Quarterly Technical Report 78 - A

for

Hanford Seismic Network

January 1, 1978 through March 31, 1978

Geophysics Program

University of Washington

April 28, 1978

This report is also being sent to Washington Public Power Supply System as part of the reporting requirements for Contract #C-10976.

PREPARED FOR THE U.S. DEPARTMENT OF ENERGY
UNDER CONTRACT NO. EY-76-S-06-2225
TASK AGREEMENT NO. 39

Operations

The eastern Washington seismic array has continued in operation in virtually the same configuration as the last two quarters. There have been minor problems with the new stations at IRG and GLD which mean some lost data. We feel, however, that the array is sensitive enough to miss no events larger than M_L = 2 east of longitude 120.5 in the southern part of the state. The deployment of the WPPSS sponsored event recorders has been farther delayed due to continuing problems with instrument operations. We do have some interesting data from equipment in the Ellensburg area. These data are presently being analyzed and will be covered in detail in our annual report.

The eastern Washington seismicity data retrieval system is complete and is currently implemented on the John Lock DEC-System-10 computer at the University of Washington. Included in this report is a description of this system which will allow anyone with dial-up computer terminals to interrogate our eastern Washington catalogs. This catalog is constantly updated with the latest located events plus any older events previously mislocated or misidentified as a blast, etc. The catalog is complete from July, 1975 through the present quarter. We will be updating it to go back to 1969 within the next quarter.

Data

The activity in eastern Washington was above normal this quarter with 85 events located of which 17 are known or probable blasts. There are a great deal of road construction blasts in the new stretch of 395 between Mesa and Connell. We located and report 5 of these blasts as a check on our routine location accuracy. There were 38 other blasts in this area which we have records for but did not bother to locate. The blasts on

the Hanford reservation on February 1, 2, and 3, as reported to us by Rockwell were only recorded on stations GBL and MDW on February 2, and February 3 only. They were much too small to locate. The earthquake activity in the Hanford area includes one swarm in the Corfu vicinity which started slowly in January and built up through the end of March and is still going on at the end of April. There were two other small clusters of events, several too small to be located along the Columbia River in the north part of the Hanford reservation.

The Entiat area to the north was about as active as usual. There were several earthquakes to the north of the usually arctic area, on the north shore of Lake Chelan about 12 km NW of the town of Chelan. One of these events was over magnitude 3 and quite shallow. It may have been felt though we are aware of no felt reports.

The map of figure 2 is slightly different than the maps of the past several reports because the Geophysics computer is broken during the map period for this report. The symbols on this map are coded by event type. Circles are earthquakes whose size is proportional to magnitude. An asterisk in the circle designates a focal depth greater than 10 km. The X symbols are known explosions and the + symbols are probable explosions.

Magnitude Calibration

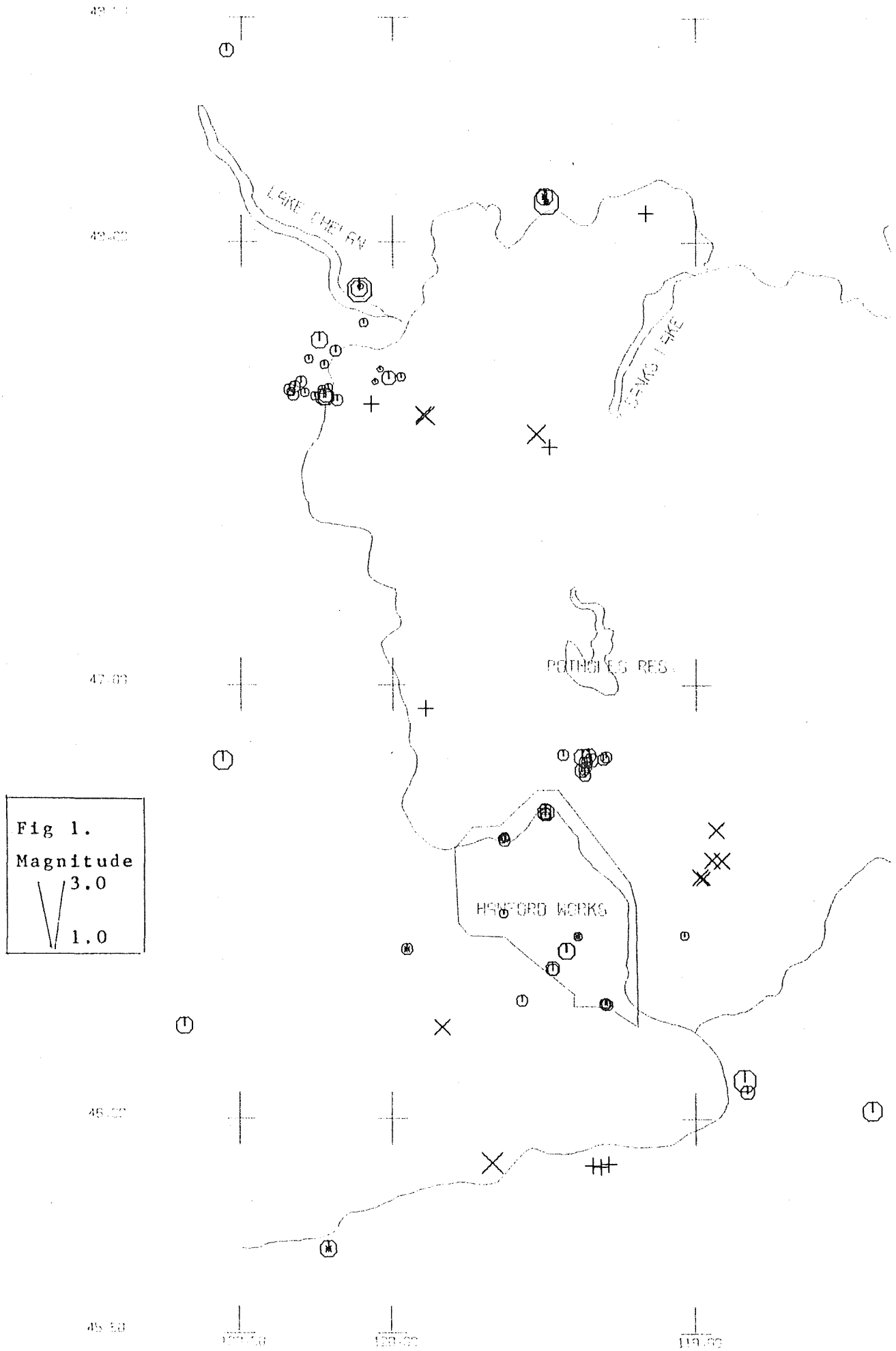
Wood Anderson seismographs are presently operating at Newport and near Richland. We have read many of the larger events over the past year at Newport and have recorded several events over the past quarter at Richland. The magnitudes computed from these records will be used to update the code length magnitude scale for different parts of eastern Washington.

Other Studies

During this quarter we have explored the potential of using intensity data for studying regional attenuation patterns for strong ground motion. This approach has been moderately fruitful. A paper on this subject was given at the Spring SSA meeting in Reno. The abstract for this paper follows. Details of this investigation will be included in our Annual Technical Report.

Tiltmeters

The two tiltmeters are still not tracking in the long term sense and they drift on the order of 20 μrad/yr. Diurnal temperature fluctuations are at the 0.1 μrad. level. Either the site conditions or the instruments themselves, are the cause of the large non-tracking drifts. Detailed analysis of the observations will follow in the Annual Technical Report. Although tilt is a valuable data point in determining the region's tectonics, the current tilt installation is poor for measuring this tilt.



EASTERN WASHINGTON JAN - MARCH 1978

TABLE 1. Eastern Washington Velocity Models

North Model	V_p (km/sec)	Depth
	5.1	0.0
	6.05	0.5
	7.2	19.0
	8.0	24.5
South Model		
	3.7	0.0
	4.7	0.8
	5.15	1.2
	6.05	7.5
	7.2	19.0
	8.0	28.0

S - arrival times are computed by using the P - wave model and dividing the resulting travel time by 1.72.

TABLE 2.

EASTERN WASHINGTON SEISMIC STATIONS

NAME	LAT			LON		
MDW	46	36	48.00	119	45	39.00
SYR	46	51	46.80	119	37	04.20
OTH	46	44	20.40	119	12	59.40
WAH	46	45	07.20	119	34	40.80
CRF	46	49	30.60	119	23	05.60
GBL	46	35	51.60	119	27	35.40
ETP	46	27	53.40	119	03	32.40
BDG	46	14	04.80	119	19	03.00
EUK	46	23	45.00	118	33	43.50
PRO	46	12	45.60	119	41	09.00
PEN	45	36	43.20	118	45	46.50
RSW	46	23	28.20	119	35	19.20
WGW	46	02	40.80	118	55	57.60
WIW	46	25	55.80	119	17	17.40
HER	45	50	08.40	119	22	51.00
MFW	45	54	10.80	118	24	21.00
OMK	48	28	49.20	119	33	39.00
DYH	47	57	37.80	119	46	09.60
WBW	48	01	04.20	119	08	13.80
SAW	47	42	06.00	119	24	03.60
WAT	47	41	55.00	119	57	15.00
FPW	47	58	00.00	120	12	46.50
CBW	47	48	25.50	120	01	57.60
WTP	48	28	16.20	120	14	52.20
PLN	47	47	04.80	120	37	58.20
ETT	47	39	18.00	120	17	36.00
EPH	47	21	07.80	119	35	46.20
ODS	47	18	24.00	118	44	42.00
WEN	47	31	46.20	120	11	39.00
DAV	47	38	18.00	118	13	33.60
VTG	46	57	28.80	119	59	14.40
WRD	46	58	11.40	119	08	36.00
NEW	48	15	50.00	117	07	13.00
FMC	45	37	28.	120	01	42.
RPK	45	45	42.	120	13	50.
ALD	45	49	10.	120	04	00.
GLD	45	50	00.00	120	49	00.00
EBW	47	00	15.00	120	40	28.20

IRG WTP

SEISMOLOGICAL SOCIETY OF AMERICA
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Title, Author(s), Affiliation

SEISMIC ATTENUATION PATTERNS IN WASHINGTON STATE FROM INTENSITY DATA

MALONE, STEPHEN D., AND BOR, SHENG-SHEANG, Geophysics Program, University of Washington, Seattle, Washington 98195

Body of Abstract

Intensity data from seventeen historic earthquakes in or near Washington as reported at over 1000 localities are used to study attenuation patterns in Washington. The empirical relation of Everden (1975) is used to determine the fault length, 2 L and the depth factor, C, for each earthquake and the local attenuation factor, k for two physiographic parts of the state. The value for k in the Puget Sound region and north into Canada is 2 while k = 1-3/4 is more appropriate for eastern Washington and northern Oregon. Individual local amplification factors are computed for all localities at which 4 or more earthquakes have been felt, by averaging the difference between the computed intensity and reported intensity at each site. Using these correction factors the intensities for the north Cascade earthquake of 1872 are used to place constraints on its size and location.

CLASSIFICATION (underline one):

Recent Earthquakes
Seismic Source Functions
Wave Propagation
Seismicity
Seismic Risk
Engineering Seis.
Strain Seis.
Microseismicity
Instrumentation
Array Processing
Mantle-Core Struct
Gen. Seismology & Geophysics
Other_____

Communications regarding this abstract should be sent to:

Stephen D. Malone	Geophysics Program, Univ. of Wash. AK-50 Seattle, WA 98195	206-543-8020
Name	Address	Phone

Name of Speaker: Stephen D. Malone

Indicate Authors who are not members of SSA:_____

Only 2" x 2" slides will be permitted. Employer's permission to publish, if required is the author's responsibility.

University of Washington
Seismicity Data Retrievals

A catalog program exists on the DEC System-10 computer at the Universith of Washington to get located earthquake data from the DOE and WPPSS supported eastern Washington seismic net on any standard computer terminal. The program can do selection of the data for date interval, magnitude interval, depth interval and latitude and longitude intervals. Symbols and headings are as in the University of Washington annual technical report of 1977.

To use:

Dial 543-9551 (for 300 baud terminal)
543-9581 (for 1200 " ") Full duplex

Type: "control C" to get computer to respond with a period "." (do not type quotes)

Type: "LOGIN 203,777"

Reply to password request with "LIST" (non printing)

The program automatically runs and requests responses from the user. A "HELP" file exists to give more details of the program and what is available.

When you are through you must stop the program before hanging up or it will stay active, and we are charged even though you are not connected. Please make sure the program logs out before you hang up by taking one of the "STOP" options provided in the program. If the program runs away, and you want to start over, type "control C" twice and "RUN LIST" and it will start over at the beginning.

For questions or problems, see Steve Malone - ATG 226 (543-7010).

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	5.1	0.0
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	7.2	19.0
	8.0	28.0

S - arrival times are computed by using the P - wave model and dividing the resulting travel time by 1.72.

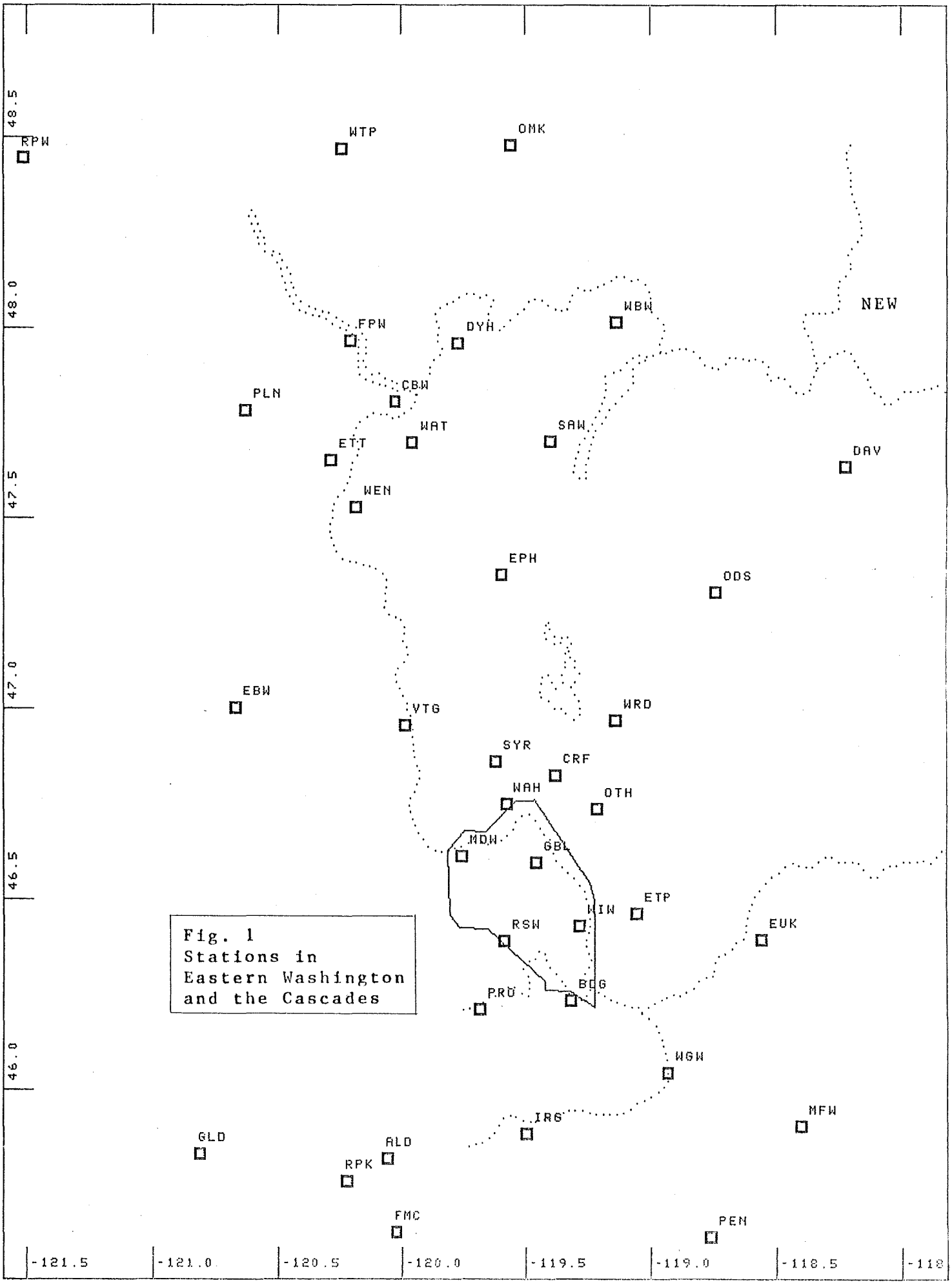
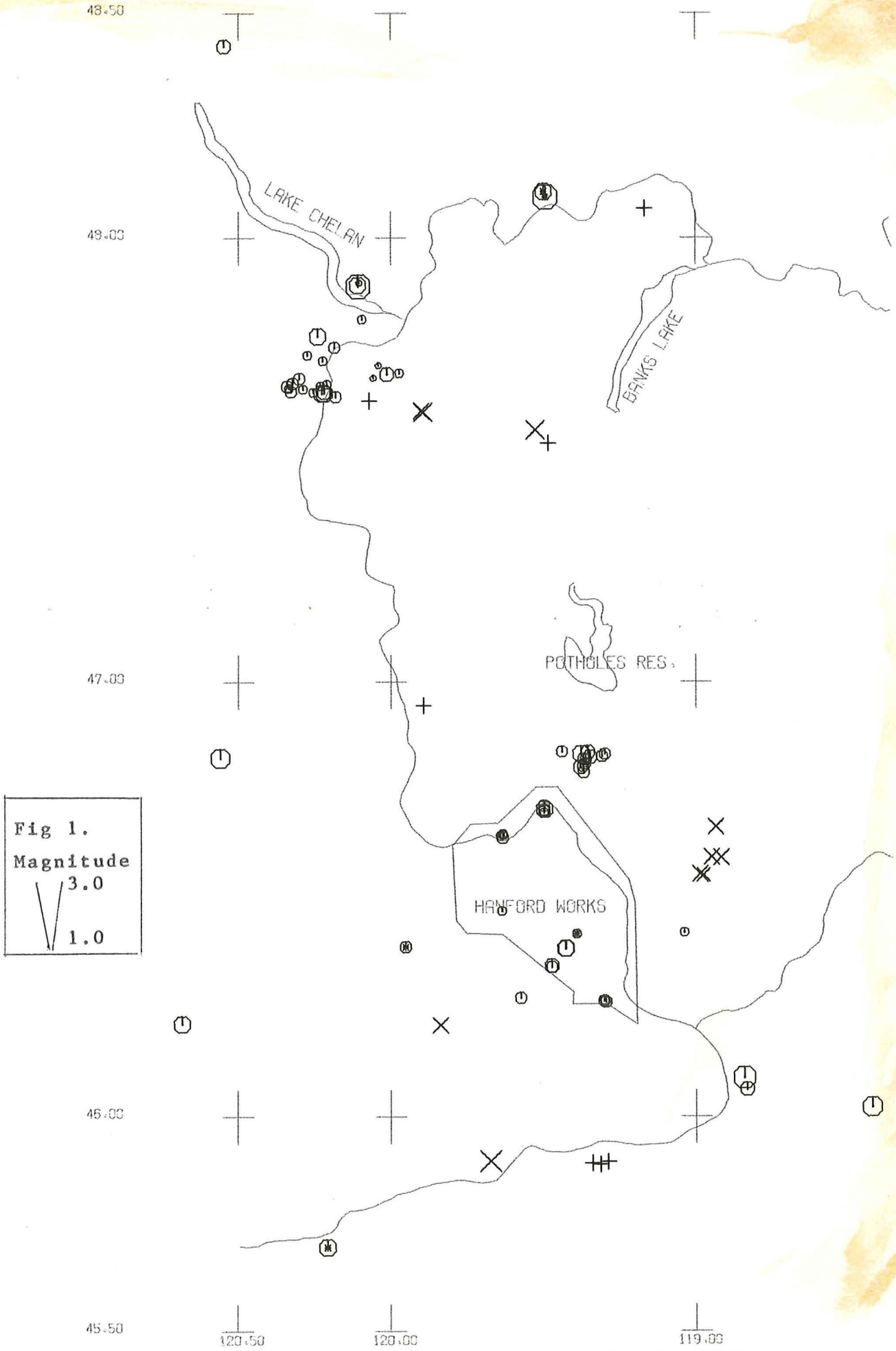


Fig. 1
Stations in
Eastern Washington
and the Cascades



EASTERN WASHINGTON JAN - MARCH 1978

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TABLE 2. Eastern Washington Seismicity Jan 1 - Mar. 31,1978

THIS IS FROM THE EASTERN WASH. CATALOG JULY,1975-MAR,1978 (4/78)

DATE	DAY	TIME	LAT	LONG	DEPTH	MAG	#	Q	TYPE
1/ 5/78	5	458:36.6	46-20.79	119-28.28	1.6	.9	8	C	
1/ 7/78	7	1656: 4.8	46-23.61	119-57.10	17.3	.9	8	C	
1/10/78	10	711:45.8	46-49.71	119-20.72	1.5	1.3	8	D	
1/11/78	11	2046:17.5	46-43.01	119-29.86	7.1	.8	6	B	
1/12/78	12	1428: 5.2	46-42.43	119-29.82	4.0	.9	7	B	
1/13/78	13	224:34.7	46-42.52	119-29.76	5.1	1.8	7	B	
1/13/78	13	337:15.1	46-42.08	119-29.82	5.4	.7	6	B	
1/14/78	14	035: 1.4	46-42.23	119-29.78	3.8	1.0	6	C	
1/14/78	14	2254:37.7	46-42.40	119-29.90	1.5	1.2	9	C	
1/17/78	17	1941:50.7	47-38.69	120-10.99	9.0	1.1	9	B	
1/18/78	18	1059:32.8	47-53.67	120- 6.59	1.3	2.2	12	C	
1/19/78	19	2159: 2.0	47-39.72	120-17.43	4.4	.7	8	B	
1/19/78	19	2248:48.0	48- 3.95	119- 9.92	1.0	1.8	6	D	P
1/21/78	21	1322:55.6	46-50.09	119-17.85	1.9	1.0	10	C	
1/22/78	22	052:18.6	46-33.64	118-59.10	2.4	2.2	13	C	X
1/24/78	24	2358:36.0	46-33.49	118-58.50	0.4	1.3	10	C	X
1/25/78	25	1 5:57.5	47-54.01	120- 6.29	5.2	.2	6	C	
1/25/78	25	1 9:20.8	47-53.51	120- 6.48	1.0	3.3	15	B	
1/25/78	25	731:49.9	47-49.10	120- 5.70	5.5	.7	8	B	
1/26/78	26	1812:53.6	46-47.58	119-22.05	5.0	1.2	8	C	
1/28/78	28	016:36.3	46-35.97	118-56.83	2.7	2.1	14	C	X
1/28/78	28	11 8:41.3	47-39.84	120-20.16	2.8	.5	6	C	
1/30/78	30	1217:30.6	48-25.62	120-32.92	4.8	1.4	10	B	
1/30/78	30	1824: 8.8	47-41.87	119-58.31	5.8	.4	8	B	
1/31/78	31	2112:39.8	47-39.31	120-15.42	2.9	.7	7	B	

DATE	DAY	TIME	LAT	LONG	DEPTH	MAG	#	Q	TYPE
1/31/78	31	2329:15.7	46-16.52	119-34.46	3.9	1.0	6	C	
2/ 1/78	32	124:21.4	46-35.89	118-54.91	0.5	1.8	12	C	X
2/ 1/78	32	1250:29.2	47-40.52	120-19.39	4.0	1.2	9	B	
2/ 6/78	37	049:46.6	46-15.97	119-17.64	2.6	.8	7	C	
2/ 6/78	37	058:56.0	46-16.11	119-17.94	2.3	.5	7	C	
2/ 6/78	37	1 2:27.6	46-16.06	119-18.00	1.9	.9	7	C	
2/ 8/78	39	756:21.0	47-40.16	120-13.91	5.9	.5	7	B	
2/ 9/78	40	1439:42.8	45-41.76	120-12.50	13.5	2.1	10	D	
2/ 9/78	40	1958: 2.8	46-56.76	119-53.52	0.5	2.0	9	C	P
2/10/78	41	0 8:22.8	46-40.12	118-56.03	0.4	2.0	10	C	X
2/10/78	41	1754:43.1	46-20.94	119-28.35	3.9	1.4	7	B	
2/12/78	43	1324:35.9	47-43.53	120-13.47	5.0	.7	7	B	
2/17/78	48	314:52.7	46-50.41	119-26.31	6.2	1.0	5	D	
2/19/78	50	2048:52.1	46-38.58	119-37.99	4.6	.9	7	C	
2/20/78	51	1459:32.8	47-44.30	120-16.53	5.6	.5	8	B	
2/20/78	51	1739:27.3	46-23.41	119-25.48	0.9	2.1	9	C	
2/20/78	51	2123:16.1	45-53.83	119-40.28	0.3	3.2	13	C	X
2/20/78	51	2227:46.0	46-25.59	119- 2.30	3.3	.7	8	C	
2/21/78	52	2320: 2.1	47-32.45	119-28.97	1.5	2.2	7	C	P
2/22/78	53	1059: 7.1	46-23.36	119-25.64	5.3	2.0	6	C	
2/23/78	54	037:39.9	46-12.74	119-50.22	0.3	1.8	7	D	X
2/23/78	54	048:59.6	46- 1.28	118-25.18	3.0	2.4	9	D	
2/23/78	54	655:36.2	46-38.82	119-38.44	5.4	.4	7	B	
2/23/78	54	754:29.3	46-21.12	120-55.47	0.4	2.4	21	D	
2/26/78	57	526: 0.7	47-39.15	120-13.22	5.2	1.8	10	B	

DATE	DAY	TIME	LAT	LONG	DEPTH	MAG	#	Q	TYPE
2/26/78	57	539: 8.2	47-46.83	120-14.47	8.6	1.9	9	B	
2/28/78	59	1244:24.6	46-12.93	120-41.00	1.3	2.2	10	D	
2/28/78	59	13 3:20.9	47-39.34	120-13.14	4.3	1.4	8	B	
3/ 1/78	60	20 1:54.6	46-39.12	119-37.96	5.5	.4	7	B	
3/ 4/78	63	034:35.4	47-36.77	119-53.96	0.5	2.2	10	C	X
3/ 4/78	63	512:25.2	46-49.78	119-18.35	3.0	1.2	8	B	
3/ 4/78	63	1947: 5.7	46- 5.38	118-50.39	7.2	2.8	19	C	
3/ 5/78	64	1151:48.6	46-48.73	119-21.77	0.1	1.2	9	B	
3/ 5/78	64	1813:34.9	48- 3.64	123- 4.69	3.0	4.1	9	D	W
3/ 5/78	64	1846:35.7	47-40.13	120-20.49	1.9	.8	7	C	
3/ 6/78	65	010:20.0	46-49.34	119-21.61	1.2	1.0	6	D	
3/10/78	69	614:26.2	46- 3.78	118-49.85	3.0	1.6	6	C	
3/10/78	69	8 2:11.1	47-39.43	120-19.69	4.3	.9	6	C	
3/10/78	69	19 7:17.0	47-36.63	119-53.59	0.5	2.5	11	C	X
3/11/78	70	1553:12.5	47-27.76	122-55.70	40.0	5.0	9	D	W
3/12/78	71	0 5: 3.2	45-53.35	119-18.74	0.9	1.9	7	C	P
3/12/78	71	1245:40.1	46-49.60	120-33.59	0.6	2.3	13	C	
3/12/78	71	2250: 8.5	46-50.34	119-21.19	1.2	1.3	7	D	
3/14/78	73	650:46.1	47-39.16	120-13.61	6.5	1.9	10	B	
3/15/78	74	2 5:33.7	46-28.54	119-38.13	8.1	.7	6	C	
3/16/78	75	251:33.6	47-41.71	120- 0.74	6.4	1.6	9	B	
3/16/78	75	2228:42.6	47-34.23	119-31.50	0.5	2.3	10	C	X
3/18/78	77	850:34.7	46-25.38	119-23.38	16.2	.6	8	B	
3/21/78	80	6 5:21.1	46-38.98	119-37.89	1.0	.5	8	B	
3/22/78	81	3 8:59.6	48- 5.43	119-29.51	12.0	3.3	11	B	

DATE	DAY	TIME	LAT	LONG	DEPTH	MAG	#	Q	TYPE
3/22/78	81	327: 7.1	48- 6.17	119-29.88	10.2	1.8	12	C	
3/23/78	82	547: 42.2	46-50.11	119-22.54	1.3	2.2	12	A	
3/23/78	82	2030: 39.0	47-41.17	120-18.15	4.4	1.1	8	B	
3/24/78	83	914: 43.0	47-45.34	120-11.16	5.8	1.1	9	B	
3/25/78	84	1517: 25.4	45-53.49	119-20.27	1.5	1.9	6	D	P
3/26/78	85	239: 11.6	47-40.36	120-12.67	5.4	.6	6	B	
3/28/78	87	6 2: 17.5	46-48.27	119-22.68	0.2	1.3	9	A	
3/28/78	87	1516: 16.2	46-48.44	119-22.15	0.5	1.1	7	C	
3/29/78	88	042: 6.1	47-38.16	120- 4.26	2.0	2.2	8	C	P
3/30/78	89	1545: 0.3	46-49.37	119-22.07	1.9	.9	7	C	
3/31/78	90	8 3: 5.5	47-21.43	122-27.08	40.0	4.4	10	D	W
3/31/78	90	2128: 22.0	45-53.72	119-17.22	1.8	1.8	7	D	P