NEW ZEALAND EARTHQUAKES IN 1989

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SUMMARY

During 1989 the Seismological Observatory recorded and analysed 9892 earthquakes in the New Zealand region. Preliminary locations and magnitudes are now available for all these events. This is about five times the number usually analysed in previous years, thanks to the new digital recording equipment which is being installed throughout the country.

No earthquakes reached magnitude 6 during the year, although one of magnitude 5.9 in Fiordland was close to that figure. This caused intensity MM VI throughoUt Fiordland, and lower intensities elsewhere in the southern half of the South Island. Earthquakes of magnitude 5 and greater are listed: they indicate an ongoing level of activity commensurate with New Zealand's seismic history and geographic location.

ANALYSIS PROCEDURES

The analysis of all the earthquakes that occur in New Zealand during one year is a huge task. Traditionally, it has been a matter of analysing paper seismograms written at about 30 seismographs throughout the country, entering the measured parameters manually into a computer, and progressively refining the interpretation of the records until a satisfactory solution for the epicentre and depth is obtained.

But before all this can be done, the seismograms must be collected from outstations by mail, and then carefully annotated by identifying the time signals impressed upon them. The overall result is that for the last several years, definitive solutions have not been available until about 6 to 8 months after the event. Some of this delay represents the time taken to get the records in from outstations by mail, some is the actual data analysis and data handling procedures, and some is a backlog which the Observatory has not been successful in reducing completely.

There is in progress a programme of replacing the analogue equipment with new digital seismographs. Figure 1 shows the current status of the network, including instruments already installed and other planned stations. The new instruments record on magnetic tapes, which are changed weekly. Most of the new instruments should be in place by the end of 1990.

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Figure 1 also shows the telemetered networks in the Wellington, Taupo and Hawke's Bay areas, and at Clyde. Data are continuously telemetered to central sites, where they are recorded digitally. The Observatory has the facility to access these networks through the DSIR computer network, in the event of an important earthquake for which data are needed rapidly. The precision of preliminary locations well removed from Wellington can usually be improved by adding data from one or more of these networks.

The installation of digital seismographs, and the implementation of corresponding procedures at the Observatory, have meant a new analysis schedule and the prospect of definitive solutions becoming available on a routine basis within a month or two of the occurrence of the events. Data still come in by mail from outstations, but magnetic tapes are now read into the computer system and seismograms are displayed on the screen. Interactive analysis is much more automated than before, and the result is that the whole process is more rapid.

But until. the digital network is completed, the analogue records still being produced must be read manually and the data merged with the digital analysis. Also, the new stations have not yet been calibrated for the determination of earthquake magnitudes. and this calibration must await the acquisition of enough data at each station.

Figures 2 and 3 show the preliminary epicentres for earthquakes of magnitude 3 and greater in 1989. Some of these still await the addition of the analogue data, and all magnitudes will need to be recomputed when the magnitude constants are known. Final locations of events near to digital seismographs should be little different from

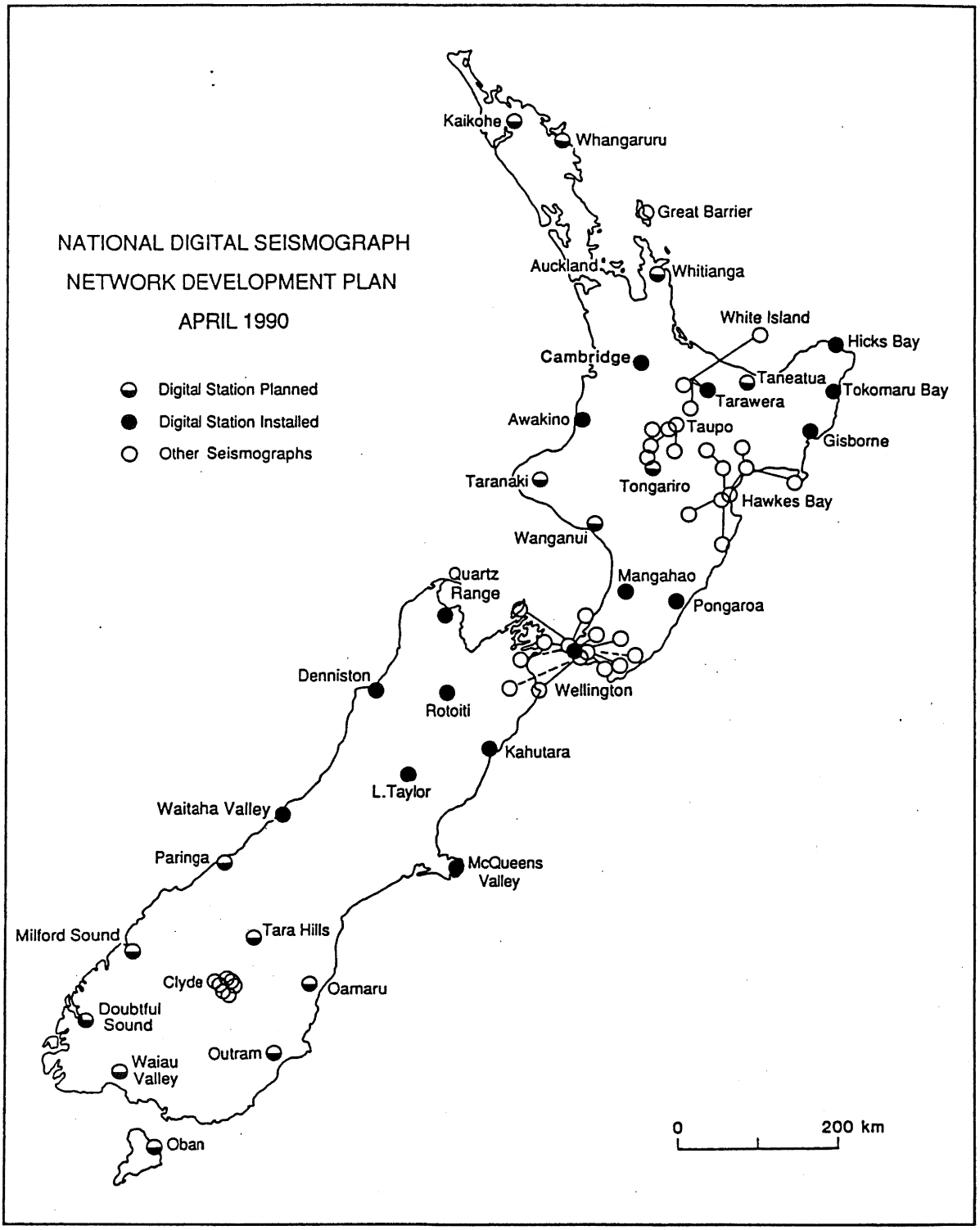
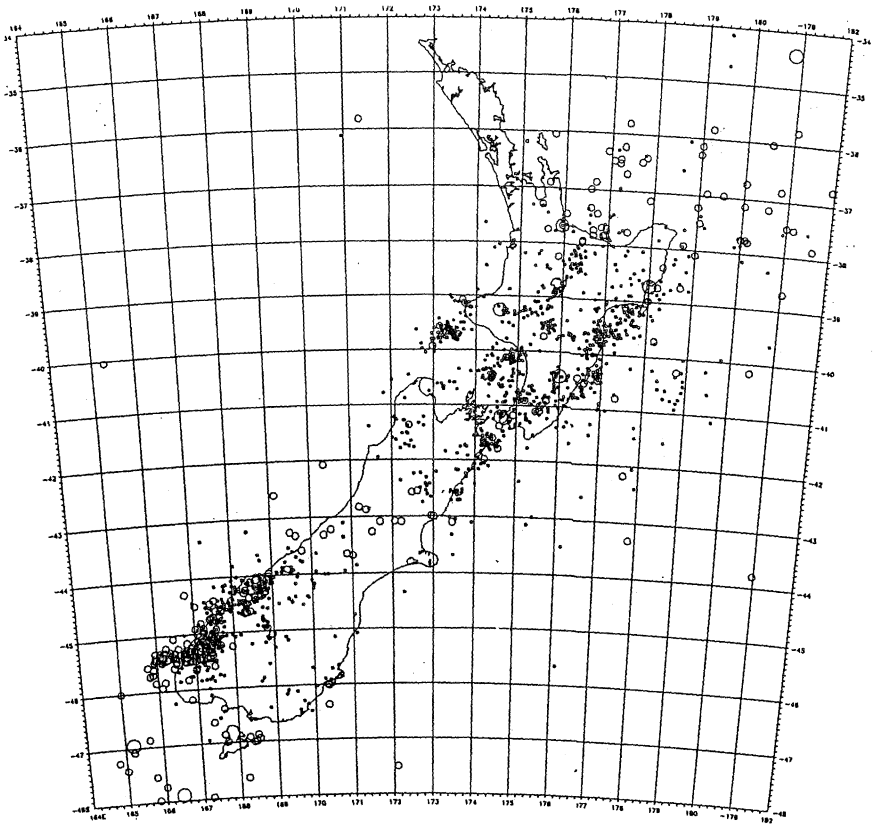
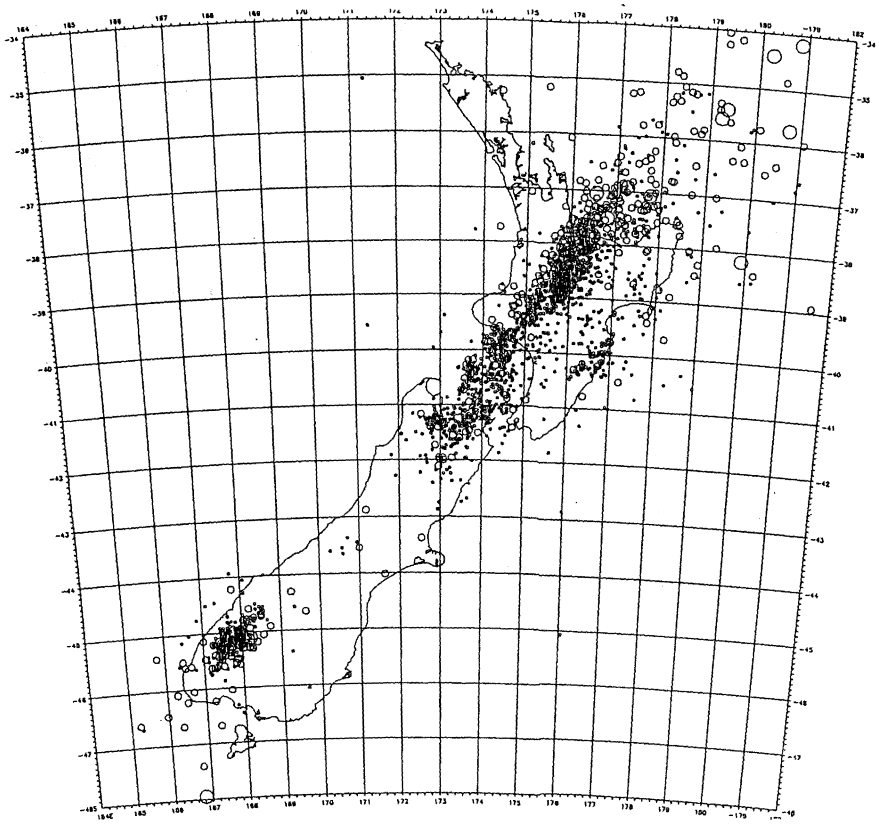


FIGURE 1. STATUS OF THE SEISMOGRAPH NETWORK IN APRIL 1990



URE 2. PRELIMINARY LOCATIONS FOR EARTHQUAKES WITH FOCAL DEPTHS LESS THAN 40 KM DURING 1990.



RE 3. PRELIMINARY LOCATIONS FOR EARTHQUAKES WITH FOCAL DEPTHS GREATER THAN 40 KM DURING 1990.

those shown. However, locations of earthquakes well removed from digital seismographs (such as in Fiordland) should be considered approximate until data from analogue instruments can be added and revised solutions obtained. This is the first time the Observatory has been able to produce as comprehensive an annual earthquake catalogue, so early in the following year.

There is another big change, in that the Observatory catalogue for 1989 contains 9892 events. This is about five times as many as were processed each year using the analogue network, because the digital instruments are installed, where possible, on firmer ground, where the magnification can be set higher. It is no longer necessary to locate the instruments at places where staff are available seven days a week to change the records. Power stations have been used in the past, for this reason, but they turn out to be too noisy for the new recorders because of the vibration caused by the generating equipment. It is now possible to use farms, for instance, located on more stable geological foundations, and the cooperation of the farmer is sought for changing records once a week.

Coverage of the country is now generally complete at the magnitude 3.5 level: there were 837 shallow earthquakes (depth less than 40 km) and 1236 deeper events of magnitude 3.S and greater located during 1989. Particular small regions, such as that around Wellington, are instrumented to a lower magnitude threshold for research purposes.

PRINCIPAL EARTHQUAKES IN 1989

No earthquake reached magnitude 6 during the year. Tables 1 and 2 list those of magnitude 5 and greater: 19 shallow shocks and 18 deep ones. Most of the focal depths in Table 1 are at nominal values of 12 or 33 km, and on final revision it is expected that these will be refined.

The largest earthquake within New Zealand was in Fiordland on May 31, of magnitude 5.9. It was centred near Doubtful Sound, and was felt throughout Fiordland at intensity MM VI, and at lower intensities throughout Southland and Otago and as far north as Christchurch. It was followed 5 minutes later by an aftershock of magnitude 5.0. Portable digital recorders were deployed in the area in the days following the quake, and the data obtained are currently being subjected to detailed analysis. One interesting fact to emerge already is that the mechanism of the earthquake was opposite to that of the 1988 Te Anau earthquake, located only 30 km away.

But even larger was the Macquarie Ridge earthquake on May 23. Its magnitude was 8.2, which makes it the largest in the world for 11 years. Being well out to sea, its felt effects in New Zealand were very modest: in Invercargill, 800 km away, it was felt slightly as a gentle rolling motion

The earthquake which affected the most people was undoubtedly that on August 8, centred 120 km deep in the South Taranaki Bight, just south of Patea. One report of intensity MM VII from Raumati, north of Wellington, probably represents a case of ground motion amplified by the sandy ground there. The report from Wanganui was of MM V. The earthquake was felt from the Bay of Plenty to Christchurch and Greymouth.

Fiordland was the centre of several other shallow earthquakes exceeding magnitude 5: on February 24, May 30 and July 24. Felt reports of these are very few, and represent low intensities. Waihi, in the western Bay of Plenty, experienced intensity MM VI from a very shallow event of about magnitude S on August 19, as it did two days earlier from a much smaller event a little closer to the town. And there is a report of MM VI from Gisborne on November 30 from the magnitude 5 event near that city. Most other earthquakes in Table 1 are offshore, either to the north of the Bay of plenty or to the south of Fiordland.

The deep earthquake beneath the Bay of Plenty on May 25 was reported at intensity MM V from Ormond, near Gisborne, and felt slightly as far away as Palmerston North and Paekakariki. The April 17 event, just north of Rotorua, was felt over a similar region, but nowhere strongly. Deep earthquakes usually pose no danger, by virtue of the attenuation between the focus and the Earth's surface.

A series of small earthquakes was felt in Wellington on November 4, 5 and 8. There was some alarm because of these, but it must be remembered that they came very soon after the Californian earthquake which had been publicized very widely and very graphically, The Observatory issued a statement at the time that we regarded these earthquakes as not being connected in any particular way, so were not necessarily indicators of larger magnitude activity to follow. And this did indeed prove to be the case.

ACKNOWLEDGEMENT

The assistance of the Earthquake and War Damage Commission in the upgrading of the seismograph network is gratefully acknowledged. Figures 2 and 3 were prepared by Martin Reyners. The data analysis is the result of very many hours of work by the staff of the Seismological Observatory.

TABLE 1. SHALLOW EARTHQUAKES.

Date	Time	Latitude	Longitude	Depth km	Magnitude
Jan 11	0652	46.95°S	165.21°E	12	5.0
Feb 13	0218	34.55°S	177.25°E	33	5.2
Feb 24	1556	45.38°S	166.23°E	33	5.1
Apr 23	0300	40.44°S	175.99°E	33	5.3
Apr 28	1404	34.15°S	177.41°E	33	5.1
May 07	0318	34.19°S	177.01°E	33	5.4
May 30	0559	45.00°S	174.81°E	33	5.1
May 31	0554	45.20°S	167.20°E	33	5.9
May 31	0559	45.40°S	166.19°E	33	5.0
Jul 09	1533	34.65°S	177.05°E	33	5.1
Jul 24	1158	45.43°S	166.78°E	20	5.1
Aug 19	1016	37.67°S	175.95°E	9	5.0
Oct 03	0215	41.21°S	174.62°E	32	5.0
Oct 13	0037	47.90°S	166.44°E	33	5.1
Oct 16	0814	34.41°S	179.16°W	33	5.3
Oct 20	1541	35.10°S	176.65°E	5	5.3
Nov 16	1922	35.33°S	177.01°E	33	5.0
Nov 30	0858	38.71°S	178.01°E	35	5.1
Nov 30	2007	39.26°S	174.56°E	13	5.0

TABLE 2. DEEP EARTHQUAKES

Date	Time	Latitude	Longitude	Depth km	Magnitude
Jan 26	2357	34.18°S	179.15°W	207	5.0
Feb 06	1748	35.59°S	179.24°E	240	5.1
Mar 15	0413	35.73°S	179.27°W	159	5.1
Apr 12	083S	45.14°S	168.14°E	149	5.0
Apr 17	1305	37.98°S	175.88°E	280	5.2
Apr 20	0408	45.10°S	168.21°E	163	5.0
Apr 23	0645	37.51°S	176.51°E	286	5.0
May 2S	1301	36.92°S	177.23°E	279	5.4
Jul 03	1115	34.40°S	179.25°W	302	5.0
Jul 07	0340	37.05°S	176.54°E	355	5.0
Aug 08	0759	40.09°S	174.44°E	120	5.5
Sep 25	1847	35.42°S	179.35°E	218	5.3
Oct 06	1010	37.06°S	177.75°E	183	5.0
Oct 08	2224	47.95°S	166.81°E	219	5.3
Oct 21	1416	37.93°S	175.92°E	303	5.1
Oct 27	0835	37.50°S	176.81°E	229	5.0
Nov 22	2121	38.17°S	179.90°E	100	5.1
Dec 27	2256	38.88°S	175.49°E	221	5.2

N.B. Times are in Universal Time, which is 12 hours behind New Zealand Standard Time (13 hours behind NZ Daylight Time).