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A METHOD OF ESTIMATING MAGNITUDE OF LOCAL EARTHQUAKES FROM SIGNAL DURATION*

by

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ABSTRACT

Richter magnitude of local earthquakes may be conveniently estimated from signal duration using an empirical formula:

$$\hat{M} = -0.87 + 2.00 \log(\tau) + 0.0035 \Delta$$

where $\hat{M}$ is an estimate of Richter magnitude, τ, signal duration in seconds, and Δ, epicentral distance in kilometers. This magnitude scale was established by analyzing the relation between Richter magnitude, signal duration, and epicentral distance for 351 earthquakes in central California.

INTRODUCTION

An instrumental magnitude scale for local earthquakes was originally proposed by Richter (1935) and subsequently extended for teleseisms by Gutenberg and Richter (see Richter, 1958, p. 345-352). Richter's local magnitude is given by

$$M = \log A - \log A_o \qquad (1)$$

where A is the maximum recorded trace amplitude for a given earthquake at a given distance as written by a Wood-Anderson torsion seismometer, and A_o is that for a particular earthquake selected as standard (Richter, 1958, p. 340). A table of " $-\log A_o$ " as a function of epicenter distance was also provided by Richter to facilitate computation.

Because of low magnification, the Wood-Anderson seismometers seldom give useful records for earthquakes with magnitude less than 2. In recent years, they have been replaced by more sensitive instruments in local seismograph networks. Consequently, we need a convenient method for estimating Richter magnitude of local earthquakes recorded by modern seismographs.

One approach (e.g. Eaton, O'Neill and Murdock, 1970) is to calculate the actual ground motion from the recorded maximum amplitude, and from this calculation, the expected response of the Wood-Anderson seismometer may be computed. As Richter (1958, p. 345) has pointed out, the maximum amplitude on the Wood-Anderson record may not correspond to the wave with maximum amplitude on a different instrument's record. It is also difficult to calibrate and maintain the seismic system so that the actual ground motion may be calculated.

Since 1967, the National Center for Earthquake Research (NCER) of the U.S. Geological Survey has gradually built up a dense telemetered seismographic network in central California to study microearthquakes in detail. Each station is equipped with a high-gain (about 10^6) vertical-component seismometer (Mark Products L-4C, 1 Hz) and a preamplifier and voltage-controlled oscillator (Develco, Model 6202). The seismic signal is telemetered continuously to Menlo Park and is recorded on 16-mm film (Develocorder by Teledyne Geotech). Sixteen stations are usually recorded on one film to save recording cost. For data processing, the film is projected on a Geotech film viewer (model 6585) so that 1 cm = 1 sec, and trace spacing between stations is about 1 cm. Because of high gain and closely spaced traces, maximum amplitudes can not be read from more than about 20 percent of the recorded stations. Consequently, it is not convenient to determine magnitude using amplitude data in the traditional way.

Bisztricsany (1958) proposed a new method of determining earthquake magnitudes using the duration of the surface wave. Unlike amplitudes, which change rapidly with distance, the duration of the surface wave remains remarkably constant with distance within the interval of 4 to 160 degrees. From seismograms recorded at Budapest, Prague, and Warsaw, Bisztricsany (1958, p. 81) suggested that

$$M = 2.92 + 2.25 \log(t) - 0.001 \Delta° \qquad (2)$$

where M is magnitude (mainly in the range of 5 to 8, t, the duration of the surface wave, and Δ°, epicentral distance in degrees.

Solov'ev (1964) applied this technique in the study of seismicity of Sakhalin Island, USSR, but used the total duration instead of the duration of the surface wave. Tsumura (1967) studied in detail the determination of earthquake magnitude from the total duration of oscillation in seconds, "F-P", for local earthquakes recorded by the Wakayama microearthquake network in Japan. An empirical formula

$$M = -2.53 + 2.85 \log(F-P) + 0.0014 \Delta \qquad (3)$$

was derived using magnitudes (3 to 5) determined by the Japan Meteorological Agency; Δ is epicentral distance in kilometers.

In this paper, we have established an empirical formula for estimating Richter magnitude of local earthquakes, using signal duration for the NCER microearthquake network in central California. A total of 351 earthquakes were used; their magnitudes (0 to 5) were based either on Wood-Anderson records or on their computed equivalents.

EARTHQUAKE DATA

The earthquake data used in this paper consist of two groups. In the first group, the Richter magnitude was determined from the Wood-Anderson records. From January 1, 1969 to March 31, 1971, about 4,000 earthquakes were located by the NCER microearthquake network in central California. About 500 earthquakes were selected on the basis of whether a readable amplitude was expected at one or more of the three Wood-Anderson stations in central California: BKS and MHC operated by the University of California, and PAC operated jointly by Stanford University and NCER (see Figure 1).

Of the 500 selected earthquakes, we obtained magnitudes (computed according to Richter, 1958, p. 342-344) for 333 events. Because the maximum amplitude of Wood-Anderson records is small for earthquakes of magnitude less than 2, we arbitrarily deleted all earthquakes of magnitude less than 1.75. As a result only 259 earthquakes in the first group were used in the final analysis.

In the second group of the earthquake data, the Richter magnitude was estimated from records obtained by the NCER portable seismograph units. From January 6 to March 5, 1970, 18 portable seismographs were installed along the Sargent fault (see Figure 1) for a 'saturation' recording experiment. From several hundred earthquakes recorded, we selected 92 events that have magnitudes determined from amplitudes recorded on 6 or more portable seismographs. Most of the magnitudes of the selected events range from 0 to 2, where Wood-Anderson records are usually not readable. The method of estimating Richter magnitude from the NCER portable seismograph units has been described in detail by Eaton, O'Neill and Murdock (1970, p. 1160-1162).

A list of the 351 earthquakes used in this paper is given in Table 1, and their locations are plotted on Figure 1. Signal durations for these earthquakes were measured on all possible NCER telemetered stations, and their average and standard deviation are also listed in Table 1. Signal duration, τ, is defined rather arbitrarily as the duration time in seconds from the onset of the first P-arrival to the point where the trace amplitude (peak-to-peak) falls below 1 cm as it appears on a Geotech film viewer (Model 6585). This practice insures that measurements of signal durations can be repeated by different observers, and the values usually do not differ by more than a few seconds if the total signal durations were measured. Telemetered stations with unusually high or low gain were avoided in reading the signal duration.

Figure 2 is a record of an earthquake that occurred south of Livermore, California at 8:02, November 13, 1971. The first two traces and the last trace are for timing purposes. Each of the remaining 16 traces is the record of an individual seismograph station. Code names for the seismograph stations are shown on each seismic trace. The epicentral distances, Δ, range from 6 to 56 km. All stations (except CAL and PAL where slightly different instruments are used) are equipped with identical instruments, and are adjusted according to the background noise level by different attenuation settings (normally 36 to 48 db). The sensitivity factor, C, for each station is also given at the right side of each trace. For example, C = 10 corresponds to a peak magnification of 3.3×10^6 at 15 Hz. Signal durations, τ, were measured at 10 of the 16 stations and are indicated on Figure 2. Stations where signal durations were not measured either had some instrumentation defects or registered low overall amplitudes.

Figure 2 shows that the signal duration does not critically depend on either epicentral distance or sensitivity of the instrument. Seismic phases are poorly separated, and the coda length (and hence signal duration) probably depends mainly on the back-scattering of seismic waves (Aki, 1969). Generally, such waves diminish slowly in amplitude as distance increases. Sensitivity of the instrument is also not a critical factor for signal duration because stations are adjusted according to the background noise level. Such adjustment compensates for the effects of local site conditions. For example, stations on poorly consolidated sediments record higher ground motion, but are set with a lower instrumental gain because they also record a higher level of background noise.

DATA ANALYSIS

There are several ways to derive an empirical relation between Richter magnitude, signal duration, epicentral distance, and instrument sensitivity. As discussed above, we will ignore instrument sensitivity because it is not a critical factor; most of our instruments are identical and are set against the background noise level.

One approach taken by Lee, Eaton, and Brabb (1971) is to find the relation between signal duration and epicentral distance first. Figure 3 is an unpublished diagram used by them. Signal durations of 8 selected earthquakes are plotted against epicentral distances. Each earthquake is represented by a different symbol, and these 8 earthquakes may be divided into 3 groups. Straight lines are fitted by eye through the data, indicating that the signal duration at 0 km epicentral distance (τ_o) is related to the signal duration at Δ km (τ_Δ) by

$$\log(\tau_o) = \log(\tau_\Delta) + 1.5 \times 10^{-3} \Delta \qquad (4)$$

The magnitude is then fitted as a function of signal duration at 0 km, and the following equation is obtained:

$$M(\tau_o) = -1.2 + 2.2 \log(\tau_o) \qquad (5)$$

Using equation (4), one may derive the magnitude at Δ km as

$$M(\tau_\Delta) = -1.2 + 2.2 \log(\tau_\Delta) + 0.0033 \Delta \qquad (6)$$

A different and simpler procedure is taken in this paper to derive the relation between Richter magnitude, signal duration, and epicentral distance. For a given earthquake, its Richter magnitude is defined as the average of magnitudes ($\bar{M}$) computed at various stations. Similarly, we may take the average signal duration ($\bar{\tau}$) at various stations and its corresponding average epicentral distance ($\bar{\Delta}$). We may then determine the coefficients (a, b, and c) in the following equation:

$$\bar{M} = a + b \log(\bar{\tau}) + c \bar{\Delta}$$

from a set of earthquake data ($\bar{M}_i$, $\bar{\tau}_i$, $\bar{\Delta}_i$, $i = 1, 2, \ldots, n$, where n is the total number of earthquakes studied). This procedure involves the approximation:

$$\frac{1}{n} \sum_i \log(\tau_i) \approx \log \left[\sum_i \tau_i / n\right] \tag{8}$$

which is valid if the τ_i's have similar values as in our case. By averaging, one greatly reduces both the number of data to be analyzed and the scatterings in the data. Once equation (7) is determined, it is obvious that if equation (7) applies to the average signal duration and the average epicentral distance, it also applies to the individual signal duration and epicentral distance at various stations, i.e.:

$$M = a + b \log(\tau) + c \Delta \tag{9}$$

Hence one may compute the magnitude at various stations by equation (9), and take the average as the magnitude of the earthquake.

Table 1 summarizes the data used in the analysis. Each earthquake is specified by the origin time, latitude and longitude of the epicenter, and focal depth. The magnitude data are given in three columns: number of stations used in computing the Richter magnitude (NM), average station magnitude (MAG) and its standard deviation (MSD). The signal duration data are given in five columns: number of stations at which signal duration was read (NS), average epicentral distance (DELTA) and its standard deviation (DSD) in kilometers, average signal duration (TAU) and its standard deviation (TSD) in seconds.

Figure 4 is a plot of Richter magnitude (M) versus average signal duration ($\bar{\tau}$) in log scale. A strong linear trend is evident from this plot. A quantitative analysis of the data listed in Table 1 was made using stepwise multiple regression analysis (Draper and Smith, 1966). The stepwise procedure is preferred over ordinary multiple regression analysis because it allows a step by step inclusion and exclusion of independent variables to be fitted to the data. It is considered to be the best practical method of finding linear relation between the dependent and independent variables. In our case, the dependent variable is Richter magnitude (M), and the independent variables are average signal duration ($\bar{\tau}$) and average epicentral distance ($\bar{\Delta}$):

$$M = M(\log\bar{\tau}, \bar{\Delta}) \tag{10}$$

Since detailed computation procedure for stepwise multiple regression analysis has been given by Draper and Smith (1966, p. 178-195), we will simply report the results here. Among the two variables ($\log\bar{\tau}$, and $\bar{\Delta}$), $\log\bar{\tau}$ is far more significant in the regression. The fit of

$$M(\log\bar{\tau}) = -0.90 + 2.12\ (\pm 0.03)\ \log(\bar{\tau}) \tag{11}$$

will account for 92.8 percent of the variance about the regression. Similarly, the fit

$$M(\log\bar{\tau}, \bar{\Delta}) = -0.87 + 2.00\ (\pm 0.04)\ \log(\bar{\tau}) + 0.0035\ (\pm 0.0006)\ \bar{\Delta} \tag{12}$$

will account for 93.4 percent of the variance about the regression.

As mentioned above, equation (12) also applies to $M(\log\tau, \Delta)$ at any individual station where the signal duration is τ and the epicentral distance is Δ. The passage from averages ($\bar{\tau}$ and $\bar{\Delta}$) to individual values (τ and Δ) is simply the limiting case when only one individual value is available for the average. Alternatively, one may compute the average signal duration and its corresponding average epicentral distance first, and calculate the magnitude using equation (12). However, this approach differs from the traditional method of computing magnitudes at various stations and then taking the average as the magnitude of the earthquake.

DISCUSSION

Results of the above analysis permit us to estimate Richter magnitude of local earthquakes at individual stations by

$$\hat{M} = -0.87 + 2.00 \log(\tau) + 0.0035 \Delta \qquad (13$$

where τ is signal duration in seconds, and Δ is epicentral distance in kilometers. Equation (13) is very similar to the one used by Lee, Eaton, and Brabb (1971) in computing the F-magnitude for the Danville earthquake sequence:

$$\text{FMAG} = -1.2 + 2.2 \log(\tau) + 0.0033 \Delta \qquad (14$$

Coefficients in equation (13) differ from Tsumura's result (equation 3) because of different instrumentation. Since the coefficient of the epicen[tral] distance term in equation (13) is small, one may ignore it. A final check on equation (13) was made by comparing the observed Richter magnitude (M) [ver]sus the estimated Richter magnitude ($\hat{M}$) for the data listed in Table 1. This [plot], which is shown in Figure 5, indicates a good fit. The standard deviation [of] $\hat{M}$ from M for 351 earthquakes is

$$\sigma = \sqrt{\sum_i (M - \hat{M})_i^2 \Big/ 351} \qquad (15$$

$$= 0.22$$

As originally proposed by Richter (1935), magnitude of local earthqu[akes] is used to segregate large, moderate, and small shocks. Therefore, precis[ion] was neither expected nor required. In this paper, we have established a convenient method of estimating the Richter magnitude of local earthquakes from signal duration. Our experience indicated that the Richter magnitude [c]an be estimated to about ± 1/4 unit using this method. Since the empirical [form]ula relating signal duration to Richter magnitude depends on the type of instruments used and perhaps on the geographical location of the network, similar analysis must first be made if one wishes to apply this method elsewhere employing different instruments.

It must be emphasized that the results in this report are preliminary. Figures 4 and 5 indicate more data above magnitude 3.5 are needed to verify that the relation between magnitude and signal duration can be extended to larger earthquakes. No adequate theory exists to account for the observations, although theories based on scattering of seismic waves (e.g. Aki, 1969; Wesley, 1965) seem promising.

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FIGURE CAPTIONS

Figure 1. Index map showing location of earthquakes and of stations used in this paper.

Figure 2. An example of an earthquake recorded by the NCER microearthquake network in central California. Each seismic trace corresponds to a station coded at the left. Δ means epicentral distance; τ, signal duration; and C, sensitivity factor of the instruments.

Figure 3. Signal duration versus epicentral distance for 8 selected earthquakes. Each earthquake is represented by a different symbol.

Figure 4. Richter magnitude versus average signal duration. Symbol x denotes that magnitude was based on Wood-Anderson records, and symbol + denotes that magnitude was based on portable seismograph records.

Figure 5. Observed Richter magnitude versus estimated Richter magnitude computed by equation (13). Symbols same as Figure 4.

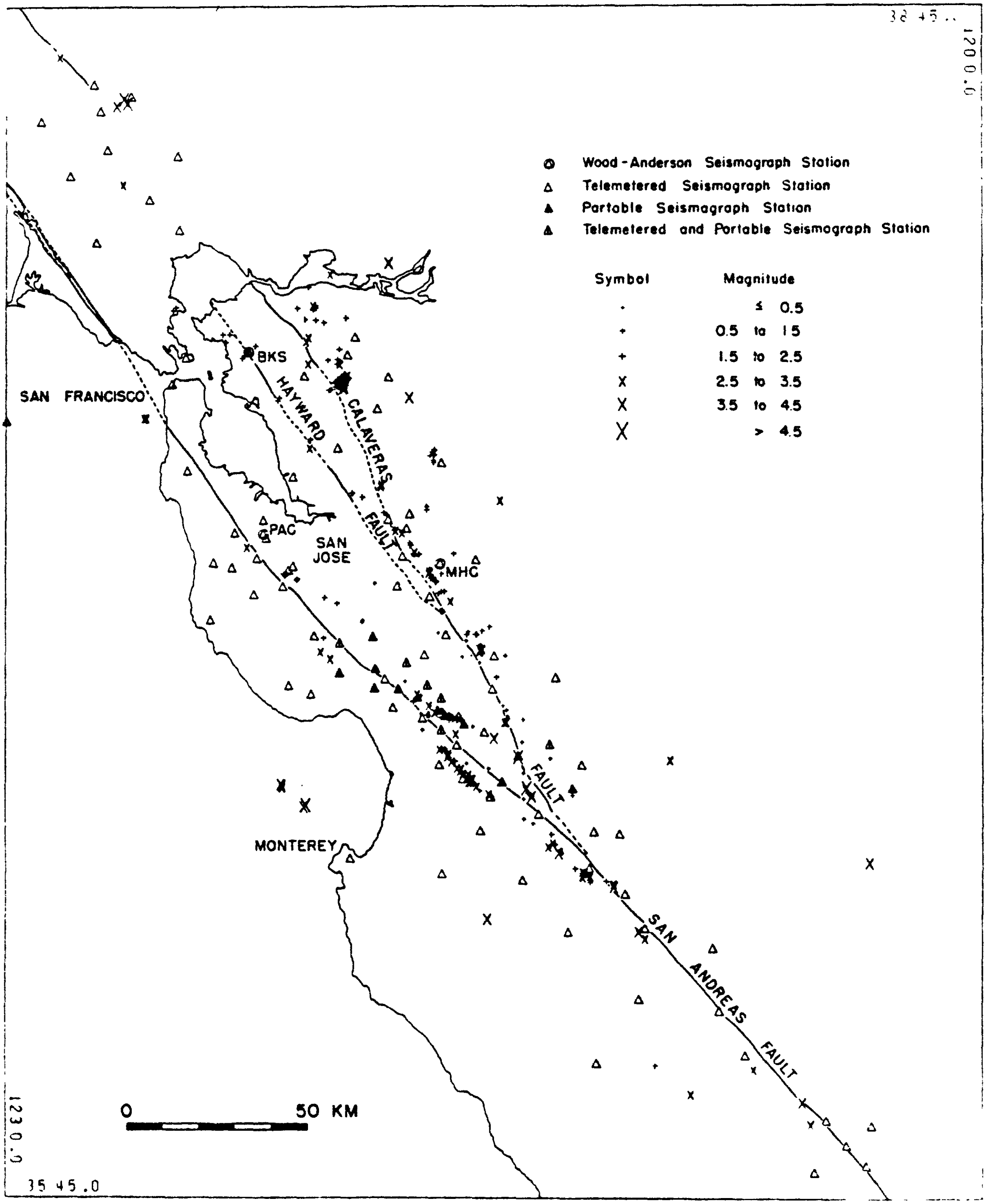

38 45.
120 0.0
Wood-Anderson Seismograph Station
Telemetered Seismograph Station
Portable Seismograph Station
Telemetered and Portable Seismograph Station
Symbol
Magnitude
≤ 0.5
0.5 to 1.5
1.5 to 2.5
2.5 to 3.5
3.5 to 4.5
> 4.5
BKS
SAN FRANCISCO
HAYWARD
CALAVERAS
FAULT
PAC
SAN JOSE
MHC
FAULT
MONTEREY
SAN ANDREAS
FAULT
0
50 KM
123 0.0
35 45.0

Figure 1

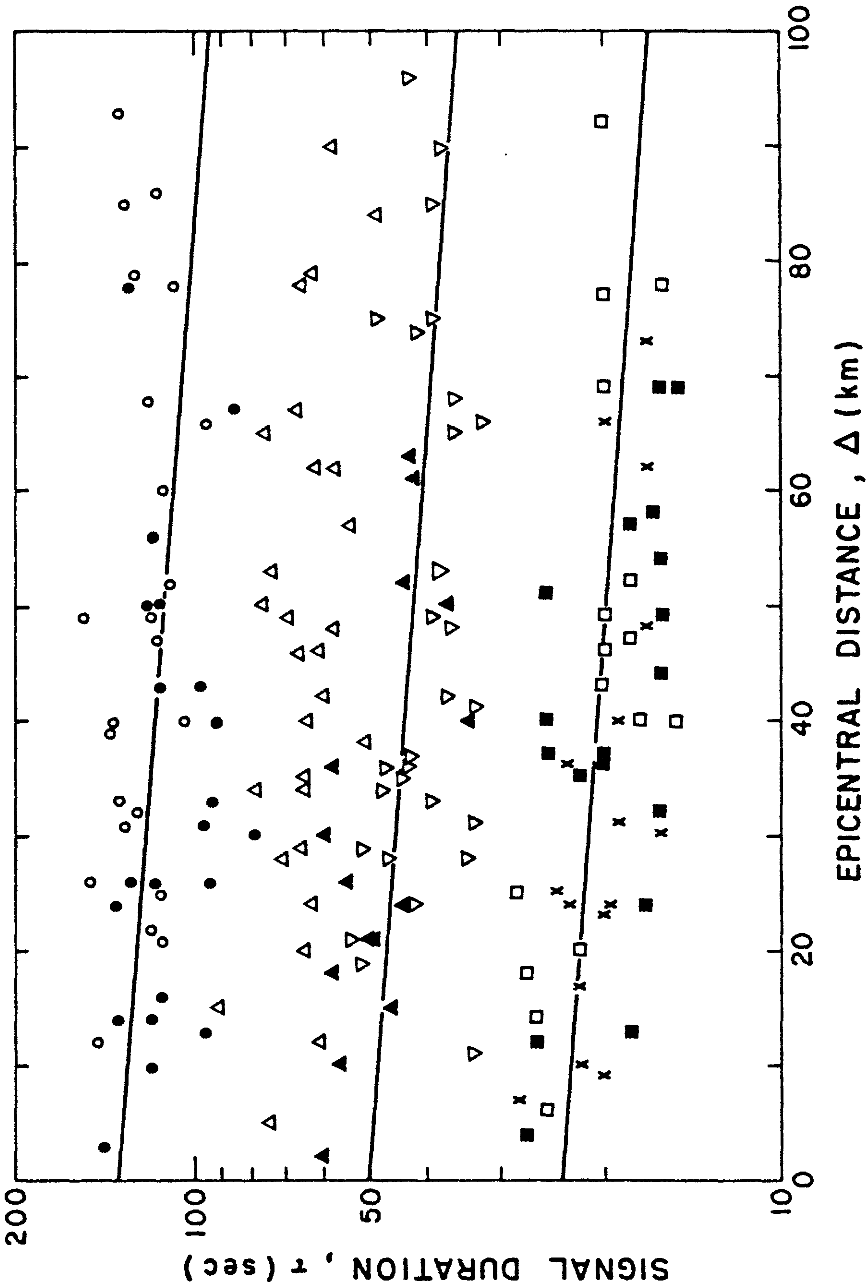

SIGNAL DURATION, τ (sec)
200
100
50
10
EPICENTRAL DISTANCE, Δ (km)
0
20
40
60
80
100

Figure 3

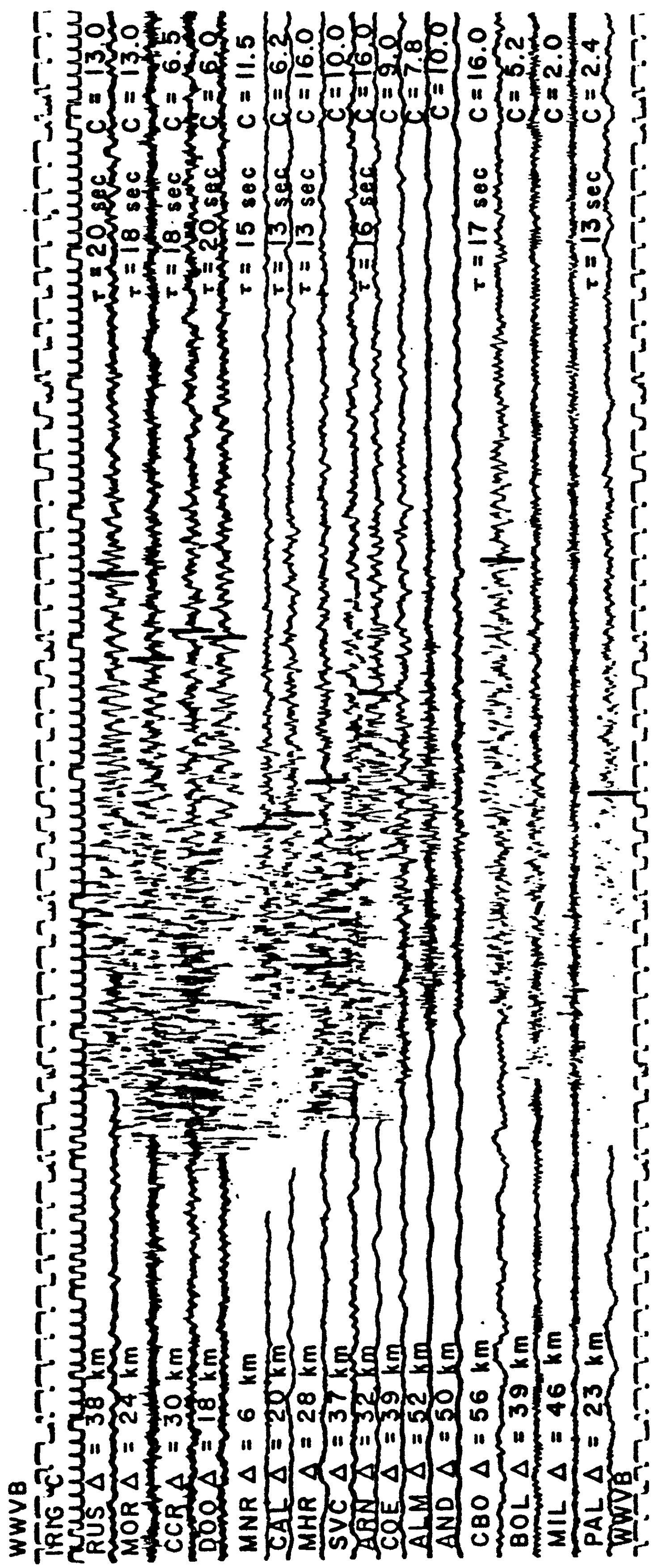
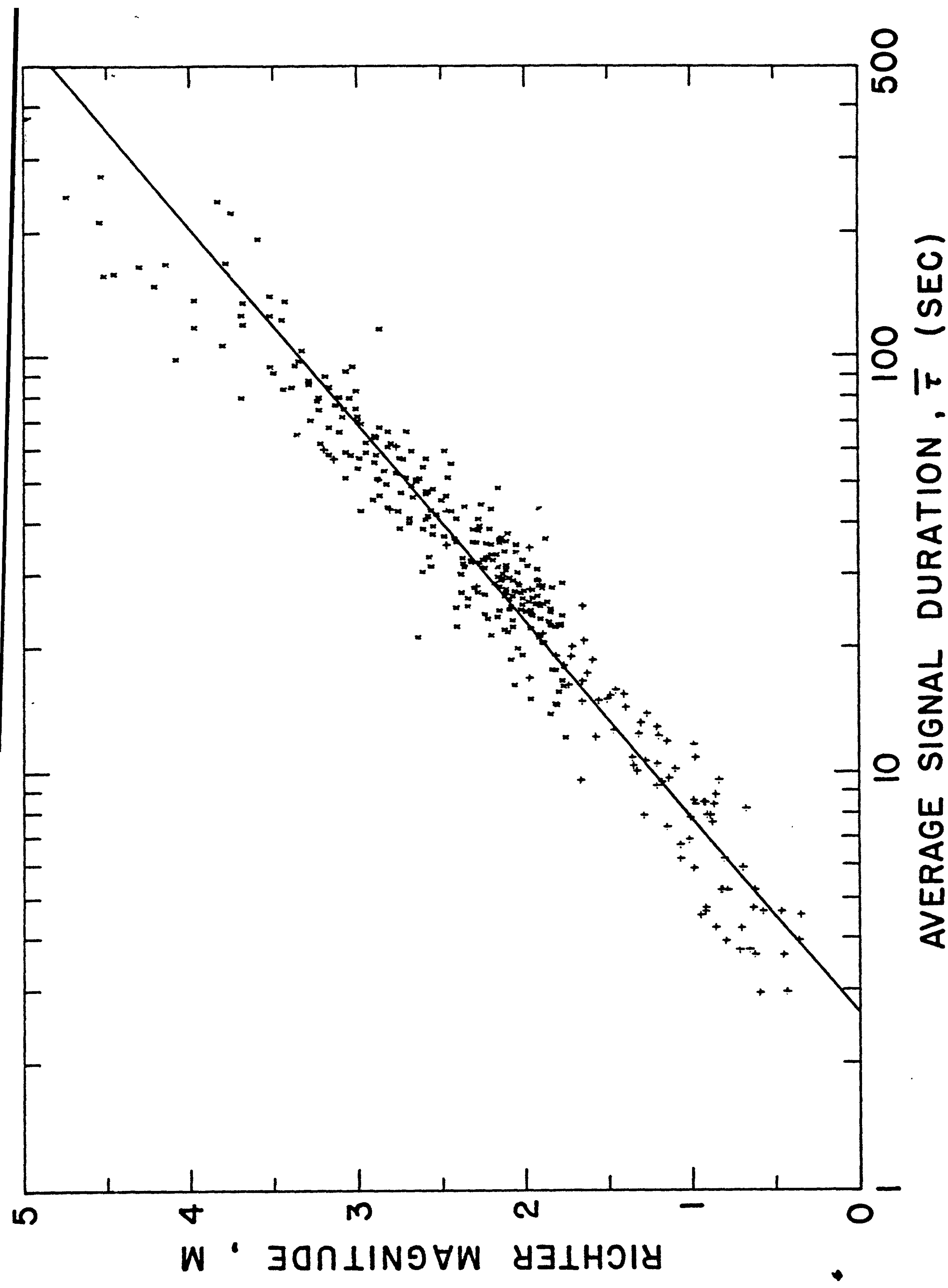
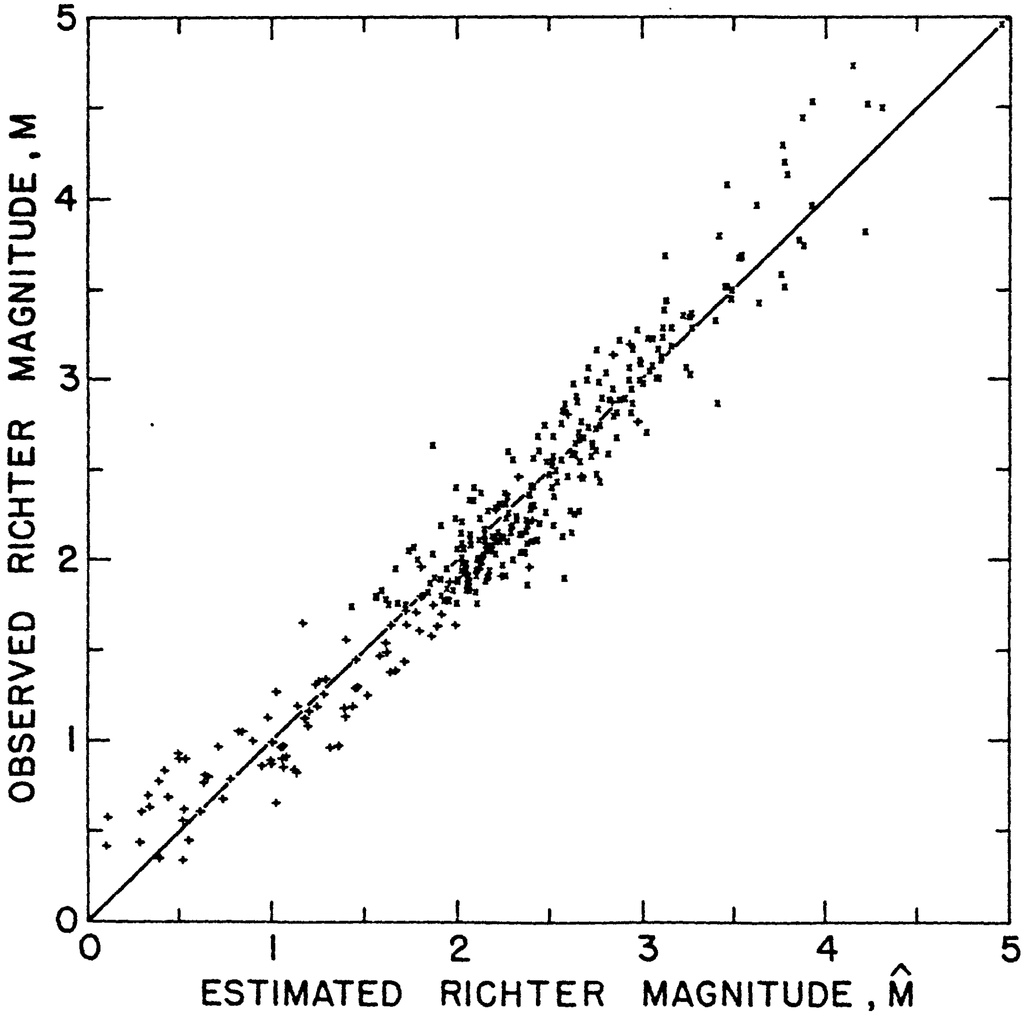

WWVB
IRIG 'C'
RUS Δ = 38 km τ = 20 sec C = 13.0
MOR Δ = 24 km τ = 18 sec C = 13.0
CCR Δ = 30 km τ = 18 sec C = 6.5
DOO Δ = 18 km τ = 20 sec C = 6.0
MNR Δ = 6 km τ = 15 sec C = 11.5
CAL Δ = 20 km τ = 13 sec C = 6.2
MHR Δ = 28 km τ = 13 sec C = 16.0
SVC Δ = 37 km C = 10.0
ARN Δ = 32 km τ = 16 sec C = 16.0
COE Δ = 39 km C = 9.0
ALM Δ = 52 km C = 7.8
AND Δ = 50 km C = 10.0
CBO Δ = 56 km τ = 17 sec C = 16.0
BOL Δ = 39 km C = 5.2
MIL Δ = 46 km C = 2.0
PAL Δ = 23 km τ = 13 sec C = 2.4
WWVB

Figure 2



AVERAGE SIGNAL DURATION, τ̄ (SEC)
1
10
100
500
RICHTER MAGNITUDE, M
0
1
2
3
4
5

Figure 4



OBSERVED RICHTER MAGNITUDE, M
ESTIMATED RICHTER MAGNITUDE, M̂
0
1
2
3
4
5

Figure 5

TABLE 1

List of Data Used in the Final Analysis

For each earthquake, the following data are given:

1. Origin time in Greenwich Civil Time: DATE (first two digits for year, e.g. 69 means 1969; the next two digits for month, e.g. 09 means September; and the last two digits for day), HRMN (first two digits for hour, and the last two digits for minute), and SEC (second).
2. Epicenter in LAT N (northern latitude in degrees and minutes), and in LONG W (western longitude in degrees and minutes).
3. Focal depth in kilometers (DEPTH).
4. Quality of hypocenter location (Q), where A = excellent, B = good, C = fair, and D = poor.
5. Number of station-magnitudes (NM).
6. Average of station-magnitudes (MAG).
7. Standard deviation of station-magnitudes (MSD).
8. Number of stations in which signal duration was measured (NS).
9. Average epicentral distance in kilometers to station where signal duration was measured (DELTA).
10. Standard deviation of epicentral distance in kilometers (DSD).
11. Average signal duration in seconds (TAU).
12. Standard deviation of signal duration in seconds (TSD).

DATE	HRMN	SEC	LAT N	LONG W	DEPTH	Q	NM	MAG	MSD	NS	DELTA	DSD	TAU	TSD
690108	2113	25.9	37-52.9	122-14.7	9.2	C	1	2.14		22	86.9	36	37.2	5
690109	942	47.3	35-59.5	120-32.9	13.7	C	2	3.78	0.05	8	73.3	56	171.1	26
690303	1615	44.1	37-53.0	121-57.4	11.4	C	1	2.48		12	64.1	16	37.4	6
690304	2054	26.3	37-53.6	122-13.0	5.0	D	1	2.12		9	71.2	16	22.3	5
690313	323	22.7	38- 6.0	121-48.4	11.6	C	2	3.52	0.30	14	103.3	21	96.2	16
690314	2313	27.5	37-27.2	121-47.1	3.2	B	1	1.65		11	40.7	26	29.1	5
690320	1716	13.2	37- 9.8	121-33.8	5.0	C	1	2.03		10	29.9	7	28.5	6
690414	422	36.3	37-52.7	122-14.5	10.0	B	1	2.58		13	67.5	23	47.9	7
690423	2347	25.5	37-22.3	121-43.3	0.1	C	2	3.19	0.14	9	30.7	15	91.2	19
690428	2102	56.5	37-35.8	121-39.8	5.0	C	1	2.27		15	37.7	16	32.3	6
690430	551	23.9	37-51.4	121-59.5	5.0	D	1	2.09		12	52.4	14	26.4	3
690512	2334	55.0	37-16.5	121-37.9	1.2	B	1	2.07		8	49.8	7	26.9	4
690520	2210	24.8	37-16.1	121-38.9	2.8	C	1	2.00		9	35.5	20	27.7	6
690523	1738	48.1	37- 0.8	121-42.8	10.6	B	2	3.23	0.17	8	31.9	24	81.0	19
690524	1241	44.9	36-59.1	121-40.6	7.8	A	1	3.00		10	22.4	13	72.8	10
690525	2231	28.2	37-54.2	122- 3.5	5.0	C	2	2.95	0.04	6	74.9	12	59.7	8
690527	1337	39.1	36-33.3	121-11.3	0.0	C	1	3.29		4	68.5	20	89.0	5
690530	926	29.1	37-54.8	122- 3.1	5.0	D	1	2.57		6	68.6	24	33.3	2
690604	1210	18.6	37-19.4	121-40.5	5.0	B	1	2.69		10	44.8	9	41.4	8
690720	1703	33.7	37-45.2	122- 8.7	5.0	D	1	2.37		14	62.8	28	33.1	4
690809	1018	29.1	37-19.6	121-40.4	6.0	B	1	2.34		12	43.6	15	25.4	6
690809	1020	20.2	37-19.7	121-40.4	5.1	B	1	2.42		11	38.8	18	36.9	7
690818	1515	19.6	37-23.4	121-44.0	2.2	B	1	2.36		10	42.1	25	31.5	4
690907	1632	24.1	37-30.0	121-27.7	0.0	D	1	2.65		10	51.2	18	51.3	13
690912	1202	44.9	37-59.7	122- 1.9	7.5	C	1	1.89		12	68.7	19	20.8	3
691002	514	25.3	38-17.9	122-38.1	10.0	D	1	3.36		5	130.1	43	66.0	9
691002	619	56.7	38-30.3	122-37.3	5.0	C	1	4.97		10	191.1	64	380.7	16
691002	1227	5.4	38-30.9	122-38.1	5.0	C	1	4.51		11	219.9	67	159.6	15
691005	654	54.5	37-50.7	122- 3.1	7.1	C	1	2.59		10	79.7	34	41.0	9
691006	1428	6.8	38-29.8	122-39.3	7.2	C	1	3.97		7	144.4	45	138.9	29
691020	1838	50.1	37-19.1	121-38.4	1.9	B	1	2.41		11	46.1	20	25.2	2
691027	1059	42.7	36-46.7	121-22.9	11.5	B	2	4.53	0.04	6	61.2	28	276.3	23
691106	1216	15.6	37-55.3	122-19.2	0.0	D	1	1.96		10	61.0	21	24.3	2
691110	1650	53.1	37-22.1	121-43.6	7.9	B	1	2.16		12	39.9	18	23.9	5
691115	2058	3.2	36-45.4	121-22.0	11.3	B	2	4.14	0.03	11	56.8	38	169.5	15
691117	2049	19.4	36-24.9	121- 2.6	11.8	C	2	4.30	0.05	5	51.7	18	167.8	18
691119	628	50.3	36-26.9	121-30.0	5.0	C	2	4.21	0.07	8	82.0	45	150.4	15
691207	1154	41.2	36-56.6	121-26.6	0.3	C	1	3.39		11	34.9	21	85.6	11
691215	31	33.0	37- 8.2	121-31.6	0.0	C	1	2.44		9	41.8	20	55.9	8
691216	909	42.4	36-56.6	121-26.9	5.0	B	1	3.08		13	46.6	29	76.0	14
691222	303	26.3	37-50.6	121-57.3	8.1	B	2	3.07	0.32	13	70.4	26	59.8	5
691227	1130	12.5	37-22.0	121-43.3	5.0	B	1	2.38		12	48.0	13	30.3	4
691229	1931	11.5	37-45.6	121-44.4	9.1	C	1	3.80		12	62.0	30	108.4	13
700101	2057	47.6	36-46.5	121-23.1	10.0	B	1	3.37		24	46.5	34	96.8	21
700104	2313	0.6	37- 7.6	121-30.9	5.0	C	2	3.13	0.25	11	55.2	32	77.6	14
700105	346	51.9	37-51.1	121-57.3	7.1	B	1	2.12		15	67.3	29	34.3	3
700105	1731	11.7	37-32.5	121-49.4	0.3	C	2	3.24	0.20	17	52.0	22	79.5	6
700106	229	7.4	36-31.7	121- 7.0	10.0	B	2	3.97	0.08	26	96.3	45	119.5	23
700106	834	54.6	37-32.1	121-49.4	0.0	C	2	2.84	0.11	22	48.4	21	53.8	6
700111	1205	4.4	37-28.2	121-48.9	5.0	A	1	1.91		25	48.5	13	43.6	12
700122	1358	7.0	37-57.5	122- 1.8	10.4	C	1	2.28		34	88.0	28	38.6	7
700131	23	6.7	37-45.6	122- 8.5	7.2	B	1	2.28		22	86.0	29	41.1	11
700212	1749	19.6	37-28.6	121-41.1	0.0	C	1	2.06		21	48.1	23	27.6	7
700214	31	58.9	36-52.5	121-38.7	5.0	B	2	3.01	0.17	27	31.9	20	83.8	18
700219	1746	32.1	37-29.1	121-41.1	2.1	C	1	2.17		24	53.2	23	33.8	9
700228	10	22.0	37-44.3	122- 7.7	5.0	C	1	1.73		16	47.5	20	22.4	5
700228	204	59.4	37-48.0	121-56.8	0.0	C	2	2.71	0.09	20	68.2	31	67.0	16
700301	1459	31.2	37-44.5	122- 9.4	0.0	C	1	1.54		8	32.9	15	16.1	3
700307	1412	15.9	37-14.8	121-36.8	1.4	B	2	2.76	0.17	24	48.3	31	43.0	6
700327	656	53.5	36-49.1	121-35.1	6.8	B	2	3.17	0.14	11	25.9	16	85.8	12

DATE	HRMN	SEC	LAT N	LONG W	DEPTH	Q	NM	MAG	MSD	NS	DELTA	DSD	TAU	TSD
700327	1608	12.1	36-48.9	121-34.5	5.0	B	2	3.05	0.13	11	27.2	18	80.6	11
700328	1631	43.4	37-57.6	122- 3.8	5.0	D	1	2.07		7	58.3	26	22.6	2
700330	1328	45.4	37-19.1	121-40.7	5.0	B	2	2.75	0.11	16	46.7	32	39.0	6
700331	502	6.2	36-51.9	121-37.1	5.0	B	1	3.11		3	44.6	37	81.0	16
700331	702	28.4	36-51.4	121-24.5	11.9	B	1	4.54		20	37.2	21	214.8	30
700409	140	56.6	37-23.7	121-44.2	1.9	B	1	1.79		17	30.1	14	22.9	5
700423	1245	35.3	37-54.1	122-18.7	0.0	D	1	2.06		8	52.7	18	16.4	3
700424	958	35.5	37-18.5	121-40.1	0.0	B	1	2.41		25	45.1	24	22.7	4
700428	1949	27.3	37-51.7	122-15.1	7.8	B	1	1.50		6	34.2	13	16.7	3
700508	1059	56.6	36-35.4	120-20.4	7.8	D	1	3.52		13	96.0	19	142.1	16
700508	1859	3.2	37-59.5	122-27.9	0.0	D	1	1.81		6	53.0	22	17.8	3
700516	941	50.0	37-25.2	121-45.6	3.7	B	1	2.58		37	42.5	16	41.8	16
700522	29	14.8	37-48.4	121-57.0	5.0	B	1	1.95		10	35.6	15	26.6	5
700522	1039	57.3	37-48.4	121-56.5	5.0	B	1	2.41		13	44.1	22	41.2	9
700525	42	40.8	37-48.1	121-57.0	3.8	B	1	2.55		14	45.7	21	48.6	9
700525	813	32.1	37-48.4	121-56.9	5.0	B	1	2.46		9	34.3	16	51.8	12
700525	2026	34.9	37-48.0	121-56.9	5.0	B	1	2.20		8	32.9	16	33.8	8
700526	1647	8.6	37-48.5	121-57.0	5.0	B	1	2.05		9	37.8	18	35.6	9
700526	2210	23.1	37-48.1	121-56.8	3.8	B	1	2.87		8	37.2	16	118.3	13
700526	2219	54.6	37-48.3	121-57.0	5.0	B	1	2.41		11	47.4	15	36.2	5
700526	2306	43.3	37-48.4	121-56.6	5.0	B	2	2.63	0.01	21	51.2	20	51.6	14
700526	2333	40.0	37-47.9	121-57.2	3.8	B	1	3.68		9	63.6	16	121.3	18
700526	2340	33.1	37-47.9	121-56.4	6.2	B	1	2.18		8	30.4	13	28.8	6
700526	2358	27.5	37-48.0	121-56.5	5.0	B	1	1.91		7	37.1	15	28.4	3
700527	42	46.4	37-47.7	121-57.1	4.9	B	1	2.31		15	45.4	14	36.2	7
700527	1042	19.6	36- 0.6	120-53.2	5.0	C	2	3.50	0.12	15	119.6	45	92.8	14
700527	1943	29.7	36-51.4	121-37.3	8.0	B	2	3.04	0.17	15	39.1	26	58.7	13
700528	247	4.7	37-48.9	121-56.8	5.1	B	1	2.44		12	41.8	19	42.9	13
700528	623	32.6	37-48.2	121-56.7	5.8	B	1	1.89		12	34.9	18	28.4	7
700528	1901	21.0	37-56.4	122-25.9	0.0	D	1	1.66		8	56.5	21	19.0	3
700529	228	32.7	37-48.3	121-56.4	5.5	A	1	1.90		9	32.4	15	21.7	4
700529	253	7.5	37-48.2	121-57.0	4.4	A	2	3.11	0.15	7	59.7	14	66.7	6
700529	254	17.5	37-48.1	121-56.6	5.6	A	1	2.19		6	38.6	20	32.7	9
700529	255	48.7	37-48.2	121-56.9	5.1	A	2	3.33	0.05	10	63.7	40	105.2	7
700529	257	35.7	37-48.4	121-56.6	5.5	A	1	2.20		5	34.2	14	43.4	8
700529	311	32.9	37-48.5	121-56.4	5.4	A	1	2.11		10	40.4	15	31.8	5
700529	313	15.1	37-48.4	121-56.4	5.0	A	2	2.98	0.03	13	52.5	17	70.0	6
700529	316	49.9	37-48.4	121-56.1	5.4	A	1	2.12		5	39.6	12	26.8	2
700529	326	55.3	37-48.0	121-56.9	6.1	A	1	2.04		8	31.4	14	30.6	7
700529	633	21.0	37-48.0	121-56.8	6.1	A	1	2.11		9	39.0	15	27.9	5
700529	915	11.8	37-48.0	121-56.7	6.1	A	1	2.11		7	34.3	13	31.0	5
700529	921	58.7	37-48.1	121-56.7	6.0	A	1	1.96		8	38.4	16	24.8	4
700529	1206	49.6	37-48.2	121-56.6	5.8	A	1	2.16		11	41.7	15	29.8	5
700531	257	45.3	37-48.5	121-56.7	5.1	A	1	2.15		7	34.6	12	28.3	7
700601	449	37.2	37-48.1	121-56.8	5.0	A	1	2.24		8	41.3	24	31.4	7
700603	414	45.2	37-47.4	121-56.4	5.7	A	1	2.27		11	45.4	20	39.5	7
700605	849	60.0	37-47.9	121-56.8	6.0	A	1	1.99		9	40.9	25	24.6	6
700606	1603	36.8	37-16.4	121-38.4	5.1	B	1	2.01		22	39.6	23	26.5	5
700611	2332	55.2	37-47.6	121-56.7	5.0	B	2	3.03	0.17	14	46.8	17	96.0	16
700611	2339	48.9	37-47.5	121-56.8	5.0	B	2	2.87	0.02	11	41.4	15	68.5	10
700611	2344	53.8	37-47.1	121-56.4	5.0	B	1	2.16		13	47.9	22	31.5	7
700611	2345	48.9	37-47.3	121-56.4	6.2	B	1	2.01		8	48.3	27	25.6	2
700611	2346	52.9	37-48.1	121-56.5	5.8	B	1	1.86		6	32.1	13	26.0	5
700611	2348	34.7	37-47.3	121-56.5	5.0	B	1	2.68		13	47.0	20	49.6	8
700612	39	24.2	37-48.3	121-57.1	5.0	B	2	3.07	0.11	15	46.8	20	93.7	16
700612	210	57.9	37-48.6	121-56.2	5.0	B	1	2.07		10	37.3	18	29.2	7
700612	330	3.3	37-47.2	121-56.5	5.0	B	2	3.83	0.19	2	92.1	80	240.0	0
700612	330	18.1	37-47.0	121-56.6	5.0	B	2	3.75	0.10	1	12.8	0	225.0	0
700612	330	49.9	37-47.9	121-56.9	7.6	B	2	3.59	0.09	1	12.6	0	195.0	0
700612	333	47.8	37-47.1	121-56.5	5.0	B	2	2.48	0.03	3	19.7	7	60.0	14

DATE	HRMN	SEC	LAT N	LONG W	DEPTH	Q	NM	MAG	MSD	NS	DELTA	DSO	TAU	TSD
700612	357	48.8	37-47.2	121-56.3	5.6	B	1	2.59		9	41.9	23	48.0	8
700612	405	58.8	37-48.1	121-56.8	5.0	B	2	2.64	0.01	5	23.9	12	21.4	6
700612	634	0.7	37-46.9	121-56.4	5.5	B	2	3.00	0.14	13	44.7	17	70.9	15
700612	739	24.3	37-48.0	121-56.6	5.0	B	1	2.09		7	33.9	12	29.7	9
700612	838	48.8	37-47.7	121-56.3	5.0	B	1	1.84		10	41.2	17	25.0	5
700612	1037	19.0	37- 7.4	121-31.3	5.0	C	2	2.90	0.28	20	44.0	20	56.3	11
700612	1455	20.3	37-47.4	121-56.5	5.0	B	1	1.95		12	45.9	26	27.8	7
700612	1603	31.2	37-48.1	121-56.7	5.0	B	2	2.83	0.68	1	12.4	0	50.0	0
700612	1608	33.4	37-47.5	121-56.5	5.0	B	1	1.98		10	33.4	14	31.7	7
700612	1610	50.6	37-47.3	121-56.6	5.0	B	2	3.01	0.03	11	52.5	22	76.0	10
700612	1626	5.1	37-47.6	121-56.5	6.1	B	1	2.02		6	31.6	13	27.3	5
700612	1657	57.4	37-47.8	121-56.7	5.0	B	1	2.13		12	45.7	21	30.4	6
700612	1710	49.8	37-47.8	121-57.8	5.0	B	1	2.23		10	39.1	13	35.9	6
700612	1741	54.9	37-47.9	121-56.5	6.1	B	1	2.16		6	31.9	13	48.8	5
700612	1800	48.8	37-47.3	121-56.5	5.0	B	1	2.53		10	39.0	14	42.1	6
700612	1805	37.6	37-47.9	121-56.8	5.0	B	1	2.01		11	40.8	14	32.8	5
700612	1900	37.6	37-47.0	121-57.1	3.1	B	1	1.90		9	36.4	12	23.7	4
700612	2058	14.8	37-47.6	121-56.4	6.2	A	1	2.15		5	28.0	11	36.0	7
700612	2234	52.3	37-48.3	121-56.7	5.8	B	1	2.13		9	38.0	24	29.7	7
700612	2254	38.6	37-47.9	121-56.4	5.6	A	2	2.89	0.04	9	44.3	13	58.8	8
700613	650	1.8	37-47.4	121-56.4	5.6	A	1	1.92		9	32.5	14	25.8	6
700613	801	39.1	37-47.5	121-56.4	5.6	A	1	2.21		10	39.2	23	38.9	10
700614	138	23.0	37-46.9	121-56.9	6.7	A	1	1.88		9	31.2	13	25.7	6
700614	911	9.0	37-47.6	121-56.4	5.4	A	2	2.68	0.07	14	49.5	38	60.1	11
700614	918	9.5	37-47.8	121-56.4	5.0	A	2	2.82	0.06	13	45.1	17	67.0	7
700614	2108	0.4	37-48.4	121-56.3	5.0	A	1	2.23		12	43.1	23	33.2	8
700614	2324	20.1	37-47.9	121-56.4	5.0	A	1	2.20		13	42.8	19	35.7	7
700615	155	47.6	37-48.2	121-56.4	5.9	A	1	2.02		8	30.3	13	24.9	7
700618	636	1.6	37- 7.2	121-31.2	8.9	C	2	2.38	0.37	15	36.9	15	27.4	4
700620	919	8.1	37- 7.3	121-31.3	5.9	C	2	2.61	0.36	14	38.0	18	38.9	6
700620	946	47.5	37- 7.0	121-31.1	5.0	C	1	2.05		16	39.5	19	35.5	6
700622	1437	5.8	37-47.7	121-56.4	5.0	A	1	1.87		5	33.6	14	36.8	6
700624	1222	34.6	37-48.3	121-57.7	8.4	B	1	1.92		8	34.0	13	26.9	6
700627	254	13.7	37-50.6	122- 2.5	11.9	B	1	1.46		10	42.0	12	16.2	3
700627	703	59.3	36-45.5	121-21.9	11.6	B	2	3.29	0.02	23	42.8	23	87.1	14
700628	2119	20.3	37-48.5	121-56.7	5.3	A	1	2.31		5	31.3	14	38.8	12
700630	2248	56.2	37-18.4	121-40.4	0.0	B	1	1.81		11	27.1	16	14.8	3
700701	1813	21.5	37-21.9	121-42.3	1.6	A	1	1.53		12	26.8	17	16.7	4
700701	1814	30.4	37-22.1	121-42.5	1.5	B	1	2.14		16	36.9	27	29.3	6
700702	1835	9.1	37-27.2	121-46.3	5.0	B	1	1.62		14	31.0	15	22.4	5
700704	1131	54.7	36-58.0	121-39.5	4.6	B	2	2.73	0.31	16	29.7	23	57.3	7
700705	527	53.1	37-47.8	121-56.6	5.0	A	2	2.47	0.17	7	37.0	10	46.7	5
700705	528	46.3	37-47.9	121-56.6	5.4	A	2	2.82	0.02	11	44.7	13	61.5	6
700706	233	26.5	37-47.6	121-56.5	5.6	A	1	2.05		13	42.6	22	34.2	6
700711	1901	3.9	37- 7.2	122- 0.4	9.0	B	2	3.28	0.18	14	39.2	20	71.4	10
700716	1554	46.8	37-59.3	122- 5.2	10.0	C	1	2.11		9	60.3	17	27.4	4
700722	1928	59.1	36-51.5	121-37.1	2.9	B	1	3.00		16	28.2	15	54.6	9
700724	1850	28.8	37-48.5	121-56.7	4.4	A	1	2.59		11	47.0	17	57.6	7
700725	1635	6.0	37-47.3	121-58.1	5.5	A	1	1.97		10	49.2	25	26.0	4
700804	414	23.4	36-44.2	122- 3.2	10.0	C	1	4.74		15	66.1	21	247.1	24
700811	956	30.9	37-52.1	122-15.1	9.8	B	1	2.28		14	47.3	16	27.4	5
700816	1629	5.4	36-36.7	121-17.0	6.3	B	2	3.68	0.11	10	37.9	21	136.5	12
700816	1726	14.6	37-30.7	121-53.0	7.0	B	1	2.26		13	59.9	21	44.5	5
700821	322	38.6	37-51.7	122-15.4	8.0	B	1	2.25		13	46.4	16	32.8	4
700823	1753	48.4	36-43.9	122- 3.5	10.0	C	2	3.69	0.13	12	51.2	10	80.9	4
700827	2017	32.1	37-16.8	121-38.5	0.0	B	1	1.47		15	35.0	22	19.8	4
700828	321	6.9	37-22.1	121-36.2	0.0	C	1	2.20		11	34.2	16	21.6	3
700829	1930	59.0	37-17.8	121-39.5	4.7	B	1	2.34		11	28.1	15	26.5	4
700830	1316	50.8	36-54.2	121-28.8	8.0	B	2	3.52	0.24	12	31.6	27	127.2	12
700831	1212	59.4	38- 4.3	121-59.1	11.1	C	2	3.43	0.18	8	63.8	23	137.8	12

DATE	HRMN	SEC	LAT N	LONG W	DEPTH	Q	NM	MAG	MSD	NS	DELTA	DSD	TAU	TSD
700902	225	35.1	36-48.0	121-32.7	2.7	B	2	2.88	0.10	19	23.1	17	51.5	8
700903	609	22.0	37-57.1	122-10.9	10.0	C	1	1.62		7	44.8	26	13.0	2
700903	1642	16.3	37-47.9	121-58.3	3.4	B	1	1.90		11	33.6	21	25.4	3
700904	520	19.0	37-47.6	121-58.3	3.9	B	1	1.64		9	33.3	20	16.4	3
700904	1038	12.6	37-13.4	121-38.0	0.0	B	1	1.36		9	13.4	10	15.3	4
700904	1043	37.8	37-13.2	121-38.4	0.2	B	1	1.62		12	23.2	10	18.9	3
700905	612	10.7	37-13.2	121-38.5	0.0	B	1	1.64		11	24.8	9	17.9	3
700905	1400	32.4	37-13.2	121-38.3	0.0	C	1	1.57		11	21.5	11	29.2	5
700905	2215	55.3	37-13.4	121-38.5	0.0	C	1	1.92		16	31.8	13	29.3	3
700906	229	10.3	36-57.0	121-36.9	5.0	B	1	2.32		17	23.6	12	32.4	5
700906	1916	0.1	37-13.5	121-38.4	0.6	C	1	1.58		11	25.0	9	17.9	3
700906	2028	21.4	37-13.6	121-38.7	0.0	C	1	1.68		16	30.5	11	21.1	4
700906	2155	22.1	37-49.3	121-56.5	0.4	C	1	1.81		7	23.3	13	22.6	6
700908	809	6.6	36-49.5	121-34.8	2.9	B	1	2.65		21	27.6	17	50.8	11
700908	2012	47.0	37-50.8	122- 2.8	5.0	B	1	1.65		9	25.3	11	18.7	2
700909	1754	25.0	37-13.5	121-38.2	0.0	B	1	1.77		14	30.7	15	24.1	4
700918	36	56.4	37-37.9	122- 2.7	7.8	B	2	2.67	0.01	31	55.2	26	46.5	7
700918	229	49.8	37-42.5	122-33.7	5.0	C	1	2.56		13	50.1	16	31.7	8
700918	934	12.7	36-54.9	121-35.8	6.7	B	2	3.09	0.19	33	40.2	26	72.7	16
700922	1827	15.7	37-19.2	122- 7.1	0.0	B	1	1.69		7	14.3	11	13.4	4
700922	2359	47.6	37-25.5	121-46.8	5.0	B	3	2.56	0.19	29	48.0	21	43.1	7
700923	451	27.9	37-23.0	122-14.3	6.8	B	2	3.22	0.26	26	43.5	20	62.8	9
700923	838	3.6	37-49.0	121-55.9	0.0	A	2	2.59	0.10	14	41.5	20	47.3	10
700925	1958	29.9	37-48.4	121-56.3	1.2	A	3	2.90	0.09	17	41.4	24	65.4	21
700925	2135	4.4	37-19.1	122- 6.6	0.0	B	1	1.44		2	19.8	0	8.5	1
700926	44	26.0	37-48.4	121-56.4	0.4	A	3	2.74	0.03	[illegible]	54.2	32	47.6	13
700926	218	39.1	37-48.8	121-57.1	0.0	C	1	1.83		[illegible]	22.2	15	28.1	6
700929	207	33.5	36-59.9	121-43.4	8.4	C	1	2.24		22	37.3	25	27.1	6
700929	546	10.6	37-47.5	122-10.4	5.0	C	1	1.38		[illegible]	32.9	14	12.6	3
701001	837	42.7	36-59.8	121-43.4	11.9	B	1	2.32		23	30.5	15	32.6	6
701002	2258	39.4	37-59.0	122-28.4	0.0	C	1	1.75		[illegible]	36.3	13	12.3	1
701002	2308	16.3	37-48.6	121-56.3	1.3	B	1	1.64		[illegible]	14.4	8	17.7	5
701004	1650	34.9	37-25.2	121-45.3	5.0	B	1	1.60		[illegible]	32.9	14	9.9	1
701008	1729	18.4	36-46.9	121-32.0	7.2	B	2	3.17	0.13	[illegible]	42.0	30	68.6	13
701012	215	46.5	36-45.8	121-29.8	5.0	B	1	2.80		[illegible]	34.4	24	62.8	8
701013	1247	35.2	37-19.7	121-40.4	0.0	B	1	1.48		[illegible]	19.5	12	9.5	2
701014	503	24.4	37-50.5	121-57.5	0.0	C	1	1.31		[illegible]	11.6	2	22.5	2
701015	1544	24.0	37-21.1	121-41.1	3.5	C	1	1.50		[illegible]	29.3	11	13.0	3
701017	1141	24.8	36-48.7	121-33.5	5.0	B	1	2.71		[illegible]	28.5	17	51.8	13
701019	444	34.5	37-17.7	121-39.1	2.5	B	1	1.70		[illegible]	34.3	18	13.6	3
701020	2022	3.0	37-50.4	121-56.6	3.5	C	1	1.73		[illegible]	19.7	13	24.9	7
701022	434	44.4	37-48.7	121-55.6	0.0	B	1	1.77		[illegible]	18.2	12	28.8	9
701026	1140	59.5	37- 3.4	121-28.3	8.4	B	1	2.24		[illegible]	27.3	11	24.3	5
701028	1022	2.1	37-52.0	121-58.1	0.0	C	1	1.66		[illegible]	22.6	15	19.0	5
701031	214	56.2	37-14.9	121-37.1	6.1	C	1	1.41		[illegible]	17.2	9	10.4	3
701031	1933	25.7	37-25.6	121-47.1	5.0	B	1	1.84		[illegible]	40.5	19	24.6	5
701103	525	50.5	36-48.6	121-34.5	5.0	B	3	3.29	0.1[illegible]	[illegible]	27.0	15	87.8	13
701104	640	43.2	38-47.2	122-51.4	15.0	D	1	3.07		[illegible]	42.8	13	51.8	7
701105	1929	21.4	37-19.2	122- 7.4	0.0	B	1	1.35		[illegible]	24.0	16	16.1	3
701106	1934	1.7	37-56.9	121-56.6	0.0	D	1	1.70		[illegible]	41.8	18	10.8	1
701107	1131	20.1	37-48.4	121-56.1	0.0	C	1	2.07		[illegible]	37.8	16	23.5	9
701107	1137	13.8	37-48.0	121-56.2	5.0	B	1	1.89		[illegible]	13.3	2	28.0	5
701107	1250	57.2	37-48.2	121-56.2	1.3	B	1	2.10		[illegible]	26.2	15	37.9	13
701107	1322	15.9	37-47.6	121-56.2	1.8	B	3	2.36	0.[illegible]	[illegible]	30.8	16	44.0	13
701107	1336	8.4	37-47.6	121-56.3	1.1	B	1	1.85		[illegible]	24.3	15	23.3	8
701107	1345	8.2	37-48.1	121-56.4	0.5	B	3	2.61	0.13	[illegible]	41.1	17	55.0	18
701109	52	6.0	36-47.5	121-33.4	7.1	B	3	3.23	0.1[illegible]	[illegible]	41.6	26	75.7	15
701109	118	12.8	36-47.5	121-33.0	5.0	B	2	2.99	0.1[illegible]	[illegible]	33.2	20	57.7	11
701109	1137	22.1	36-32.1	121- 7.0	11.5	B	1	2.89		[illegible]	36.5	14	64.8	15
701109	1335	51.9	36-57.2	121-35.8	6.8	B	3	3.45	0.1[illegible]	[illegible]	46.1	33	124.4	26

DATE	HRMN	SEC	LAT N	LONG W	DEPTH	Q	NM	MAG	MSD	NS	DELTA	DSD	TAU	TSD
701110	1119	40.5	37-42.6	122-33.4	5.0	D	1	2.61		14	49.4	16	30.7	6
701110	1242	0.7	37-48.0	121-56.5	2.1	B	1	1.78		8	22.2	15	23.0	7
701111	227	8.9	37-26.8	121-37.8	0.0	C	1	1.63		2	18.1	3	8.5	0
701111	1823	14.3	37-55.3	122-17.9	5.0	D	1	2.04		9	38.7	14	20.1	5
701111	1929	34.2	37-58.7	122- 2.2	0.0	D	1	1.70		8	29.6	10	18.3	5
701112	2110	22.6	37-51.5	121-57.7	3.4	B	2	2.37	0.09	17	71.5	14	32.1	6
701112	2117	4.6	37-50.7	121-57.8	0.0	B	1	2.10		10	61.0	8	22.0	4
701113	1928	13.8	37-18.9	122- 7.1	0.0	B	1	2.08		16	25.3	15	18.9	4
701114	1803	58.3	36-33.1	121-12.6	4.8	B	3	3.35	0.09	22	38.2	15	99.3	19
701114	1932	32.8	37-25.3	121-45.6	1.1	B	2	1.96	0.22	20	32.9	13	22.4	5
701115	36	20.0	36-50.8	121-35.9	1.3	B	1	2.50		20	25.1	14	45.7	9
701115	1819	32.2	36-33.3	121-12.7	6.5	B	2	3.44	0.16	9	40.1	11	84.9	9
701116	1452	8.5	36-57.1	121-35.2	3.1	B	2	2.69	0.27	22	28.3	16	40.2	8
701116	1913	43.0	37-47.8	121-56.8	0.0	C	2	2.15	0.02	10	26.4	13	36.7	13
701119	2243	59.5	37-15.3	121-36.8	1.9	B	1	1.65		11	21.5	10	15.3	3
701120	413	7.9	37-19.8	122-12.9	9.2	B	1	1.65		15	26.2	17	17.8	5
701120	2236	2.9	37-19.1	122- 7.4	0.0	B	1	2.01		16	24.8	15	19.4	4
701123	347	60.0	37-47.6	121-57.1	4.2	B	1	1.64		8	16.5	10	18.0	3
701125	1756	4.8	37-59.0	122- 2.2	10.0	C	1	2.14		14	51.0	18	29.4	7
701125	1941	15.6	37-19.1	122- 7.4	0.0	B	1	1.79		12	26.1	13	15.8	3
701129	2341	31.8	37-18.7	121-39.7	4.1	B	1	1.55		9	20.2	10	8.8	1
701202	1226	30.5	37-31.0	121-39.4	0.0	C	1	1.55		9	24.2	8	14.1	4
701204	2137	47.2	37-46.9	121-58.9	3.3	A	1	1.93		9	26.3	15	25.6	5
701207	2326	52.8	38-37.3	122-50.0	0.0	D	2	3.17	0.03	4	24.5	7	59.0	8
701211	2234	1.4	37-19.1	122- 6.9	0.0	B	1	1.58		11	23.2	13	14.5	2
701213	1446	15.3	37-14.6	121-57.6	5.0	C	1	1.99		26	33.4	14	24.7	4
701214	54	51.6	37-46.8	121-59.2	2.9	B	1	2.08		15	66.6	35	25.3	3
701218	1700	14.0	36-48.4	121-33.8	5.6	B	1	2.77		20	25.7	15	53.2	12
701218	1907	45.3	37-10.4	121-31.0	0.0	C	1	1.78		19	32.5	14	22.8	4
701218	1909	53.7	37-10.5	121-30.6	0.0	C	1	1.61		19	30.3	11	18.2	3
701218	1952	42.7	37-36.8	121-40.4	4.9	B	1	1.76		6	23.0	10	16.3	3
701218	2134	20.1	37-37.0	121-39.7	7.2	C	1	1.91		10	27.0	10	21.3	5
701219	353	36.8	37-10.5	121-31.0	1.8	C	1	1.61		18	32.5	14	17.3	2
701226	206	49.7	37-37.7	121-39.6	5.5	C	1	2.15		19	44.5	18	24.8	7
701226	210	16.6	37-37.4	121-40.1	7.1	B	1	2.09		17	44.4	20	24.9	6
701231	1456	35.4	36-50.8	120-56.8	5.0	D	1	2.91		21	54.9	15	45.9	8
710101	929	0.3	37-18.0	121-39.4	0.0	B	1	1.80		18	29.6	14	14.7	2
710101	1502	5.9	37-36.1	121-39.9	5.0	B	1	2.04		8	28.1	10	28.8	6
710106	1626	40.2	37-15.5	121-59.9	5.0	C	1	1.77		16	28.9	10	16.8	4
710106	2043	15.1	37-59.4	122- 1.9	12.9	D	1	1.92		8	43.3	15	31.1	6
710107	737	10.8	37-51.8	122-15.4	5.0	C	1	1.34		10	39.6	17	12.7	2
710107	801	8.8	37-20.1	122- 8.5	3.2	B	1	1.67		13	24.3	14	13.8	2
710109	1359	44.7	37-23.6	121-27.3	5.7	D	1	1.55		8	29.9	11	12.5	2
710113	1712	22.1	37-53.6	122-16.2	0.0	D	1	1.59		7	43.8	15	15.1	2
710118	2331	19.4	36-57.6	121-37.4	2.8	B	2	2.75	0.27	27	35.0	21	57.7	13
710120	2214	29.8	37-50.7	122- 3.2	0.0	C	1	1.74		4	27.5	13	15.5	5
710121	1311	43.6	36-50.6	121-36.5	5.0	B	2	2.95	0.18	29	33.3	20	63.0	14
710122	1936	7.9	37-19.4	122- 7.5	0.0	B	1	1.66		13	23.2	15	15.2	3
710125	1549	20.5	37-11.0	121-29.6	0.0	C	1	2.11		28	45.1	21	36.3	8
710126	2102	2.0	37-17.2	122- 5.8	2.0	B	1	1.59		13	29.8	18	15.1	3
710128	1435	52.7	37-25.4	121-42.5	0.0	C	1	1.44		8	27.7	10	9.5	2
710129	909	42.1	37-20.5	121-45.6	0.0	C	1	1.38		10	24.1	9	12.2	2
710131	1222	49.3	35-56.1	120-31.4	10.4	B	2	3.69	0.01	15	56.3	45	127.6	22
710131	2142	35.4	37- 9.8	121-32.1	4.9	B	1	2.29		29	44.4	22	36.0	8
710202	2238	20.3	37-18.9	122- 7.2	0.0	B	1	1.88		14	27.7	18	20.7	4
710204	325	43.6	37-31.2	121-54.8	0.0	C	1	2.22		27	43.5	21	23.7	4
710209	333	48.1	37-50.8	122- 2.9	5.1	C	1	1.62		6	24.6	11	16.0	4
710209	1927	46.6	37-18.8	122- 7.5	0.0	B	1	1.71		9	23.3	11	17.0	3
710213	1818	11.3	36-37.7	121-18.9	5.3	C	1	2.87		20	31.6	13	46.3	9
710215	1004	59.7	37-51.3	122- 3.7	0.0	C	1	1.53		2	28.6	4	11.0	3

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710218	11	46.9	37-57.8	121-56.3	0.0	D	1	1.84		7	49.6	25	14.0	1
710219	1012	53.0	37-57.1	122- 0.3	8.6	C	1	1.83		17	60.2	23	17.9	5
710222	2039	12.7	37- 6.1	121-58.6	13.3	B	2	2.55	0.23	39	55.3	28	39.5	8
710225	2234	49.1	37-19.2	122- 7.3	0.0	B	1	1.71		11	21.3	15	19.1	3
710304	1931	22.1	37-19.1	122- 6.8	0.0	B	1	1.60		11	26.0	12	12.4	3
710304	2235	2.0	37-18.9	122- 7.0	0.0	B	1	1.49		9	22.6	14	13.6	2
710305	1930	55.6	37-19.1	122- 6.9	0.0	B	1	1.76		11	21.7	14	18.2	4
710307	320	18.8	36-49.7	121-35.6	7.1	B	1	2.82		42	49.8	30	43.9	10
710308	1831	46.4	36-47.1	122- 7.6	8.2	C	3	4.08	0.09	59	95.4	47	100.1	21
710309	1137	31.9	37-38.7	122- 5.7	1.9	B	1	1.72		20	43.9	20	16.9	4
710309	1535	16.2	36-47.3	122- 7.8	9.3	C	2	4.45	0.12	60	95.1	46	160.4	31
710310	915	42.7	36-46.7	122- 7.5	5.0	C	2	2.98		21	65.7	20	43.1	9
710310	1547	40.8	37- 9.4	121-59.9	7.7	A	2	2.30	0.10	23	52.2	24	28.1	6
710314	448	51.5	38- 2.5	122- 3.2	10.0	D	1	1.96		9	50.8	19	15.2	4
710314	2139	20.9	37-47.9	121-58.4	3.0	B	1	1.60		7	30.4	24	16.6	3
710314	2204	7.7	37-47.9	121-57.9	3.2	B	1	1.63		9	36.4	24	19.6	3
710314	2204	49.6	37-47.8	121-58.1	3.5	B	1	1.74		12	46.3	22	20.7	4
710314	2220	24.8	37-47.6	121-58.5	3.2	B	1	1.46		6	29.5	19	12.5	2
710315	927	1.9	37-47.9	121-58.1	3.4	B	1	1.58		9	35.0	24	16.3	3
710315	1931	27.0	37-19.2	122- 6.9	0.0	B	1	1.63		11	18.9	13	19.4	5
710316	1817	39.7	37-18.6	122- 7.0	0.0	B	1	1.26		3	25.7	4	6.3	0
710316	1930	24.3	37-18.8	122- 7.0	0.0	B	1	1.49		8	23.1	13	11.4	3
710316	2256	28.1	37-48.1	121-58.1	3.3	B	1	1.95		14	37.9	22	24.1	4
710317	2130	4.6	37-56.8	121-56.9	0.0	D	1	1.63		2	26.3	8	8.0	2
710319	1548	9.2	37- 9.8	121-32.0	10.0	B	1	1.84		25	38.7	17	22.8	4
710322	1523	34.7	37-48.3	121-55.8	5.0	B	1	1.42		6	17.2	11	17.2	3
710325	601	42.5	37-59.7	122- 2.3	13.1	C	1	2.55		24	57.7	22	37.7	10
710325	644	4.7	37-59.1	122- 3.3	10.0	C	1	1.47		7	34.1	11	10.6	1
710325	817	49.3	37-59.4	122- 3.1	10.0	C	1	1.46		9	38.9	13	11.0	2
710325	2204	16.0	37-49.8	121-58.6	15.0	B	1	1.63		10	35.1	15	11.0	3
710326	1934	22.4	37-19.2	122- 6.7	0.0	B	1	1.65		9	21.2	14	16.8	3
710331	122	21.8	37-20.1	121-45.5	2.5	B	1	1.38		9	18.8	11	11.1	2