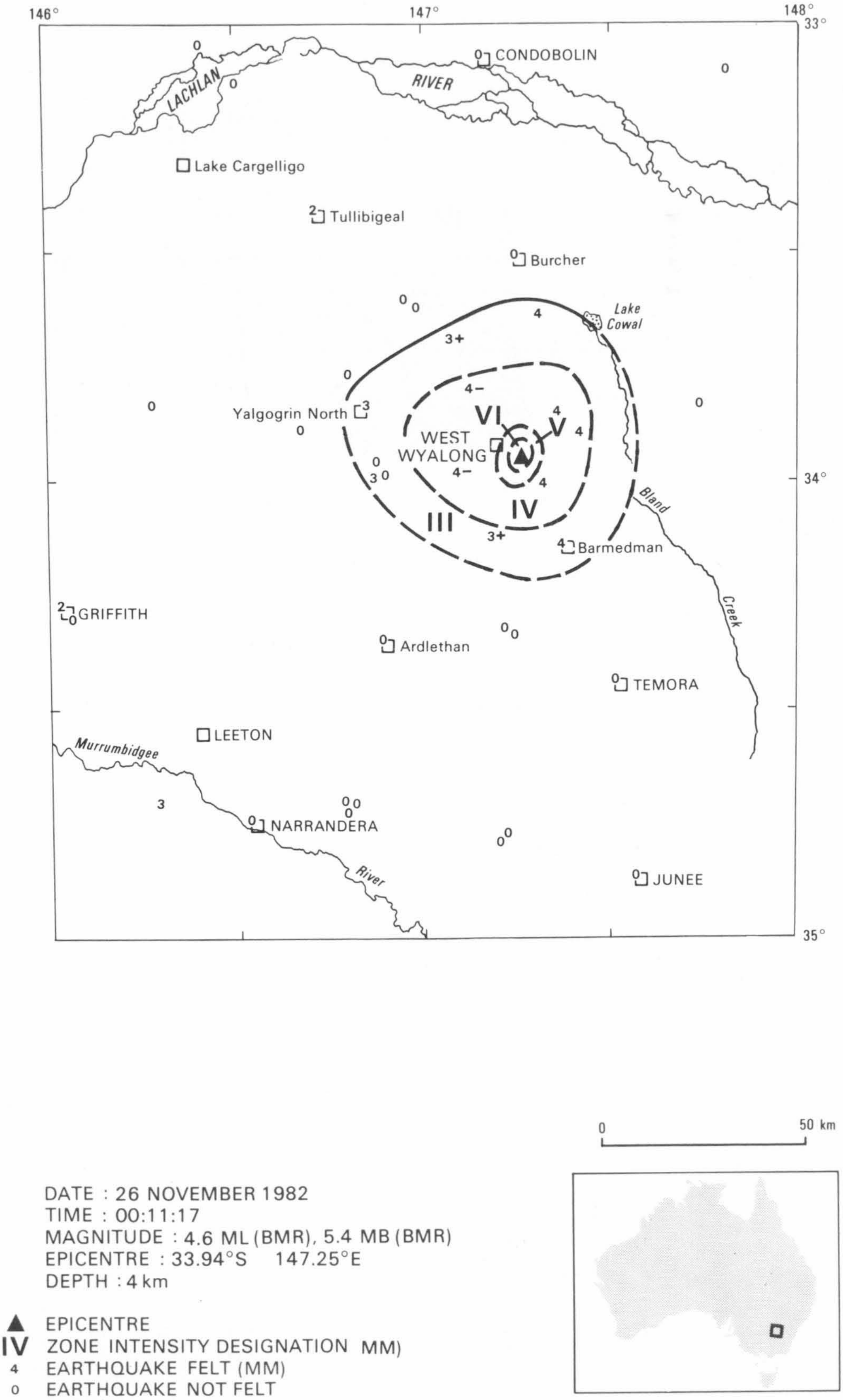
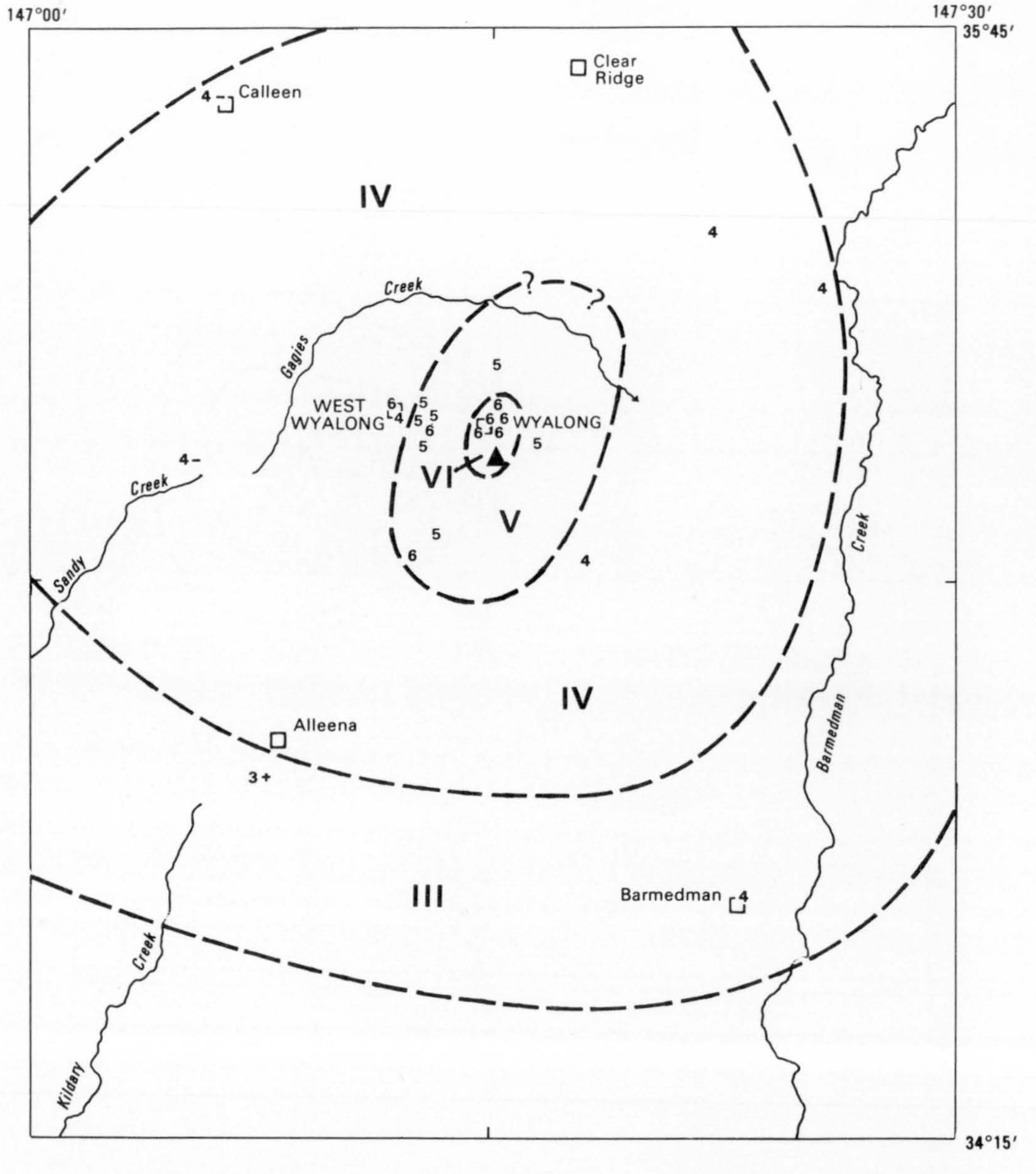
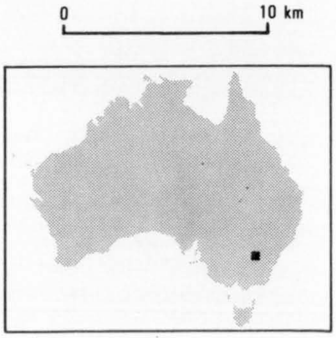


Fig. 13. Isoseismal map of the West Wyalong Earthquake, NSW, 26 November 1982. 24/155/5





DATE : 26 NOVEMBER 1982
TIME : 00:11:17 UT
MAGNITUDE : 4.6 ML (BMR), 5.4 ML (BMR)
EPICENTRE : 33.94°S 147.25°E
DEPTH : 4 km

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

Fig. 14. Isoseismal map of the West Wyalong Earthquake, NSW near epicentre, 26 November 1982. 24/155/6

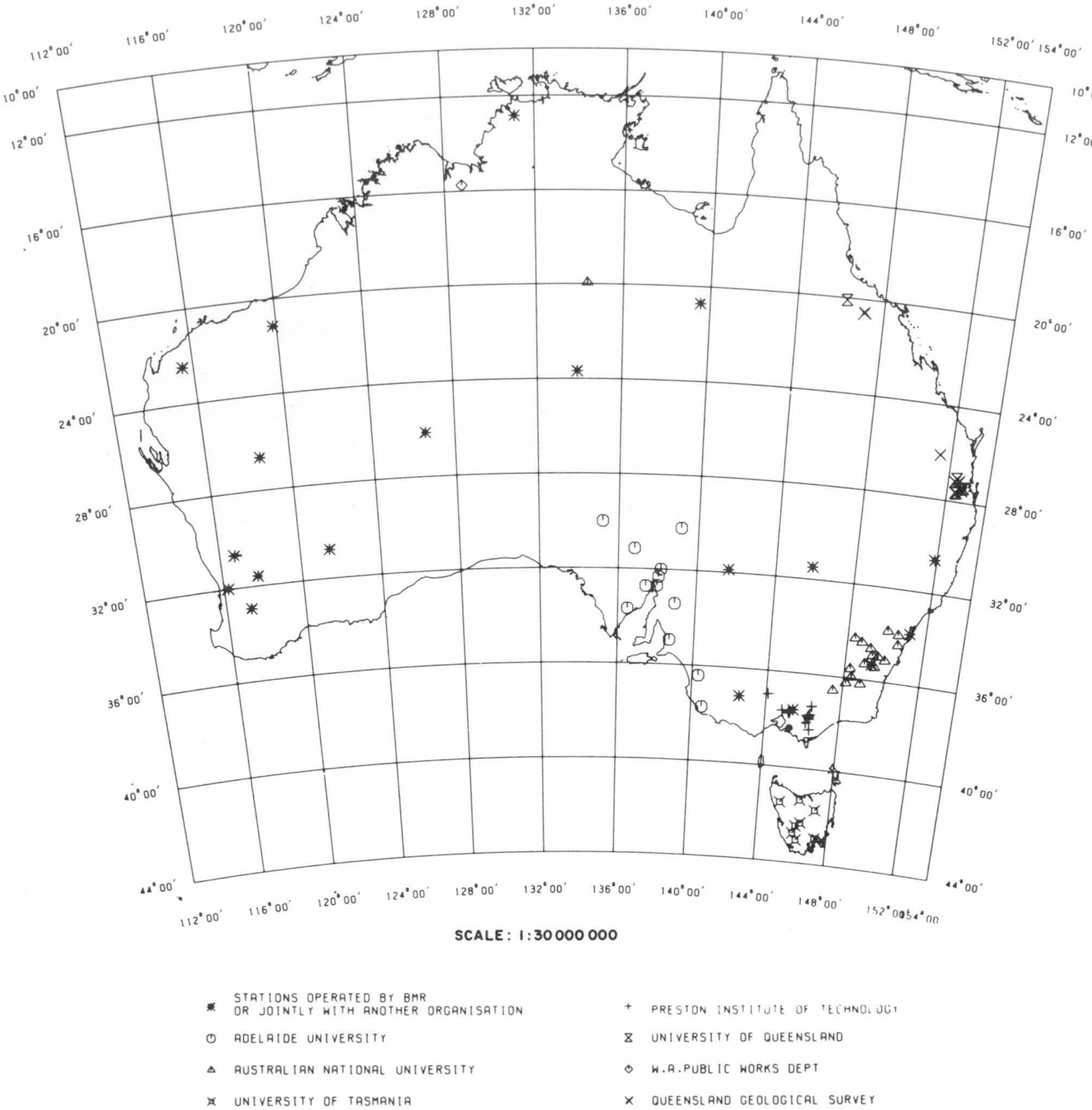


Fig. 15. Australian seismograph stations 1982.

24/A/5-4

listed on page iii and BMR co-ordinated these to provide Table 1. The BMR alsc maintains the definitive Australian earthquake data file and provides basic earthquake data for the Australian region, on request to scientists, insurance companies, engineers, and the general public.

STRONG-MOTION SEISMOGRAPH DATA

For earthquake hazard to be properly assessed, it is necessary to estimate the response of the surface of the earth close to an earthquake. Conventional seismographs become overloaded during strong ground motion and accelerographs are normally used then. These instruments are less sensitive and only operate when the ground motion reaches a threshold level which activates the recorder.

Twenty-one accelerographs operated in Australia during 1982, these are given in Table 3. Table 4 lists the principal facts from the twenty-seven triggerings obtained during the year from the Southwest Seismic Zone of Western Australia and the two obtained in Victoria from the Wonnangatta earthquake of 21 November. The largest acceleration of 77 cm/s^2 was recorded near Meckering from a 2.8 ML earthquake approximately 2 km from the accelerograph.

PRINCIPAL WORLD EARTHQUAKES, 1982

Table 5 lists earthquakes of magnitude 7.0 or greater and/or damaging earthquakes that occurred throughout the world in 1982.

The most disastrous earthquake was that of 13 December in Yemen which killed more than 2 800 people. The total world-wide death-toll from earthquakes for 1982 was about 3 300 (about 800 less than for 1981). These data are based on 'Earthquake Data Reports' published by the United States Department of the Interior, Geological Survey and SEAN Bulletin of the Smithsonian Intitution (Washington DC, USA). Figure 16 shows the locations of these earthquakes and numbers of casualties.

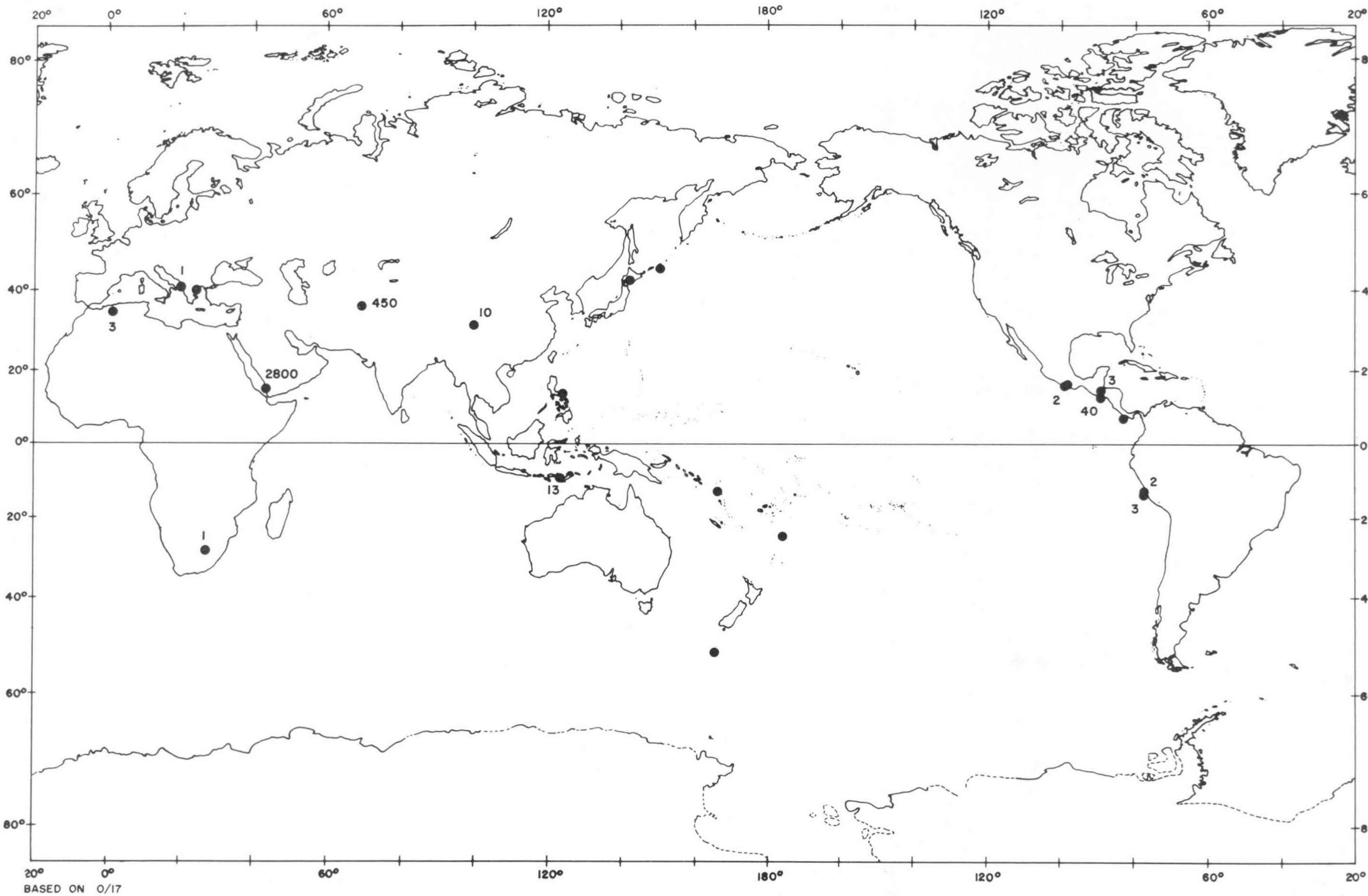


Fig. 16. Principal world earthquakes 1982.

24/0/2-2

TABLE 1. AUSTRALIAN EARTHQUAKES 1982: HYPOCENTRAL PARAMETERS

DATA * SOURCE	DATE yr mo dy	ORIGIN (UT) hr mn sec	LAT S	LONG E	DEPTH (km)	MAGNITUDE	N*
MUN	82 01 02	06 36 33.	16.680	120.210	37	4.7 ML	7
BMR	82 01 09	06 08 16.4	21.278	120.409	28	4.0 ML	9
MUN	82 01 17	15 35 53.	37.530	121.650	10	3.2 ML	4
CAN	82 01 22	07 26 07.0	36.235	148.768	1	3.1 ML	10
MUN	82 01 22	18 02 40.3	30.930	117.110	5	3.8 ML	8
MUN	82 01 24	04 06 20.0	30.900	117.120	5	4.3 ML	8
QLD	82 01 25	11 26 08.2	28.470	149.200	-	3.0 ML	6
MUN	82 01 25	23 26 58.7	30.910	117.130	5	4.4 ML	7
MUN	82 01 27	23 12 55.6	27.350	125.390	10	3.6 ML	4
MUN	82 02 05	14 24 09.1	30.890	117.120	10	3.1 ML	5
MUN	82 02 05	14 34 18.9	30.880	117.120	10	3.2 ML	4
MUN	82 02 06	15 24 39.5	30.880	117.150	10	4.9 ML	8
MUN	82 02 06	15 30 36.7	30.870	117.100	10	4.6 ML	6
MUN	82 02 07	13 07 31.4	30.890	117.090	10	4.1 ML	6
MUN	82 02 07	18 33 33.5	30.890	117.110	10	3.4 ML	4
MUN	82 02 08	03 37 37.	16.580	120.220	37	3.1 ML	3
MUN	82 02 08	04 39 34.5	30.890	117.100	10	4.1 ML	4
MUN	82 02 08	14 23 13.	12.540	123.380	37	3.6 ML	3
MUN	82 02 08	16 11 37.7	30.880	117.110	10	3.9 ML	3
CAN	82 02 09	19 04 24.	37.290	151.360	0	3.2 ML	10
MUN	82 02 09	22 06 24.3	30.870	117.090	10	3.4 ML	4
CAN	82 02 13	07 22 13.1	36.371	148.223	0	3.3 ML	12
BMR	82 02 13	08 26 57.6	22.096	126.643	10	5.3 ML	23
MUN	82 02 14	11 19 46.0	22.000	126.600	10	3.3 ML	3

TABLE 1 (cont.)

DATA * SOURCE	DATE yr mo dy	ORIGIN (UT) hr mn sec	LAT S	LONG E	DEPTH (km)	MAGNITUDE	N*
BMR	82 02 19	01 11 20.8	18.902	123.349	0	4.3 ML	9
MUN	82 02 19	09 36 11.9	18.840	118.430	10	3.4 ML	4
MUN	82 02 19	20 26 40.	22.290	113.900	10	3.6 ML	4
MUN	82 02 20	05 26 24.1	31.640	117.090	10	3.5 ML	8
MUN	82 02 26	15 24 33.	17.670	122.490	37	3.8 ML	5
MUN	82 02 27	18 43 01.5	18.860	121.180	37	3.3 ML	5
CAN	82 03 04	10 01 00.	29.800	151.000	0	4.5 ML	14
MUN	82 03 04	23 44 09.5	16.490	120.110	37	3.9 ML	7
MUN	82 03 08	23 16 28.0	30.700	117.100	5	3.5 ML	6
BMR	82 03 09	00 09 26.5	36.241	147.919	13	3.4 ML	16
BMR	82 03 11	14 20 50.0	16.232	120.243	35	4.2 ML	8
MUN	82 03 13	18 17 20.0	23.360	120.710	10	3.0 ML	4
CAN	82 03 13	21 28 15.	33.900	146.650	0	3.3 ML	12
MUN	82 03 17	04 29 07.6	14.860	127.510	10	3.6 ML	3
MUN	82 03 20	10 04 22.5	30.880	117.120	10	3.7 ML	5
MUN	82 03 27	15 43 12.0	22.470	114.000	10	4.0 ML	7
MUN	82 03 28	21 04 02.	25.570	116.020	10	3.0 ML	3
TAU	82 04 01	01 31 36.5	40.260	142.930	-	4.0 ML	14
CAN	82 04 14	15 07 08.	38.800	153.500	0	3.8 ML	10
MUN	82 04 15	17 50 32.1	30.890	117.120	10	3.9 ML	5
ADE	82 04 19	15 58 49.7	32.354	138.610	13	3.0 MN	12
CAN	82 04 19	20 14 55.0	33.110	148.880	15	3.4 ML	12
MUN	82 04 20	12 04 00.1	30.870	117.100	10	3.4 ML	5
MUN	82 04 22	14 44 38.0	15.710	120.190	37	3.5 ML	2
MUN	82 04 28	15 01 50.0	26.550	110.920	10	3.3 ML	3

TABLE 1 (cont.)

DATA SOURCE *	DATE yr mo dy	ORIGIN (UT) hr mn sec	LAT S	LONG E	DEPTH (km)	MAGNITUDE	N*
CAN	82 05 02	09 56 32.7	34.110	148.250	16	3.0 ML	13
PIT	82 05 02	11 56 52.9	35.981	144.204	6	3.1 ML	16
CAN	82 05 05	06 36 02.	35.240	151.410	0	3.2 ML	12
CAN	82 05 14	14 39 10.	38.800	153.500	0	3.9 ML	8
CAN	82 05 14	20 39 56.	37.600	152.900	0	3.3 ML	6
BMR	82 05 20	07 36 17.9	33.965	147.237	2	3.6 ML	26
CAN	82 05 20	15 37 19.9	34.150	147.540	24	3.4 ML	13
MUN	82 05 26	17 55 54.2	22.240	120.830	10	3.4 ML	5
MUN	82 06 06	14 06 16.0	32.510	121.960	10	4.1 ML	6
MUN	82 06 16	15 13 26.4	18.050	118.470	37	4.5 ML	7
MUN	82 06 23	11 39 59.2	22.000	126.600	10	3.3 ML	5
TAU	82 06 26	07 28 24.8	40.880	141.970	-	3.2 ML	7
MUN	82 06 30	07 57 23.2	30.740	117.090	10	3.1 ML	5
MUN	82 07 01	17 20 29.0	33.520	127.220	37	3.5 ML	4
MUN	82 07 04	07 05 26.0	26.470	131.010	10	3.5 ML	3
MUN	82 07 11	02 22 05.4	22.930	114.470	10	3.2 ML	3
CAN	82 07 11	23 09 35.	36.830	151.020	0	3.1 ML	11
CAN	82 07 13	09 30 19.	34.250	152.000	0	3.0 ML	9
ADE	82 07 15	01 44 21.2	31.048	138.339	18	4.4 MB	11
GS	82 07 21	21 01 55.6	12.019	119.956	33	3.0 MB	6
MUN	82 08 04	22 00 52.0	29.280	117.310	10	3.1 ML	4
BMR	82 08 19	10 49 00.8	40.609	145.191	0	3.6 ML	15
CAN	82 08 23	18 03 34.	38.800	153.750	0	3.5 ML	7
MUN	82 08 24	02 32 41.0	26.410	131.420	10	4.5 ML	9
CAN	82 09 09	04 28 23.0	33.600	151.960	15	4.1 ML	12

TABLE 1 (cont.)

DATA	DATE	ORIGIN (UT)	LAT S	LONG E	DEPTH	MAGNITUDE	N*
MUN	82 09 11	10 15 01.0	30.330	123.030	10	3.4 ML	5
CAN	82 09 15	04 30 42.	34.750	150.870	0	3.0 ML	11
CAN	82 09 15	04 33 49.9	34.750	150.870	26	3.3 ML	11
CAN	82 09 18	17 45 08.9	36.990	147.930	17	3.2 ML	11
CAN	82 09 20	08 21 01.5	34.030	147.420	21	3.2 ML	7
CAN	82 09 25	16 11 49.3	33.950	147.210	12	3.3 ML	12
CAN	82 09 29	13 21 49.2	34.570	149.250	16	3.0 ML	10
CAN	82 09 30	22 21 39.7	36.720	146.450	13	3.4 ML	12
MUN	82 10 01	19 13 17.7	30.830	117.070	10	3.4 ML	4
ADE	82 10 02	22 09 07.7	34.061	135.870	6	3.1 MD	11
ADE	82 10 03	13 25 55.4	34.076	135.828	3	3.1 MD	12
ADE	82 10 03	14 02 16.6	34.068	135.811	4	3.2 MD	12
MUN	82 10 03	17 00 44.0	22.090	115.850	10	5.0 ML	9
GS	82 10 06	13 27 19.0	12.090	117.178	33	4.1 MB	17
MUN	82 10 10	02 56 30.6	31.000	116.740	7	3.0 ML	6
BMR	82 10 12	16 58 46.0	34.110	135.730	33	3.2 ML	16
MUN	82 11 03	02 40 32.0	20.530	120.480	37	5.2 ML	10
CAN	82 11 05	10 33 28.5	34.950	148.840	8	3.0 ML	9
CAN	82 11 09	21 47 24.	38.060	149.100	0	3.4 ML	10
BMR	82 11 10	09 31 15.6	38.120	137.290	17	4.0 ML	24
CAN	82 11 13	10 54 53.	35.800	144.430	0	3.8 ML	6
MUN	82 11 20	02 00 26.0	19.020	127.180	19	4.2 ML	6
BMR	82 11 21	11 34 18.2	37.122	146.884	8	5.5 ML	19
CAN	82 11 24	07 07 54.	33.990	147.330	0	4.0 ML	3
CAN	82 11 24	07 09 23.	33.990	147.330	0	4.0 ML	3

TABLE 1 (cont.)

DATA * SOURCE	DATE yr mo dy	ORIGIN (UT) hr mn sec	LAT S	LONG E	DEPTH (km)	MAGNITUDE	N*
ADE	82 11 25	18 42 29.4	36.968	139.919	22	3.0 MD	13
BMR	82 11 26	00 11 16.7	33.940	147.250	4	4.6 ML	17
CAN	82 11 26	05 07 41.5	33.960	147.380	19	3.0 ML	12
CAN	82 11 26	09 02 00.	33.850	147.290	0	3.3 ML	12
CAN	82 11 26	20 44 52.6	33.060	147.350	16	3.6 ML	14
CAN	82 11 27	11 20 47.4	33.920	147.290	17	3.3 ML	13
CAN	82 11 30	02 07 17.0	33.930	147.270	13	3.1 ML	11
CAN	82 12 01	06 31 14.0	33.980	147.330	17	3.2 ML	12
MUN	82 12 07	14 40 03.0	16.880	120.250	37	4.5 ML	9
CAN	82 12 09	18 32 15.	36.630	146.700	0	3.1 ML	9
TAU	82 12 10	19 14 41.6	40.150	143.870		3.0 ML	8
MUN	82 12 13	16 19 37.4	27.560	113.020	10	3.0 ML	2
MUN	82 12 14	12 54 33.0	22.000	126.390	10	3.4 ML	4
MUN	82 12 16	14 31 24.0	18.320	121.150	37	3.5 ML	4
MUN	82 12 21	21 59 19.5	32.110	117.190	10	3.0 ML	7
CAN	82 12 22	21 02 14.	37.210	146.530	0	3.6 ML	7
CAN	82 12 22	21 06 23.	37.140	146.340	0	3.1 ML	8
CAN	82 12 25	16 48 40.	33.000	151.900	0	3.5 ML	5
GS	82 12 31	22 19 19.4	17.449	124.154	33	4.5 MB	7

* Code refers to the contributors listed in the text p.iii.
N Is the number of stations used to determine hypocentre.

TABLE 2. AUSTRALIAN SEISMOGRAPH STATIONS 1982

CODE	STATION NAME	LAT S	LONG E	ELEV (m)	OPERATOR*	CATEGORY**
QUEENSLAND						
AWMQ	MT. GOLEGUMMA	24.0462	151.3157	125	GSQ	1
BDMQ	BOONDOOMA DAM	26.1123	151.4443	320	GSQ	1
BGCQ	GL'DON CROSSINGS	20.6140	147.1609	160	GSQ	1
BGRQ	GLENROY	20.5492	147.1052	160	GSQ	1
BMGQ	MT GRAHAM	20.6142	147.0608	160	GSQ	1
BRS	BRISBANE	27.3917	152.7750	525	QLD	5
CTAO	CHARTERS TOWERS	20.0883	146.2550	357	QLD	3
ISQ	MOUNT ISA	20.7150	139.5533	500	BMR	1
QNN	WIVENHOE DAM	27.3507	152.5404	120	QLD	3
WMBQ	MT BRISBANE	27.1155	152.5502	160	GSQ	1
WPLQ	PLAINLAND	27.6058	152.4168	160	GSQ	1
WPMQ	PINE MOUNTAIN	27.5357	152.7355	35	GSQ	1
WTGQ	TOOGOOLAWAH	27.1458	152.3333	130	GSQ	1
NORTHERN TERRITORY						
ASP	ALICE SPRINGS	23.6786	133.8886	600	BMR	3
ASPA	ALICE SPRINGS	23.6669	133.9014	600	BMR	3
MTN	MANTON	12.8467	131.1300	80	BMR	1
WB2	WARRAMUNGA ARRAY	19.9444	134.3525	366	CAN	3
WESTERN AUSTRALIA						
BAL	BALLIDU	30.6065	116.7072	300	MUN	1
KLB	KELLERBERRIN	31.5778	117.7600	300	MUN	1
KLG	KALGOORLIE	30.7833	121.4583	360	MUN	1
KNA	KUNUNURRA	15.7500	128.7667	150	PWD/MUN	1
MBL	MARBLE BAR	21.1600	119.8333	200	MUN	1

TABLE 2 (cont.)

CODE	STATION NAME	LAT S	LONG E	ELEV (m)	OPERATOR*	CATEGORY**
MEK	MEEKATHARRA	26.6133	118.5450	520	MUN	1
MUN	MUNDARING	31.9783	116.2083	253	MUN	2
NAU	NANUTARRA	22.5442	115.5000	80	MUN	1
NWAO	NARROGIN	32.9267	117.2333	265	MUN	4
WBN	WARBURTON	26.1400	126.5780	457	MUN	1
NEW SOUTH WALES AND A.C.T.						
AVO	AVON	34.3764	150.6150	532	CAN	1
BWA	BOOROWA	34.4250	148.7513	656	CAN	1
CAH	CASTLE HILL	34.6467	149.2417	700	CAN	1
CAN	CANBERRA (ANU)	35.3208	148.9986	650	CAN	1
CBR	CABRAMURRA	35.9433	148.3928	1537	CAN	1
CMS	COBAR	31.4867	145.8283	225	BMR	1
CNB	CANBERRA (BMR)	35.3137	149.3620	855	BMR	1
COO	COONEY	30.5783	151.8917	650	BMR	1
IVN	INVERALOCHY	34.9650	149.6667	650	CAN	1
JNL	JENOLAN	33.8258	150.0172	829	CAN	1
KHA	KHANCOBAN	36.2136	148.1288	435	CAN	1
LER	LERIDA	34.9344	149.3642	940	CAN	1
MEG	MEANGORA	35.1007	150.0367	712	CAN	1
RIV	RIVERVIEW	33.8293	151.1585	21	RIV	2
SBR	STH BLACK RANGE	35.4250	149.5333	1265	CAN	1
STK	STEPHENS CREEK	31.8817	141.5917	213	BMR	1
TAO	TALBINGO	35.5958	148.2900	570	CAN	1
WAM	WAMBROOK	36.1928	148.8833	1290	CAN	1
WER	WEROMBI	33.9503	150.5803	226	CAN	1

TABLE 2 (cont.)

CODE	STATION NAME	LAT S	LONG E	ELEV (m)	OPERATOR*	CATEGORY**
YOU	YOUNG	34.2783	148.3817	503	CAN	1
SOUTH AUSTRALIA						
ADE	ADELAIDE	34.9670	138.7136	655	ADE	2
CLV	CLEVE	33.6911	136.4955	238	ADE	1
EDO	ENDILLOE	32.3216	138.0483	300	ADE	1
HTT	HALLETT	33.4305	138.9217	708	ADE	1
HWK	HAWKSNEST	29.9578	135.2035	180	ADE	1
MGR	MT GAMBIER	37.7283	140.5710	190	ADE	1
NBK	NECTAR BROOK	32.7010	137.9830	180	ADE	1
PNA	PARTACOONA	32.0057	138.1647	180	ADE	1
RPA	ROOPENA	32.7250	137.4033	95	ADE	1
UMB	UMBERATANA	30.2400	139.1280	610	ADE	1
WKA	WILLALOOKA	36.4170	140.3210	40	ADE	1
WRG	WOOMERA	31.1046	136.7634	168	ADE	1
VICTORIA						
ABE	ABERFELDY	37.7194	146.3890	549	PIT	1
BFD	BELLFIELD	37.1767	142.5450	235	BMR	1
DRT	DARTMOUTH	36.5900	147.4928	950	CAN	1
FRT	FORREST	38.5342	143.7156	230	PIT	1
GVL	GREENVALE	37.6186	144.9006	188	PIT	1
JEN	JEERALANG JNTN	38.3507	146.4198	330	PIT	1
KGD	KANGAROO GROUND	37.6988	145.2694	80	PIT	1
LIL	LILYDALE	37.6936	145.3424	80	PIT	1
MAL	MARSHALL SPUR	37.7491	146.2919	1076	PIT	1
MIC	MOUNT ERICA	37.9433	146.3590	805	PIT	1

TABLE 2 (cont.)

CODE	STATION NAME	LAT S	LONG E	ELEV (m)	OPERATOR*	CATEGORY**
PAT	PLANE TRACK	37.8573	146.4556	771	PIT	1
PEG	PEGLEG	36.9848	144.0912	340	PIT	1
PNH	PANTON HILL	37.6346	145.2709	180	PIT	1
TOM	THOMSON	37.8102	146.3485	941	PIT	1
TOO	TOOLANGI	37.5717	145.4900	604	BMR	1
WIL	WILLOW GROVE	38.0619	146.2001	124	PIT	1
TASMANIA						
MOO	MOORLANDS	42.4417	146.1903	325	TAU	1
SAV	SAVANNAH	41.7208	147.1889	180	TAU	1
SFF	SHEFFIELD	41.3375	146.3075	213	TAU	1
SPK	SCOTTS PEAK	43.0383	146.2750	425	TAU	1
STG	STRATHGORDON	42.7508	146.0533	350	TAU	1
SVR	SAVAGE RIVER	41.4888	145.2108	360	TAU	1
TAU	TASMANIAN UNIV	42.9097	147.3206	132	TAU	1
TRR	TARRALEAH	42.3042	146.4500	579	TAU	1

* Operator refers to the contributors listed in p.iii.

** 1. Short period (vertical and/or horizontal)
   2. Word-wide standard seismograph station
   3. Array
   4. Seismological Research Observatory

   5. Long and short period seismographs

TABLE 3. ACCELEROGRAPH LOCATIONS, 1982

LOCALITY		LAT S	LONG E	ELEV (m)	FOUNDATION	INSTRUMENT	OPERATOR*
New South Wales							
Oolong		34.773	149.163	600	Firm soil/ granite	SMA1	BMR
Yass		34.830	149.043	300		SMA1	BMR
Hume Weir		36.110	147.043	600	Dam Wall	SMA1	WRC
Hume Weir		36.110	147.043	600	Dam Wall	SMA1	WRC
Hume Weir		36.110	147.043	600	Dam Wall	SMA1	WRC
South Australia							
Kangarro Ck Dam		34.87	138.78	244	Slates/Schists	MO2	EWSSA
Little Para Dam		34.75	138.72	102	Dolomite		EWSSA
Modbury Hospital		34.83	138.70		Marl & Clay	MO2	PWDSA
Admin. Centre		34.925	138.608		Alluvium	MO2	PWDSA
Tasmania							
Gordon Dam		42.71	145.97		Quartzite	MO2	HEC
Western Australia							
Cadoux							
Kalajzics	(CA-K)	30.719	117.143	300	Granite	MO2	BMR
Meckering							
Kelly's	(ME-K)	31.694	116.982	200	Alluvium/ granite	MO2	BMR
Morrell's	(ME-M)	31.659	117.089	220	Alluvium/ granite	MO2	BMR
Mundaring Weir	(MU-W)	31.967	116.169	250	Concrete wall	SMA1	PWDWA
Ord River Dam							
abutment	(KU-A)	16.113	128.737	160	Phyllite	MO2	PWDWA
wall	(KU-W)	16.113	128.738	120	Rockfill	MO2	PWDWA
Perth							
Telecom)	(PT-B)	31.953	115.850	10	Basement	SMA1	TEL
Exchange)	(PT-M)	31.953	115.850	40	Middle floor	SMA1	TEL
Building)	(PT-T)	31.953	115.850	70	Top floor	SMA1	TEL
Victoria							
Jeeralong (JNA)		38.351	146.419	330		PIT	PIT
Plane Track (PTA)		37.357	146.357	771		PIT	PIT

*

BMR = Bureau of Mineral Resources, Canberra or Mundaring
EWSSA = Enginering and Water Supply Department, South Australia
HEC = Hydro-electric Commission, Tasmania
PIT = Preston Institute of Technology
PWDSA = Public Works Department, South Australia
PWD = Public Works Department, Western Australia
TEL = Telecom (Perth)

TABLE 4. ACCELEROGRAM DATA: PRINCIPAL FACTS

YR MN DY	UT	LAT S	LONG E	ML	LOC	H/E	COM	T(S)	ACC	R	DUR
82 02 20	0527	31.62	117.07	3.5	ME-K	(15)/(11)	SZ	0.04	3.4		
Rumbling at ME-Z For an estimated 20 secs,							N	0.04	10.8	15.0	14.1
Felt MM111-1V.							E	0.04	9.8		
					ME-M	(11)/(4)	SZ	0.02	2.1		
							N	0.02	4.7	12.9	6.3
							E	0.02	11.8		
82 02 21	2306	30.73	117.13	2.8	CA-K	2.5/2	PZ	0.04	9.8		
Felt at 2 nearby farmhouses							N	0.02	5.9	12.9	
at MM1V.							E	0.02	5.9		
							SZ	0.04	49.0		15.4
							N	0.03	49.0	75.3	
							E	0.03	29.4		
							LZ	0.04	53.9		
							N	0.04	39.2	77.3	
							E	0.04	39.2		
82 02 23	1214	31.69	116.92	2.0	ME-K	(7)/6	SZ	0.03	2.0		
							N	0.03	10.8	12.5	4.7
							E	0.03	5.9		
82 02 24	2339	31.70	116.97	1.5	ME-K	3/1	PZ	0.02	1.0		
							N	0.02	2.0	2.5	
							E	0.02	1.0		
							SZ	0.02	2.0		4.7
							N	0.02	1.0	4.5	
							E	0.02	3.9		
							LZ	0.02	4.9		
							N	0.03	8.8	15.5	
							E	0.03	11.8		
82 03 08	2316	30.70	117.10	3.5	CA-K	(10)/(4)	LZ	0.05	9.8		
							N	0.05	7.8	17.2	12.0
							E	0.05	11.8		
82 03 10	1730	30.73	117.08	2.7	CA-K	(10)/(4)	SZ	0.03	2.0		
							N	0.03	0.6	2.2	1.8
							E	0.03	0.6		
82 03 17	1708	30.72	117.13	1.8	CA-K	(2)/(1)	SZ	0.03	3.4		
							N	0.02	1.0	3.7	1.7
							E	0.03	1.0		
82 03 20	1004	30.91	117.14	3.7	CA-K	(25)/(22)	SZ	0.04	3.8		
							N	0.03	1.0	4.1	3.4
							E	0.03	1.0		

TABLE 4 (cont.)

YR MO DY	UT	LAT S	LONG E	ML	LOC	H/E	COM	T(S)	ACC	R	DUR
82 04 02	1604	30.76	117.11	2.5	CA-K	(6)/(5)	SZ	0.04	9.8		
							N	0.03	0.6	9.9	2.3
							E	0.03	1.0		
82 04 14	0012	30.78	117.13	1.5	CA-K	(7)/(7)	SZ	0.03	3.8		
Felt nearby for 4 secs.							N	0.02	1.1	4.1	4.7
							E	0.02	1.2		
82 04 15	1217	30.77	117.12	1.4	CA-K	(6)/(6)	SZ	0.03	2.7		
Felt nearby.							N	0.03	1.1	7.5	1.7
							E	0.03	6.9		
82 04 15	1750	30.85	117.16	3.9	CA-K	20/17	SZ	0.03	4.6		
Felt nearby at MM1V,							N	0.03	1.1	5.0	
felt for 7 secs.							E	0.03	1.7		8.1
							LZ	0.03	49.0		
							N	0.03	24.5	55.1	
							E	0.05	5.9		
82 04 17	1506	30.74	117.12	1.3	CA-K	4/3	PZ	0.03	0.2		
Felt for 1 1/2 secs.							N	0.03	0.6	0.9	
							E	0.03	0.6		0.6
							SZ	0.03	5.9		
							N	0.02	7.8	10.9	
							E	0.02	4.9		
82 04 20	1204	30.88	117.12	3.4	CA-K	(20)/(19)	SZ	0.03	2.9		
							N	0.03	4.9	9.7	2.9
							E	0.03	7.8		
82 04 20	2103	30.75	117.10	2.1	CA-K	6/5	PZ	0.03	3.9		
Felt for 3 1/2 secs.							N	0.03	1.0	5.0	
							E	0.03	2.9		5.8
							SZ	0.03	5.9		
							N	0.03	3.9	8.6	
							E	0.03	4.9		
82 05 08	1215	30.76	117.11	2.0	CA-K	6/5.5	PZ	0.03	2.0		
Felt nearby at MM1V							N	0.03	0.6	2.2	
							E	0.03	0.6		5.8
							SZ	0.03	19.6		
							N	0.03	5.9	22.7	
							E	0.03	9.8		
82 05 20	0728	30.76	117.17	1.4	CA-K	6/5.5	SZ	0.03	3.9		
Felt nearby at MM1V							N	0.03	3.9	6.2	2.9
							E	0.03	2.9		
82 07 02	0331	31.69	117.01	2.1	ME-K	3/3	PZ	0.02	1.0		

TABLE 4 (cont.)

YR MO DY	UT	LAT S	LONG E	ML	LOC	H/E	COM	T(S)	ACC	R	DUR
Event felt 7 km away at about MM111							E	0.02	1.7		3.6
							SZ	0.045	7.6		
							N	**	±16	±18	
							E	0.03	4.0		
82 07 16	2006	30.72	117.13	1.8	CA-K	(5)/(1)	SZ	0.04	2.0		
							N	0.04	1.1	3.3	1.6
							E	0.04	2.4		
82 07 28	1923	30.78	117.08	2.1	CA-K	(10)/(9)	SZ	0.04	9.8		
							N	0.04	2.2	10.1	1.6
							E	0.04	0.6		
82 08 02	1256	31.71	117.01	2.8	ME-K	3.5/3	PZ	0.025	3.0		
Felt at nearby farmhouse MM1V,							N	0.025	9.1	10.9	
Felt at another 9 km away at MM111.							E	0.02	5.1		
Double event.							N	0.035	4.3	10.0	8.0
							E	0.035	7.5		
							LZ	0.035	19.6		
							N	0.025	35.3	59.1	
							E	0.03	43.1		
Second event occurred 37 secs				2.2	ME-K	3.5/3	PZ	0.03	3.4		
later-assume same location							N	0.03	0.5	4.8	
as event above.							E	0.025	3.4		3.6
							LZ	0.035	3.0		
							N	0.035	5.9	8.7	
							E	0.035			
82 08 06	0915	30.76	117.16	2.2	CA-K	(7)/(5)	LZ	0.04	9.8		
Felt MM1V at two nearby farms							N	0.04	2.8	10.8	8.8
							E	0.04	3.5		
82 08 12	1503	30.76	117.10	1.4	CA-K	(7)/(6)	LZ	0.04	4.2		
Felt MM1V							N	0.04	2.2	4.9	5.9
							E	0.04	1.2		
82 08 21	2156	30.76	117.12	1.4	CA-K	(6)/(4.5)	SZ	0.03	2.8		
Felt MM1V							N	0.03	1.7	6.7	7.1
							E	0.03	5.9		
82 08 31	2229	30.77	117.11	2.3	CA-K	6/5	PZ	0.03	2.0		
							N	0.03	0.6	4.7	
							E	0.03	0.6		7.1
							SZ	0.05	7.8		
							N	0.025	1.6	8.7	
							E	0.025	3.4		
** Trace very faint.							N	0.02	2.7	3.3	

82	11	21	1134	37.26	147.02	5.4	PTA	84/83	PZ	0.13	3.5
									PN	0.14	3.1
									PE	0.20	2.3
									SZ	0.12	6.9
									SN	0.18	15.6
									SE	0.18	16.0
							JNA	133/132	PZ	0.13	0.66
									PN	0.13	0.53
									PE	0.21	0.46
									SZ	0.13	6.8
									SN	0.15	6.2
									SE	0.23	7.3

KEY

YR = Year, MO = Month, DY = Day, UT = Universal Time, LAT = Latitude
LONG = Longitude, ML = Richter magnitude, LOC = Accelerograph location,
H/E = Hypocentral distance/ epicentral distance, COM = component, T(S) = Ground period in seconds, ACC = ground acceleration (cm/s^2), at time of peak acceleration
R = Resultant peak acceleration (cm/s^2), DUR = duration in seconds while ground accerleration remained above 0.5 cm/s^2. No resultant acceleration is available for PTA and JNA triggerings. The numbers in the ACC column for these stations are the maximum acceleration for each component.

TABLE 5. PRINCIPAL WORLD EARTHQUAKES, 1982

[Earthquakes of magnitude 7.0 or greater, or causing damage or fatalities. PAS--Pasadena, BRK--Berkeley, PMR--Palmer, Alaska, PAL--Palisades, New York, JMA--Japan Meterological Agency]*

Date	Origin Time (UT)	Region	Lat.	Long.	Magnitude
Jan 11	06 10 06.4	Luzon, Philippine Islands	13.75N	124.36E	6.0mb 7.1MS 7.2MS(BRK) 7.4MS(PAS)

Depth 46km. Several people injured and some damage (VII RF) at Virac, Catanduanes. Felt (V RF) at Manila and Legaspi, Luzon, and Catbalogan, Samar. Felt from Baguio, Luzon to Hinatuan, Mindanao.

Date	Origin Time (UT)	Region	Lat.	Long.	Magnitude
Jan 18	19 27 24.4	Aegean Sea	40.00N	24.32E	5.8mb 6.8MS 6.8MS(BRK) 7.0MS(PAS)

Depth 10km. Felt strongly throughout Greece. Felt in Bulgaria, southeastern Italy, southeastern Yugoslavia, and western Turkey.

Date	Origin Time (UT)	Region	Lat.	Long.	Magnitude
Mar 21	02 32 07.7	Hokkaido, Japan region	42.16N	142.36E	6.4mb 6.7MS 6.5MS(BRK) 6.4MS(PAS)

Depth 44km. One hundred ten people injured and extensive damage (VI JAM) in southern Hokkaido. Also felt in northern and central Honshu, Japan. Tsunami (80cm peak-to-trough) recorded at Urakawa, (24cm peak-to-trough) at Hachinohe.

Date	Origin Time (UT)	Region	Lat.	Long.	Magnitude
Mar 23	05 10 07.3	Near coast of Peru	12.41S	77.67W	5.1mb

Depth 57km. Two people killed and damage (V) in the Lima area.

Date	Origin Time (UT)	Region	Lat.	Long.	Magnitude
Mar 28	23 24 51.1	Near coast of Peru	12.69S	76.07W	6.1mb

Depth 95km. Three people reported killed and extensive damage (VI) at Lunahuana. Felt (V) at Lima. Also felt at Huancayo.

Date	Origin Time (UT)	Region	Lat.	Long.	Magnitude
Apr 13	11 26 47.2	Republic of South Africa	27.93S	26.78E	5.0mb

Depth 5km. One person killed, 20 injured from rock slides in a gold mine near Welkom.

Date	Origin Time (UT)	Region	Lat.	Long.	Magnitude
Jun 07	06 52 37.3	Near coast of Guerrero, Mexico	16.61N	98.15W	6.0mb 6.9MS 7.2MS(BRK) 6.7MS(PAS)

Depth 41km. Damage in southern Mexico. Felt strongly throughout southern Mexico.

* Based on 'Earthquake Data Reports' published by the US Geological Survey, and on the SEAN Bulletin of the Smithsonian Institution.

TABLE 5 (cont.)

Date	Origin Time (UT)	Region	Lat.	Long.	Magnitude
Jun 07	10 59 40.1	Near coast of Guerrero, Mexico	16.56N	98.36W	6.3mb 7.0MS 6.9MS(BRK) 6.3MS(PAS)
Depth 34km. Two people killed at Orizaba, three at Oaxaca, three at Pinotepa Nacional, and one at Guadalupe, Guerrero. Many people injured. Felt strongly throughout southern Mexico.					
Jun 15	23 24 28.6	Sichuan Province, China	31.91N	99.93E	5.6mb 5.5MS
Depth 10km. Ten people killed, five injured and damage in the Garze area.					
Jun 19	06 21 58.0	El Salvador	13.31N	89.34W	6.2mb 7.0mb(PAS)
Depth 82km. At least forty people killed, many injured, and thousands of people left homeless in El Salvador. Extensive damage (VII) and landslides south of San Salvador including some damage in San Salvador. Three people killed, forty injured, and considerable damage in south-eastern Guatemala. Felt in Costa Rica, Honduras, and Nicaragua.					
Jun 30	01 57 34.1	Kuril Islands region	44.68N	151.14E	6.6mb 6.9MS 6.9MS(BRK) 7.1MS(PAS)
Depth 33km. Felt (V) on Shikotan and at Kurilsk, and (III) on Iturup.					
Jul 07	10 43 03.7	North of Macquarie Island	51.23S	160.51E	6.3mb 7.0MS 7.3MS(BRK) 7.1MS(PAS)
Depth 10km.					
Aug 05	20 32 52.9	Santa Cruz Islands	12.60S	165.93E	6.2mb 7.1MS 7.5MS(BRK) 7.3MS(PAL)
Depth 31km.					
Aug 19	15 59 01.5	South of Panama	6.72N	82.68W	6.2mb 6.5MS 7.0MS(BRK) 6.6MS(PAL) 6.2MS(PAS)
Depth 10km. Three people injured in Costa Rica. Minor damage in Costa Rica and Panama. Felt throughout Costa Rica and along the southern coast of Panama from David to Panama City.					

TABLE 5 (cont.)

Date	Origin Time (UT)	Region	Lat.	Long.	Magnitude
Sep 29	05 50 32.2	Guatemala	14.49N	89.12W	5.5mb 5.1MS

Depth 12km. Three people killed, two injured, many homes damaged, and some landslides in the Dolores Merendon-Ocotepeque area, Honduras. Five hundred fifty-four houses damaged in southeastern Guatemala. Nine km fault scarp with 10 cm displacement observed about 15 km east of Esquipulas, Guatemala. Also felt at Tegucigalpa, Hondura and (IV) at San Salvador, El Salvador.

Date	Origin Time (UT)	Region	Lat.	Long.	Magnitude
Nov 15	20 07 47.2	Algeria	35.55n	1.35E	5.1mb 4.4MS

Depth 10km. Three people killed, fourteen injured, and ten houses collapsed in the Tissemsilt area.

Date	Origin Time (UT)	Region	Lat.	Long.	Magnitude
Nov 16	23 41 20.5	Albania	40.98N	19.54E	5.6mb 5.5MS

Depth 10km. One person killed, twelve injured and extensive damage (VIII) in the Fier, Berat, and Lushjne areas. Felt (VI) at Titograd, Yugoslavia.

Date	Origin Time (UT)	Region	Lat.	Long.	Magnitude
Dec 13	09 12 49.4	Western Arabian Peninsula	14.75N	44.29E	5.9mb 6.0MS 6.0MS(PAS)

Depth 10km. Unconfirmed reports of more than two thousand eight hundred people killed, fifteen hundred injured, seven hundred thousand homeless, and about three hundred villages destroyed or badly damaged in Yemen. Landslides occurred in the area. Believed to be the first instrumentally located hypocenter in this area.

Date	Origin Time (UT)	Region	Lat.	Long.	Magnitude
Dec 16	00 40 48.6	Hindu Kush region	36.24N	69.10E	6.2mb 6.6MS 6.8MS(PAS)

Depth 35km. Four hundred fifty people killed, many injured, and considerable damage in the Baghlan-Narin area, Afghanistan. Minor damage at Dushanbe, Tajikistan, USSR. Felt at Tashkent, Uzbekistan, USSR. Also felt in the Peshawar-Rawalpindi area, Pakistan.

Date	Origin Time (UT)	Region	Lat.	Long.	Magnitude
Dec 19	17 43 55.9	South of Tonga Islands	24.19S	175.77W	6.0mb 7.7MS 7.4MS(BRK) 7.3MS(PAS)

Depth 33km. Fifteen cm (peak-to-trough) at Papeete, Tahiti. Nine cm (peak-to-trough) tsunami at Pago Pago, Samoa Islands.

Date	Origin Time (UT)	Region	Lat.	Long.	Magnitude
Dec 25	12 28 00.9	Flores Island region	8.43S	123.08E	5.6mb 5.8MS

Depth 33km. Thirteen people killed, three hundred ninety injured, and eighteen hundred seventy five homes and other buildings damaged or destroyed.

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APPENDIX

MODIFIED MERCALLI (MM) SCALE OF EARTHQUAKE INTENSITY

after Eiby, 1966

MM I Not felt by humans, except in especially favourable circumstances, but birds and animals may be disturbed. Reported mainly from the upper floors of buildings more than ten storeys high. Dizziness or nausea may be experienced. Branches of trees, chandeliers, doors, and other suspended systems of long natural period may be seen to move slowly. Water in ponds, lakes, reservoirs, etc., may be set into seiche oscillation.

MM II Felt by a few persons at rest indoors, especially by those on upper floors or otherwise favourable placed. The long-period effects listed under MM I may be more noticeable.

MM III Felt indoors, but not identified as an earthquake by everyone. Vibrations may be likened to the passing of light traffic. It may be possible to estimate the duration, but not the direction. Hanging objects may swing slightly. Standing motorcars may rock slightly.

MM IV Generally noticed indoors, but not outside. Very light sleepers may be awakened. Vibration may be likened to the passing of heavy traffic, or to the jolt of a heavy object falling or striking the building. Walls and frame of building are heard to creak. Doors and windows rattle. Glassware and crockery rattle. Liquids in open vessels may be slightly disturbed. Standing motorcars may rock, and the shock can be felt by their occupants.

MM V Generally felt outside, and by almost everyone indoors. Most sleepers awakened. A few people frightened. Direction of motion can be estimated. Small unstable objects are displaced or upset. Some glassware and crockery may be broken. Some windows crack. A few earthware toilet fixtures crack. Hanging pictures move. Doors and shutters swing. Pendulum clocks stop, start, or change rate.

MM VI Felt by all. People and animals alarmed. Many run outside. Difficulty experienced in walking steadily. Slight damage to masonry D. Some plaster cracks and falls. Isolated cases of chimney damage. Windows, and crockery broken. Objects fall from shelves, and pictures from walls. Heavy furniture moves. Unstable furniture overturns. Small and school bells ring. Trees and bushes shake, or are heard to rustle. Material may be dislodged from existing slips, talus slopes, or slides.

MM VII General alarm. Difficulty experienced in standing. Noticed by drivers of motorcars. Trees and bushes strongly shaken. Large bells ring. Masonry D cracked and damaged. A few instances of damage to Masonry C. Loose brickwork and tiles dislodged. Unbraced parapets and architectural ornaments may fall. Stone walls crack. Weak chimneys break, usually at the roof-line. Domestic water tanks burst. Concrete irrigation ditches damage. Waves seen on ponds and lakes. Water made turbid by stirred-up mud. Small slips, and caving-in of sand and gravel banks.

MM VIII Alarm may approach panic. Steering of motorcars affected. Masonry C damage, with partial collapse. Masonry B damage in some cases. Masonry A undamaged. Chimneys, factory stacks, monuments, towers, and elevated tanks twisted or brought down. Panel walls thrown out of frame structures. Some brick veneers damaged. Decayed wooden piles break. Frame houses not secured to the foundation may move. Cracks appear on steep slopes and in wet ground. Landslips in roadside cuttings and unsupported excavations. Some tree branches may be broken off.

MM IX General panic. Masonry D destroyed. Masonry C heavily damaged, sometimes collapsing completely. Masonry B seriously damaged. Frame structures racked and distorted. Damage to foundations general. Frame houses not secured to the foundations shift off. Brick veneer fall and expose frames. Cracking of the ground conspicuous. Minor damage to paths and roadways. Sand and mud affected in alluviated areas, with the formation of earthquake fountains and sand craters. Underground pipes broken. Serious damage to reservoirs.

MM X Most masonry structures destroyed, together with their foundations. Some well-built wooden buildings and bridges seriously damaged. Dams, dykes, and embankments seriously damaged. Railway lines slightly bent. Cement and asphalt roads and pavements badly cracked or thrown into waves. Large landslides on river banks and steep coasts. Sand and mud on beaches and flat land moved horizontally. Large and spectacular sand and mud fountains. Water from rivers, lakes, and canals thrown up on the banks.

MM XI Wooden frame structures destroyed. Great damage to railway lines. Great damage to underground pipes.

MM XII Damage virtually total. Practically all works of construction destroyed or greatly damaged. Large rock masses displaced. Lines of slight and level distorted. Visible wave-motion of the ground surface reported. Objects thrown upwards into the air.

Categories of non-wooden construction, etc.

Masonry A

Structures designed to resist lateral forces of about 0.1 g, such as those satisfying the New Zealand Model Building By-law, 1955. Typical buildings of this kind are well reinforced by means of steel or ferro-concrete bands, or are wholly of ferro-concrete construction. All mortar is of good quality and the design and workmanship is good. Few buildings erected prior to 1935 can be regarded as Masonry A.

Masonry B

Reinforced buildings of good workmanship and with some mortar, but not designed in detail to resist lateral forces.

Masonry C

Buildings of ordinary workmanship, with mortar of average quality. No extreme weakness, such as inadequate bonding of the corners, but neither designed nor reinforced to resist lateral forces.

Masonry D

Building with low standards of workmanship, poor mortar, or constructed of weak materials like mud brick and rammed earth. Weak horizontally.

Windows

Window breakage depends greatly upon the nature of the frame and its orientation with respect to the earthquake source. Windows cracked at MM V are usually either large display windows, or windows tightly fitted to metal frames.

Chimneys

The 'weak chimneys' listed under MM VII are unreinforced domestic chimneys of brick, concrete block, or poured concrete.

Water tanks

The 'domestic water tanks' listed under MM VII are of the cylindrical corrugated-iron type common in New Zealand rural areas. If these are only partly full, movement of the water may burst soldered and riveted seams. Hot-water cylinders constrained only by supply and delivery pipes may move sufficiently to break pipes at about the same intensity.

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