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DEPARTMENT OF NATURAL RESOURCES

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INFORMATION CIRCULAR 56

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COMPILATION OF EARTHQUAKE HYPOCENTERS  
IN  
WESTERN WASHINGTON - 1974

By

**ROBERT S. CROSSON and RICHARD C. MILLARD**



1975

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# COMPILATION OF EARTHQUAKE HYPOCENTERS

IN

## WESTERN WASHINGTON-1974

By

Robert S. Crosson and Richard C. Millard

### SUMMARY

A multistation telemetered seismograph network has been operated in western Washington on a continuous basis since 1970 by the Geophysics Program at the University of Washington. This network provides basic data for accurately locating both large and small earthquakes in a region centered on the Puget Sound basin. This area is bounded on the east and west by the Cascade and Olympic Mountains, respectively, and extends north to the latitude of Mount Baker and south to the latitude of Mount St. Helens. During a 1-year period, a large number of earthquakes are located that may have significance for many areas of investigation. Accordingly, this is the third in a series of reports, to be up-dated on a yearly basis, which are designed to make these data available to the public.

The present report covers the year 1974 in which 314 earthquakes were reliably located. A machine-plotted epicenter map is included to provide a large-scale impression of the distribution of these earthquakes. Background and descriptive information presented in the previous two reports are not repeated here. It is worth re-emphasizing, however, that the number of earthquakes successfully located, as apart from recorded, by the network depends critically on

the number of and the areal distribution of seismograph stations, the seismic "quality" of each site, and of course the actual earthquake activity of the region. The central Puget Sound basin region, between approximately latitudes 47 and 48 degrees, appears to be the most seismically active area of Washington State and is well covered by the present network configuration. Although the total number of stations was constant (14) during 1974, the coverage is not of uniform quality over the whole of western Washington. Furthermore, some stations inevitably fail to operate for various periods of time producing additional variations in the quality of coverage. Thus, caution must be exercised in interpreting the hypocenter data since the magnitude threshold of detection is not uniform throughout the network, and moreover the accuracy of location deteriorates for earthquakes lying outside the network perimeter.

### INTRODUCTION

During 1974 the University of Washington operated a 13-station telemetered seismograph network, plus one World-Wide Standard (WWSN) station

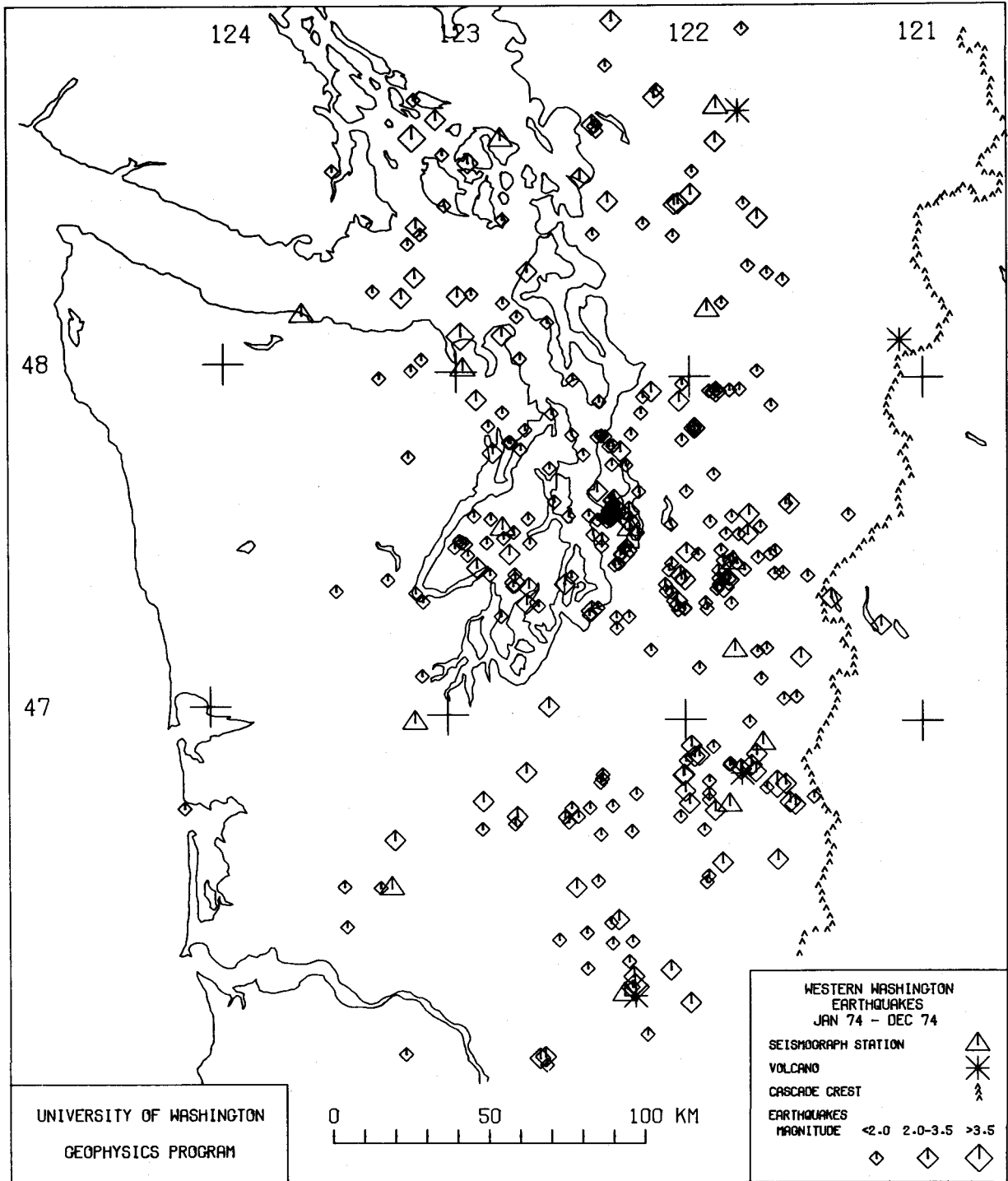


FIGURE 1.—Map showing epicenters for 1974.

(LON) which is on-site recording. This operation is part of a long-range program, initiated with a five-station network in 1970, to obtain high quality data on western Washington earthquakes for seismicity, crustal structure, tectonics, and earthquake hazard studies. A substantial body of data on earthquake locations, magnitudes, and depths have emerged from this work.

This is the third in a series of reports designed to present accurate earthquake location data in a standard format for western Washington. The first report (Crosson, 1974) includes earthquake data for 1970, 1971, and 1972 in addition to background information and technical specifications of the network. Thus the reader is referred to that report for a description of the network instrumentation, procedure of analysis, glossary of terms and other information. The second report (Crosson, 1975) covers earthquake data for 1973 in addition to including description of a revised velocity model and revised station delays used to calculate the hypocenter data. These model revisions also apply to the present report.

The basic information of this report is contained in the Appendix. The Appendix listing is a direct copy of a machine listing and should be free of typographical errors. In addition a machine drawn map of the epicenter distribution is included. Suggestions as to how to make this series of reports more efficient, useful, or informative are welcome and can be directed to the Washington State Department of Natural Resources, Division of Geology and Earth Resources.

### HYPOCENTER LISTING

A total of 314 earthquakes which were successfully located for the year 1974 are listed in the Appendix of this report. Figure 1 shows the epicen-

ter locations of these earthquakes on a base map of western Washington, indicating a general breakdown into magnitude range. This figure is machine drawn for accuracy and completeness. Comments contained in the first report of this series (Crosson, 1974) are appropriate and may be helpful in interpreting these data. In addition the changes in format and corrections noted in the second report of this series (Crosson, 1975) are incorporated here. The velocity model described in Crosson (1975) is used for this report and its description is not repeated here.

During 1974, no stations were added to the network. Thus the station coverage can be considered relatively uniform during the period covered by this report. Table 1 lists pertinent data for each station active during 1974, including the station locations, elevations, P time corrections (P delays), and installation data. Although the network is currently being expanded to over 20 stations, only the 14 stations listed in table 1 apply to the data in the present report. In spite of the constancy of station coverage, inevitable failure did occur in the operation of some stations which affect the uniformity of coverage. In an attempt to indicate where such failure may affect the data in this report we have incorporated a station activity graph (fig. 2) in which major gaps in station operation are indicated.

### ACKNOWLEDGMENTS

Many individuals and organizations have contributed to make this work possible and it is difficult to achieve full acknowledgment. Joyce Wu, Rose Mary Silling, and Carla Marsh provided assistance in reading seismograms and basic data handling. Leland Bond and Laurens Engel provided major technical support for the network operation, fulfilling the demanding task of keeping the network running, often in

TABLE 1.—Summary of network station data  
List of NEIS abbreviated stations in western Washington

Station name	LAT			LON			ELEV KM	P DELAY SEC	Install date	Mag at 1 HZ	Location
	DEG	MN	SEC	DEG	MN	SEC					
SPW	047	33	13.30	122	14	45.10	0.008	1.029	9/17/69	65000	Seward Park
GMW	047	32	52.50	122	47	10.80	0.506	0.100	2/27/70	145000	Gold Mountain
GSM	047	12	11.40	121	47	40.20	1.305	0.399	6/11/70	165000	Grass Mountain
BLN	048	00	26.50	122	58	18.64	0.585	-.137	7/ 2/70	115000	Blyn Mountain
CPW	046	58	25.80	123	08	10.80	0.792	0.241	7/29/70	135000	Capitol Peak
RMW	047	27	34.95	121	48	19.20	1.024	0.385	7/27/71	190000	Rattlesnake Mountain
JCW	048	11	36.60	121	55	46.20	0.616	-.033	2/18/71	120000	Jim Creek
FMW	046	55	54.00	121	40	19.20	1.890	0.246	9/ 4/72	100000	Mount Fremont
BFW	046	29	12.00	123	12	53.40	0.902	0.113	10/25/72	150000	Baw Faw Mountain
SHW	046	11	33.00	122	14	12.00	1.423	0.319	10/25/72	45000	Mount St. Helens
MCW	048	40	46.80	122	49	56.40	0.693	0.125	11/ 8/72	70000	Mount Constitution
MBW	048	47	02.40	121	53	58.80	1.676	0.453	11/ 8/72		Mount Baker
STW	048	09	0.75	123	40	12.00	0.308	0.009	6/27/73		Striped Peak
LON	046	45	00.00	121	48	36.00	0.853	0.011		60000	Longmire

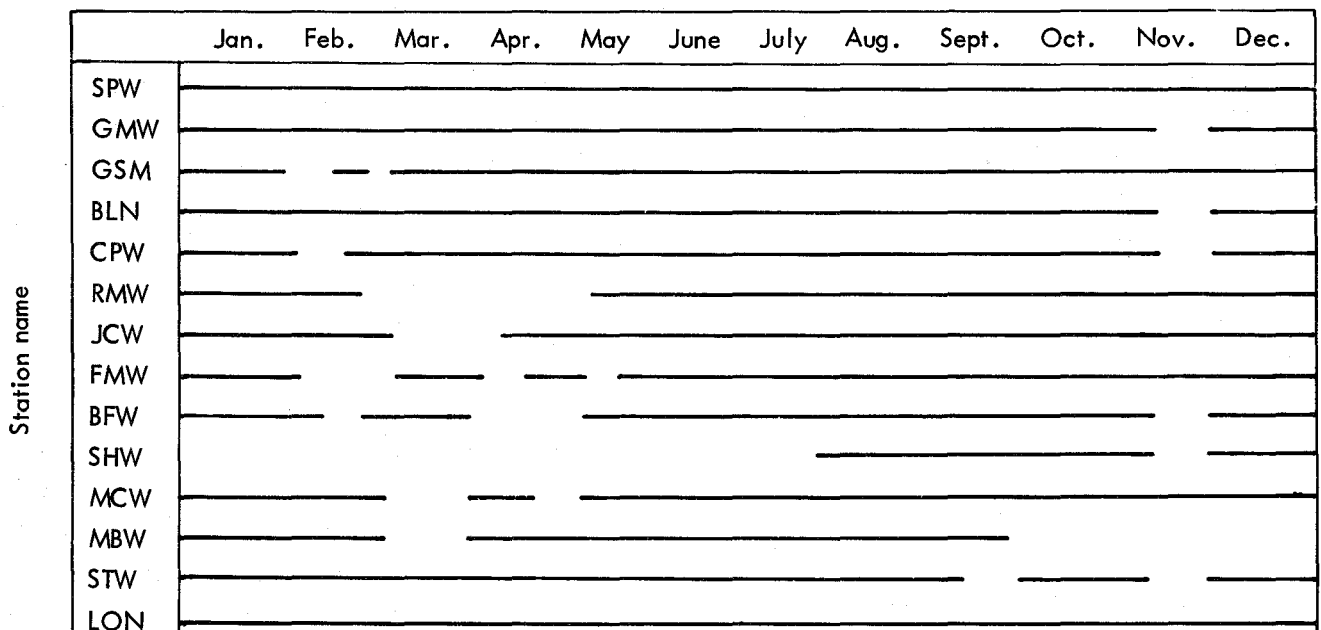


FIGURE 2.—Station activity graph. Solid lines indicate periods station is active.



adverse conditions. Access to lands and facilities for the purpose of station installation has been generously provided by the State Department of Natural Resources, U.S. Forest Service, Washington State Parks Commission, Weyerhaeuser Company, U.S. Navy, U.S. National Park Service, and the City of Seattle Parks Department. The U.S. Department of

the Interior, Geological Survey provided support for radio telemetering operations. Research support has been provided by the Earth Science Section, National Science Foundation, NSF Grant DES-69-00059 A03 (formerly GA-12826) and the U.S. Geological Survey under Grant 14-08-0001-G-120 and Contract 14-08-0001-14127.

#### REFERENCES CITED

- Crosson, R. S., 1974, Compilation of earthquake hypocenters in western Washington: Washington Division of Geology and Earth Resources Information Circular 53, 25 p.
- Crosson, R. S., 1975, Compilation of earthquake hypocenters in western Washington-1973: Washington Division of Geology and Earth Resources Information Circular 55, 14 p.



APPENDIX

## CATALOG OF EARTHQUAKES (1974)

Earthquakes located with the western Washington seismograph network are listed chronologically in this Appendix. The columns are generally self-explanatory except the following features should be noted:

- a) The origin time listed is that calculated for the earthquake on the basis of multistation arrival times. It is given in Coordinated Universal Time (UTC), which is identical to Greenwich Civil Time, in hours (HR), minutes (MN), and seconds (SEC). To convert to Pacific Standard Time (PST), subtract eight hours.
- b) The epicenter location is given in north latitude (LAT N) and east longitude (LONG E) in degrees, minutes and seconds.
- c) In most cases the depths, which are given in kilometers, are freely calculated by computer from the arrival-time data. In some instances depths must be fixed arbitrarily to obtain epicenter solutions. Such depths are noted by an F (fixed) in the column immediately following the depth.
- d) The residual standard deviation (SD) is taken about the mean of the station first-arrival residuals. It is only meaningful as a general statistical measure of the goodness of the solution when 5 or more stations are used in the solution. Good solutions are normally characterized by SD values less than about 0.4.
- e) NO is the number of station observations used in calculating the earthquake location. A minimum of three station observations are required and generally the greater the number of observations used, the better the solution quality.
- f) MAG is the local Richter magnitude as calculated using the coda length-magnitude relationship determined for western Washington. Where blank, data were insufficient or impossible to obtain for a reliable magnitude determination.
- g) SDMAG is the magnitude standard deviation. Where blank, either no magnitude was calculated or only one station observation was used to determine the magnitude.

## APPENDIX—Continued

	DY	HR	MN	SEC	LAT N	LONG E	DEPTH	SD	NO	MAG	SDMAG
JAN	2	8	55	14.0	47-19-28	121-54-53	39.6	.3	4	1.6	.3
	4	12	26	58.3	47-55- 4	121-38-56	10.6	.1	4	1.7	.1
	6	12	33	35.2	47-45-57	122-50- 7	50.3	.2	13	3.1	.3
	7	3	32	38.6	47-28-26	122-45-16	18.6	.1	7	2.0	.3
	8	0	59	42.0	47-35-40	121-48-52	11.5	.3	7	1.9	.4
	9	0	2	27.9	47- 3-48	121-35- 7	.5	.4	3	1.2	.0
	9	4	0	54.1	47-49-21	122-22-25	34.5	.1	4	1.3	.3
	10	5	6	49.5	47-28-33	121-42- 0	15.2	.2	5	1.7	.0
	12	1	5	35.3	47-25-54	121-35-35	9.3	.2	4	1.8	.3
	25	22	53	17.8	46-50- 5	122-20-39	.1	.3	9	1.9	.4
	28	10	49	46.1	47-24-52	122-43-51	22.5	.4	8	1.3	.4
FEB	3	18	21	34.5	47-37-20	122-19- 4	5.4	.2	4	1.7	.3
	3	19	36	25.3	47-38-16	122-19-43	1.0F	.2	4	1.9	.4
	8	5	8	10.3	47-21-10	123- 8-52	42.3	.1	6	1.5	.5
	9	9	43	44.3	46-52- 7	121-43-12	1.3	.3	6	2.3	.4
	11	3	18	39.3	47-28-51	122-16- 4	8.7	.2	8	2.2	.3
	11	8	2	9.7	47-29-27	122-14-37	10.1	.1	4	1.8	.4
	18	0	30	51.7	48-30-20	121-46-33	8.3	.4	5	1.7	.3
	24	8	31	15.3	47-53-28	122-12-22	25.2	.2	7	1.8	.5
	25	4	11	27.9	47-28- 1	122-55-51	16.4	.2	6	1.7	.3
	25	21	45	11.5	47-42-56	121-53-35	68.7	.4	3	1.0	.5
	27	9	7	54.0	47-48-51	122- 1-46	30.0	.3	7	1.8	.5
MAR	2	20	33	29.7	48-43-42	122-26- 7	12.3	.1	6	2.3	.3
	7	2	46	27.6	47-59- 2	122-30- 1	18.5	.4	8	1.9	.4
	14	2	38	58.8	47-12- 4	122- 8-58	24.8	.2	4	1.5	.5
	15	2	32	1.2	47-36-16	122-15- 2	8.8	.1	7	2.4	.3
	18	19	37	11.7	46-20-52	122-30-49	10.0	.1	5	1.9	.2
APR	7	3	33	33.8	47-31-24	122-21-49	24.1	.0	4	1.1	.3
	7	13	39	54.1	47-32-40	122-12-46	.4	.6	6	2.0	.2
	7	18	3	28.6	47-30-27	122-40-10	22.9	.5	5	.8	.4
	8	8	19	4.3	47-37- 3	122-17-53	7.9	.3	6	.9	.4
	9	9	14	46.3	48-37-50	123- 4-55	8.4	.3	5	1.4	.3
	11	2	24	30.9	47-35-36	122-19-16	7.2	.1	8	2.3	.5
	12	3	51	36.2	47-35-53	122-19- 9	8.7	.1	8	1.5	.5
	14	4	35	35.8	47-49-14	122-21-27	7.5	.1	4	.8	.2
	15	5	3	46.1	46-52-45	121-59-47	.0	.1	8	1.8	.4
	15	6	21	58.7	46-53-31	121-57-35	5.9	.4	9	2.4	.5
	17	13	4	35.5	46-45-56	121-53-50	23.0	.1	5	1.5	.5
	19	4	27	1.1	46-46-37	121-27-23	1.0F	.5	5	1.9	.5
	20	0	38	59.2	48-48-37	122-10- 5	4.7	.4	6	2.1	.5
	20	3	0	10.5	46-48-46	121-36-39	2.2	.3	10	4.7	.2
	20	3	9	34.6	46-50-56	121-42- 4	2.4	.2	9	2.3	.4
	20	21	2	58.7	47-55-39	122- 2-39	17.3	.1	7	2.1	.4
	21	2	39	49.0	47-24-41	122- 1-28	8.6	.2	5	1.5	.2
	21	3	35	33.8	47-26-12	121-52- 0	8.8	.0	4	1.6	.3
	21	6	3	59.9	46-45-14	121-32- 2	6.7	.3	10	2.4	.4
	21	14	8	54.5	46-45-39	121-33-20	6.3	.3	11	3.5	.5
	22	4	54	55.2	47-49-10	122-23-29	23.1	.1	7	1.6	.5
	24	4	21	48.9	46-48-10	121-39-16	8.4	.5	6	1.8	.5
	24	19	21	32.0	47-35-28	122-25-16	25.6	.2	8	1.0	.5

## APPENDIX—Continued

	DY	HR	MN	SEC	LAT N	LONG E	DEPTH	SD	NO	MAG	SUMAG
APR	25	14	41	8.4	47-30-11	122-21-52	23.8	.3	8	1.6	.3
	26	1	57	27.4	47-32-10	122-24- 9	20.0	.6	7	1.3	.3
	26	6	7	15.8	46-35-37	121-36-20	5.3	.1	4	2.1	.2
	26	7	42	44.9	47-59-57	123-11-33	2.1	.2	4	.9	.4
	26	16	58	5.2	46-54- 2	121-41-55	7.4	.3	6	2.2	.5
	27	14	51	25.8	47-26-53	122-18-27	.5	.0	4	1.6	.3
	30	3	5	14.9	48-26-48	122-48-57	9.2	.2	4	1.0	.3
MAY	4	7	38	47.5	48-54- 5	122-22-57	10.6	.2	5	1.3	.3
	4	10	25	5.2	48-42-35	122-24-60	5.8	.0	4	1.4	.5
	4	11	33	13.4	48-43-26	122-25-33	10.0	.1	4	1.4	.4
	5	14	54	2.8	48-22- 5	123-13-16	5.1	.0	4	.5	.4
	7	6	24	34.4	47-36-45	122-19- 8	6.2	.2	4	1.4	.4
	7	7	26	43.1	47-38-12	122-19-46	1.8	.1	4	1.2	.0
	7	9	44	14.5	47-35-56	122-19-18	7.3	.2	5	1.2	.0
	8	18	32	34.6	47-35-24	122-20- 6	8.5	.3	7	1.3	.5
	8	19	24	10.2	47-39-46	122-12-36	5.9	.6	7	1.3	.3
	9	23	10	22.7	47-35-23	122-19-55	8.2	.4	9	1.2	.4
	10	6	5	12.8	46-55-16	121-52-52	1.6	.4	5	1.5	.5
	12	2	49	21.9	48-13-35	123-21-59	37.9	.0	5	1.7	.2
	14	17	10	23.5	47-29-60	122-56-26	15.1	.2	6	1.6	.3
	15	17	40	24.6	48-17- 2	121-36-10	1.8	.2	5	1.8	.3
	16	13	4	36.4	48- 6-13	122-59- 3	52.6	.1	11	4.2	.3
	17	10	52	22.3	46-46-50	122-12- 7	8.9	.1	4	1.4	.6
	17	11	47	28.4	46-52-22	121-48-35	.6	.1	4	2.0	.4
	17	20	13	.7	48-25- 4	123-11-15	26.9	.3	12	2.2	.4
	19	13	17	24.3	47-37-55	121-34-10	6.1	.1	5	2.1	.3
	20	11	25	9.8	46-12-51	122-12-14	4.7	.1	3	1.6	.3
	20	18	39	58.8	47-24-42	122-50- 8	50.9	.0	3	1.2	.0
	21	15	47	25.9	46-12-51	122-11-42	11.2	.2	9	3.5	.4
	21	15	49	38.8	46- 4-38	122- 8-22	6.4	.1	3	1.3	.1
	22	0	30	15.7	47-35-50	122-19-18	7.2	.2	10	1.4	.4
	22	7	50	34.5	47-23-48	121-51-52	20.3	.4	5	1.6	.4
	22	7	51	28.2	47-24-49	121-51-57	17.8	.2	9	1.9	.3
	22	11	58	18.3	48-36-30	122-58-13	13.7	.3	12	3.1	.3
	22	12	22	2.5	47-20-48	122- 2-31	16.3	.3	13	3.0	.3
	22	12	49	40.1	47-20-26	121-48-42	19.7	.3	5	.9	.5
	22	15	11	18.4	47-26- 8	122- 4-37	19.3	.0	4	1.4	.3
	23	19	51	33.7	46-48-41	122-21-13	10.2	.1	4	.7	.5
	24	1	32	37.9	47-27-29	121-47-23	4.2	.2	4	1.2	.5
	24	8	5	56.6	47-27-21	122- 3-59	16.3	.1	11	1.9	.3
	24	15	13	25.6	47-19-40	123- 6-54	43.7	.2	10	2.0	.2
	24	21	5	42.7	47-25-19	122- 1-41	18.7	.2	9	2.2	.4
	25	6	59	20.9	47-57-22	121-53-10	22.3	.2	13	3.3	
	25	7	32	25.7	47-57-20	121-52-18	17.8	.1	6	1.9	.0
	25	12	42	6.0	47-57-28	121-54-58	21.9	.1	5	1.5	.5
	27	5	33	9.7	47-19-33	122- 0-28	18.8	.1	7	1.7	.2
	27	5	54	46.5	47-19-24	122- 0-33	19.2	.3	7	1.6	.3
	27	8	18	23.6	47-19-11	122- 2- 8	14.5	.2	6	1.1	.4
	27	11	1	43.2	47-20- 5	122- 2-45	11.4	.2	6	.6	.5
	28	19	37	5.6	47-51- 1	121-58-41	15.8	.5	6	1.4	.2

## APPENDIX—Continued

	DY	HR	MN	SEC	LAT N	LONG E	DEPTH	SD	NO	MAG	SDMAG
MAY	31	1	19	31.7	47-57-50	121-47- 6	9.7	.3	4	1.4	.1
	31	22	53	16.5	49- 6-53	122- 0- 4	.7	.5	6	1.8	.3
JUN	1	11	35	29.2	47-53- 5	122-35-15	16.1	.1	6	.6	.5
	2	9	21	52.4	47-27-57	121-50-56	20.5	.0	4	1.4	.3
	3	8	28	48.6	47- 1-48	122-34-34	17.9	.1	9	2.2	.3
	4	17	51	3.8	47-35-17	122-19-58	7.7	.2	7	1.6	.0
	4	18	41	48.3	47-34-46	122-23- 4	6.0	.0	3	1.4	.3
	4	22	43	50.3	47-34-30	122-20-38	7.8	.1	6	2.0	.2
	5	9	22	24.7	47-36- 3	122-16- 4	7.7	.3	6	1.7	.1
	6	22	16	31.5	48-43-57	123- 6-53	71.3	.2	8	2.3	.2
	8	9	42	29.9	47-35-13	122-20-47	7.2	.0	4	1.1	.4
	8	17	51	23.0	46-39-35	122-20-54	2.8	.0	4	1.4	.4
	8	18	4	34.1	46-44- 5	122-28-21	10.7	.1	5	1.5	.0
	10	6	6	55.8	47-39-55	122- 0-31	7.4	.1	5	.7	.3
	10	7	7	14.2	47-50-38	122-51-24	22.1	.2	12	1.9	.3
	11	0	26	33.5	46-49-13	121-53-51	21.2	.2	5	1.8	.4
	11	9	48	18.9	46-53-43	121-56-27	5.3	.5	6	2.1	
	12	5	10	24.3	46-40-41	121-54-55	10.9	.0	5	1.7	.5
	12	5	28	53.8	47-56-18	122-11-55	9.0	.1	5	1.4	.4
	15	2	22	47.0	47-17-45	122-17-51	21.0	.3	9	1.9	.4
	15	14	8	.7	47-50- 7	122-41-59	22.1	.0	5	1.4	.5
	16	7	10	41.5	47-21- 3	123-29- 1	8.1	.4	10	1.9	.4
	16	13	56	19.1	47-29- 6	121-38-53	2.9	.0	3	.6	.5
	16	18	5	59.6	47-22-28	122- 5-16	8.4	.3	5	1.4	.4
	18	15	15	34.2	47-24-54	121-49- 4	19.5	.3	7	1.9	.4
	20	10	28	54.3	47-33-56	121-41-27	10.8	.0	3	.9	.4
	21	16	1	8.9	47-46-41	122-42-60	20.7	.1	5	1.5	.4
	22	17	30	28.4	47-36-26	122-19-33	7.4	.2	8	2.0	.2
	23	0	54	55.5	47-35-20	122-19-49	8.0	.2	11	2.8	.2
	23	0	56	56.1	47-38- 8	122-19-57	4.2	.1	4	.6	.4
	23	1	28	37.9	47-35-41	122-20-16	7.7	.0	4	1.4	.4
	23	13	0	.3	47-26-24	121-45-22	23.2	.1	5	1.7	.4
	23	16	10	44.9	47-38-53	122-18-56	2.0	.5	5	1.2	.0
	24	1	8	12.4	47-35-10	122-21-37	7.3	.3	5	1.3	.3
	24	11	44	41.4	47-43-32	122-35-32	12.0	.1	3	.9	.0
	25	11	47	9.1	47-30-17	122-57-19	16.3	.1	5	1.0	.4
	25	20	31	32.6	48-34-20	123-33-27	8.4	.1	5	1.1	.3
	26	4	14	1.7	47-29-20	122-59-15	15.3	.2	7	1.2	.5
	26	5	16	4.2	47-35-37	122-19-39	7.5	.2	11	1.8	.3
	26	5	16	51.2	47-35-43	122-19-54	7.5	.1	6	1.5	.3
	26	5	18	39.3	47-36-39	122-19-25	7.4	.2	6	1.7	.3
	26	14	16	18.4	47-58-27	123-19-43	44.8	.2	7	1.5	.4
	26	18	53	27.5	47-30-32	122-58- 5	13.8	.2	5	1.1	.2
	27	19	21	40.7	47-36- 5	121-19- 1	11.4	.0	4	1.2	.0
JUL	2	5	18	20.6	47-57-11	121-53-51	16.9	.0	6	1.9	.5
	2	21	5	24.7	46-22- 7	123-23-49	2.1	.0	3	1.6	.3
	3	9	57	32.7	47-46- 1	122-26-58	19.3	.0	5	1.3	.3
	3	22	28	38.6	47-34-55	122-54-30	21.8	.0	3	.3	.2
	6	17	34	54.2	47-22-16	122- 3-49	4.3	.4	6	1.0	.4
	6	7	18	46.5	48- 6-33	122-48-28	53.3	.1	10	2.1	.2

## APPENDIX—Continued

	DY	HR	MN	SEC	LAT N	LONG E	DEPTH	SD	NO	MAG	SDMAG
JUL	9	10	46	56.6	48-23-50	123-10- 5	48.4	.0	5	1.4	.3
	9	19	50	31.7	47-19-50	122-40-40	25.1	.2	8	2.3	.2
	11	6	14	33.5	47-44-22	122-15-59	33.5	.4	7	1.8	.1
	11	14	58	54.2	47-44-22	122-19-36	24.2	.2	8	1.7	.1
	14	5	4	48.1	48- 1- 5	121-42-37	32.6	.0	4	1.0	.4
	14	19	54	9.4	47-24-44	121-49-17	18.4	.2	8	1.9	.1
	15	6	6	42.1	47-25-47	121-37-42	14.3	.1	4	.4	.5
	16	6	15	11.7	47-19-30	122-37-37	22.2	.0	5	1.0	.3
	17	16	21	58.7	47-34-44	121-54-22	8.4	.3	3	1.1	.2
	20	1	27	42.9	48- 1-56	123- 8-58	5.6	.0	4	.9	.3
	22	0	14	.4	48-18-13	121-40-17	9.4	.3	4	1.2	.2
	23	10	49	48.3	47-44-49	123-11-39	42.8	.2	9	1.4	.5
	23	10	58	40.3	47-34- 9	122- 4-20	13.3	.1	5	1.6	.4
	23	22	55	21.3	49- 0-46	121-47-26	2.9	.1	3	1.7	.1
	24	3	43	47.7	47-23-15	121-50-42	24.3	.3	10	2.2	.3
	29	3	28	30.8	46- 0-24	122-33-37	5.9	.3	9	2.8	.2
	29	14	10	56.3	45-52-19	122-34-10	3.5	.3	8	2.0	.3
	30	0	44	21.2	47-20-32	121-55-15	16.7	.0	4	1.7	.2
	31	20	34	57.7	46-14-43	122-11-59	9.7	.0	4	2.0	.4
AUG	2	9	56	58.2	47-37-57	121-35- 3	.2	.0	4	1.7	.2
	3	0	53	36.9	46-41- 8	122-42-24	5.2	.1	8	1.6	.4
	3	12	3	19.1	47-47-35	122-20-27	4.2	.0	4	1.5	.2
	3	19	47	5.9	46-30-11	122-26-45	10.2	.3	9	2.3	.3
	4	9	15	10.6	46-50-19	122- 0-11	3.3	.2	5	2.0	.3
	5	14	52	52.1	45-58-56	122-33-13	6.0	.1	4	1.6	.3
	9	10	11	57.0	47-24-41	122-29-25	22.0	.1	6	1.7	.0
	10	16	35	4.5	47-23- 0	121-52-26	16.7	.0	4	.7	.4
	10	21	52	28.2	47-23-32	122-43-41	23.8	.1	11	2.2	.5
	12	11	35	12.5	46-50-12	122- 0-25	1.7	.3	7	2.0	.4
	13	6	13	49.9	48-19-26	121-45-12	17.5	.1	4	1.5	.2
	14	17	18	5.4	46-44- 6	121-52-13	7.8	.0	5	2.1	.0
	15	23	33	4.0	47-18-49	122-24-11	5.5	.3	12	2.8	.5
	16	13	7	42.3	48-12-12	122-48-20	15.6	.1	4	1.9	.1
	17	11	8	38.0	47-24-33	121-49-27	20.1	.2	11	2.3	.4
	18	19	1	37.1	47-46-44	122-17-26	23.6	.2	13	2.1	.5
	19	8	17	.1	47-57-15	122- 9-46	31.1	.3	14	2.4	.5
	21	15	47	55.9	47-49-25	122-29-59	20.2	.2	8	2.0	.2
	22	4	4	4.1	47- 4- 9	121-31-57	3.0	.0	4	1.7	.3
	22	7	52	48.8	47-16-47	121-10-29	1.0F	.0	3	2.1	.0
	25	4	41	57.2	48-24-37	122-25-30	27.8	.2	8	1.9	.1
	25	10	58	51.7	47-30-19	122-51- 8	20.4	.1	5	1.4	.5
	25	17	35	34.2	48-47-15	123-12-44	16.2	.1	6	1.8	.4
	25	19	32	2.6	47- 9- 5	121-56-39	5.9	.0	3	1.4	.3
	27	7	13	57.4	47-55-10	122-54-40	20.7	.4	13	2.2	.6
	27	10	4	33.1	47-15-50	122-17-42	14.2	.0	4	.9	.2
	29	13	36	.1	47-23-18	123-15-59	4.6	.3	6	1.5	.2
	30	18	23	45.9	46-59-43	121-43-45	8.7	.1	4	1.8	.4
	30	19	23	38.2	47-47-51	122-45-35	20.6	.1	6	1.2	.5
	30	21	26	42.1	47- 6-38	123- 6-41	4.4	.0	3	1.3	.2
	30	21	48	33.5	46-49-22	122-20-49	11.1	.6	5	1.3	.5

## APPENDIX—Continued

	DY	HR	MN	SEC	LAT N	LONG E	DEPTH	SD	NO	MAG	SDMAG
AUG	31	15	7	26.7	46-31-25	122-21-23	4.7	.1	9	2.0	.4
SEP	5	2	29	19.8	48-13-37	122-56-34	52.1	.3	8	1.8	.3
	5	14	2	31.0	46-52- 6	121-48-42	3.1	.6	8	2.0	.5
	6	4	58	2.6	47-39-42	122-23-14	23.0	.2	11	2.2	.3
	10	14	46	2.8	47-36- 7	121-44-24	13.4	.1	5	2.0	.2
	11	23	7	27.6	47-11- 6	121-30-53	1.3	.1	4	2.0	.4
	11	23	28	40.6	47-31-13	122-46-51	5.6	.0	3	1.0	.5
	13	13	44	36.3	46-45-19	121-58-43	1.1	.3	10	2.6	.2
	14	2	56	26.1	47-49-44	122-14-47	22.5	.2	8	1.1	.4
	16	8	14	4.9	48-35-46	121-59-59	9.5	.2	4	1.7	.1
	17	3	25	18.9	47-25-24	121-29-18	11.9	.1	3	1.6	.3
	17	13	36	37.6	48-49-54	122- 9-24	6.3	.3	7	1.8	.4
	18	7	27	7.4	48-16-15	123-11-15	46.7	.2	8	2.2	.3
	19	4	52	7.4	47-23-39	122- 5-32	7.8	.2	7	1.9	.4
	19	12	14	10.6	46-42-57	122- 0-56	.1	.2	6	1.9	.5
	20	5	10	13.5	47-34-41	122-40-44	11.6	.2	5	1.0	.4
	23	20	3	41.6	46- 0- 6	122-34-58	3.4	.4	9	2.4	.2
	24	14	12	21.6	47-32-36	121-44-38	19.5	.2	6	2.1	.3
	25	3	5	57.8	47-32-39	121-50-14	22.3	.0	4	1.6	.2
	25	3	16	34.2	48-12-37	123-14-34	41.1	.4	6	2.1	.6
	25	7	21	17.9	47-32-36	121-46-58	20.3	.0	4	1.8	.3
	27	23	51	51.8	47-50-58	121-58-34	13.7	.1	5	2.1	.1
OCT	1	15	28	36.6	48-13-12	123- 0- 8	29.4	.3	8	2.3	.2
	2	6	55	7.6	46-15-58	122- 2-48	8.9	.1	9	2.2	.3
	7	5	49	45.7	46-24-39	122-15-59	1.4	.3	12	2.5	.3
	14	0	5	54.0	46-50-14	122-39-54	8.0	.3	10	2.5	.4
	15	19	11	25.4	46-40- 4	122-50-37	57.9	.1	4	1.1	.2
	15	23	21	9.8	46-41-37	122-28-60	3.1	.1	5	1.3	.4
	16	2	24	3.2	46-24- 4	122-17-55	3.7	.3	7	1.5	.2
	16	6	26	45.9	46-20-28	122-17-26	9.4	.0	4	1.5	.4
	16	10	29	28.6	47-18- 6	122-24-45	6.4	.1	9	1.4	.4
	16	23	20	26.4	46-42-30	122-29-60	5.0	.2	5	1.1	.2
	19	18	30	45.6	48- 2-34	122-43-42	10.0F	.4	4	1.4	.0
	20	2	15	42.3	46-37-42	123-12-26	1.1	.4	6	2.0	.3
	21	21	21	59.1	46-10-14	121-57-44	1.5	.4	5	2.1	.5
	22	2	22	47.0	45-55- 0	122-31-32	4.1	.1	4	1.8	.2
	22	3	44	47.1	46-17-20	122-13-13	20.7	.0	3	1.9	.5
	22	23	41	32.7	47-29-46	121-37-39	2.3	.1	4	2.0	
	24	6	4	19.3	47-28-60	121-57-15	19.9	.3	6	1.9	.3
	24	6	51	18.5	47-34-29	122-50-14	24.0	.2	7	1.7	.3
	24	22	59	53.9	46-44-15	122-23-47	25.4	.0	4	1.9	.5
	25	4	29	5.5	47-23-25	122-31- 6	22.1	.2	7	2.0	.0
	27	7	18	11.3	48-29- 1	123- 4- 6	25.4	.3	4	1.4	.1
	29	2	46	21.0	47-57-36	121-53- 5	14.8	.2	6	2.0	.1
	29	5	8	18.0	48-17-48	122-42-18	26.7	.3	6	2.0	.2
	29	13	31	42.3	46- 0- 9	123- 8-14	32.9	.2	3	1.9	.5
	31	7	41	18.5	47-47-54	122-46- 5	23.2	.0	4	1.7	.6
	31	23	38	9.5	47- 7-20	121-40-59	.3	.1	4	1.9	.0
NOV	1	5	24	13.1	46-40-15	122-13- 5	59.8	.2	5	1.9	
	1	20	22	58.6	48-40-36	123-12-52	57.6	.2	13	3.5	.2



## APPENDIX—Continued

	DY	HR	MN	SEC	LAT N	LONG E	DEPTH	SD	NO	MAG	SDMAG
NOV	1	23	56	28.4	48-30-23	122-21-49	23.5	.3	4	2.4	.3
	2	16	40	30.0	48-34-19	122-29- 4	8.8	.2	3	2.0	.4
	4	4	45	16.6	47-34-38	122-15- 1	6.3	.2	8	2.2	.4
	4	11	46	47.7	47-47-40	122-19-22	30.7	.0	4	1.7	.1
	5	14	44	17.4	46-55-26	121-58-25	11.5	.4	6	2.2	
	5	17	24	28.4	47-12- 4	121-41-56	.3	.1	4	1.6	.4
	6	1	25	33.2	46-42-26	122-41-55	4.6	.3	9	2.2	.2
	6	9	29	26.0	47-24-32	122- 0-33	21.7	.1	6	2.3	.3
	7	20	5	29.1	47-21-31	121-23-14	1.0F	.5	4	2.4	
	7	23	44	9.3	46-22-14	122-23-56	8.9	.3	5	1.9	.1
	8	19	48	33.8	46-41-53	124- 5-32	1.0F	.6	5	2.0	.5
	9	0	31	54.3	46-44-56	122-50-33	9.8	.2	6	2.8	
	11	23	11	45.0	47-29-19	122- 0-16	24.9	.1	9	2.3	.5
	12	15	36	39.5	49- 1-51	122-21-41	1.0F	.2	4	2.2	.4
	13	17	58	44.9	46-47-24	121-59-49	21.2	.0	4	2.0	
	14	5	11	3.1	47-25-57	122-53-27	5.9	.6	7	2.0	.5
	14	9	16	42.4	47-57-41	121-49-42	19.6	.3	5	1.9	.2
	14	20	57	2.6	46-44-37	122-18- 4	.0	.1	4	1.6	.2
	15	3	8	.3	46-34-59	121-50-13	5.1	.3	9	2.2	.5
	15	8	30	42.3	47-29-46	121-51-29	9.9	.1	5	1.8	.3
	15	13	49	39.2	48-31-52	122- 0-19	2.9	.2	8	2.2	.5
	15	21	15	51.3	46-29-12	123-24-44	2.9	.0	3	1.7	.3
	15	21	30	38.6	47-51-25	121-58-28	18.4	.1	4	1.5	
	15	22	29	31.5	48-12-55	121-51-56	6.3	.1	3	1.9	.1
	16	8	22	34.5	47-53- 5	122-47-52	9.1	.1	4	1.5	.1
	16	10	37	5.6	47-55-21	122-23- 9	20.1	.1	4	1.3	.3
	17	5	53	56.5	47-50-30	121-58-37	25.6	.1	4	1.9	.2
	17	9	1	53.5	47-17-33	122-47- 4	16.3	.3	5	1.3	.5
	18	15	3	59.8	47-12-39	121-39-39	5.0	.0	4	1.8	.5
	19	12	38	11.4	48-27-50	121-42-52	10.5	.0	3	2.2	.4
	19	12	39	46.5	46-51-24	121-45-50	4.0	.3	4	2.1	.1
	22	20	3	30.9	48-26-40	122-12-30	9.2	.4	4	1.2	
	23	6	34	51.6	47-27-57	121-49-16	15.3	.4	3		
	23	11	18	47.5	46-48-54	121-34-28	2.1	.3	6	2.0	.2
	25	1	47	19.8	48- 9-54	122-44-41	23.9	.3	3	1.8	.3
	27	12	0	20.8	47-58-41	122- 1-57	35.5	.1	4	1.8	.3
	28	0	14	48.5	46-31-30	121-54- 7	7.1	.3	8	1.8	.3
	29	21	47	36.1	47-32-17	122-44-18	19.1	.0	5	1.5	.4
	29	23	4	35.2	46-42-38	122-26-39	27.1	.2	10	1.5	.4
DEC	1	3	1	13.2	47-27-10	122-17-25	21.0	.1	7	1.6	.3
	1	3	28	49.7	47-28-53	122-17- 0	24.2	.1	9	1.9	.1
	1	6	23	57.8	47-35-58	122-19-15	7.2	.3	11	2.9	.3
	1	7	33	59.7	47-37-18	122-19-27	6.9	.3	5	1.4	.1
	1	7	38	48.6	47-36- 6	122-19-12	8.1	.1	7	1.3	.3
	2	4	17	39.8	46-20-52	122-12-26	18.5	.1	4	1.7	.3
	2	16	20	19.6	47-28-43	122-17- 2	23.4	.0	5	1.6	.3
	2	22	3	26.2	46-32-35	121-53-41	4.6	.2	6	1.3	.5
	5	20	6	1.8	48-41- 5	121-54- 2	11.7	.3	4	2.3	.5
	5	21	20	31.6	46-29-14	123-15-39	3.8	.2	7	1.5	.3
	5	21	30	28.9	46-15-59	122-23-37	12.4	.1	3	1.0	.5

APPENDIX—Continued

	DY	HR	MN	SEC	LAT N	LONG E	DEPTH	SD	NO	MAG	SDMAG
DEC	8	12	24	23.5	48-24-35	122- 4-43	30.2	.5	10	1.8	.3
	9	9	58	58.2	46-47- 4	121-53-47	8.7	.2	7	1.9	.3
	10	7	21	57.8	45-39-53	122-51-13	1.0F	.1	8	2.1	.3
	15	17	58	6.1	48-30-15	122- 3-29	1.2	.5	13	2.8	.2
	15	18	6	58.9	48-30- 3	122- 4-29	1.0	.6	11	2.1	.3
	24	15	49	6.5	47-17-55	122-14-40	31.2	.3	3	.5	.4
	25	21	20	8.0	47-37-45	122-34-10	12.7	.0	3	1.4	.3
	27	3	29	46.2	47-35-18	122-30-28	26.3	.2	5	1.2	.1
	28	16	59	37.1	47-30-23	122-15-28	7.2	.2	5	1.4	.6
	28	17	8	28.3	47-29-58	122-16- 5	16.6	.0	3	1.0	.5
	29	9	22	50.9	47-36-60	122-19-40	1.0F	.1	4	1.5	.2
	30	11	53	13.3	47-22-42	122-40-13	25.1	.1	8	2.4	.2
	31	13	22	44.7	47-22-52	122-44-14	23.1	.0	4	1.1	.2
	31	16	17	39.7	48- 9- 2	122-36-51	24.3	.0	3	1.5	.2