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EARTHQUAKES FROM PENINSULAR INDIA DATA FROM THE GAURIBIDANUR SEISMIC ARRAY

by

B. K. Gangrade, A. G. V. Prasad and R. D. Sharma
Seismology Section

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GOVERNMENT OF INDIA
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Arrival times of the P and S wave signals recorded at the Gauribidanur seismic array from earthquakes in the neighbouring areas in peninsular India have been analysed to estimate their locations (latitudes and longitudes of the epicenters), magnitudes and origin times. Considering typical inaccuracies in the observed data, uncertainties in the estimated epicentral parameters have been illustrated. Using a crustal model, which has been specifically derived for the region around the array, expected arrival times of these signals at other important seismic stations (Kodaikanal, Hyderabad, Poona, New Delhi and Shillong) have been computed for identifying events at these stations in order to determine accurate arrival times at these stations. Due to a higher signal detection capability of the Gauribidanur array, the number of events given in this catalogue is much greater than that detected by these stations. The M_S magnitude estimates of events detected at the Hyderabad station have been used to obtain a magnitude scale for Gauribidanur. Origin times, epicentral locations and magnitudes of these events are listed in this report.

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by

(B.K.Gangrade, A.G.V.Prasad and R.D.Sharma)

1_INTRODUCTION

Shield areas such as the peninsular India region, the Canadian and the Australian shields etc. are generally considered seismically stable. Though earthquakes have occurred in these regions during the historical times, strong earthquakes to cause concern in safety matters have been almost nonexistent. In 1967 a strong earthquake of magnitude 6+ struck the Koyna region of peninsular India. The Koyna seismic network (Guha et. al., 1970) has been recording seismic activity which became more pronounced after the filling of the Koyna reservoir. A large number of events has also been recorded by the array from other parts of the peninsular region over the past two decades. Though there are limitations on the location accuracy of these data, they contain information on the seismicity of the region, which is an important factor in locating a critical facility, e.g., a nuclear power plant or a dam. These data are analysed and interpreted and their limitations have been discussed.

2_THE_GAURIBIDANUR_ARRAY

The Gauribidanur seismic array (GBA) is a medium aperture array of seismometers spread over an area of 25km x 25km with twenty short period instruments placed along two mutually perpendicular arms, ten instruments along each arm (see Figure 1). The region around the array comprises tracts of granite-gneiss of archaen age underlain by rocks resting on precambrian crustal blocks. The geology of the region is described in detail by Campbell and Marshall (1964). Seismic velocities in the neighbourhood of the array have been investigated in detail by Arora (1977). This array became operational in 1965. The short period instruments deployed by the array are narrow band instruments (one sec. natural period) and do not record the entire spectrum of high frequency events because the array was basically designed for studying events from teleseismic distances (epicentral distances greater than 2000 kms). This is one of the UKAEA type arrays, similar to the ones in Australia (WRA), Canada (YKA), and Scotland (EKA). The instrumentation used at the array has been described by Keen et.al.(1965). Though significant renovations have taken place in data acquisition and data processing equipment since the initial installation of the array, the data processing philosophy has remained almost unchanged over the number of years (see Birtill and Whiteway, 1965), at least from the point of view of this report.

3 DATA ON SEISMIC ARRIVALS

The basic data for accurately locating the source of an earthquake signal are the arrival times of the P and S waves at several instrument locations suitably distributed around the earthquake source, and an accurate seismic velocity model. For an array of seismometers designed to produce accurate earthquake data to meet the requirements of accurate locations (i.e., seismometer locations known within a few meters and the arrival times and travel times of the seismic signals accurate within a fraction of a second), it would be possible to predict the error bars on the locations of events for a given location and specified configuration of the array. The philosophy of locating events using an array like GBA is somewhat different. Here, the earthquake source lies on one side of the array. A seismic signal travelling towards the array shows differences in the arrival times of the signal onset at different seismometer locations. The extent of the time difference (measured as delay in seconds/km) is dependent on the location of the earthquake source with respect to the array on one hand and the seismic velocity on the other. After reading the onset time of the first arrival at each sensor location, the source direction is estimated using the relation:

$$\tan Z = T_B/T_R \quad \text{..............(1)}$$

where Z is called the backbearing at the station (angle between the meridian through the station and the arc joining the epicenter and the station measured clockwise from north) and T_R and T_B are the average delays (measured in seconds per kilometer, the algebraic sign of T_B and T_R being positive when the signal arrives earliest at the farthest point of the array, i.e., R_{10} or B_{10}), suffered by the signal while traversing the RED and BLUE arms of the array. The formula is based on the assumption of a plane wave front crossing the array, and is more accurate for events which are far away from the array. The array because of its geometry has a directional response, so that the delays T_R and T_B cannot be determined simultaneously most accurately for any event. The accuracy of the determination depends on the location of the earthquake with respect to the array. The directions of accurate determination of the apparent velocity (whose reciprocal $dT/d\Delta$ is often used in seismic velocity studies) given by:

$$V_a = d/\sqrt{(T_R^2 + T_B^2)} \quad \text{.............(2)}$$

where d is the average inter seismometer spacing (measured in kilometers) and the direction Z given by equation (1), are mutually perpendicular (see Figure 2) for a typical case. The errors have been computed using the procedure given by Kelly (1964). As long as the earthquake source is not too close to the array, which makes the accurate estimation of the delays T_R and T_B difficult, it is always possible to determine an approximate location for the event provided the P and S difference can be estimated accurately. Sharma and Varghese (1979) had obtained locations of some events recorded by the array in this manner. Taking into account the inaccuracies associated with the uncertainties in the determinations of the delays T_R and T_B, and the P and S travel time difference, it is also possible to estimate the extent of uncertainties on locations obtained in this manner.

Earthquake signals at GBA are recorded on (i) a helical recorder running at a speed of 60 mm per minute continuously, (ii) a multichannel analog magnetic tape and (iii) a multichannel paper chart recorder triggered when the signal threshold exceeds a specified level, and now on continuously recording digital magnetic tapes. The threshold of the triggering device is adjusted so as to detect maximum number of events keeping the false trigger rate reasonably low. It has been found that the number of events really detected by the triggering device exceeds that detected visually from the helical recorder (Kolvankar, 1986). The multichannel records are generally obtained at 10 mm per second speeds. Records with improved signal to noise ratios and higher time resolution when required, are obtained by playing the analog tapes back with desired speeds of the paper chart recorder and filter settings. These records are used to obtain the following information on each event:

1) Date of the event.

2) P onset time at the central point of the array (B1).

3) Amplitude of the signal and sensitivity of the record.

4) Predominant period of the seismic signal.

5) Approximate signal duration.

6) P-S arrival time difference.

7) The delays along the RED and the BLUE arms, T_R and T_B, with their appropriate algebraic signs.

From these data the RED and BLUE line delays and the P-S differences are converted into source backbearing and distance using a suitable travel time model, which are then used to compute the latitude and longitude of the source. Using typical values of uncertainties in the determinations of the P-S travel time differences and the RED and BLUE line delays, error bars for the source locations are also computed. A more characteristic estimate of the error bars requires that the uncertainties are determined for each event separately. The gains of carrying out such an exercise are, however, not proportionately rewarding. In making these calculations all events are treated as surface focus. On the basis of the locations estimated in this manner, expected arrival times at the global network stations i.e., Kodaikanal(KOD), Hyderabad(HYB), New Delhi(NDI), Poona(Poo) and Shillong(SHI) were computed to look for the corresponding signals at these stations.

3.1 SEISMIC VELOCITY MODEL

The conversion of P-S travel time difference to epicentral distance for arriving at the locations of event sources, the P travel times of these signals to estimate the origin times of the events and computation of expected arrival times of the first arrivals at the global stations have been based on a seismic velocity model, which has been derived from travel times of local earthquakes, rockbursts and explosions recorded at the array (Arora, 1977).This model describes the crustal velocities in this region in terms of a three layer structure above the Mohorovicic discontinuity, viz.

i) The top granite layer of 8.7 km thickness with P-wave velocity, V_P=5.62 km/s and S-wave velocity, V_S=3.28 km/s. Arrivals bottoming in this layer have been identified as P_g and S_g.

ii) A second layer of 10.5 km thickness with V_P=6.1 km/s and V_S=3.5 km/s. Arrivals bottoming in this layer have been described as P_y and S_y.

iii) A third layer is the basaltic layer of 17.2 km thickness characterised by V_P=6.5 km/s and V_S=3.95 km/s. Its arrivals are described as P_x and S_x.

The depth of the Mohorovicic discontinuity has been placed at 36 km, and the estimated P_n and S_n velocities are 7.98 km/s and 4.62 km/s respectively.

3.2 DEPTH OF FOCUS

From array records of events an estimate of the source depth may be obtained only if the surface reflected phase, pP, can be identified without ambiguity, but that is a rare occurrence for records of local events. For an event with source depth of 15 km and epicentral distance of 100 km, the T_S-T_P (the difference in the travel times of the S and P signals) is shorter by about 0.7 seconds. For an epicentral distance of 500 km this figure goes to 1 second. In peninsular India most events are shallow focus and their depths may be considered to be around 15 kms, unless they are very strong earthquakes in which case they would be recorded by several other stations as well allowing more accurate estimates of source depth. A zero depth assumption in arriving at the preliminary locations of the events may lead to overestimating the epicentral distance by not more than 10 kms for an event at about 500 kms distance, when the P and S arrivals have been identified accurately.

3.3 MAGNITUDES OF THE EVENTS

It has been mentioned earlier that the GBA short period records do not provide a true representation of the signals received at the array from local events because of the limited allowable bandwidth of the seismograph. It is, therefore, not possible to accurately estimate the energy release associated with the record of a local earthquake. It is, however, desirable to provide for gradation of the records a "working magnitude", based on the strength of the signal received. For estimating this magnitude from the trace of the earthquake signal, the two alternative approaches, which are commonly adopted are considered. These are:

(1) Use of the trace amplitude through a formula of the type:

$$M_{AMP} = Log_{10} (A/T) + Q(\Delta,h) + C_s + C_r \text{ ....(4a)}$$

where M_{AMP} is the magnitude based on amplitude and may be called amplitude magnitude. A is the zero-pk trace amplitude of the signal in microns, T the predominant period in seconds, $Q(\Delta,h)$ is a factor which depends on the epicentral distance Δ and source depth h and C_s and C_r represent corrections due to specific source and receiver characteristics respectively.

(2) Use of the duration of the signal to define a duration magnitude through a formula of the type:

$$M_{DS} = A_0 + A_1 Log_{10}(D) + A_2 d + A_3 Log_{10}(d) \text{......(4b)}$$

where D is the duration of the signal (measured in seconds) as estimated from the record, d is the epicentral distance in kms and A_0, A_1, A_2 and A_3 are constants (see Lee and Stewart,1981).

Sharma and Varghese (1979) had estimated the magnitudes of events recorded at GBA using the signal amplitude, and the extrapolated values of the Q factor defined for teleseisms. A serious problem in this approach, apart from the questionable validity of the used Q-values, arises from the saturation of the records for many events on one hand, and large inaccuracies in the measurement of the A/T ratios on the other. Most events, which are likely to be recorded by the stations of th global network, produce saturated records making the process of calibration of the magnitude scale almost impossible. No reliable value of magnitude can be assigned to the events with saturated records.

Duration magnitudes have not been used earlier at GBA. However, estimated signal durations are given in the GBA bulletins. The definition of signal duration has not been strictly adhered to while reading the records. As only the logarithm of the signal duration appears in the above expression, magnitude estimated on the basis of this duration is good enough to provide a gradation of the records in terms of the signal strength. Duration magnitudes estimated in this manner for a data set for the period 1977-June 86 (both inclusive) have been calculated using a formula of the type given in equation 4b.

The duration magnitude scale needs to be calibrated against a standard magnitude scale. A well accepted approach is that of making it to agree with the local magnitude scale, M_L (see Lee and stewart,1981). However, no reliable M_L estimates are available for earthquakes in this region. M_S values for 36 events, which were recorded at GBA and HYB stations, could be obtained from the HYB station bulletins. These events are listed in Table I. The constants A_0,A_1, A_2 and A_3 of equation (4b) were estimated using the least squares method from these data. This led to a duration magnitude scale, M_{DS}, defined by:

$$M_{DS}=-0.68+2.39Log_{10}(D)+0.00217d-1.097Log_{10}(d) \ldots\ldots (4c)$$

where D is the estimated duration at GBA and d is the epicentral distance in kilometres.(We have used the letter D instead of the conventional usage τ, for τ is reserved for the exact signal duration measured as per certain duration measurement criteria, e.g., the time interval between the signal onset and the point at which the signal-to-noise ratio becomes 1:1. Also, the subscript DS has been used instead of D to emphasize that the duration magnitude scale used here is not necessarily equivalent to the duration magnitude scale in the conventional sense). Comparison of M_{AMP} based on equation (4a) and M_{DS} shows that M_{AMP} are often on the higher side as compared to M_{DS} values.

4_EARTHQUAKE_DATA

Table - II gives a list of events having duration magnitudes M_{DS} greater than 2 recorded at GBA from the period 1977 to June 1986. The estimated origin time of the events, the magnitude estimated on the scale described above, the epicentral distance and backbearing at the station, the latitude and longitude are listed in this table. Though most of the quantities have been listed to the third decimal place, they do not possess the accuracy of that order. The fractions have been retained in order to keep the cumulative errors and the quantization errors as low as possible. The probable errors in the latitudes and longitudes have been calculated by using typical uncertainties (one second) in the estimated P and S travel time difference and 0.004 in the estimated delay times T_B and T_R. Table-III illustrates the accuracy of these source locations. Here, the origin times of the 36 events of Table-I which were detected both at GBA and HYB, were estimated using the locations given in the catalogue of Table-II. The estimated times are compared with the observed times at the HYB station.

5_DISCUSSIONS

The Gauribidanur array is basically designed for recording teleseismic events (epicentral distances greater than 2000 kms).Its narrow frequency band width for recording earthquake signals is not well suited for recording signals from the local events, which cover a much wider frequency range. In order to faithfully record signals from local earthquakes, a dense network of seismometers is commonly used. However, such a network does not exist in the region around the array. Although, the limitations of the array (and the inherent inaccuracies of the event location process used in array data) leave much doubt in the accuracy of these data, the array data still provide valuable information on the seismic status of the region.

Location of events is primarily based on the assumption of a plane wave front, which is not as accurately valid for the local events as for the teleseismic ones. This leads to a varying degree of inaccuracy in the azimuth estimates (depending on the location of the event with respect to the array). However, the P-S travel-time differences have been read reasonably accurately. Locations of the Koyna earthquakes have given credence to such a belief. In Table-II the errors shown against the location estimates are only illustrative, in that they represent the order of the inaccuracy which could be expected in these locations, as a result of random errors. An improvement over the earlier situation which has been effected in these data, is the use of a more specific crustal velocity model. This model has been derived exclusively for the region around Gauribidanur and a comparison of the P times of this model with those of the J-B model is shown in figure 3. The comparison of the arrival times estimated from the GBA locations and using this model with those observed at the HYB station for the events listed in Table-III is a testimony to the validity of the approach adopted for event locations. These times differ by 0.4 second to 25 seconds.

The primary objective of estimating the magnitude of the events is to assess the amount of energy release during each earthquake, and thus estimate the rate of energy release in the earthquake region. As mentioned earlier, the seismogram recorded at GBA from local earthquakes does not represent the true signatures of the event, particularly with respect to the frequency content. Hence the use of signal amplitude in estimating the magnitude is not advisable. Signal duration is a quantity which is preserved to a great extent and is, therefore, a candidate parameter for magnitude determination. A problem, however, arises from the lack of adequate M_L data to calibrate the duration magnitude scale. The use of the M_S scale for calibrating the magnitude scale may be a deviation from the current practices of magnitude determination. Nevertheless the use of this scale ensures that the calibration of the magnitude scale has a rationale. Hence, until such times when adequate magnitude data becomes available to calibrate the GBA magnitude scale, M_{DS} will continue to be used for GBA magnitudes of local earthquakes.

Another noteworthy aspect of these data is that some of the events, which are well-known, may not appear in this catalogue. The reason for such a situation lies in the very nature of the entire process of source location from these data. In case of some strong local events, the Gauribidanur records do not permit the determinations of the P-S arrival time differences, and hence the locations are not carried out in the above manner. Similarly, in some situations the signal onset lacks clarity making the determination of the signal delays across the array difficult, thereby, forcing the exclusion of the event from the catalogue. However, such events are likely to be reported by the global network. No attempt has been made here to make the catalogue up-to-date in that sense.

Earthquake data presented in this report adequately demonstrate that the Indian peninsular region is not as much devoid of seismic activity as one would have thought in the early sixties. While using these data the limitations mentioned above must be noted, and in case a particular set of events becomes important in a decision making process, it would be possible to scrutinize the GBA data in greater detail to reconfirm the events reported in the catalogue, and even extract additional information on those events. This effort is only a step forward in the direction of producing an up-to-date catalogue of earthquakes in the peninsular region.

A large bulk of data has been analysed within a very short time using a digital computer and on events collected over a number of years. Unless the record of each event is examined with the view of preparing an authentic catalogue, the catalogue given in this report does not qualify for basing vital decisions on individual events recorded here. This is rather aimed at providing an overall picture of the seismic activity in the region.

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REFERENCES

1) Arora, S.K. (1977). Crustal structure near Gauribidanur in southern India from the Gauribidanur array data of local earthquakes, rockbursts and explosions. Ph.D. thesis, University of Bombay.

2) Birtill, J.W. and F.E. Whiteway (1965). The application of phased arrays to the analysis of seismic body waves. Phil. Trans. A258, 421-493.

3) Campbell, C.B. and P.D. Marshall (1964). The geological reconnaisance and noise survey for a teleseismic array in India. Rept. U.K.A.E.A., A.W.R.E., Blacknest, SFP/336/17, 1-15.

4) Guha, S.K., P.D. Gosavi, M.M. Varma, S.P. Agarwal, J.G. Padale and S.C. Marwadi (1970). Recent seismic disturbances in the shivajisagar lake area of the Koyna Hydroelectric Project, Maharashtra, India. Central water and power research station, Khadakwasla, Poona

5) Kolvankar, V.G. (1986) Operating performance of a recording system for a short period seismic array data on a single track of an audio tape and in interrupt mode. Personal communication.

6) Lee, W.H.K. and S.W. Stewart (1981). Principles and applications of microearthquake networks. Advances in Geophys. Supp. 2, Academic Press, New York and London.

7) Richter, C.F. (1958). Elementary Seismology. W.H. Freeman and Co., San Francisco.

8) Keen, C.G., J. Montgomery, W.M. Mowat, J.E. Mullard and D.C. Platt (1965). British seismometer array recording systems. The Radio and Electronic Engineer, 30, 297-306.

9) Kelly, E.J. (1964). Limited network processing of seismic signals. Massachusettcs Inst. Tech., Technical group report 44.

10) Sharma, H.S.S. and T.G. Varghese (1979). The role of Seismic arrays in monitoring seismicity. Mausam, 30, 237-245.

TABLE I

Data used in calibrating the duration magnitude scale

DATE	ORIGIN TIME	M_S *	SIGNAL DURATION (sec.)	EPICENTRAL DISTANCE (km.)	M_{DS}
1 12 77	11:02:15	3.8	600	223	3.9
10 10 79	13:04:50	2.8	360	433	3.5
22 10 79	19:39:58	2.5	240	411	3.0
30 03 80	13:31:55	4.3	660	630	4.4
12 04 80	07:28:47	3.7	300	539	3.4
01 05 80	00:39:38	4.1	480	734	4.2
03 05 80	06:53:05	3.8	600	96	4.0
02 06 80	08:35:29	3.6	240	558	3.2
19 08 80	22:32:13	4.2	480	528	3.9
20 09 80	07:29:01	4.3	900	548	4.6
20 09 80	10:45:54	4.2	960	560	4.7
21 09 80	08:18:43	4.0	480	568	3.9
21 09 80	18:19:27	4.2	480	538	3.9
27 09 80	08:54:56	4.5	420	558	3.8
26 10 80	01:32:29	4.5	360	558	3.6
26 11 80	21:26:00	3.8	420	558	3.8
31 12 80	17:51:56	3.5	360	548	3.6
15 03 84	12:18:22	3.6	340	538	3.5
20 03 84	10:45:22	4.5	900	122	4.4
28 03 84	02:53:48	4.8	470	746	4.2
28 03 84	19:13:37	3.3	300	741	3.7
14 04 84	19:42:11	4.1	650	705	4.5
24 04 84	17:35:27	3.5	300	538	3.4
27 04 84	02:00:19	3.0	290	548	3.4
30 04 84	16:36:01	3.9	420	558	3.8
20 06 84	18:22:35	3.4	320	724	3.7
27 06 84	15:56:43	3.4	340	451	3.4
31 07 84	21:58:17	2.6	210	472	3.0
23 08 84	06:25:51	3.2	240	675	3.4
14 11 84	11:58:22	4.7	840	561	4.5
27 11 84	17:19:43	4.1	720	181	4.1
28 11 84	02:29:49	3.3	360	185	3.3
03 12 84	17:02:58	4.1	900	181	4.3
03 12 84	17:34:12	3.5	360	182	3.3
03 12 84	19:17:19	3.9	420	183	3.5
21 12 84	17:26:59	4.1	660	528	4.2

* M_S values are based on HY8 estimates.

TABLE II

Magnitudes and locations of earthquakes of peninsular India estimated from Gauribidanur data

DATE	ORIGIN TIME (GMT)	MAG. M_{DS}	EPICENTRAL DISTANCE (km.)	BACK BEARING (deg.)	LAT.(&ERROR) (deg.)	LON.(&ERROR) (deg.)
24 9 1977	7 38 7.0	2.8	75.700	167.855	12.937(0.0739)	77.583(0.0164)
30 9 1977	11 59 47.0	3.3	661.167	40.746	18.081(0.1174)	81.522(0.1266)
12 10 1977	8 59 51.0	3.3	734.537	125.576	9.700(0.0778)	82.893(0.0685)
4 11 1977	18 57 21.0	3.9	558.403	320.435	17.458(0.0925)	74.079(0.0914)
4 11 1977	20 35 49.0	3.6	557.434	320.435	17.452(0.0925)	74.085(0.0915)
4 11 1977	20 54 47.0	4.0	551.586	320.435	17.411(0.0929)	74.121(0.0916)
23 11 1977	13 46 24.0	2.0	99.098	122.000	13.130(0.0508)	78.214(0.0751)
1 12 1977	11 2 15.0	3.9	222.991	315.627	15.036(0.0806)	75.982(0.0830)
6 12 1977	2 38 27.0	2.7	103.587	123.591	13.087(0.0536)	78.234(0.0751)
7 12 1977	8 17 .0	3.3	103.587	123.548	13.087(0.0533)	78.235(0.0750)
9 12 1977	18 54 40.0	2.7	558.403	110.690	11.782(0.1759)	82.243(0.1412)
9 12 1977	22 3 12.0	2.9	568.009	233.801	10.549(0.4448)	73.237(0.3697)
12 12 1977	15 0 58.0	2.5	103.587	125.094	13.066(0.0547)	78.220(0.0738)
17 12 1977	8 23 55.0	2.2	150.873	334.471	14.830(0.0819)	76.830(0.0438)
25 12 1977	22 1 28.0	2.0	103.587	124.936	13.069(0.0542)	78.221(0.0736)
28 12 1977	4 5 41.0	2.5	103.587	125.180	13.065(0.0550)	78.219(0.0739)
8 12 1977	10 27 3.0	3.0	103.587	125.013	13.068(0.0544)	78.221(0.0737)
1 12 1977	17 19 31.0	2.4	216.597	325.629	15.212(0.0853)	76.295(0.0662)
6 1 1978	4 14 52.0	2.8	604.723	77.000	14.768(0.1086)	82.926(0.1001)
8 1 1978	7 52 34.0	2.8	181.062	334.829	15.079(0.0858)	76.718(0.0459)
2 1 1978	23 29 8.0	2.4	218.724	328.565	15.283(0.0871)	76.371(0.0615)
7 1 1978	12 11 52.0	2.4	212.353	123.685	12.538(0.0715)	79.067(0.0935)
5 2 1978	9 59 57.0	2.6	184.145	338.870	15.151(0.0876)	76.817(0.0381)
9 2 1978	16 55 42.0	2.3	125.766	145.552	12.669(0.0734)	78.093(0.0538)
2 2 1978	5 48 46.0	2.5	103.587	125.013	13.068(0.0544)	78.221(0.0737)
7 2 1978	3 10 53.0	3.0	101.786	92.803	13.558(0.0171)	78.378(0.0839)
1 3 1978	12 16 1.0	2.2	144.011	351.236	14.886(0.0870)	77.232(0.0154)
1 3 1978	7 49 9.0	3.0	366.647	217.711	10.983(0.1093)	75.379(0.1011)
4 5 1978	13 50 23.0	3.8	558.403	318.504	17.346(0.0969)	73.947(0.0989)
7 5 1978	7 46 18.0	2.7	105.396	123.548	13.078(0.0536)	78.249(0.0754)
1 5 1978	7 40 3.0	3.1	548.642	38.340	17.459(0.1194)	80.648(0.1239)
1 5 1978	8 15 10.0	2.6	181.062	327.906	14.984(0.0822)	76.539(0.0579)
2 6 1978	10 25 25.0	2.2	185.175	334.829	15.113(0.0862)	76.701(0.0462)

(TABLE II continued)

(TABLE II continues)

DATE	ORIGIN TIME (GMT)	MAG. M_{DS}	EPICENTRAL DISTANCE (km.)	BACK BEARING (deg.)	LAT.(&ERROR) (deg.)	LON.(&ERROR) (deg.)
4 6 1978	12 49 12.0	3.9	552.565	321.026	17.451(0.0933)	74.156(0.0915)
6 6 1978	2 51 8.0	2.8	160.801	358.310	15.052(0.0901)	77.392(0.0074)
7 6 1978	8 35 10.0	2.7	101.786	123.507	13.097(0.0527)	78.221(0.0745)
26 6 1978	18 35 30.0	2.3	117.331	194.121	12.579(0.0833)	77.172(0.0292)
6 7 1978	2 13 16.0	3.0	103.587	125.013	13.068(0.0544)	78.221(0.0737)
13 7 1978	10 40 11.0	2.2	191.381	303.685	14.556(0.0678)	75.954(0.0919)
25 7 1978	6 42 13.0	2.0	103.587	123.469	13.088(0.0528)	78.235(0.0748)
8 8 1978	12 17 28.0	3.9	45.414	113.254	13.442(0.0312)	77.823(0.0660)
22 8 1978	1 7 10.0	2.3	103.587	125.094	13.066(0.0547)	78.220(0.0738)
30 8 1978	7 47 47.0	2.5	101.786	127.856	13.040(0.0565)	78.179(0.0708)
2 9 1978	11 25 23.0	2.0	103.587	123.432	13.089(0.0526)	78.236(0.0747)
3 9 1978	1 6 33.0	2.0	103.587	124.862	13.070(0.0539)	78.222(0.0735)
3 9 1978	8 26 49.0	3.4	103.587	122.000	13.108(0.0512)	78.249(0.0758)
3 9 1978	9 16 49.0	3.3	103.587	123.469	13.088(0.0528)	78.235(0.0748)
3 9 1978	10 7 35.0	2.5	103.587	123.432	13.089(0.0526)	78.236(0.0747)
3 9 1978	20 40 3.0	2.3	103.587	123.432	13.089(0.0526)	78.236(0.0747)
11 9 1978	9 8 15.0	2.5	103.587	120.493	13.129(0.0501)	78.262(0.0771)
18 9 1978	8 38 27.0	2.0	101.786	123.507	13.097(0.0527)	78.221(0.0745)
27 9 1978	3 54 26.0	3.0	103.587	124.936	13.069(0.0542)	78.221(0.0736)
27 9 1978	12 2 30.0	2.5	103.587	124.936	13.069(0.0542)	78.221(0.0736)
28 9 1978	6 56 22.0	2.3	103.587	123.469	13.088(0.0528)	78.235(0.0748)
30 9 1978	15 22 54.0	2.3	103.587	125.013	13.068(0.0544)	78.221(0.0737)
16 10 1978	22 51 1.0	2.3	103.587	124.936	13.069(0.0542)	78.221(0.0736)
24 10 1978	21 25 40.0	3.2	746.062	156.216	7.441(0.0107)	80.165(0.0224)
9 11 1978	20 15 15.0	2.5	105.396	177.125	12.656(0.0816)	77.485(0.0066)
11 11 1978	16 56 17.0	2.7	103.587	125.013	13.068(0.0544)	78.221(0.0737)
19 11 1978	20 34 32.0	2.3	94.656	96.026	13.513(0.0191)	78.308(0.0825)
17 12 1978	12 59 23.0	2.2	165.817	241.745	12.893(0.0655)	76.086(0.0941)
26 1 1979	9 48 27.0	2.0	103.587	125.013	13.068(0.0544)	78.221(0.0737)
4 6 1979	23 48 56.0	2.6	150.873	159.147	12.334(0.0839)	77.931(0.0346)
6 6 1979	20 59 46.0	2.4	160.801	154.471	12.296(0.0833)	78.075(0.0437)
9 6 1979	6 52 13.0	3.2	144.011	157.707	12.403(0.0825)	77.940(0.0368)
14 6 1979	23 34 37.0	2.7	101.786	125.094	13.076(0.0544)	78.206(0.0734)
21 6 1979	0 43 21.0	2.5	103.587	124.936	13.069(0.0542)	78.221(0.0736)

(TABLE II continued)

(TABLE II continues)

DATE			ORIGIN TIME (GMT)			MAG. M_{DS}	EPICENTRAL DISTANCE (km.)	BACK BEARING (deg.)	LAT.(&ERROR) (deg.)	LON.(&ERROR) (deg.)
21	7	1979	4	47	.0	2.7	103.587	124.936	13.069(0.0542)	78.221(0.0736)
22	7	1979	11	53	22.0	2.7	122.000	100.199	13.407(0.0327)	78.548(0.0887)
29	8	1979	7	41	7.0	3.0	661.167	38.340	18.243(0.1118)	81.323(0.1223)
21	9	1979	9	26	28.0	2.3	103.587	125.013	13.068(0.0544)	78.221(0.0737)
10	10	1979	13	4	50.0	3.5	433.297	30.091	16.973(0.1107)	79.481(0.0979)
22	10	1979	19	39	58.0	3.0	411.236	28.532	16.852(0.1076)	79.284(0.0890)
29	1	1980	17	20	14.0	2.2	277.382	17.174	15.990(0.1009)	78.203(0.0509)
9	2	1980	19	30	30.0	2.0	103.587	124.936	13.069(0.0542)	78.221(0.0736)
10	2	1980	3	39	53.0	2.2	181.062	331.745	15.040(0.0841)	76.637(0.0511)
13	2	1980	8	29	31.0	2.9	538.734	325.429	17.583(0.0912)	74.549(0.0809)
20	2	1980	18	5	5.0	2.2	281.801	18.760	16.007(0.1012)	78.285(0.0550)
26	2	1980	2	57	31.0	2.5	100.888	124.936	13.083(0.0537)	78.201(0.0731)
24	3	1980	2	39	7.0	2.6	154.827	60.179	14.295(0.0647)	78.685(0.0923)
29	3	1980	18	26	53.0	2.1	487.261	54.479	16.126(0.1142)	81.154(0.1248)
30	3	1980	6	13	12.0	2.8	465.919	107.530	12.307(0.0912)	81.533(0.1148)
30	3	1980	13	31	55.0	4.4	630.240	99.834	12.570(0.1137)	83.168(0.0942)
3	4	1980	19	48	24.0	2.3	388.998	53.038	15.694(0.1118)	80.344(0.1241)
7	4	1980	20	42	36.0	2.5	411.236	54.932	15.712(0.1130)	80.585(0.1259)
12	4	1980	7	28	47.0	3.4	538.734	324.479	17.536(0.0922)	74.481(0.0841)
18	4	1980	7	12	2.0	2.0	101.786	124.936	13.078(0.0538)	78.208(0.0733)
21	4	1980	7	54	48.0	2.2	212.353	84.431	13.782(0.0411)	79.397(0.1008)
1	5	1980	0	39	38.0	4.2	734.537	357.008	20.212(0.0281)	77.069(0.0298)
3	5	1980	6	53	5.0	4.0	96.427	186.722	12.741(0.0799)	77.332(0.0138)
3	5	1980	19	53	51.0	3.1	81.625	185.435	12.872(0.0769)	77.365(0.0108)
4	5	1980	13	16	12.0	2.4	77.382	4.784	14.299(0.0759)	77.496(0.0097)
16	5	1980	14	37	5.0	2.0	100.888	125.013	13.082(0.0539)	78.200(0.0731)
2	6	1980	8	35	29.0	3.2	558.403	326.905	17.801(0.0901)	74.554(0.0787)
16	8	1980	16	49	55.0	2.4	207.070	261.764	13.330(0.0448)	75.539(0.1012)
19	8	1980	22	32	13.0	3.9	528.686	318.504	17.148(0.0980)	74.136(0.0995)
3	9	1980	5	2	15.0	3.2	130.511	317.751	14.473(0.0688)	76.620(0.0660)
7	9	1980	21	8	26.0	2.2	166.824	125.013	12.739(0.0647)	78.698(0.0848)
11	9	1980	11	27	59.0	2.6	94.656	27.101	14.363(0.0748)	77.837(0.0457)
20	9	1980	7	29	1.0	4.6	548.642	325.429	17.656(0.0904)	74.495(0.0807)
20	9	1980	10	45	54.0	4.6	560.337	320.435	17.471(0.0923)	74.068(0.0913)

(TABLE II continues)

(TABLE II continues)

DATE	ORIGIN TIME (GMT)	MAG. M_{DS}	EPICENTRAL DISTANCE (km.)	BACK BEARING (deg.)	LAT.(&ERROR) (deg.)	LON.(&ERROR) (deg.)
21 9 1980	8 18 43.0	3.9	568.009	321.026	17.558(0.0923)	74.063(0.0909)
21 9 1980	10 45 53.0	2.0	103.587	124.862	13.070(0.0539)	78.222(0.0735)
21 9 1980	18 19 27.0	3.9	538.734	324.479	17.536(0.0922)	74.481(0.0841)
27 9 1980	8 54 56.0	3.8	558.403	321.026	17.492(0.0930)	74.121(0.0913)
21 10 1980	5 32 50.0	3.2	548.642	320.435	17.391(0.0930)	74.139(0.0917)
22 10 1980	7 4 9.0	2.3	103.587	124.936	13.069(0.0542)	78.221(0.0736)
26 10 1980	1 32 29.0	3.6	558.403	324.479	17.678(0.0908)	74.371(0.0836)
5 11 1980	7 37 26.0	3.6	558.403	324.479	17.678(0.0908)	74.371(0.0836)
19 11 1980	14 7 51.0	2.3	99.992	125.013	13.086(0.0538)	78.194(0.0730)
24 11 1980	6 32 57.0	2.2	175.949	237.906	12.758(0.0676)	76.059(0.0915)
26 11 1980	21 26 .0	3.8	558.403	321.094	17.495(0.0959)	74.126(0.0949)
7 12 1980	5 28 53.0	3.6	558.403	321.094	17.495(0.0959)	74.126(0.0949)
13 12 1980	2 59 30.0	2.2	191.381	335.690	15.174(0.0873)	76.701(0.0452)
21 12 1980	7 51 23.0	2.2	184.145	344.274	15.201(0.0896)	76.970(0.0277)
25 12 1980	22 7 7.0	2.3	127.659	154.347	12.567(0.0788)	77.946(0.0414)
30 12 1980	12 20 19.0	2.2	187.239	353.340	15.280(0.0929)	77.233(0.0155)
31 12 1980	17 51 56.0	3.6	548.642	332.651	17.982(0.0886)	75.051(0.0642)
4 1 1981	11 54 3.0	3.6	558.403	319.819	17.423(0.0948)	74.037(0.0950)
11 1 1981	4 16 41.0	3.0	417.876	192.463	9.927(0.1032)	76.612(0.0491)
12 1 1981	0 15 19.0	3.4	558.403	324.479	17.678(0.0908)	74.371(0.0836)
12 1 1981	0 40 40.0	3.8	558.403	324.479	17.678(0.0908)	74.371(0.0836)
13 1 1981	11 42 25.0	3.6	548.642	324.479	17.608(0.0916)	74.426(0.0839)
14 1 1981	21 26 46.0	3.8	548.642	319.819	17.357(0.0953)	74.097(0.0953)
25 1 1981	14 37 45.0	2.2	336.407	191.864	10.637(0.1033)	76.802(0.0433)
25 1 1981	20 30 45.0	4.2	558.403	321.654	17.527(0.0935)	74.166(0.0911)
3 2 1981	22 16 33.0	3.6	558.403	321.026	17.492(0.0930)	74.121(0.0913)
3 2 1981	22 34 16.0	2.3	406.800	195.142	10.065(0.1039)	76.464(0.0540)
3 2 1981	23 5 12.0	3.6	558.403	321.026	17.492(0.0930)	74.121(0.0913)
7 2 1981	23 8 24.0	2.7	411.236	188.194	9.937(0.1017)	76.900(0.0347)
8 2 1981	15 40 10.0	2.1	69.056	99.249	13.503(0.0217)	78.068(0.0767)
9 2 1981	6 17 17.0	2.2	181.062	330.073	15.016(0.0839)	76.594(0.0551)
12 2 1981	11 43 7.0	2.3	411.236	190.962	9.966(0.1019)	76.721(0.0393)
17 2 1981	11 39 35.0	3.3	411.236	189.620	9.951(0.1021)	76.808(0.0387)
20 2 1981	13 11 52.0	2.5	103.587	125.013	13.068(0.0544)	78.221(0.0737)

(TABLE II continues)

(TABLE II continues)

DATE	ORIGIN TIME (GMT)	MAG. M_{DS}	EPICENTRAL DISTANCE (km.)	BACK BEARING (deg.)	LAT. (&ERROR) (deg.)	LON. (&ERROR) (deg.)
21 2 1981	8 54 15.0	2.2	217.660	333.504	15.357(0.0888)	76.529(0.0513)
24 2 1981	12 10 53.0	4.4	497.787	227.642	10.561(0.1266)	74.067(0.1292)
26 2 1981	7 54 15.0	2.2	338.646	192.017	10.619(0.1030)	76.790(0.0418)
17 3 1981	8 39 8.0	2.2	196.583	336.509	15.227(0.0880)	76.705(0.0436)
18 3 1981	8 30 45.0	2.0	102.686	125.013	13.072(0.0543)	78.214(0.0735)
23 3 1981	10 29 44.0	2.3	366.647	14.474	16.801(0.1030)	78.298(0.0486)
30 3 1981	23 52 30.0	2.0	103.587	124.936	13.069(0.0542)	78.221(0.0736)
19 4 1981	15 2 29.0	3.7	577.452	320.435	17.589(0.0911)	73.963(0.0906)
27 4 1981	9 19 41.0	2.7	103.587	124.936	13.069(0.0542)	78.221(0.0736)
27 4 1981	9 28 4.0	4.2	568.009	319.819	17.488(0.0942)	73.977(0.0946)
8 5 1981	0 27 25.0	2.0	103.587	124.936	13.069(0.0542)	78.221(0.0736)
8 7 1981	7 40 18.0	3.4	568.009	322.136	17.621(0.0907)	74.143(0.0875)
16 7 1981	15 15 34.0	2.2	200.765	324.751	15.079(0.0835)	76.355(0.0665)
22 7 1981	16 10 38.0-	3.2	284.014	69.235	14.499(0.0772)	79.907(0.1129)
17 8 1981	14 52 47.0	2.8	74.862	139.103	13.094(0.0599)	77.889(0.0540)
17 9 1981	8 10 32.0	3.6	518.507	324.479	17.389(0.0934)	74.594(0.0844)
17 9 1981	8 32 18.0	3.9	548.642	325.429	17.656(0.0904)	74.495(0.0807)
18 9 1981	8 30 20.0	2.2	175.949	335.690	15.048(0.0854)	76.760(0.0436)
28 9 1981	3 9 11.0	2.0	101.786	125.013	13.077(0.0541)	78.207(0.0733)
29 9 1981	8 58 37.0	2.2	201.813	328.565	15.153(0.0855)	76.454(0.0600)
9 10 1981	14 31 36.0	4.2	739.745	61.745	16.680(0.1096)	83.562(0.0714)
9 10 1981	16 28 26.0	2.2	266.370	96.983	13.301(0.0512)	79.884(0.1060)
13 10 1981	8 27 54.0	2.2	186.207	332.964	15.097(0.0857)	76.646(0.0501)
19 10 1981	8 31 2.0	2.2	185.175	337.538	15.145(0.0874)	76.776(0.0413)
22 10 1981	8 36 24.0	2.6	179.013	338.254	15.101(0.0869)	76.817(0.0392)
26 10 1981	2 48 9.0	3.4	675.159	116.806	10.804(0.0988)	82.961(0.0926)
2 11 1981	23 15 50.0	3.7	377.833	48.260	15.856(0.1170)	80.076(0.1250)
13 11 1981	10 26 44.0	2.2	299.551	190.499	10.950(0.1017)	76.935(0.0356)
16 11 1981	8 18 7.0	2.2	193.458	334.005	15.169(0.0867)	76.645(0.0483)
23 11 1981	8 23 10.0	2.2	191.381	330.073	15.097(0.0850)	76.545(0.0561)
28 11 1981	7 24 17.0	2.2	172.895	148.565	12.274(0.0820)	78.267(0.0550)
1 12 1981	8 21 37.0	2.2	189.308	332.700	15.118(0.0857)	76.626(0.0505)
4 12 1981	8 22 18.0	3.0	661.167	39.395	18.160(0.1071)	81.428(0.1152)
8 12 1981	11 24 11.0	3.1	455.118	51.093	16.156(0.1198)	80.757(0.1287)

(TABLE II continues)

(TABLE II continues)

DATE	ORIGIN TIME (GMT)	MAG. M_{DS}	EPICENTRAL DISTANCE (km.)	BACK BEARING (deg.)	LAT. (&ERROR) (deg.)	LON. (&ERROR) (deg.)
16 12 1981	2 46 22.0	3.3	653.791	32.000	18.576(0.0922)	80.725(0.0966)
23 12 1981	22 58 42.0	2.5	105.396	125.013	13.058(0.0548)	78.234(0.0741)
29 12 1981	3 57 48.0	2.0	103.587	125.013	13.068(0.0544)	78.221(0.0737)
29 12 1981	4 26 56.0	2.3	103.587	125.013	13.068(0.0544)	78.221(0.0737)
30 12 1981	10 0 .0	2.2	259.790	272.945	13.713(0.0452)	75.030(0.1032)
7 1 1982	21 4 6.0	2.6	231.567	240.179	12.560(0.0795)	75.582(0.1041)
13 1 1982	0 27 29.0	3.8	675.159	107.069	11.751(0.1099)	83.375(0.0896)
14 1 1982	5 43 23.0	2.5	321.860	8.571	16.471(0.1023)	77.887(0.0349)
27 1 1982	11 51 14.0	3.3	104.491	124.936	13.064(0.0543)	78.228(0.0738)
7 2 1982	12 34 29.0	3.0	102.686	125.013	13.072(0.0543)	78.214(0.0735)
8 2 1982	10 14 18.0	2.0	103.587	124.936	13.069(0.0542)	78.221(0.0736)
5 3 1982	1 14 56.0	2.7	101.786	124.862	13.079(0.0536)	78.209(0.0732)
13 3 1982	18 42 17.0	4.0	103.587	125.013	13.068(0.0544)	78.221(0.0737)
15 3 1982	11 31 49.0	2.2	170.866	111.563	13.034(0.0513)	78.906(0.0940)
29 3 1982	13 17 55.0	2.7	103.587	123.432	13.089(0.0526)	78.236(0.0747)
29 3 1982	10 40 47.0	2.2	103.587	124.862	13.070(0.0539)	78.222(0.0735)
5 4 1982	8 3 56.0	2.2	179.013	336.592	15.083(0.0864)	76.773(0.0426)
13 4 1982	8 19 7.0	2.2	188.273	336.992	15.164(0.0874)	76.749(0.0423)
20 4 1982	16 13 11.0	2.3	103.587	125.013	13.068(0.0544)	78.221(0.0737)
30 4 1982	8 10 53.0	2.2	201.813	328.565	15.153(0.0855)	76.454(0.0600)
30 4 1982	9 9 46.0	2.2	252.143	263.340	13.330(0.0519)	75.117(0.1052)
6 5 1982	4 24 14.0	2.3	102.686	124.862	13.074(0.0538)	78.215(0.0734)
10 5 1982	18 28 38.0	3.8	558.403	332.964	18.073(0.0864)	75.033(0.0610)
20 5 1982	8 4 9.0	2.4	185.175	339.476	15.166(0.0880)	76.830(0.0371)
5 7 1982	21 3 51.0	2.6	169.854	124.936	12.725(0.0647)	78.722(0.0851)
11 7 1982	5 5 32.0	2.2	130.511	202.789	12.520(0.0832)	76.970(0.0437)
12 7 1982	8 15 7.0	2.4	184.145	305.576	14.565(0.0693)	76.042(0.0898)
15 7 1982	8 23 .0	2.2	192.419	336.160	15.189(0.0877)	76.710(0.0446)
8 8 1982	14 36 37.0	4.1	568.009	319.354	17.461(0.0907)	73.944(0.0911)
12 8 1982	8 2 37.0	2.2	186.207	341.806	15.197(0.0891)	76.893(0.0330)
8 9 1982	8 29 47.0	3.0	99.992	123.432	13.107(0.0519)	78.208(0.0739)
9 9 1982	8 21 6.0	2.2	185.175	336.115	15.129(0.0867)	76.736(0.0437)
11 9 1982	2 41 34.0	4.3	558.403	334.196	18.122(0.0869)	75.134(0.0595)
13 9 1982	8 3 3.0	2.2	183.116	339.569	15.149(0.0880)	76.840(0.0373)

(TABLE II continues)

(TABLE II continues)

DATE	ORIGIN TIME (GMT)	MAG. M_{DS}	EPICENTRAL DISTANCE (km.)	BACK BEARING (deg.)	LAT.(&ERROR) (deg.)	LON.(&ERROR) (deg.)
14 9 1982	7 26 20.0	2.2	206.017	327.769	15.172(0.0858)	76.411(0.0622)
14 9 1982	8 30 6.0	2.9	194.499	335.690	15.200(0.0876)	76.689(0.0454)
1 10 1982	17 41 33.0	2.7	386.767	56.905	15.488(0.1044)	80.465(0.1214)
6 10 1982	3 52 20.0	3.7	724.036	111.380	11.154(0.1001)	83.626(0.0707)
10 10 1982	8 15 52.0	3.6	558.403	327.641	17.836(0.0916)	74.610(0.0800)
13 10 1982	7 51 35.0	2.7	366.647	126.970	11.604(0.1027)	80.130(0.1140)
21 10 1982	9 32 35.0	2.3	102.686	124.862	13.074(0.0538)	78.215(0.0734)
28 10 1982	7 43 19.0	2.2	182.089	330.610	15.032(0.0839)	76.603(0.0536)
29 10 1982	7 55 43.0	2.6	193.458	348.397	15.311(0.0919)	77.073(0.0205)
31 10 1982	6 21 57.0	2.8	277.382	245.690	12.565(0.3867)	75.103(0.2536)
3 11 1982	7 43 5.0	3.0	103.587	125.366	13.063(0.0556)	78.217(0.0741)
11 11 1982	2 6 11.0	2.7	109.950	46.036	14.291(0.0850)	78.172(0.0892)
19 11 1982	8 0 45.0	2.3	90.262	100.199	13.459(0.0399)	78.259(0.0844)
24 11 1982	8 10 1.0	2.2	193.458	344.510	15.283(0.0906)	76.954(0.0275)
24 11 1982	11 9 33.0	2.2	131.465	221.211	12.712(0.0744)	76.635(0.0691)
25 11 1982	8 47 9.0	2.2	166.824	331.358	14.922(0.0826)	76.691(0.0510)
25 11 1982	9 4 32.0	2.2	187.239	332.700	15.102(0.0855)	76.635(0.0503)
27 11 1982	12 47 52.0	2.3	443.150	358.310	17.595(0.0986)	77.313(0.0130)
1 12 1982	3 8 4.0	2.2	160.801	208.634	12.332(0.0868)	76.726(0.0583)
6 12 1982	8 46 2.0	2.9	161.801	338.254	14.957(0.0849)	76.877(0.0380)
11 12 1982	8 17 51.0	2.2	186.207	345.877	15.231(0.0902)	77.012(0.0242)
16 12 1982	7 39 26.0	2.3	103.587	30.568	14.407(0.0746)	77.926(0.0509)
18 12 1982	8 24 35.0	2.2	192.419	303.332	14.552(0.0641)	75.940(0.0900)
23 12 1982	10 6 59.0	2.2	182.089	334.152	15.079(0.0853)	76.695(0.0467)
24 12 1982	8 6 12.0	2.4	181.062	357.923	15.234(0.0925)	77.375(0.0079)
25 12 1982	10 48 25.0	2.9	101.786	123.302	13.099(0.0515)	78.223(0.0739)
30 12 1982	7 55 59.0	2.2	196.583	332.141	15.168(0.0863)	76.579(0.0524)
7 1 1982	21 4 6.0	2.6	231.567	240.179	12.560(0.0795)	75.582(0.1041)
31 12 1982	8 11 28.0	2.2	214.473	349.603	15.504(0.0943)	77.074(0.0197)
3 1 1983	8 24 5.0	2.6	185.175	336.115	15.129(0.0867)	76.736(0.0437)
4 1 1983	7 37 16.0	3.9	548.642	328.565	17.806(0.0900)	74.731(0.0746)
4 1 1983	8 23 28.0	2.2	188.273	330.217	15.075(0.0837)	76.564(0.0536)
6 1 1983	8 22 29.0	2.2	212.353	331.358	15.281(0.0874)	76.486(0.0550)
8 1 1983	8 5 7.0	2.2	175.949	327.017	14.932(0.0819)	76.543(0.0601)

(TABLE II continues)

(TABLE II continues)

DATE	ORIGIN TIME (GMT)	MAG. M_{DS}	EPICENTRAL DISTANCE (km.)	BACK BEARING (deg.)	LAT.(&ERROR) (deg.)	LON.(&ERROR) (deg.)
10 1 1983	8 7 16.0	2.2	186.207	330.393	15.061(0.0838)	76.578(0.0537)
10 1 1983	11 21 11.0	3.9	538.734	327.821	17.696(0.0897)	74.725(0.0743)
13 1 1983	7 36 34.0	2.2	184.145	335.232	15.109(0.0864)	76.716(0.0457)
16 1 1983	0 0-17.0	2.0	101.786	124.793	13.080(0.0534)	78.209(0.0731)
16 1 1983	7 33 49.0	2.0	103.587	123.397	13.089(0.0524)	78.236(0.0746)
17 1 1983	20 55 18.0	2.3	102.686	299.138	14.053(0.0477)	76.603(0.0780)
18 1 1983	8 0 28.0	2.2	186.207	324.989	14.976(0.0816)	76.440(0.0639)
22 1 1983	8 4 45.0	2.6	183.116	334.735	15.095(0.0862)	76.707(0.0468)
23 1 1983	6 18 44.0	2.2	183.116	334.829	15.096(0.0860)	76.709(0.0461)
24 1 1983	8 28 2.0	2.2	231.567	327.906	15.369(0.0871)	76.287(0.0625)
25 1 1983	7 58 .0	2.2	177.990	334.005	15.044(0.0850)	76.708(0.0471)
28 1 1983	18 53 48.0	2.7	361.049	52.772	15.557(0.1035)	80.124(0.1175)
31 1 1983	21 45 22.0	2.0	103.587	125.013	13.068(0.0544)	78.221(0.0737)
5 2 1983	7 44 52.0	2.2	181.062	334.347	15.073(0.0857)	76.705(0.0470)
5 2 1983	15 43 39.0	3.4	105.396	123.432	13.080(0.0529)	78.250(0.0751)
5 2 1983	22 53 38.0	4.3	548.642	320.435	17.391(0.0930)	74.139(0.0917)
6 2 1983	10 5 .0	2.2	234.797	156.563	11.662(0.0908)	78.295(0.0429)
9 2 1983	7 45 7.0	2.2	181.062	336.992	15.105(0.0867)	76.776(0.0418)
12 2 1983	12 57 22.0	2.2	179.013	336.992	15.088(0.0865)	76.783(0.0417)
13 2 1983	10 45 48.0	2.2	230.492	29.955	15.401(0.0980)	78.511(0.0762)
15 2 1983	10 44 54.0	2.4	163.806	51.290	14.524(0.0701)	78.626(0.0846)
16 2 1983	8 4 40.0	2.4	194.499	334.005	15.178(0.0868)	76.640(0.0484)
23 2 1983	6 26 38.0	2.0	417.876	275.435	13.931(0.0678)	73.575(0.1071)
24 2 1983	8 2 37.0	2.2	184.145	335.690	15.115(0.0865)	76.729(0.0446)
24 2 1983	9 8 43.0	2.2	214.473	327.866	15.238(0.0859)	76.371(0.0616)
24 2 1983	12 49 51.0	2.0	104.491	124.936	13.064(0.0543)	78.228(0.0738)
26 2 1983	5 49 5.0	2.0	102.686	124.862	13.074(0.0538)	78.215(0.0734)
7 3 1983	8 14 12.0	2.4	186.207	327.866	15.023(0.0830)	76.512(0.0589)
11 3 1983	8 10 58.0	2.2	177.990	331.358	15.010(0.0839)	76.640(0.0520)
12 3 1983	8 37 1.0	2.2	186.207	331.932	15.083(0.0849)	76.619(0.0515)
14 3 1983	8 39 22.0	2.2	182.089	330.610	15.032(0.0839)	76.603(0.0536)
15 3 1983	11 43 14.0	2.2	249.965	25.660	15.632(0.1010)	78.449(0.0719)
17 3 1983	6 35 13.0	2.2	184.145	330.610	15.048(0.0841)	76.593(0.0538)
18 3 1983	19 3 10.0	2.2	191.381	329.216	15.084(0.0840)	76.522(0.0566)

(TABLE II continues)

(TABLE II continues)

DATE			ORIGIN TIME (GMT)			MAG. M_{DS}	EPICENTRAL DISTANCE (km.)	BACK BEARING (deg.)	LAT.(&ERROR) (deg.)	LON.(&ERROR) (deg.)
21	3	1983	15	2	9.0	4.2	561.302	316.931	17.270(0.0945)	73.822(0.0979)
22	3	1983	8	9	20.0	2.2	181.062	330.610	15.024(0.0838)	76.607(0.0535)
24	3	1983	14	5	10.0	3.4	366.647	54.166	15.522(0.1063)	80.215(0.1208)
25	3	1983	8	7	12.0	2.2	177.990	329.979	14.991(0.0832)	76.606(0.0546)
25	3	1983	10	31	41.0	2.2	249.965	254.797	13.004(0.0599)	75.206(0.1065)
27	3	1983	11	17	25.0	3.0	102.686	126.086	13.058(0.0546)	78.204(0.0721)
29	3	1983	9	15	48.0	2.5	102.686	126.185	13.057(0.0548)	78.203(0.0721)
29	3	1983	10	2	30.0	2.5	103.587	126.185	13.052(0.0550)	78.209(0.0723)
29	3	1983	12	51	2.0	3.0	388.998	55.749	15.558(0.1118)	80.443(0.1257)
29	3	1983	13	17	15.0	2.0	103.587	128.789	13.018(0.0571)	78.183(0.0699)
29	3	1983	13	20	38.0	2.0	101.786	128.789	13.029(0.0568)	78.170(0.0695)
29	3	1983	16	35	48.0	2.0	103.587	126.289	13.051(0.0552)	78.208(0.0724)
30	3	1983	3	55	7.0	2.0	103.587	129.125	13.014(0.0577)	78.179(0.0698)
31	3	1983	0	12	51.0	2.5	349.848	52.136	15.525(0.1013)	80.018(0.1152)
3	4	1983	14	18	7.0	2.4	207.070	237.115	12.586(0.0755)	75.831(0.0971)
4	4	1983	8	13	6.0	2.2	191.381	333.504	15.146(0.0863)	76.639(0.0493)
6	4	1983	8	4	16.0	2.2	186.207	331.932	15.083(0.0849)	76.619(0.0515)
6	4	1983	14	5	56.0	2.0	101.786	125.991	13.064(0.0542)	78.198(0.0719)
7	4	1983	8	26	42.0	2.2	173.912	330.887	14.972(0.0835)	76.647(0.0531)
8	4	1983	7	40	53.0	2.2	189.308	331.932	15.108(0.0853)	76.605(0.0518)
8	4	1983	11	20	5.0	3.0	653.791	38.582	18.176(0.1155)	81.298(0.1260)
9	4	1983	7	53	47.0	2.2	175.949	333.218	15.018(0.0844)	76.697(0.0482)
9	4	1983	7	58	19.0	2.2	207.070	333.218	15.268(0.0875)	76.565(0.0507)
11	4	1983	8	15	48.0	3.2	737.087	74.797	15.255(0.1050)	84.078(0.0507)
13	4	1983	7	57	3.0	2.2	191.381	336.509	15.184(0.0874)	76.724(0.0432)
15	4	1983	8	17	42.0	2.2	186.207	331.745	15.080(0.0847)	76.614(0.0515)
19	4	1983	10	35	23.0	2.2	247.789	359.265	15.836(0.0980)	77.406(0.0097)
22	4	1983	3	2	41.0	2.0	101.786	123.332	13.099(0.0516)	78.223(0.0740)
22	4	1983	4	47	44.0	3.0	110.867	194.072	12.635(0.0819)	77.187(0.0277)
22	4	1983	8	16	7.0	2.2	190.344	338.254	15.196(0.0881)	76.778(0.0399)
22	4	1983	21	2	1.0	2.0	101.786	122.000	13.117(0.0507)	78.235(0.0753)
23	4	1983	8	21	17.0	2.6	183.116	334.152	15.088(0.0854)	76.691(0.0468)
24	4	1983	10	4	2.0	3.7	380.068	54.166	15.592(0.1079)	80.318(0.1220)
24	4	1983	14	30	10.0	3.4	377.833	52.323	15.668(0.1090)	80.234(0.1215)

(TABLE II continues)

(TABLE II continues)

DATE			ORIGIN TIME (GMT)			MAG. M_{DS}	EPICENTRAL DISTANCE (km.)	BACK BEARING (deg.)	LAT.(&ERROR) (deg.)	LON.(&ERROR) (deg.)
26	4	1983	8	2	15.0	2.2	181.062	335.690	15.090(0.0862)	76.741(0.0444)
27	4	1983	8	47	35.0	2.2	183.116	349.203	15.224(0.0911)	77.116(0.0191)
30	4	1983	17	45	41.0	2.3	105.396	198.675	12.704(0.0797)	77.124(0.0337)
3	5	1983	8	12	48.0	2.2	184.145	336.992	15.130(0.0870)	76.764(0.0421)
3	5	1983	10	26	32.0	2.2	244.531	258.123	13.141(0.0547)	75.222(0.1056)
6	5	1983	8	13	28.0	2.2	186.207	337.362	15.152(0.0873)	76.767(0.0413)
11	5	1983	8	15	44.0	2.9	548.642	32.000	17.780(0.1113)	80.184(0.1105)
13	5	1983	5	53	42.0	4.2	565.144	320.435	17.504(0.0949)	74.038(0.0948)
18	5	1983	7	37	59.0	2.2	183.116	327.769	14.998(0.0833)	76.525(0.0598)
18	5	1983	8	12	23.0	2.2	186.207	338.254	15.161(0.0877)	76.792(0.0397)
18	5	1983	14	56	44.0	2.3	433.297	13.030	17.405(0.1028)	78.358(0.0530)
18	5	1983	21	32	41.0	3.0	333.048	51.983	15.440(0.1134)	79.888(0.1245)
20	5	1983	4	0	50.0	3.9	366.647	54.166	15.522(0.1063)	80.215(0.1208)
28	5	1983	18	8	49.0	4.2	554.517	316.931	17.226(0.0948)	73.867(0.0982)
1	6	1983	22	36	23.0	2.8	154.827	246.592	13.047(0.0561)	76.122(0.0930)
9	6	1983	5	47	41.0	3.0	388.998	52.772	15.707(0.1066)	80.334(0.1199)
14	6	1983	9	46	49.0	3.9	538.734	324.479	17.536(0.0922)	74.481(0.0841)
20	6	1983	5	47	13.0	3.5	574.637	317.945	17.420(0.0952)	73.804(0.0980)
20	6	1983	21	48	25.0	2.5	548.642	328.565	17.806(0.0912)	74.731(0.0766)
30	6	1983	6	59	29.0	4.2	455.118	17.964	17.501(0.1057)	78.761(0.0733)
30	6	1983	7	44	10.0	2.4	191.381	332.466	15.132(0.0856)	76.611(0.0508)
5	7	1983	22	57	59.0	3.2	302.890	120.493	12.208(0.0769)	79.842(0.1035)
10	7	1983	10	9	37.0	2.5	104.491	126.289	13.046(0.0554)	78.215(0.0725)
11	7	1983	1	34	25.0	2.0	103.587	124.726	13.071(0.0534)	78.223(0.0734)
16	7	1983	12	3	51.0	2.7	101.786	124.793	13.080(0.0534)	78.209(0.0731)
19	7	1983	13	31	1.0	2.0	100.888	123.397	13.103(0.0519)	78.215(0.0740)
28	7	1983	10	27	9.0	2.3	118.261	146.567	12.714(0.0731)	78.038(0.0519)
13	8	1983	6	37	48.0	2.0	100.888	124.862	13.083(0.0534)	78.202(0.0730)
14	8	1983	10	9	8.0	3.2	375.597	53.801	15.586(0.1116)	80.270(0.1245)
17	8	1933	9	37	1.0	4.1	699.887	328.565	18.958(0.0606)	73.964(0.0586)
28	8	1983	7	43	34.0	2.2	231.567	19.471	15.570(0.0989)	78.158(0.0562)
29	8	1983	11	8	26.0	2.2	321.860	230.970	11.768(0.0977)	75.136(0.1076)
31	8	1983	5	3	54.0	2.0	101.786	124.793	13.080(0.0534)	78.209(0.0731)
31	8	1983	8	37	23.0	2.2	187.239	332.466	15.099(0.0852)	76.629(0.0504)

(TABLE II continues)

(TABLE II continues)

DATE			ORIGIN TIME (GMT)			MAG. M_{DS}	EPICENTRAL DISTANCE (km.)	BACK BEARING (deg.)	LAT.(&ERROR) (deg.)	LON.(&ERROR) (deg.)
3	9	1983	8	24	16.0	2.2	186.207	334.005	15.111(0.0859)	76.675(0.0477)
7	9	1983	5	33	12.0	2.7	102.686	125.094	13.071(0.0546)	78.213(0.0736)
11	9	1983	18	12	22.0	2.9	705.345	112.538	11.101(0.1071)	83.416(0.0840)
14	9	1983	21	53	51.0	4.8	688.088	335.690	19.237(0.0594)	74.738(0.0453)
15	9	1983	12	0	26.0	3.8	411.236	54.166	15.753(0.1115)	80.556(0.1244)
24	9	1983	16	44	46.0	2.2	331.928	74.274	14.397(0.0810)	80.408(0.1157)
25	9	1983	18	55	29.0	4.6	558.403	327.017	17.806(0.0888)	74.562(0.0765)
27	9	1983	10	13	48.0	3.6	548.642	320.435	17.391(0.0930)	74.139(0.0917)
27	9	1983	12	8	35.0	3.6	548.642	323.801	17.573(0.0912)	74.376(0.0845)
28	9	1983	11	43	24.0	3.2	528.686	332.964	17.835(0.0894)	75.164(0.0618)
29	9	1983	11	12	23.0	2.6	233.719	27.914	15.463(0.0986)	78.459(0.0730)
1	10	1983	8	55	37.0	4.5	556.463	320.435	17.445(0.0926)	74.091(0.0915)
1	10	1983	11	41	29.0	3.3	103.587	125.013	13.068(0.0544)	78.221(0.0737)
4	10	1983	8	32	9.0	2.2	234.797	258.169	13.162(0.0544)	75.310(0.1050)
7	10	1983	15	2	35.0	4.3	487.261	233.801	10.987(0.1249)	73.829(0.1294)
7	10	1983	15	29	38.0	2.2	321.860	347.000	16.429(0.0981)	76.756(0.0239)
12	10	1983	11	18	5.0	2.2	157.808	77.000	13.920(0.0449)	78.863(0.0960)
18	10	1983	7	58	25.0	2.3	101.786	124.936	13.078(0.0538)	78.208(0.0733)
19	10	1983	8	52	21.0	2.0	99.992	123.469	13.106(0.0522)	78.208(0.0740)
20	10	1983	22	55	33.0	2.3	102.686	124.936	13.073(0.0540)	78.215(0.0734)
1	11	1983	20	43	7.0	3.4	548.642	319.241	17.324(0.0947)	74.058(0.0952)
22	11	1983	0	59	58.0	2.0	99.992	122.000	13.126(0.0508)	78.221(0.0751)
24	11	1983	12	49	53.0	2.8	122.939	85.842	13.682(0.0249)	78.573(0.0883)
25	11	1983	7	39	8.0	2.6	195.540	99.380	13.311(0.0392)	79.222(0.0992)
1	12	1983	19	33	38.0	2.7	102.686	123.507	13.092(0.0529)	78.228(0.0747)
3	12	1983	8	23	8.0	2.2	162.803	329.979	14.873(0.0814)	76.677(0.0530)
8	12	1983	5	3	39.0	2.2	181.062	329.979	15.015(0.0836)	76.591(0.0548)
8	12	1983	10	0	.0	2.2	233.719	26.094	15.493(0.0984)	78.397(0.0686)
14	12	1983	8	7	9.0	2.6	186.207	334.005	15.111(0.0859)	76.675(0.0477)
3	1	1984	17	35	25.0	2.8	103.587	123.507	13.088(0.0531)	78.235(0.0749)
27	1	1984	20	40	12.0	2.6	653.791	105.811	11.935(0.1061)	83.228(0.0931)
12	2	1984	7	28	4.0	3.1	558.403	320.435	17.458(0.0925)	74.079(0.0914)
13	2	1984	8	22	2.0	2.5	188.273	333.701	15.124(0.0858)	76.658(0.0482)
25	2	1984	8	7	39.0	2.1	180.037	333.701	15.057(0.0850)	76.692(0.0475)

(TABLE II continues)

(TABLE II continues)

DATE			ORIGIN TIME (GMT)			MAG. M_{DS}	EPICENTRAL DISTANCE (km.)	BACK BEARING (deg.)	LAT.(&ERROR) (deg.)	LON.(&ERROR) (deg.)
29	2	1984	9	21	8.0	2.1	224.060	156.077	11.758(0.0903)	78.272(0.0445)
7	3	1984	18	9	9.0	2.1	101.786	123.302	13.099(0.0515)	78.223(0.0739)
14	3	1984	8	11	3.0	2.4	180.037	333.218	15.051(0.0848)	76.679(0.0486)
15	3	1984	12	18	22.0	3.5	538.734	316.470	17.097(0.0946)	73.941(0.0984)
19	3	1984	8	5	6.0	2.2	185.175	332.466	15.082(0.0850)	76.637(0.0503)
20	3	1984	10	45	22.0	4.4	122.000	162.601	12.555(0.0811)	77.773(0.0270)
28	3	1984	2	53	48.0	4.2	746.062	56.146	17.276(0.0951)	83.278(0.0638)
28	3	1984	19	13	37.0	3.7	741.787	351.399	20.209(0.0181)	76.373(0.0138)
2	4	1984	7	9	27.0	2.5	333.048	127.356	11.772(0.0885)	79.872(0.1024)
2	4	1984	8	4	47.0	2.3	406.800	138.390	10.852(0.0937)	79.913(0.0884)
3	4	1984	8	1	4.0	2.1	175.949	334.471	15.034(0.0849)	76.729(0.0459)
14	4	1984	19	42	11.0	4.4	705.345	81.970	14.406(0.1141)	83.933(0.0617)
17	4	1984	10	24	13.0	2.2	260.885	259.291	13.156(0.0561)	75.064(0.1069)
24	4	1984	17	35	27.0	3.4	538.734	15.811	18.270(0.0977)	78.827(0.0678)
26	4	1984	8	45	46.0	2.0	266.370	276.799	13.876(0.0445)	74.982(0.1051)
27	4	1984	2	0	19.0	3.4	548.642	22.538	18.161(0.1077)	79.428(0.1012)
30	4	1984	7	28	8.0	2.0	255.417	259.121	13.159(0.0528)	75.115(0.1059)
30	4	1984	16	36	1.0	3.8	558.403	321.026	17.492(0.0930)	74.121(0.0913)
12	5	1984	8	32	37.0	2.4	176.969	334.005	15.036(0.0849)	76.713(0.0470)
13	5	1984	6	49	39.0	2.9	174.930	135.671	12.474(0.0744)	78.564(0.0743)
17	5	1984	8	30	30.0	2.0	244.531	258.123	13.141(0.0547)	75.222(0.1056)
23	5	1984	15	27	23.0	2.5	99.098	43.310	14.253(0.0655)	78.068(0.0648)
31	5	1984	8	36	40.0	2.4	187.239	335.275	15.135(0.0865)	76.705(0.0454)
7	6	1984	1	13	59.0	2.5	100.888	123.432	13.102(0.0521)	78.215(0.0741)
17	6	1984	19	4	18.0	2.1	131.465	186.722	12.428(0.0861)	77.294(0.0160)
20	6	1984	7	43	6.0	2.3	101.786	124.862	13.079(0.0536)	78.209(0.0732)
20	6	1984	18	22	35.0	3.7	724.036	9.068	20.043(0.0437)	78.528(0.0577)
21	6	1984	8	15	55.0	2.2	188.273	333.701	15.124(0.0858)	76.658(0.0482)
26	6	1984	8	32	41.0	2.2	174.930	333.701	15.016(0.0844)	76.713(0.0471)
27	6	1984	15	56	43.0	3.4	451.863	45.570	16.435(0.1151)	80.466(0.1212)
3	7	1984	8	32	31.0	3.4	100.888	123.397	13.103(0.0519)	78.215(0.0740)
12	7	1984	9	46	30.0	3.0	100.888	123.432	13.102(0.0521)	78.215(0.0741)
15	7	1984	9	43	26.0	2.4	174.930	334.471	15.025(0.0848)	76.733(0.0458)
31	7	1984	21	58	17.0	3.0	472.360	47.068	16.480(0.1221)	80.684(0.1287)

(TABLE II continues)

(TABLE II continues)

DATE	ORIGIN TIME (GMT)	MAG. M_{DS}	EPICENTRAL DISTANCE (km.)	BACK BEARING (deg.)	LAT.(&ERROR) (deg.)	LON.(&ERROR) (deg.)
7 8 1984	12 14 44.0	2.2	185.175	327.866	15.015(0.0829)	76.518(0.0588)
10 8 1984	8 27 2.0	2.2	185.175	333.701	15.099(0.0855)	76.671(0.0479)
11 8 1984	10 9 39.0	2.0	444.242	58.565	15.665(0.1188)	80.982(0.1301)
23 8 1984	6 25 51.0	3.4	675.159	53.541	17.163(0.0980)	82.553(0.0983)
27 8 1984	8 44 31.0	2.2	185.175	334.005	15.102(0.0858)	76.679(0.0477)
28 8 1984	8 21 34.0	2.8	185.175	334.005	15.102(0.0858)	76.679(0.0477)
3 9 1984	11 14 12.0	2.3	101.786	122.000	13.117(0.0505)	78.235(0.0751)
4 9 1984	2 28 27.0	3.7	745.674	315.134	18.311(0.0507)	72.449(0.0515)
4 9 1984	8 13 25.0	2.0	102.686	123.507	13.092(0.0529)	78.228(0.0747)
5 9 1984	10 44 40.0	2.3	105.396	123.469	13.079(0.0531)	78.249(0.0752)
7 9 1984	2 56 57.0	2.5	102.686	123.507	13.092(0.0529)	78.228(0.0747)
10 9 1984	12 45 12.0	2.2	222.991	327.115	15.289(0.0865)	76.305(0.0641)
12 9 1984	3 34 7.0	3.4	104.491	124.936	13.064(0.0543)	78.228(0.0738)
21 9 1984	8 24 20.0	2.6	192.419	334.829	15.172(0.0870)	76.672(0.0468)
24 9 1984	7 47 18.0	4.3	746.025	335.111	19.681(0.0144)	74.438(0.0282)
25 9 1984	7 46 37.0	4.5	573.695	319.241	17.492(0.0932)	73.901(0.0943)
28 9 1984	14 25 14.0	3.5	739.745	115.418	10.673(0.1096)	83.559(0.0697)
16 10 1984	12 50 46.0	2.2	185.175	334.005	15.102(0.0858)	76.679(0.0477)
17 10 1984	6 6 15.0	2.2	211.294	68.529	14.294(0.0638)	79.264(0.1035)
21 10 1984	7 31 11.0	2.6	177.990	335.275	15.060(0.0855)	76.742(0.0447)
25 10 1984	7 56 35.0	2.2	176.969	269.529	13.586(0.0239)	75.796(0.0949)
30 10 1984	8 15 58.0	2.7	688.088	38.116	18.446(0.1043)	81.465(0.1161)
1 11 1984	21 12 41.0	2.0	745.674	62.964	16.576(0.1447)	83.677(0.0757)
2 11 1984	8 18 28.0	2.2	175.949	334.829	15.038(0.0852)	76.738(0.0455)
14 11 1984	11 58 22.0	4.5	561.302	317.709	17.318(0.0920)	73.874(0.0944)
15 11 1984	23 52 37.0	2.2	154.827	172.599	12.221(0.0888)	77.620(0.0139)
17 11 1984	10 35 11.0	2.2	232.643	28.186	15.449(0.0976)	78.463(0.0716)
21 11 1984	8 14 59.0	2.2	174.930	330.610	14.976(0.0831)	76.636(0.0529)
25 11 1984	15 14 9.0	2.0	104.491	124.726	13.067(0.0536)	78.230(0.0736)
27 11 1984	0 51 48.0	2.9	180.037	130.616	12.545(0.0728)	78.697(0.0824)
27 11 1984	1 25 25.0	2.9	181.062	130.616	12.539(0.0729)	78.705(0.0826)
27 11 1984	3 26 59.0	2.6	180.037	130.366	12.551(0.0722)	78.702(0.0824)
27 11 1984	17 19 43.0	4.1	181.062	130.881	12.533(0.0735)	78.699(0.0826)
28 11 1984	2 29 49.0	3.3	185.175	130.130	12.526(0.0724)	78.743(0.0830)

(TABLE II continues)

(TABLE II continues)

DATE	ORIGIN TIME (GMT)	MAG. M_{DS}	EPICENTRAL DISTANCE (km.)	BACK BEARING (deg.)	LAT.(&ERROR) (deg.)	LON.(&ERROR) (deg.)
29 11 1984	7 19 27.0	2.6	177.990	130.130	12.568(0.0714)	78.692(0.0821)
30 11 1984	12 40 8.0	2.9	180.037	130.130	12.556(0.0717)	78.707(0.0823)
3 12 1984	17 2 58.0	4.3	181.062	129.125	12.572(0.0722)	78.733(0.0846)
3 12 1984	17 34 12.0	3.3	182.089	129.125	12.566(0.0724)	78.740(0.0847)
3 12 1984	19 17 19.0	3.5	183.116	129.125	12.560(0.0725)	78.747(0.0849)
4 12 1984	6 46 48.0	2.9	184.145	130.616	12.521(0.0733)	78.726(0.0830)
4 12 1984	6 49 31.0	2.6	184.145	130.616	12.521(0.0733)	78.726(0.0830)
8 12 1984	9 0 17.0	2.2	210.237	332.141	15.277(0.0876)	76.519(0.0535)
10 12 1984	13 20 45.0	2.9	183.116	127.711	12.592(0.0686)	78.773(0.0841)
20 12 1984	14 47 .0	3.4	518.507	321.094	17.219(0.0977)	74.367(0.0955)
21 12 1984	17 26 59.0	4.2	528.686	316.931	17.059(0.0957)	74.036(0.0989)
6 1 1985	12 51 .0	4.2	741.883	8.037	20.220(0.0239)	78.430(0.0510)
10 1 1985	8 33 .0	2.0	183.116	334.005	15.086(0.0856)	76.687(0.0475)
12 1 1985	8 39 37.0	2.1	109.036	194.474	12.653(0.0813)	77.184(0.0274)
22 1 1985	18 46 12.0	2.5	184.145	129.907	12.537(0.0717)	78.740(0.0829)
24 1 1985	16 26 21.0	2.1	39.467	168.123	13.256(0.0647)	77.511(0.0141)
30 1 1985	12 22 40.0	2.3	101.786	124.936	13.078(0.0538)	78.208(0.0733)
4 2 1985	13 37 27.0	2.9	661.167	48.504	17.504(0.1223)	82.111(0.1234)
24 2 1985	8 10 52.0	2.8	675.159	41.462	18.124(0.1068)	81.670(0.1143)
1 3 1985	10 39 7.0	2.1	166.824	47.124	14.624(0.0756)	78.574(0.0825)
1 3 1985	17 10 58.0	2.5	103.587	124.862	13.070(0.0539)	78.222(0.0735)
13 3 1985	7 30 33.0	2.0	181.062	334.005	15.069(0.0854)	76.696(0.0473)
13 3 1985	8 28 55.0	2.6	158.804	335.690	14.907(0.0834)	76.827(0.0423)
13 3 1985	8 28 55.0	2.6	201.813	335.275	15.254(0.0880)	76.648(0.0464)
15 3 1985	8 9 53.0	2.0	213.412	329.897	15.265(0.0866)	76.437(0.0575)
30 3 1985	4 23 47.0	2.1	138.187	137.524	12.684(0.0706)	78.298(0.0670)
11 4 1985	8 26 52.0	2.0	184.145	333.218	15.084(0.0853)	76.662(0.0489)
5 5 1985	7 51 10.0	2.8	4.859	255.877	13.593(0.0139)	77.392(0.0536)
7 5 1985	8 11 50.0	3.1	4.859	208.424	13.566(0.0961)	77.415(0.0228)
15 5 1985	8 15 2.0	2.4	189.308	335.275	15.152(0.0867)	76.697(0.0455)
15 5 1985	20 25 40.0	2.7	739.745	115.884	10.625(0.1017)	83.534(0.0665)
21 5 1985	7 53 30.0	2.2	170.866	96.885	13.415(0.0345)	79.007(0.0961)
27 5 1985	6 57 14.0	3.7	558.403	325.429	17.727(0.0896)	74.442(0.0804)
1 6 1985	18 20 58.0	2.4	155.819	88.821	13.629(0.0266)	78.880(0.0924)

(TABLE II continues)

(TABLE II continues)

DATE	ORIGIN TIME (GMT)	MAG. M_{DS}	EPICENTRAL DISTANCE (km.)	BACK BEARING (deg.)	LAT.(&ERROR) (deg.)	LON.(&ERROR) (deg.)
9 7 1985	8 52 46.0	2.0	182.089	335.690	15.098(0.0863)	76.737(0.0445)
13 7 1985	20 42 41.0	2.3	101.786	125.013	13.077(0.0541)	78.207(0.0733)
19 7 1985	16 54 39.0	3.1	102.686	123.507	13.092(0.0529)	78.228(0.0747)
20 7 1985	1 6 6.0	2.7	100.888	124.862	13.083(0.0534)	78.202(0.0730)
17 8 1985	14 47 15.0	2.1	103.587	123.469	13.088(0.0528)	78.235(0.0748)
22 8 1985	12 54 24.0	3.2	106.303	124.862	13.055(0.0544)	78.243(0.0741)
23 8 1985	11 39 51.0	3.4	99.098	123.432	13.111(0.0518)	78.201(0.0737)
3 9 1985	7 40 20.0	2.0	179.013	333.218	15.043(0.0847)	76.684(0.0485)
7 9 1985	12 38 51.0	3.2	653.791	43.689	17.824(0.1141)	81.706(0.1199)
9 9 1985	21 15 14.0	2.3	103.587	122.000	13.108(0.0516)	78.249(0.0760)
18 9 1985	3 36 6.0	2.2	175.949	329.216	14.965(0.0823)	76.596(0.0551)
21 9 1985	8 13 1.0	2.2	174.930	330.926	14.980(0.0828)	76.643(0.0516)
22 9 1985	7 20 52.0	3.3	277.382	140.435	11.673(0.0897)	79.061(0.0800)
25 9 1985	7 53 31.0	2.2	176.969	336.115	15.061(0.0858)	76.768(0.0431)
27 9 1985	9 6 47.0	3.0	661.167	13.565	19.390(0.0749)	78.915(0.0657)
30 9 1985	20 22 36.0	3.6	555.491	320.435	17.438(0.0926)	74.097(0.0915)
6 10 1985	8 42 19.0	2.8	305.117	145.429	11.336(0.0928)	79.027(0.0723)
17 10 1985	8 31 56.0	2.0	175.949	336.509	15.057(0.0858)	76.782(0.0422)
17 10 1985	10 7 6.0	2.3	109.036	179.171	12.622(0.0823)	77.451(0.0045)
25 10 1985	9 32 52.0	2.0	102.686	123.469	13.093(0.0526)	78.228(0.0746)
29 10 1985	7 56 53.0	2.4	181.062	334.471	15.075(0.0855)	76.708(0.0463)
29 10 1985	8 32 .0	4.0	551.586	325.199	17.666(0.0916)	74.462(0.0831)
29 10 1985	13 58 51.0	4.2	558.403	321.654	17.527(0.0935)	74.166(0.0911)
1 11 1985	11 28 .0	2.2	228.344	339.875	15.535(0.0928)	76.702(0.0410)
4 11 1985	8 3 27.0	2.2	181.062	333.701	15.065(0.0851)	76.688(0.0476)
8 11 1985	21 34 36.0	3.3	743.444	207.914	7.668(0.0522)	74.278(0.0851)
15 11 1985	7 2 53.0	4.1	548.642	323.448	17.554(0.0929)	74.351(0.0873)
21 11 1985	9 28 24.0	4.1	561.302	326.775	17.816(0.0913)	74.528(0.0811)
21 11 1985	11 37 57.0	3.7	558.403	322.136	17.553(0.0914)	74.200(0.0879)
21 11 1985	14 30 39.0	3.8	568.009	319.879	17.492(0.0913)	73.981(0.0911)
4 12 1985	0 19 28.0	2.0	101.786	126.514	13.057(0.0555)	78.193(0.0721)
15 12 1985	13 10 55.0	4.2	558.403	326.775	17.794(0.0915)	74.544(0.0811)
17 12 1985	14 44 54.0	2.8	103.587	122.000	13.108(0.0514)	78.249(0.0759)
26 12 1985	6 21 36.0	2.0	104.491	123.432	13.084(0.0527)	78.243(0.0749)
28 12 1985	14 52 15.0	3.8	568.009	319.241	17.454(0.0936)	73.936(0.0946)

MAXIMUM LATITUDE = 20.22 , MINIMUM LATITUDE = 7.441
MAXIMUM LONGITUDE = 84.078 , MINIMUM LONGITUDE = 72.449
AREA INCLUDED = 1830972.25 SQ. KMS.

TABLE III

Comparison of observed and estimated arrival times at HYB*
for some events detected both at GBA and HYB

DATE	ORIGIN TIME (GMT)	OBSERVED ARRIVAL TIME AT HYB (GMT)	ESTIMATED ARRIVAL TIME AT HYB (GMT)
1 12 77	11:02:15	11:03:13.6	11:03:09
10 10 79	13:04:50	13:05:07.3	13:05:09
22 10 79	19:39:58	19:40:25.1	19:40:15
30 03 80	13:31:55	13:33:05.0	13:33:30
12 04 80	07:28:47	07:29:59.2	07:29:48
01 05 80	00:39:38	00:40:45.3	00:40:28
03 05 80	06:53:05	06:54:30.8	06:54:12
02 06 80	08:35:29	08:36:48.2	08:36:29
19 08 80	22:32:13	22:33:27.3	22:33:19
20 09 80	07:29:01	07:30:04.4	07:30:02
20 09 80	10:45:54	10:46:38.5	10:47:00
21 09 80	08:18:43	08:19:42.6	08:19:49
21 09 80	18:19:27	18:20:30.5	18:20:28
27 09 80	08:54:56	08:56:01.0	08:56:02
26 10 80	01:32:29	01:33:37.3	01:33:31
26 11 80	21:26:00	21:27:04.0	21:27:06
31 12 80	17:51:56	17:53:12.2	17:52:50
15 03 84	12:18:22	12:19:37.0	12:19:30
20 03 84	10:45:22	10:46:33.5	10:46:31
28 03 84	02:53:48	02:54:55.5	02:54:50
28 03 84	19:13:37	19:14:40.0	19:14:32
14 04 84	19:42:11	19:43:26.0	19:43:37
24 04 84	17:35:27	17:35:43.5	17:35:44
27 04 84	02:00:19	02:00:50.5	02:00:40
30 04 84	16:36:01	16:37:18.0	16:37:07
20 06 84	18:22:35	18:23:35.0	18:23:19
27 06 84	15:56:43	15:57:18.6	15:57:19
31 07 84	21:58:17	21:59:08.2	21:58:55
23 08 84	06:25:51	06:27:10.0	06:26:51
14 11 84	11:58:22	11:59:27.2	11:59:31
27 11 84	17:19:43	17:20:58.0	17:20:51
28 11 84	02:29:49	02:31:20.5	02:30:57
03 12 84	17:02:58	17:04:12.5	17:04:05
03 12 84	17:34:12	17:35:42.0	17:35:20
03 12 84	19:17:19	19:18:35.0	19:18:27
21 12 84	17:26:59	17:28:02.5	17:28:06

* The events are same as those of Table I used for calibrating the magnitude scale.

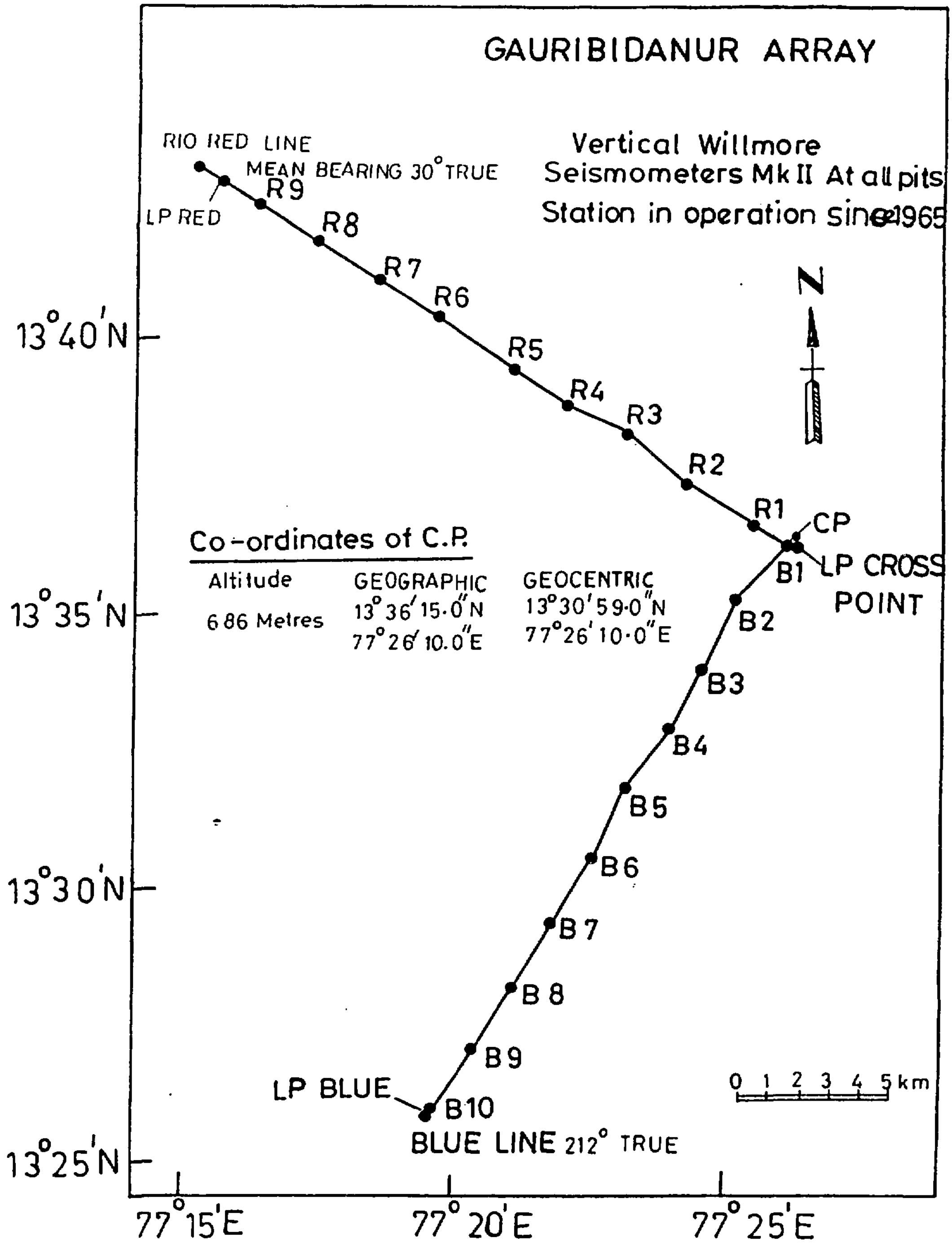

Fig.1 : Configuration of the Seismological Array

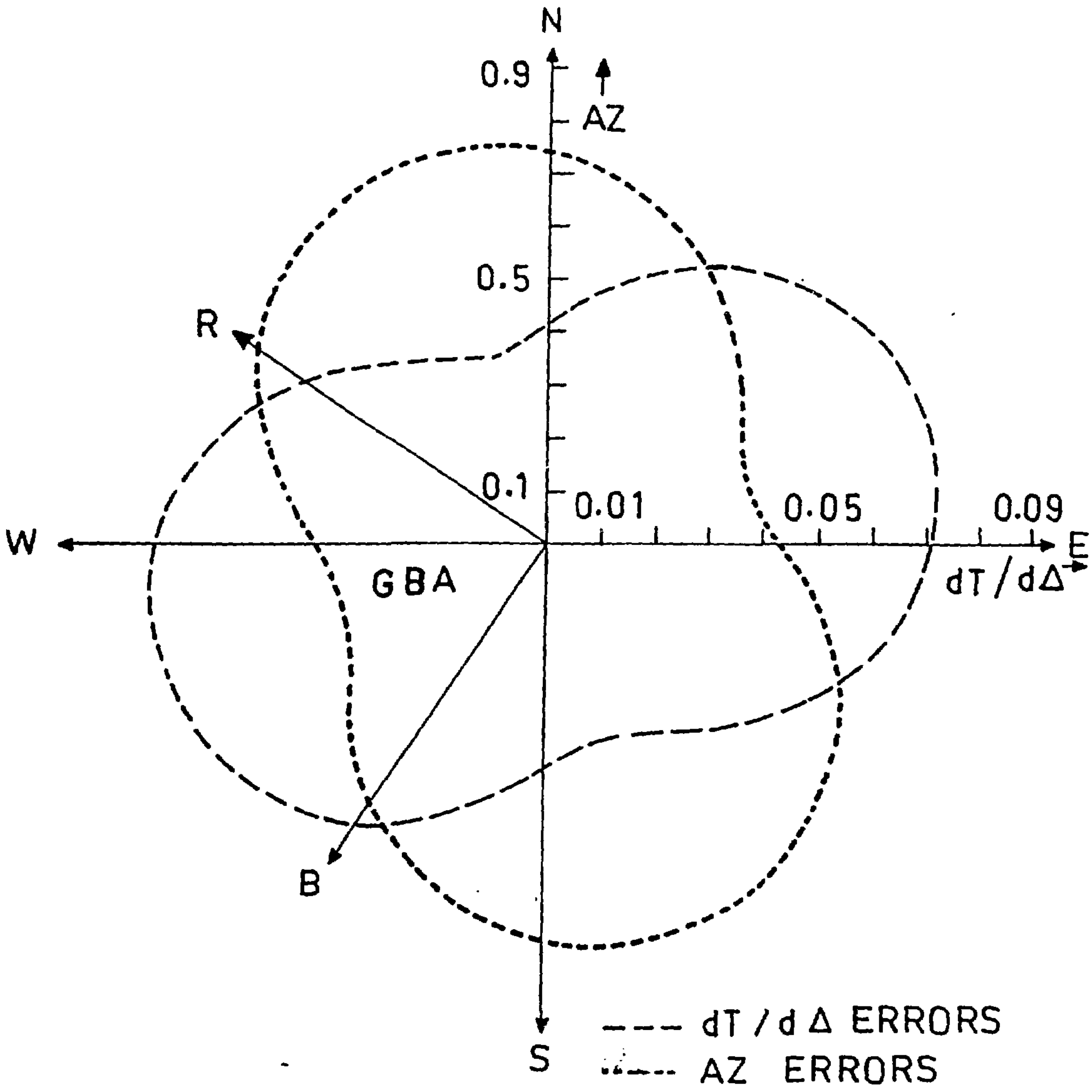

Fig.2 : Illustration of the errors in the estimated values of dT/dΔ (inverse of the apparent velocity of the signal across the array) and the backbearing

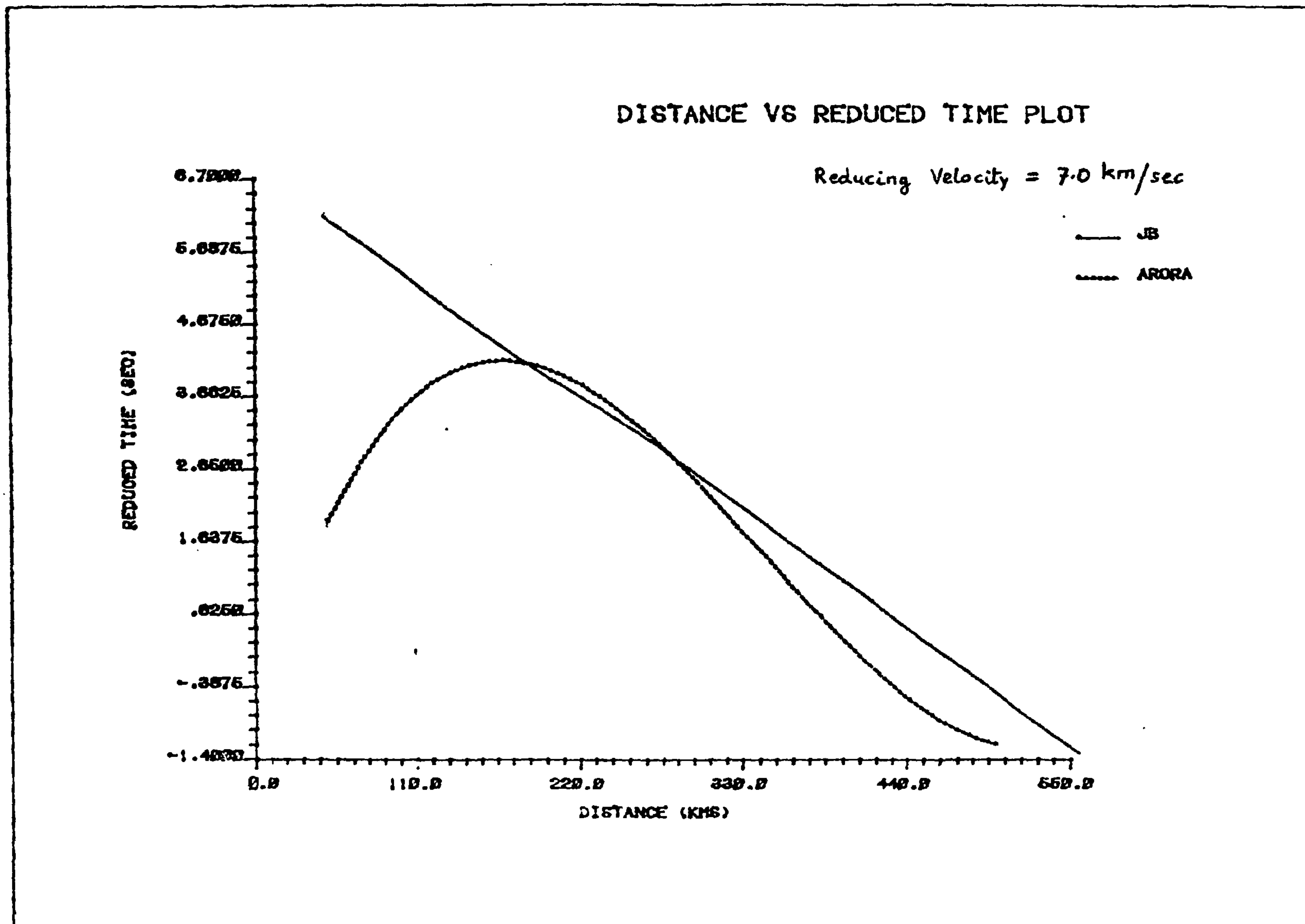

Fig.3 : Comparison of the travel-times (Arora, 1977) used in this report with those of the J-B model.