UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

Oregon Seismicity - August 1980 to October 1982

by

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INTRODUCTION

In the summer of 1977 a sixteen station seismic network was installed around Mt. Hood by the U.S. Geological Survey for "the dual purpose of monitoring local earthquakes and recording teleseismic arrivals for a study of the P-wave velocity structure of the crust and upper mantle." (Weaver, and Others, 1982) The Mt. Hood network operated continuously until December 1978, when thirteen stations were removed. The three remaining stations continued to operate and in early 1980 were incorporated into the thirty-two station Oregon Cascades Network. This new network was intended to provide both continued data for deep structure studies, using teleseisms, and to act as an early warning system for any increase in volcanic activity along the Cascade Range within the state of Oregon. The 1980 eruption of Mt. St. Helens in Washington State emphasized the need for the continued monitoring of the Cascade Range. This network has also enabled monitoring of local and regional events, significantly enlarging the very limited seismic data base previously available for the state of Oregon.

Beginning July 6, 1980 a significant increase in seismic activity in the vicinity of Mt. Hood was recorded by the Mt. Hood network.(Rite and Iyer, 1981) This activity continued through the 16th of July, prompting continued monitoring of seismic activity along the Oregon Cascades Range.

This report provides a catalog of 85 local and regional earthquakes recorded by the thirty-two station network. Also included are 152 events located in northern Oregon and southern Washington by the U.S. Geological Survey in Seattle. The data from the Oregon Cascades network, includes readings from five seismic stations in western Oregon operated by the Oregon State University, Corvallis.

INSTRUMENTATION

The telemetered seismograph system used is illustrated schematically in Figure 1. The equipment included a vertical-component 1-Hz seismometer (usually Mark products, Model L-4C). Each field installation also contained a preamplifier and voltage-controlled ocillator (U.S.G.S., Model J402) and batteries. The frequency-modulated tone produced at each station was carried by radio (or occasionally telephone wire) to a terminal (receiver site, Table 2) where it was combined with the tones of up to seven other stations. The resulting frequency-multiplexed signal was transmitted by voice-grade telephone circuits to the USGS office in Menlo Park, California.

The data from each line were recorded on one-inch analog magnetic tape. Some of the channels were demultiplexed and demodulated by discriminators and recorded on 16-mm photographic film using a Develocorder (Teledyne, Geotech, model FR-400). The develocorder records seismic signals of up to seventeen stations. In addition, timing signals from WWVB and an internal chronometer were recorded simultaneously with the seismic signals. The overall response of the seismic systems for typical stations is shown in Figure 2 (Stewart and O'Neil, 1980)

Magnification for individual stations was adjusted according to the backround noise level in steps of approximately 6 decibels. Precise calibrations indicate that most stations were operated at magnifications of 25,000 to 100,000 at 1Hz.

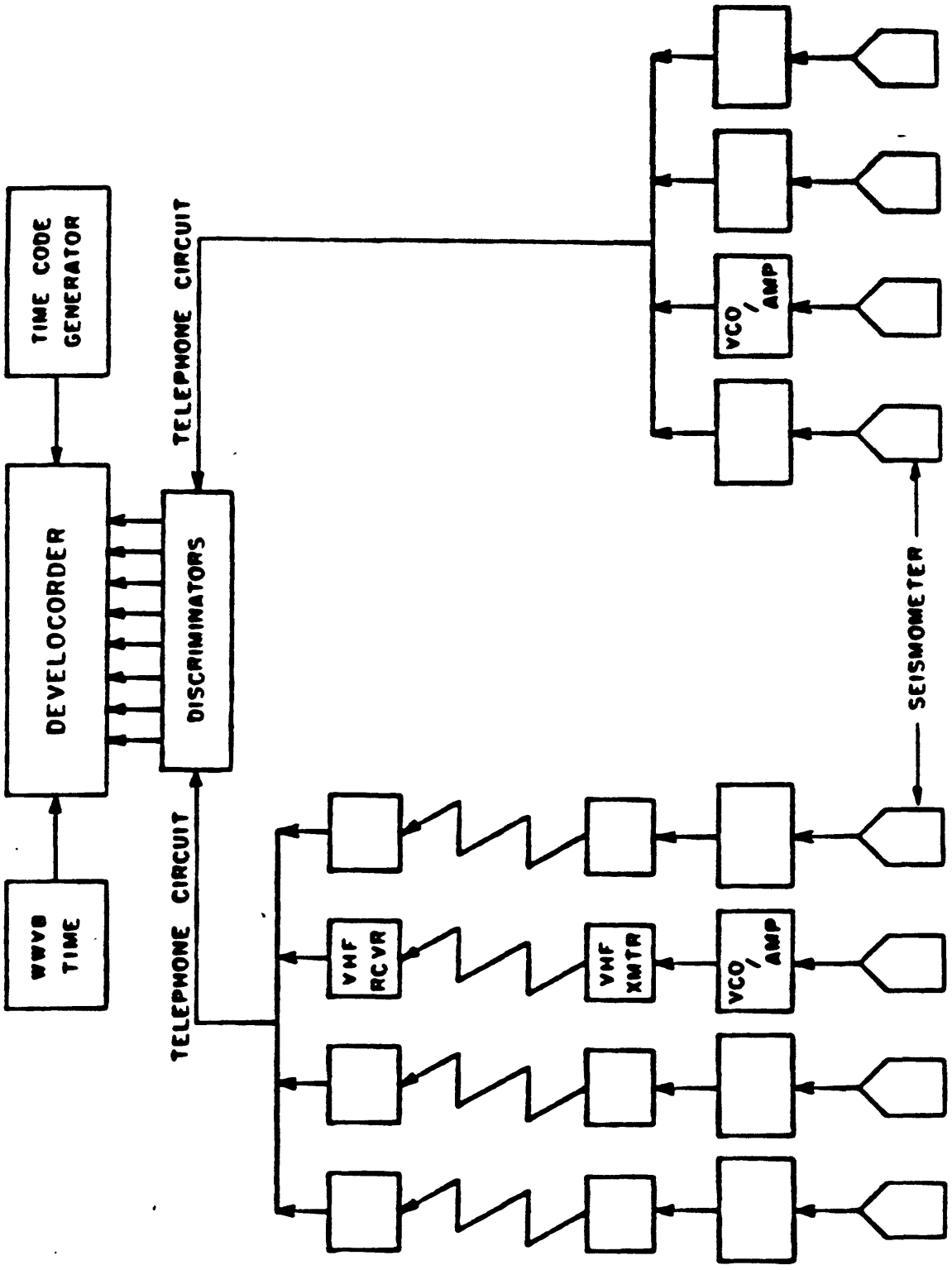

Figure 1. Block diagram of the USGS telemetered seismograph system.

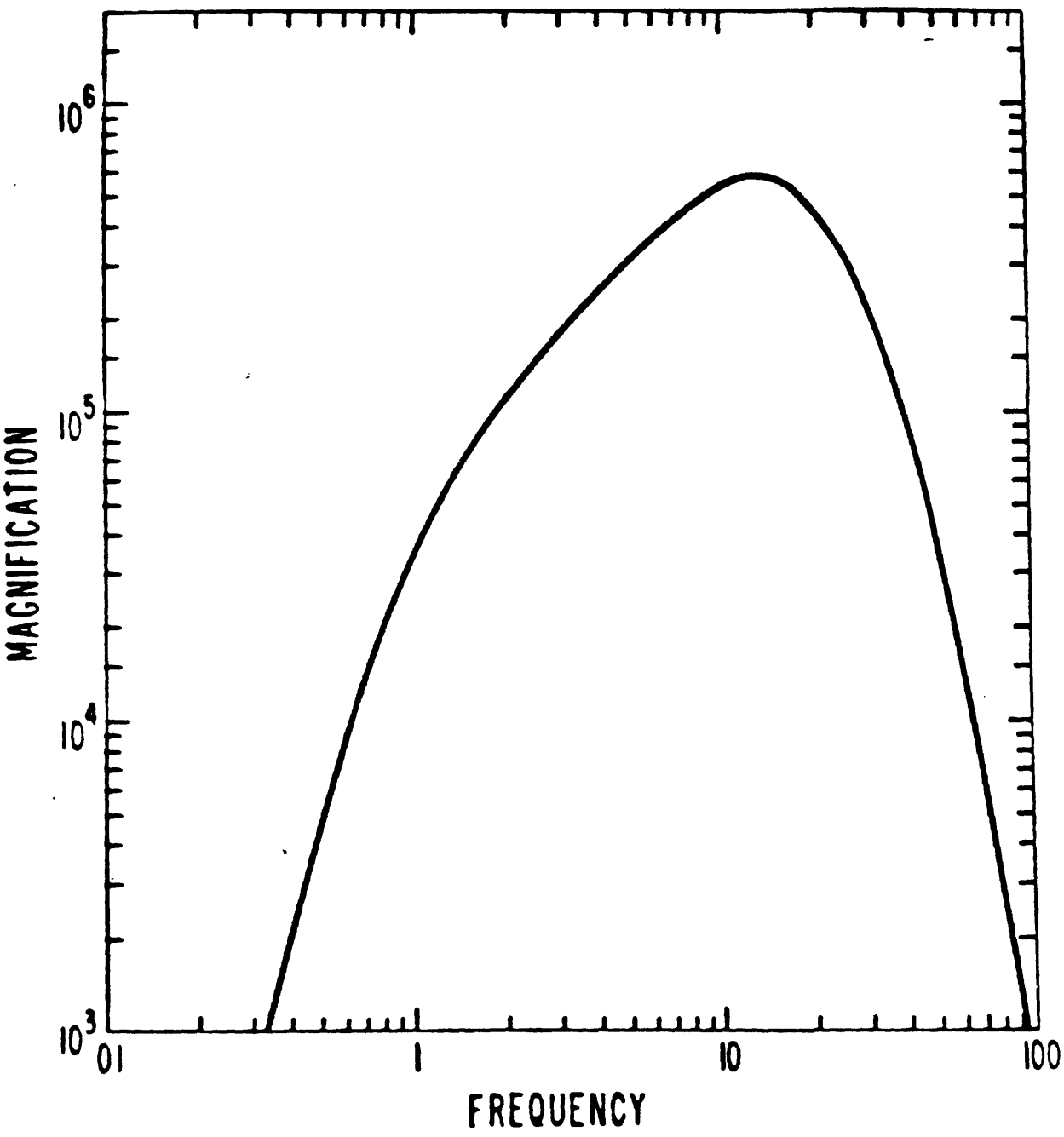

Figure 2. System Response of an U.S.G.S. telemetered seismograph station. This magnification curve os obtained for a system (L-4C seismometer, U.S.G.S. J402, VCO/Amplifier with attenuation set at 12 db, Develco Descriminator, and Geotech Develocorder).

Average station spacing was approximately 50 km, providing only a very coarse coverage of the Oregon Cascades. Station code names, locations, elevations, attenuations settings and those stations on the Oregon (ORE) develocorder film are shown in Table 1. Locations of these stations are plotted on Figure 3. I have included the five University of Oregon stations and six U.S.G.S. stations operated by the University of Washington in Table 1. Station histories, installation dates, relocation dates and removal dates for the U.S.G.S stations are shown in Table 2.

Monitoring of the stations north of Crater Lake was taken over by the U.S.G.S. at the University of Washington on November 8, 1982. Currently VAB, VBR, VPE, VRH, VCL, VWM and VWB (covering the area around Newberry Crater and Crater Lake) are still being telemetered to the USGS in Menlo Park, California. The remaining stations were ultimately removed.

DATA PROCESSING AND ANALYSIS

Normal processing followed these general procedures:

1. Develocorder films were scanned visually to detect earthquakes.

2. Signals from local, and occasionally regional, events identified during scanning were played back on paper using a high-speed oscillograph system.

3. Arrival times of P-waves, available S-waves and coda lengths were picked. This phase information was processed using HYPO71 computer location program.(Lee and Lahr, 1972)

Develocorder films, containing the telemetered seismic data of seventeen of the thirty-two stations, were scanned manually on a film viewer (Geotech, model 6585). From the beginning of the study through December 1980 the 16-mm Develocorder films were run at real-time speed. These films were changed everyday at approximately 1500 GMT. On January 1, 1981 the recording speed was slowed to accomodate two days of data on one film and were changed at approximately 2400 GMT.

The films were scanned to identify local, regional and teleseismic events. For identified events the following information was recorded on scan sheets: type of event, first station arrival time, first station code name, direction of first motion, maximum amplitude and signal duration. Detailed information on scanning criteria can be found in Table 3.

All local and some regional events were then played back on a Siemans ocillograph system, producing a 1-cm/sec paper record for all the thirty-two stations. An observed response curve for the ocillograph recording system with it's Tri-Com discriminator and low-band filter is illustrated in Figure 4. (Stewart and O'Neil, 1980).

Manual picks were made from these records for P- and S-wave arrival times, first motions and coda lengths. Most events were located with only P-wave arrivals but S-wave arrivals were included whenever readable. These data were then entered into the U.S.G.S. UNIX PDP-11/70 computer system and located using the computer program HYPO71 written by Lee and Lahr (1972).

TABLE 1. STATION DATA

USGS (Menlo Park)
TELEMETERED STATIONS

CODE	LAT N	LONG W	ELV.	ATTENUATION SETTING	DEVELOCORDER FILM
VAB	42 42.60	121 42.73	1840	18	ORE
VBE	45 03.62	121 35.21	1544	12	ORE
VBP	44 39.66	121 41.34	1876	12	ORE
VBR	42 32.10	122 17.83	2008	18	
VCL	42 54.06	122 08.14	2103	18	ORE
VCM	42 05.80	121 59.68	1889	18	ORE
VCP	44 40.27	122 05.37	1161	6	ORE
VFB	43 39.51	120 14.25	1369	12	
VFX	43 36.68	120 50.57	1841	24	
VGB	45 30.94	120 46.60	728	18	
VGM	43 35.54	122 32.76	1561	12	
VGP	44 29.00	122 34.89	1212	6	
VGT	45 08.99	122 15.92	993	12	ORE
VHB	42 47.12	121 21.00	1957	12	ORE
VHE	45 19.72	121 40.46	1739	18	ORE
VHH	45 15.88	123 18.57	533	12	
VHO	45 13.15	123 43.52	951	12	
VHY	42 25.87	121 02.92	2963	6	ORE
VIP	44 30.49	120 37.13	1731	12	
VJY	44 54.13	120 58.45	951	6	
VLM	45 32.36	122 02.31	1158	12	ORE
VLO	44 52.74	122 23.58	1351	6	
VMH	44 08.28	122 24.44	902	12	ORE
VMN	45 11.21	121 03.18	555	6	
VNP	43 07.80	121 59.93	1774	30	ORE
VPE	43 47.45	120 56.68	1932	12	ORE
VPM	43 11.60	120 39.98	1387	12	
VRB	44 36.05	121 16.21	743	18	
VRH	43 42.27	121 42.27	1814	24	
VSB	43 31.42	121 20.84	1665	18	ORE
VSC	43 22.35	123 03.79	1295	12	
VSM	44 57.62	123 07.65	290	18	
VTC	44 14.42	121 39.92	1683	18	ORE
VTD	45 32.72	121 18.69	305	12	ORE
VTH	45 10.87	120 33.63	773	6	
VWB	43 54.82	121 33.27	1734	18	ORE
VWM	43 18.30	121 42.95	2158	18	ORE

Stations indicated as being on develocorder were used at various times during this study.

Table 1. (continued)

U.S.G.S. STATIONS at U. of W.

CODE	STATION NAME	LAT N	LONG W	ELEVATION
VFP	Flag Point	45 19.09	121 27.91	1722
VLL	Lawrence Lake	45 27.80	121 40.75	1195
VMA	Mt. Adams	46 08.80	121 35.51	1370
VMD	Mt. Defiance	45 39.16	121 42.73	1317
VRM	Red Mountain	45 56.14	121 49.14	1510
VWC	Wolf Camp	45 14.51	121 47.82	1457

These stations were recorded in Menlo Park from March 5, 1981 through July 15, 1981.

UNIVERSITY OF OREGON STATIONS

CODE	STATION NAME	LAT N	LONG W	ELV.
ALO	Ashland	42 12.00	122 42.00	548
COR	Corvallis	44 35.16	123 18.18	126
KFO	Klamath Falls	42 15.30	121 47.20	1320
LGO	La Grande	45 19.23	118 05.30	858
PLO	Portland	45 27.07	122 39.98	107

LGO was removed 1/11/82.

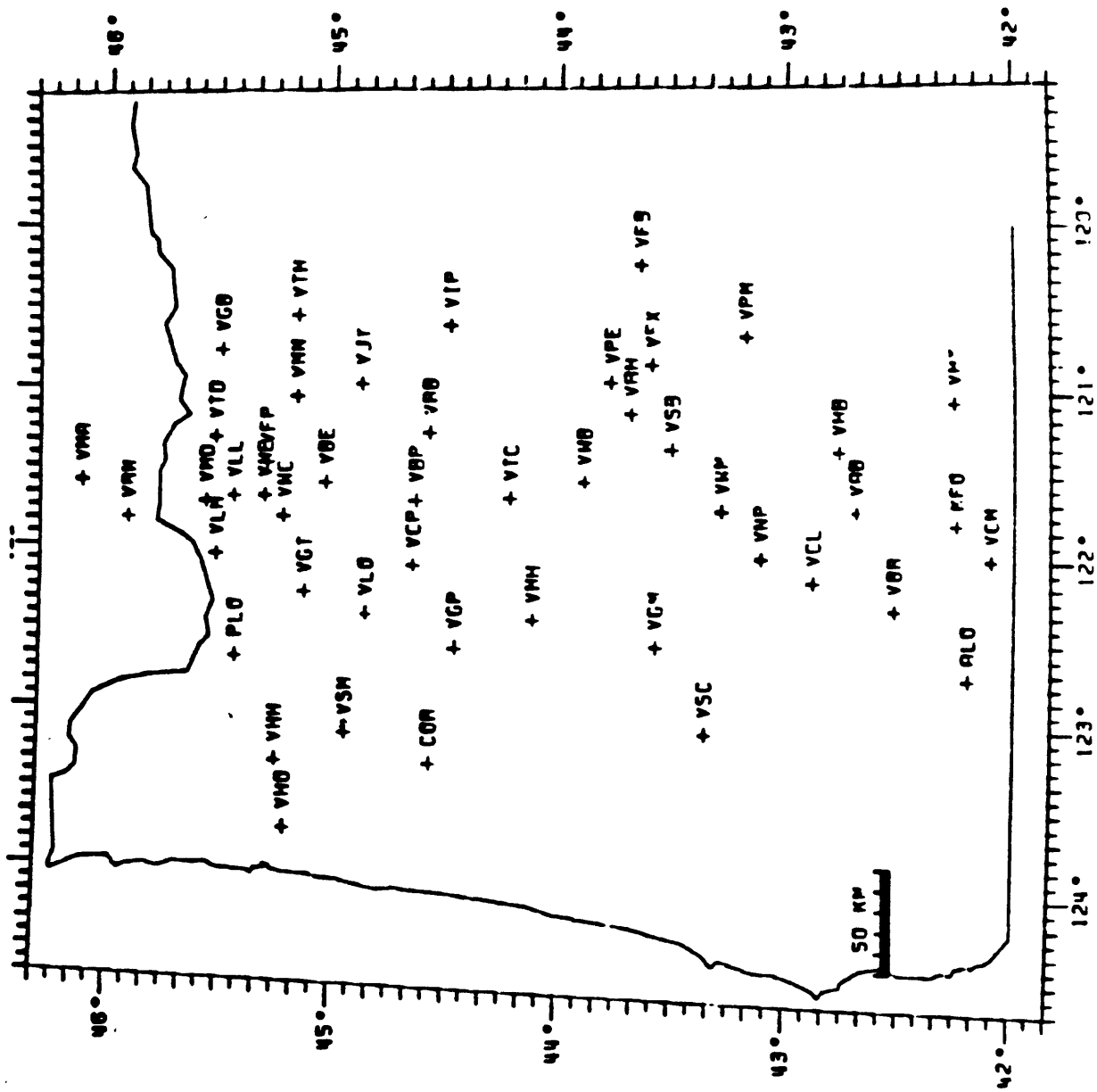

Figure 3. Station Locations

TABLE 2. STATIONS HISTORY

#	STATION	NAME	INSTALLATION DATE	NEW INSTALLATION	REMOVED
Receiver Site : Salem (VSM)					
1.	VHO	Mount Hebo	04/17/80		10/28/82
2.	VHH	High Heaven	05/17/80		6/18/82
3.	VLM	Little Larch Mt.	06/14/80		10/28/82
4.	VGT	Goat Mountain	04/16/80		11/08/82
5.	VLO	Lookout Mountain	06/14/80		10/28/82
6.	VCP	Cooper's Ridge	05/16/80		10/28/82
7.	VHE	Mount Hood East	10/26/79	07/24/80	**
8.	VSM	Salem	04/15/80		10/14/82
Receiver Site : Mount Hood (TimberLine Lodge)					
1.	VGB	Gordon Butte	04/11/80		10/29/82
2.	VTH	The Trough	03/25/80		11/08/82
3.	VMN	Maupin	03/23/80		06/15/82
4.	VJY	Jersey	03/24/80		11/08/82
5.	VBE	Beaver Butte	10/25/79		11/08/82
6.	VBP	Bald Peter	10/24/79		11/08/82
7.	VIP	Ingram Point	12/11/79		11/08/82
8.	VTD	The Dalles	03/22/80		12/21/81
Receiver Site : Eugene (WISTEC)					
1.	VGP	Green Peter	05/12/80		11/08/82
2.	VMH	Mount Hagan	05/09/80		11/08/82
3.	VGM	Grass Mountain	05/11/80		08/09/82
4.	VSC	Scott Mountain	05/13/80		11/08/82
Receiver Site : Round Butte Dam (VRB)					
1.	VTC	Trout Creek Butte	11/17/79	06/10/80	11/30/82
2.	VRB	Round Butte	11/19/79		06/14/82
Receiver Site : Pine Mountain (VPE)					
1.	VFB	Frederick Butte	01/24/80		06/13/82
2.	VPM	Patrick Mountain	01/22/80		06/13/82
3.	VSB	Spring Butte	11/18/79		06/13/83
4.	VWM	Walker Mountain	11/16/79		**
5.	VWB	Wanoga Butte	11/17/79		**
6.	VPE	Pine Mountain	12/06/79		**
7.	VRH	Red Hill	08/16/82		**
8.	VFX	Fox Butte	09/16/82		07/15/83
Receiver Site : Chase Mountain (VCM)					
1.	VAB	Applegate Butte	08/25/82		**
2.	VBR	Blue Rock	09/15/82		**
3.	VCL	Crater Lake	11/16/79	06/29/82	**
4.	VHB	Hamilton Butte	7/26/80		06/13/82
5.	VHY	Horsefly Butte	6/16/80		06/13/82
6.	VCM	Chase Mountain	12/5/79		10/29/82
7.	VNP	North Point	08/09/82		07/17/83

** Station is still operational

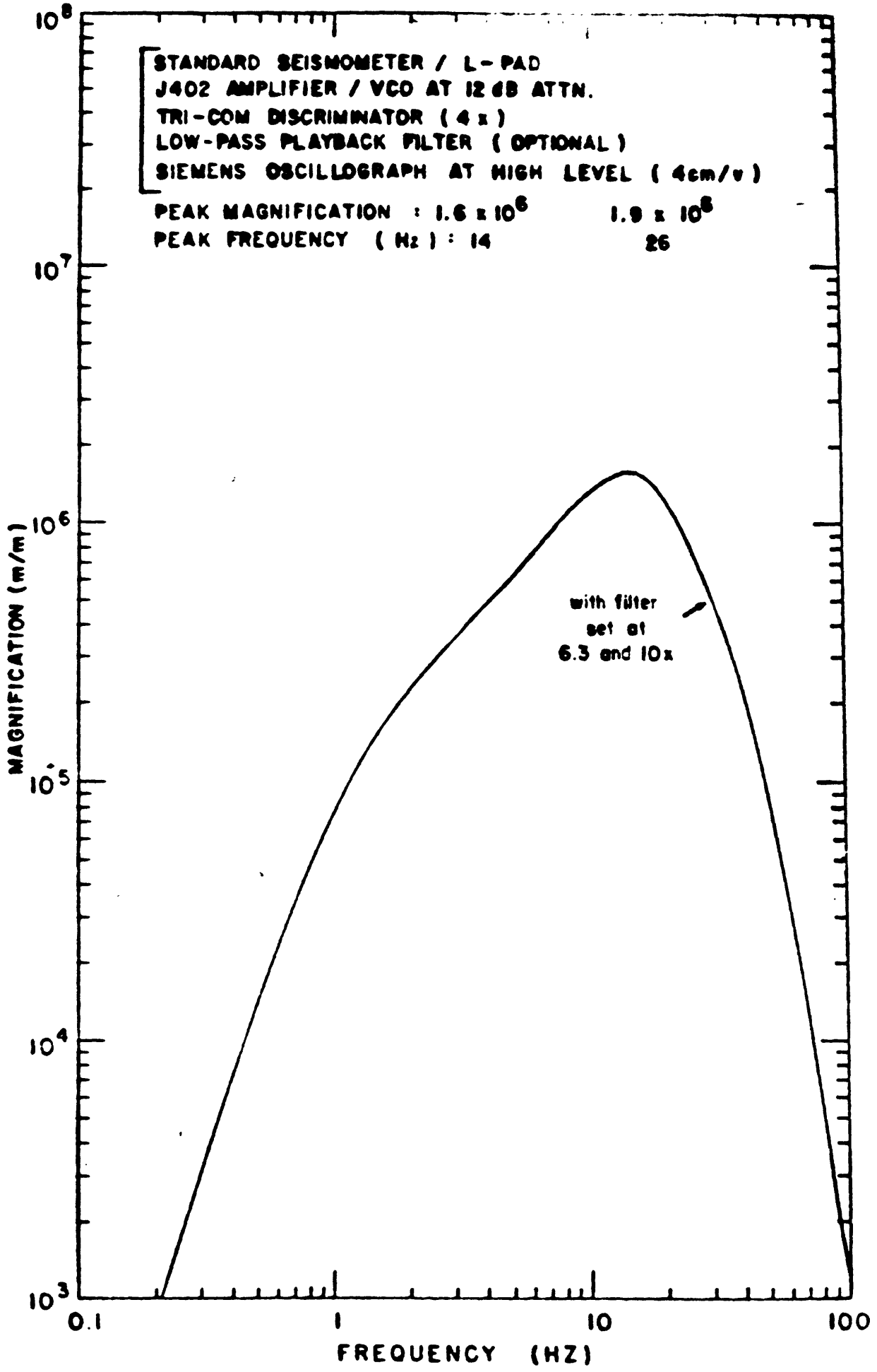

Figure 4. System response curve Seimans oscillograph using a Tri-Com Discriminator (4x) and a low-pass playback filter

During the final preparation of this catalog all the phase data were also run on the U.S.G.S VMS VAX-11/780 computer system using the location program HYPOELLIPSE (Lee and Lahr, 1980). This program provides a detailed standard error ellipsiod for each hypocenter. Events that had very large errors were then removed from this catalog.

The computer programs HYPO71 and HYPOELLIPSE use Geiger's method (Geiger, 1912) to determine hypocenters by minimizing the residuals between observed and calculated travel-times in a least squares sense. Travel-times from a trial hypocenter to the stations and their partial derivatives are computed on the assumptions of a horizontally multilayered velocity model, a technique introduced by Eaton (1969).

The crustal model used for both HYPO71 and HYPOELLIPSE was obtained from a preliminary version of Leaver's (1982) study of the crust and upper mantle of the Oregon Cascades. The crustal model is as follows:

LAYER	DEPTH to top (km)	P VELOCITY(km/sec)
1	0.0	2.8
2	0.85	5.20
3	2.65	6.10
4	6.34	6.38
5	11.00	6.82
6	38.80	7.90

The method used for estimating the Richter magnitude of earthquakes is described by Lee and others (1972a). In brief, the magnitude of an earthquake is based on the average of magnitudes estimated at various stations. Station magnitude (M) is derived from its recorded signal duration or coda (τ) in the following equation:

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

where Δ is the epicentral distance is in kilometers. The signal duration, or coda, is defined 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 the Geotech film viewer.

Monthly summary locations were plotted on a map using the Maplot graphics program (Nowack, 1980), on the Multics/Honeywell computer. In April, 1982 plotting was begun on the VMS/VAX computer utilizing the QPLOT graphics program (Klein, 1982).

Each month, a seismicity map and a summary report were mailed to State and Federal offices to apprise them of recent seismicity in the state of Oregon.

DISCUSSION OF CATALOG

This catalog contains locations for 251 earthquakes that have occured along the Oregon Cascade Range and in southern Washington from August 1, 1980 to the end of October, 1982. The locations of events determined by the U.S.G.S. in Menlo Park, California are in Appendix 1. Events located by the U.S.G.S. in Seattle, Washington have been listed separately in Appendix 2.(Zollweg, personal communication) All events are shown on Figure 5. Some hypocenters in this catalog are poorly constrained due to sparse network distribution and the use of a location program that is best suited for denser station distribution.

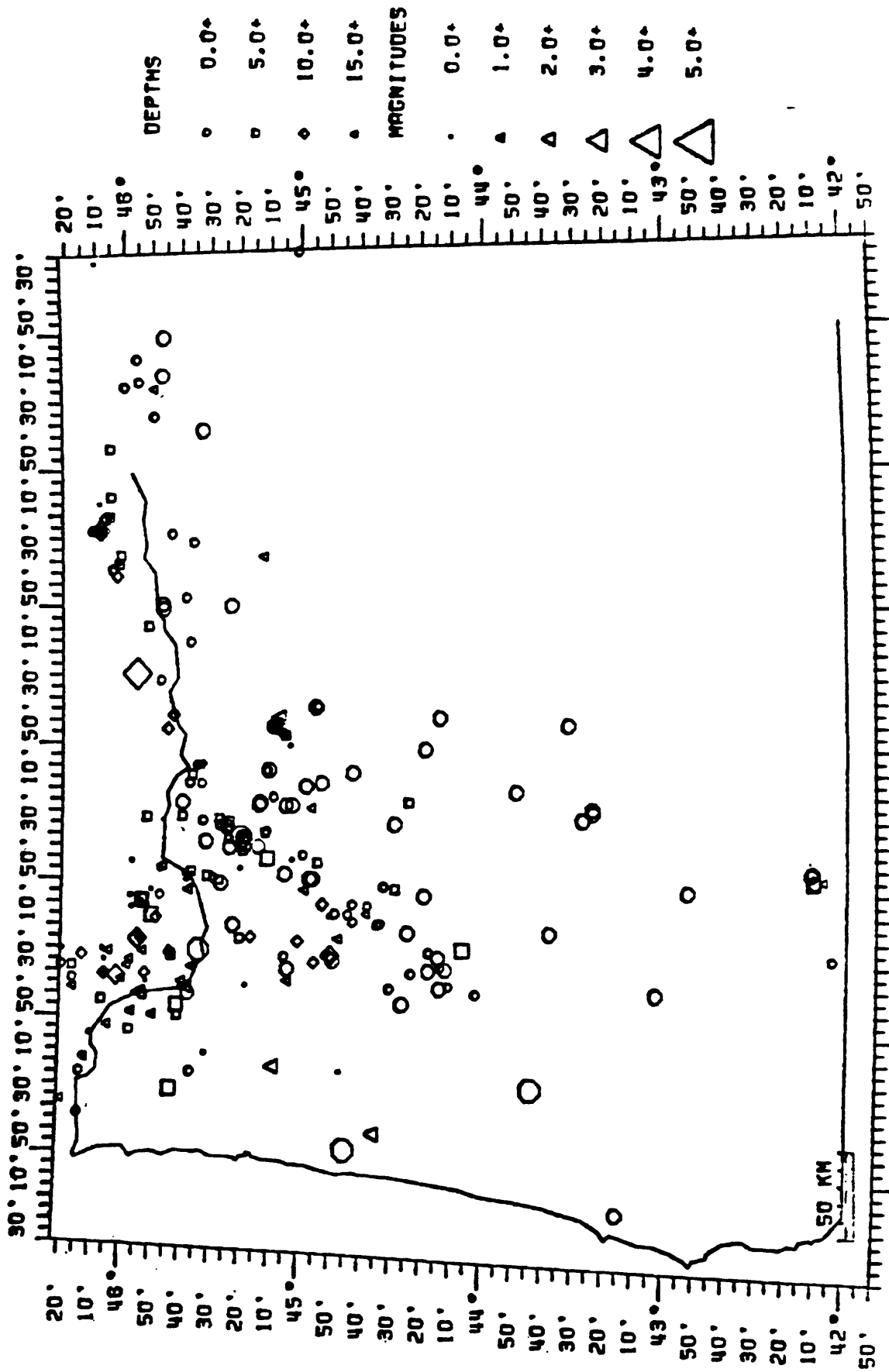

Figure 5. Event location plot

Four events that were felt and reported to us by local residents have also been included in this catalog. Of these, two occured along the Oregon coast at Lincoln City (9/28/80 at 2025 UTC) and Yachats (6/22/81 at 0741 UTC). A third event was reported at Crater Lake (6/19/82 at 0823 UTC) and the last was reported at Timberline Lodge on Mt Hood (8/18/82 at 1150 UTC).

Numerous coastal events were recorded by our network during this twenty seven month study. These coastal events were eliminated from the catalog due to insufficient station coverage for accurate locations.

Events that were reported as blasts by local authorities or that were identified as such in the U.S.G.S. records at the University of Washington were removed from this catalog. Additional events located at or near a known quarry or blasting site and that occured during normal working hours were also eliminated. The limited number of stations and wide station spacing of the network provided insufficient data for determining definitive focal mechanisms and reliable focal depths, so these descriminants could not be used as a means of identifing blasts.

There were no recorded explosions of sufficient size to test HYPO71 standard errors for the network. Based on the ERH estimates of HYPO71 Location errors for events along the Cascades may be as large as 43km. Smaller events originating $\geq$60km from the Cascades would have much larger location errors.

This catalog provides a listing of earthquakes along the Oregon Cascade range and it's surrounding area that is probably complete only above magnitude 2.0. Events located around Mt. Hood are located with more confidence, to magnitude 0.20. The format is based on that of the USGS California Network's Catalog of earthquakes along the San Andreas Fault in Central California.

I hope that the data contained in this catalog provides, if not a detailed data set, at least a foundation for further studies of the Oregon Cascade range.

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Appendix 1. Symbol Explanation

(USGS - Menlo Park)
CATALOG OF OREGON EARTHQUAKES AUGUST 1980 - OCTOBER 1982

The following data in the HYPO71 locations are given for each event:

1. Origin time in Coordinated Universal Time (UTC): date, hour (HR), minute (MN), and second (SEC). To convert to Pacific Standard Time (PST), subtract eight hours, to Pacific Daylight Time, subtract seven hours.

2. Epicenter in degrees and minutes of north latitude (LAT N) and west longitude (LONG W).

3. Depth of the focus in kilometers. If "*" follows the depth, the focal depth has been constrained by the location program.

4. MAG, local magnitude of the earthquake. If "R" follows the magnitude, the Richter magnitude calculated from the Wood-Anderson seismograph records.

5. NO, number of P- and S-arrivals used in locating the earthquake.

6. GAP, largest azimuthal separation in degrees between stations.

7. DMIN, epicentral distance in kilometers to the nearest station.

8. RMS, root-mean-square error of the time residuals:

$$RMS = \sqrt{\sum_i R_i^{\,2}/NO}$$

where R_i is the observed seismic-wave arrival time minus the computed time at the i^{th} station.

9. ERH, standard error of the epicenter in kilometers:

$$ERH = \sqrt{SDX^2 + SDY^2}$$

where SDX and SDY are the standard errors in latitude and longitude, respectively, of the epicenter.

10. ERZ, standard error of the depth in kilometers.

11. Q, solution qualitiy of the hypocenter. This measure is intended to indicate the general reliability of each solution.

Q	EPICENTER	FOCAL DEPTH
A	excellent	good
B	good	fair
C	fair	poor
D	poor	poor

Appendix 1. Symbol Explanation (cont.)

(USGS - Menlo Park)
CATALOG OF OREGON EARTHQUAKES AUGUST 1980 - OCTOBER 1982

Q is based on the nature of the station distribution with respect to the earthquake and the statistical measure of the solution. These two factors are each rated independently according to the following schemes.

STATION DISTRIBUTION

	NO	GAP	DMIN
A	≥ 6	≤ 90	$\leq$ depth or 5 km
B	≥ 6	≤ 135	$\leq$ 2 X depth or 10 km
C	≥ 6	≤ 180	$\leq$ 50 km
D	others		

STATISTICAL MEASURES

	RMS (sec)	ERH (km)	ERZ (km)
A	< 0.15	< 1.0	< 2.0
B	< 0.30	< 2.5	< 5.0
C	< 0.50	< 5.0	
D	others		

Q is taken as the average of the ratings from the two schemes, i.e., an A and a C yields a B, and two B's yield a B. When the two rating are only one level apart the lower one is used, i.e., an A and a B yield a B.

Appendix 1. OREGON CATALOG
(U.S.G.S. - Menlo Park)

DATE	ORIGIN	LAT	LONG	DEPTH	MAG	NO	GAP	DMIN	RMS	ERH	ERZ	QM
800911	2142 44.92	44-51.16	122-33.18	1.13	2.47	8	211	41.1	1.23	1.9	1.2	CC
800917	2346 2.44	45-16.33	121-44.61	4.37	2.69	8	99	8.3	0.22	1.5	2.7	BC
Lincoln City - felt report												
800928	2025 31.13	44-45.83	123-54.72	1.09	3.50	16	260	73.2	0.25	4.4	5.1	DC
801111	2032 46.04	43-44.80	123-25.23	3.00	3.02	7	266	140.3	0.22	10.5	17.9	DC
Possible duplicate, 11/13/80 2313 USGS/SEATTLE												
801113	2318 6.93	45-38.39	121-56.27	0.75	1.67	6	247	13.7	0.32	5.8	38.4	DC
810104	0721 36.75	43-15.44	124-16.39	3.00	2.24	5	315	99.0	0.18	5.8	5.2	DC
810104	859 55.08	45- 5.95	122-37.20	3.00	2.27	5	150	28.5	0.22	2.3	6.3	DC
810108	1822 46.70	45-22.13	121-54.09	2.28	0.20	4	235	18.4	0.10	0.	0.	CC
810113	143 47.34	45-14.07	121-38.77	7.18	1.98	10	89	10.7	0.20	1.5	3.2	BC
810127	2346 58.53	45-38.66	121-56.06	6.10	1.54	5	248	14.2	0.04	2.1	1.4	CC
810128	623 54.90	45-38.48	121-57.04	0.68	0.37	8	251	13.3	0.19	4.6	9.5	DC
810221	724 45.35	45-31.21	121-56.79	5.00	.00	3	209	7.5	.01	.0	.0	C1
810303	954 38.80	44-52.23	122-13.93	2.40	0.13	5	121	12.7	0.12	0.4	44.3	DC
810311	1924 29.32	45-13.43	121-37.88	1.06	1.73	6	160	12.1	0.05	0.7	1.7	BC
810410	2012 44.36	42- 7.89	121-54.36	17.45	1.48	4	164	8.3	0.04	0.	0.	CC
810424	028 18.36	44-44.99	121-12.06	4.90	2.40	7	136	24.7	0.08	0.7	1.6	BC
810429	028 2.10	43-33.25	120-49.90	3.00	2.00	4	204	95.2	0.20	0.	0.	CC
810429	2156 27.45	45-34.69	121-33.47	0.36	1.90	8	193	19.6	0.14	1.1	31.9	DC
810502	1647 45.04	45-15.51	121-25.62	0.58	2.29	9	73	25.3	0.13	0.9	23.1	CC
810502	1951 23.42	45- 7.03	121-26.63	0.13	2.48	6	132	12.9	0.12	1.5	17.9	CC
810506	1216 29.61	45-25.68	121-44.97	0.18	2.12	7	177	12.5	0.21	2.2	13.2	CC
810512	1222 46.02	45-22.15	121-39.67	3.25	1.87	5	168	4.6	0.10	1.6	3.6	CC
810512	1339 37.32	45-26.07	121-41.21	1.50	1.40	4	151	11.8	0.22	0.	0.	CC
810613	23 0 39.62	45- 7.34	120-55.59	15.17	1.95	5	112	12.2	0.06	1.1	1.8	CC
810615	1955 23.59	45- 7.81	120-55.29	13.74	1.62	8	82	12.1	0.11	0.9	1.8	AC

DATE	ORIGIN	LAT	LONG	DEPTH	MAG	NO	GAP	DMIN	RMS	ERH	ERZ	QM
Yachats - felt report												
810622	741 56.09	44-36.86	123-47.32	58.64	2.94	4	289	64.9	0.15	0.	0.	CC
810630	026 21.80	43-25.04	121-27.35	0.65	2.30	7	121	24.5	0.20	1.8	1.8	CC
810702	1816 14.34	45-15.78	121-26.15	3.64	2.84	6	179	20.1	0.12	1.6	2.8	CC
810707	1325 42.51	45- 7.14	122-32.09	3.00	1.97	8	146	21.5	0.20	1.7	3.4	CC
810707	22 4 50.23	44-16.12	122-30.42	0.47	2.38	5	164	16.6	0.08	1.6	25.4	DC
810714	1920 26.04	44-36.66	122-17.13	1.50	1.47	8	261	16.9	0.21	3.7	5.5	DC
810715	1721 27.74	45-15.32	121-26.78	0.13	2.52	6	92	19.7	0.07	0.1	1.6	BC
810716	1212 40.85	45-31.12	121-58.54	0.42	1.85	4	197	5.4	0.07	0.	0.	CC
810718	1259 17.48	44-26.39	121-24.28	8.52	1.33	8	212	33.4	0.14	1.1	1.8	CC
810720	221 10.50	43-25.10	121-25.75	1.22	2.53	6	130	13.4	0.26	1.6	14.3	CC
810721	1957 37.06	44- 7.44	122-27.74	3.00	2.04	4	237	65.0	.02	.0	.0	C1
810721	20 4 21.37	43-38.23	122- 9.44	1.35	2.37	5	239	51.4	0.12	1.2	3.5	CC
810721	23 0 38.07	43-28.25	121-30.27	3.00	2.30	3	189	14.0	.30	.0	.0	D1
810721	23 6 31.22	42-10.99	121-51.15	3.00	2.46	3	161	15.2	0.01	0.	0.	CC
810811	544 4.57	45- 2.59	122-25.21	11.28	1.94	13	197	17.0	0.13	0.8	1.4	CC
810818	650 10.89	45-39.15	122-48.87	1.14	2.45	10	220	57.9	0.11	1.0	1.3	CC
810826	1312 15.80	44-25.14	122-37.64	0.79	1.91	4	204	51.1	0.04	0.	0.	CC
810827	1926 58.16	44-26.56	122-20.20	0.38	2.05	4	314	32.1	0.13	0.	0.	CC
810905	1956 9.66	44-40.62	122-12.66	29.97	1.51	4	234	9.6	0.27	0.	0.	CC
810908	2225 35.55	45-11.33	121-22.96	0.33	1.98	8	76	21.5	0.13	0.9	24.2	CC
810926	1626 14.51	45-20.09	121-38.99	3.00	1.86	6	158	2.0	.19	2.8	3.1	C1
811001	2134 46.83	44-58.77	121-27.49	16.98	1.78	8	105	13.6	0.11	1.0	2.0	BC
811005	4 3 1.83	45-20.40	121-40.56	4.11	2.07	14	103	1.3	0.19	0.6	0.9	BC
811019	526 16.11	45-21.23	121-46.69	9.62	1.47	7	265	8.6	.17	2.7	2.1	D1
811019	530 49.78	45-20.25	121-40.79	4.76	1.60	9	166	1.1	0.14	0.8	0.9	BC
811019	545 37.03	45-20.50	121-41.49	4.04	1.54	7	168	2.0	0.18	1.3	1.9	CC
811019	740 22.95	44-55.28	121-16.65	1.11	2.18	19	84	24.0	0.28	0.8	1.9	CC

DATE	ORIGIN	LAT	LONG	DEPTH	MAG	NO	GAP	DMIN	RMS	ERH	ERZ	QM
811029	1912 23.65	45-41.74	121-25.74	0.96	2.64	7	266	19.1	0.17	3.2	6.0	DC
811101	15 2 53.39	43-50.67	121-18.93	0.23	2.24	12	110	20.7	0.17	0.9	1.0	CC
811108	754 0.92	45-35.85	122-29.98	0.75	3.00	14	207	36.6	0.25	1.9	26.1	DC
811109	2257 1.63	44-21.15	122- 4.38	0.09	2.58	15	86	34.8	0.24	0.8	14.4	CC
811117	14 1 42.36	44-50.63	122-12.94	3.45	1.99	5	199	14.5	0.10	7.9	26.1	DC
811221	1323 15.32	45-13.14	121-49.62	5.41	2.08	10	147	17.1	0.26	1.5	3.1	CC
820130	0 4 44.89	44-15.42	122-43.61	0.39	2.07	11	268	74.0	0.16	3.3	1.5	DC
820203	1445 0.95	45- 0.24	121-18.19	0.70	2.23	5	118	23.2	0.13	1.8	103.9	DC
820210	2346 43.68	44-20.90	121- 1.33	0.08	2.36	7	160	34.3	0.23	1.9	2.5	CC
820302	058 7.87	44-13.67	122-35.47	3.00	2.07	3	239	70.7	0.01	0.	0.	CC
820308	2348 48.83	44-15.42	122-34.59	0.75	1.81	4	181	25.1	0.16	0.	0.	CC
820326	17 3 40.78	45- 1.37	121-48.00	2.15	1.52	6	189	17.3	0.11	1.8	2.2	CC
820421	18 2 13.39	45-22.98	121- 6.54	0.67	2.57	6	215	44.7	0.28	8.1	4.4	DC
820505	2154 59.03	45-24.40	122-18.80	3.00	2.40	3	274	50.8	0.23	0.	0.	CC
820511	010 39.21	44-26.56	122-14.88	3.00	2.02	5	284	49.8	0.25	5.0	2.4	DC
820521	1153 31.33	44-49.71	122-23.68	19.87	1.98	4	235	5.6	0.00	0.	0.	CC
820604	19 0 22.77	43- 3.68	122-43.46	0.38	2.98	6	296	86.3	0.15	19.0	38.0	DC
820608	17 6 36.24	44-35.73	122-16.71	0.68	1.20	5	263	17.2	0.09	4.5	10.5	DC
Crater Lake - felt report												
820619	823 0.94	42-53.26	122- 0.03	1.35	2.47	10	182	51.8	0.43	6.2	18.3	DC
820619	1842 19.42	45-33.61	121-42.62	0.18	2.65	6	210	25.8	0.14	1.9	27.7	DC
820621	2149 0.79	44-57.02	120-43.66	3.00	2.80	7	143	20.2	0.22	2.2	4.7	CC
820624	19 6 15.30	45-25.20	121-36.14	0.06	2.16	8	177	11.6	0.14	0.9	6.6	CC
820627	530 41.92	45-42.89	122-54.27	5.18	2.69	7	317	101.2	0.19	21.4	43.4	DC
820706	22 9 50.73	45-28.64	122- 0.81	0.27	2.38	10	278	31.3	0.21	7.4	3.3	DC
820713	18 8 46.58	44-30.88	122- 1.71	9.78	1.25	5	254	18.0	0.37	10.6	10.6	DC
820722	2035 12.06	44-57.94	121-58.44	0.38	2.48	5	177	32.3	0.02	0.0	0.1	CC
820723	1824 5.21	44-19.34	122-28.52	3.00	1.95	6	284	49.4	0.24	8.9	6.0	DC

DATE	ORIGIN	LAT	LONG	DEPTH	MAG	NO	GAP	DMIN	RMS	ERH	ERZ	QM
820727	051 43.49	45-10.81	120-52.01	4.83	2.16	11	114	24.1	0.25	1.8	3.6	CC
820727	1021 6.70	45- 9.63	120-48.26	22.50	2.00	6	148	19.3	0.07	1.3	2.4	CC
820727	19 7 35.91	45-25.87	121-36.59	1.69	1.59	6	179	12.5	0.21	2.7	13.9	CC
820729	154 58.61	44-29.63	122- 2.71	3.57	0.94	5	179	20.0	0.10	3.7	9.0	DC
820729	2015 32.11	44-12.52	122-42.63	3.00	1.85	5	269	71.3	0.26	14.1	588.5	DC
820802	23 2 17.94	44-15.96	120-47.53	2.37	2.33	8	183	54.2	0.14	2.3	16.4	DC
820803	1722 33.34	44-44.92	122- 8.87	1.50	1.58	4	155	9.8	0.18	0.	0.	CC
820806	2246 19.25	45-22.31	121-42.02	0.14	1.92	11	132	5.2	0.18	1.0	1.0	BC
820812	1820 27.09	44-34.56	122- 0.90	0.17	1.05	5	248	12.1	0.06	2.9	0.8	DC
820817	1440 56.73	45-22.48	121-41.15	3.57	1.88	10	107	5.2	0.18	1.0	2.6	BC
820817	1718 0.65	44- 3.70	122-45.46	4.08	1.90	4	236	29.3	0.09	0.	0.	CC
820817	2344 21.35	45- 4.93	121-26.54	0.30	2.28	5	152	11.6	0.05	0.7	8.6	DC
Timberline Lodge - felt report												
820818	1150 37.78	45-22.14	121-40.59	0.82	3.27	15	78	4.5	0.18	0.6	0.7	BC
820821	2247 18.83	44-43.87	122-16.47	1.50	1.91	4	129	16.1	0.68	0.	0.	DC
820830	1953 22.21	44-32.18	122-44.50	0.81	1.88	6	240	47.0	0.13	1.7	13.5	DC
820901	2059 59.87	44-46.39	122-13.17	3.00	1.48	3	173	15.3	0.01	0.	0.	CC
820907	1832 4.04	42-10.49	121-54.72	3.41	2.47	9	149	11.0	0.14	2.2	3.0	CC
820908	18 0 41.59	44-19.44	122-36.37	4.58	2.19	6	246	17.8	0.07	2.7	2.9	DC
820910	116 39.40	44-59.02	121-58.26	3.00	2.40	7	126	29.6	0.26	2.0	5.4	CC
820915	133 10.31	44-27.95	122-50.92	3.00	2.56	8	150	21.3	0.15	1.1	2.9	CC
820918	328 59.94	45- 9.96	123-19.95	23.91	2.23	9	170	28.0	0.07	0.9	1.3	BC
820919	4 7 27.89	45-11.10	120-50.28	17.56	1.75	9	164	21.8	0.07	0.4	1.0	BC
820919	412 49.41	45-11.37	120-51.99	0.18	1.77	11	165	24.1	0.11	0.7	0.5	BC
820924	340 55.92	44-51.90	122-30.95	13.64	2.00	13	110	9.8	0.16	0.7	1.1	BC
821004	2114 41.90	42-11.69	121-51.61	0.50	2.28	6	172	15.6	0.02	0.3	5.6	CC
821015	2 6 56.06	45- 7.17	121-56.19	0.13	2.25	6	186	28.3	0.06	0.2	3.6	CC
821018	20 2 40.69	42-10.82	121-55.26	7.32	2.39	5	146	11.1	0.01	0.3	0.3	CC
821019	1545 44.79	42- 4.43	122-27.06	3.00	1.79	9	194	37.8	0.16	1.4	2.8	CC

Appendix 2. Symbol Explanation

(USGS - Seattle)
CATALOG OF OREGON EARTHQUAKES AUGUST 1980 - OCTOBER 1982

The following data in the Seattle locations are given for each event:

1. DATE, ORIGIN time in Coordinated Universal Time (UTC): hour, minute and second. To convert to Pacific Standard Time (PST), subtract eight hours, to Pacific Daylight Time, subtract seven hours.

2. Epicenter in degrees and minutes of north latitude (LAT N) and west longitude (LONG W).

3. DEPTH, depth of the focus in kilometers. If "*" follows the depth, the focal depth was fixed on the final iteration. If "$" follows the depth, 24 iterations (maximum) occured. If "#" follows the depth, the depth was fixed at the 24th iteration.

4. MAG, local magnitude of the earthquake. If "R" follows the magnitude, the Richter magnitude calculated from the Wood-Anderson seismograph records.

5. NO, The number of stations and the number of phases used in the location.

6. GAP, largest azimuthal separation in degrees between stations.

7. DMIN, epicentral distance in kilometers to the nearest station.

8. RMS, root-mean-square error of the time residuals:

$$RMS = \sqrt{\sum_i R_i \; 2/NO}$$

where R_i is the observed seismic-wave arrival time minus the computed time at the ith station.

9. ERR, combination of the standard error of the epicenter in kilometers and the standard error of the depth in kilometers.

11. Q1, solution qualitiy using statistical measures, ERH, ERZ and RMS.

Q2, solution quality using station distribution, NO, GAP and DMIN.

Q1	EPICENTER	Q2	FOCAL DEPTH
A	excellent	A	good
B	good	B	fair
C	fair	C	poor
D	poor	D	poor

Appendix 2. Symbol Explanation (cont.)

(USGS - Seattle)
CATALOG OF OREGON EARTHQUAKES AUGUST 1980 - OCTOBER 1982

Q is based on the nature of the station distribution with respect to the earthquake and the statistical measure of the solution. These two factors are each rated independently according to the following schemes.

STATION DISTRIBUTION

	NO	GAP	DMIN
A	≥ 8	≤ 90	$\leq$ depth or 5 km
B	≥ 7	≤ 135	$\leq$ 2 X depth or 10 km
C	≥ 6	≤ 180	$\leq$ 50 km
D	< 6	> 180	$>$ 50 km

STATISTICAL MEASURES

	RMS (sec)	ERH (km)	ERZ (km)
A	< 0.15	< 1.0	≤ 2.0
B	< 0.30	≤ 2.5	≤ 5.0
C	< 0.50	≤ 5.0	> 5.0
D	≥ 0.50	> 5.0	> 5.0

Appendix 2. OREGON CATALOG
(U.S.G.S. - Seattle)

DATE	ORIGIN	LAT	LONG	DEPTH	MAG	NO	GAP	DMIN	RMS	ERR	Q1	Q2
800802	2316 0.00	45N2005	122W4472	5.05	0.0	2/002	349	0	0.00	0.0	AD	S
800803	0908 1.26	45N5837	121W5162	0.55$	0.6	4/004	350	118	0.55	0.0	AD	C
800807	2051 34.42	45N4918	120W3229	0.10*	1.9	10/017	291	78	0.46	0.0	DD	E
800811	1659 36.97	45N3952	122W4698	22.21	1.9	9/011	231	54	0.08	3.6	BD	S
800811	1906 43.80	45N4018	122W4605	25.72	2.1	9/014	229	52	0.11	2.0	AD	S
800815	0511 42.84	45N4008	122W4563	24.38	0.0	13/018	228	52	0.27	2.8	BD	S
800827	2240 29.44	46N2155	122W3767	1.04	1.6	14/017	135	12	0.20	0.8	AC	S
800829	1800 52.76	45N5518	122W2511	0.05*	0.0	6/006	226	16	0.05	1.6	BD	S
800901	2302 12.85	45N5118	122W5866	22.00	1.6	9/012	273	10	0.16	1.1	BD	P
801008	2257 -0.01	46N2399	123W4190	22.00	1.8	13/016	242	38	0.29	2.8	CD	P
801105	0746 -0.57	45N3957	122W0364	55.26	1.0	5/007	250	42	0.90	28.0	DD	S
801113	2313 36.51	45N4591	122W2948	3.38	0.8	4/005	329	34	0.04	0.9	AD	S
801117	0649 19.27	44N4828	123W2110	26.00$	0.0	8/008	345	158	0.28	7.1	DD	S
801120	0800 50.33	45N5472	122W3081	19.19	1.1	6/009	315	19	0.15	1.7	BD	S
801120	1003 50.44	45N3187	121W5628	7.30*	-0.1	6/006	325	65	0.15	11.7	DD	S
801127	0038 16.25	45N5823	122W5754	23.92	1.6	15/020	244	44	0.20	2.1	BD	S
801218	2244 29.32	45N4843	119W5918	1.40	2.8	20/022	117	6	0.21	1.3	BB	C
810106	1052 55.07	46N0967	119W1489	15.74	0.8	5/007	290	30	0.09	1.0	AD	E
810115	0600 37.55	45N5119	118W2458	15.07	1.9	10/011	294	5	0.28	3.5	CD	E
810119	0047 52.72	45N4160	122W4381	21.89$	1.6	10/014	180	48	0.19	1.2	BC	P
810128	2235 48.40	45N5835	122W1163	22.40	0.7	5/007	267	6	0.12	1.4	BD	S
810130	0413 19.60	45N4825	120W0125	0.06*	2.3	9/009	151	3	0.42	11.5	DC	C
810202	2222 -7.09	45N3335	121W5762	7.62	1.7	7/007	304	43	0.09	4.1	CD	C
810207	2053 18.57	45N0482	121W5002	10.76	0.0	5/006	132	24	2.64	0.0	DD	C
810215	2000 35.89	45N3825	122W3741	18.13	1.6	9/012	198	49	0.28	2.9	CD	C
810215	2138 25.09	45N3835	122W3711	7.30	0.0	7/009	174	53	0.10	1.5	AD	S

DATE	ORIGIN	LAT	LONG	DEPTH	MAG	NO	GAP	DMIN	RMS	ERR	Q1	Q2
810318	0140	51.37	45N3670	121W0949	3.31$	1.3	8/010	176	36	0.61	4.9	CC E
810318	2021	57.61	46N0773	119W2156	12.97	1.0	6/007	274	12	0.09	0.9	AD E
810318	2114	29.02	46N0603	119W2034	6.92	0.6	4/007	288	14	0.06	0.6	AD E
810318	2231	56.33	46N0657	119W2305	5.32	0.9	4/005	300	14	0.24	3.6	CD E
810318	2334	56.95	46N0617	119W2086	7.47#	1.6	13/015	188	14	0.10	1.7	AD E
810319	0146	43.51	45N3432	121W0881	10.00#	0.9	5/007	181	36	0.56	8.3	DD C
810320	0206	59.88	45N3601	121W0910	38.91	1.1	6/010	174	37	0.57	4.6	CC C
810325	2157	1.38	45N5118	118W3670	0.61#	1.5	11/012	236	16	0.24	3.9	CD E
810326	2230	25.64	44N5645	121W5122	8.28	1.5	10/012	148	33	0.35	1.3	BC C
810403	1452	11.64	45N5352	122W4420	19.42	0.8	5/008	288	28	0.11	3.0	BD S
810411	0454	21.20	45N4668	120W5357	11.24	1.7	12/015	100	30	0.24	2.8	BC C
810420	2255	46.73	45N5356	121W3227	6.31	1.7	21/021	104	28	0.25	0.7	AC C
810423	1826	24.79	45N5412	122W5006	6.38	1.9	9/011	279	28	0.11	0.8	AD P
810428	0021	37.01	45N4055	119W5631	0.03*	1.8	24/024	107	26	0.36	10.0	CC E
810503	1545	44.70	45N5910	122W3481	20.17	1.3	15/022	152	16	0.19	0.7	BC S
810505	0005	25.00	45N5872	122W0678	9.32	0.6	13/016	137	9	0.15	0.4	AC S
810508	1844	28.62	46N1796	122W4745	20.66	1.3	22/034	132	17	0.14	0.5	AB P
810514	2324	68.08	45N5201	122W0402	9.65	0.4	6/006	235	20	0.16	1.8	BD S
810523	1152	52.56	46N0249	119W3781	6.62	1.1	5/006	160	19	0.16	1.8	BD E
810523	1217	25.15	46N0312	119W4097	8.84	0.6	9/009	143	17	0.13	1.1	AC E
810523	1231	57.56	46N0308	119W4160	8.82	1.1	11/011	140	17	0.21	1.3	BC E
810523	1242	34.61	46N0370	119W4683	11.42	1.1	5/006	206	18	0.20	2.2	BD E
810523	1635	62.13	45N5379	122W4065	12.20	1.5	29/036	111	28	0.16	4.2	BC P
810528	0047	49.65	46N1491	123W2464	4.85	1.9	8/011	260	28	0.21	1.2	BD P
810602	0046	58.10	45N2219	122W2451	9.25	1.1	7/008	181	26	0.05	0.3	AD C
810614	1306	6.23	46N1192	123W0761	18.35	0.9	10/011	245	30	0.15	1.9	BD P
810614	1312	57.80	45N5711	120W2949	14.92	3.2	53/054	47	28	0.27	0.6	BB C
810706	2300	17.26	44N5461	122W0908	12.36	1.7	11/015	104	27	0.41	3.6	BC C

DATE	ORIGIN	LAT	LONG	DEPTH	MAG	NO	GAP	DMIN	RMS	ERR	Q1	Q2
810721	0011-29.09	46N1050	117W2835	24.71	0.7	4/004	345	327	0.00	0.0	AD	P
810721	2210 62.66	45N5493	122W0878	7.48	2.9	30/032	90	13	0.13	0.5	AB	S
810721	2318 17.78	45N5484	122W0810	8.62	1.1	20/022	129	13	0.16	0.9	AB	S
810725	2115 46.25	45N5570	122W1020	0.48*	1.1	12/014	143	11	0.21	2.8	BC	S
810731	2354 50.74	46N2117	123W3728	22.00	1.3	5/008	305	33	0.23	2.1	BD	P
810801	0552 10.24	46N0897	119W2570	12.24	0.1	9/014	114	12	0.17	0.4	AB	E
810804	0113 7.21	46N0694	122W4105	9.34	0.1	16/022	138	5	0.20	0.9	BC	P
810807	1633 58.17	46N0831	119W2663	5.80$	0.9	7/009	181	30	0.53	13.1	DD	E
810819	2236 15.58	45N3796	119W3200	0.04*	1.8	19/020	165	32	0.39	6.5	CC	E
810826	1804 24.70	45N3929	121W1715	1.08	1.4	3/004	309	33	0.16	0.0	AD	C
810828	1757 54.63	45N4812	121W3347	37.14	0.9	5/006	176	20	0.47	23.5	DD	C
810903	2235 27.92	45N1340	121W1135	0.06*	1.6	7/007	205	24	0.23	10.7	CD	C
810904	2247 23.82	45N1462	119W3836	21.70	1.6	6/008	293	71	0.18	1.6	BD	E
810905	1938 56.15	45N1850	122W2375	11.24	1.2	6/008	187	20	0.08	1.7	AD	C
810908	2351 59.77	45N4486	122W3263	8.74$	1.4	23/025	153	37	0.22	8.1	CC	P
810909	1511 28.95	45N4914	122W0629	4.15	1.1	17/018	114	24	0.11	0.6	AC	S
810910	2300 2.12	45N0083	122W0297	18.71	1.6	5/006	144	30	0.12	3.1	BD	C
810917	2101 43.27	46N1502	123W4292	0.72	1.4	6/007	306	45	0.19	3.0	CD	P
810920	1223 64.80	46N0907	119W2656	10.83	2.2	18/023	80	13	0.20	0.4	AB	E
810920	1247 39.12	46N0874	119W2663	7.72$	1.8	17/023	113	13	0.20	0.5	AB	E
810922	2158 21.84	46N0892	119W2638	9.40	1.2	8/011	93	13	0.15	0.8	AB	E
810923	0011 25.11	45N4472	122W3146	14.18$	0.7	20/021	152	37	0.13	1.0	AC	S
810928	1147 47.98	46N0868	119W2725	5.58	1.4	13/016	110	14	0.24	0.6	BC	E
810928	2115 29.21	45N4735	118W0214	0.21	2.0	12/014	291	31	0.40	1.3	BD	E
810929	0540 -3.98	45N0098	117W2589	0.08#	1.7	11/011	334	123	0.15	4.3	CD	E
811006	1929 11.98	45N4255	122W5872	7.92	1.0	15/017	92	52	0.26	2.4	BD	P
811007	1027 0.42	46N1185	119W2690	3.30	1.1	4/005	307	24	0.04	0.6	AD	E
811027	2028 12.74	46N0786	122W3027	6.91$	-0.2	5/008	143	10	0.20	2.1	BD	P

DATE	ORIGIN	LAT	LONG	DEPTH	MAG	NO	GAP	DMIN	RMS	ERR	Q1	Q2
811109	1203 57.33	45N0705	120W5602	9.68	1.3	6/007	172	24	0.10	2.2	BC	C
811110	1544 42.47	45N5648	122W2413	12.70	0.8	12/016	163	14	0.25	1.7	BC	P
811119	1843 24.78	45N5604	118W2150	4.64*	1.5	5/007	265	5	0.55	18.3	DD	E
811120	2016 46.59	45N3453	118W4298	0.08*	2.1	12/012	219	43	0.37	9.8	DD	E
811120	2359 16.91	45N4800	118W1893	0.08*	2.2	13/014	255	13	0.39	5.3	CD	E
811122	1310 25.49	46N1023	119W2881	17.79	0.8	5/007	313	25	0.14	1.8	BD	E
811123	1110 21.22	46N1365	123W1845	20.78	1.6	25/028	143	18	0.14	0.3	AC	P
811123	1110 21.78	46N1423	123W1762	15.90$	0.9	11/011	240	28	0.14	2.1	BD	S
811204	2344 30.84	44N3102	121W3376	0.05*	2.2	6/008	254	18	0.32	16.3	DD	C
811206	1442 15.66	45N5955	118W3022	0.74$	1.7	4/006	178	12	0.61	99.9	DD	E
811217	0514 19.73	46N0588	118W5060	6.11$	1.4	10/013	158	39	0.68	13.2	CC	E
811218	2318 15.71	45N3538	121W1737	0.07*	1.7	6/007	115	5	0.40	10.1	DC	C
811221	0314 61.35	45N0558	121W0035	12.27*	0.5	5/007	104	21	0.24	12.7	CD	C
820110	2329 3.41	45N4523	119W2821	0.07*	1.1	4/004	294	71	0.09	0.0	AD	E
820111	0830 14.79	45N5515	122W2548	11.53	1.8	28/033	91	16	0.21	1.1	BB	S
820113	0913 33.90	46N0590	119W1195	6.11	1.2	7/007	242	42	0.15	1.0	AD	E
820118	1930 39.21	46N1791	122W4342	0.95	1.1	4/005	280	44	0.25	6.6	DD	S
820204	1039 0.73	46N0076	118W2358	1.88	1.6	6/010	224	12	0.75	7.8	DD	E
820218	0212 23.28	45N5650	118W1141	0.07*	1.8	4/006	302	17	0.37	14.1	DD	E
820219	1904 42.99	45N2114	121W4378	5.58	2.1	11/012	107	5	0.21	0.5	AB	C
820226	2344 24.84	45N3993	121W5937	10.04	0.9	11/015	166	25	0.20	0.6	BC	C
820303	0526 68.16	45N5626	122W2570	10.85	2.1	31/036	82	14	0.21	1.7	BB	S
820310	2239 28.65	45N5854	123W0548	9.22	1.3	13/013	176	30	0.12	0.8	AC	P
820311	2117 7.31	46N0507	119W4392	0.06*	1.6	6/008	200	35	0.59	13.6	DD	E
820316	0156 54.42	45N3854	121W1351	9.42	1.5	11/011	87	36	0.38	1.4	CC	C
820319	0235 60.05	45N5177	122W1507	8.17	2.6	35/041	52	18	0.25	0.4	BC	C
820406	0830 40.35	46N0315	122W4209	13.97	2.0	19/024	159	11	0.19	0.7	BC	P
820415	1137 12.94	45N4828	121W5351	15.02	1.1	20/022	136	15	0.25	1.1	BC	C
820424	1612 14.46	46N1481	122W3327	14.91	1.7	22/028	62	16	0.14	0.6	AB	S

DATE	ORIGIN	LAT	LONG	DEPTH	MAG	NO	GAP	DMIN	RMS	ERR	Q1	Q2
820506	2000 49.26	45N4473	120W4750	13.20	1.4	4/004	314	69	0.40	0.0	AD	C
820511	0447 28.31	45N5327	120W0874	7.35$	1.4	6/008	211	52	0.11	0.9	AD	E
820512	1150 68.68	45N1066	121W1442	3.87	1.4	6/009	98	24	0.17	2.0	AC	C
820526	2145 20.85	45N4524	122W3162	15.95	1.8	21/024	88	28	0.14	0.8	AB	C
820601	0509 18.34	45N5508	122W2552	20.80	0.6	14/019	169	16	0.18	0.7	AC	S
820603	1447 50.08	45N5558	122W4941	21.59	2.0	22/024	111	25	0.19	0.7	BB	P
820607	1930 26.76	45N4888	121W5537	13.86$	0.9	13/013	140	44	0.17	1.5	AC	C
820611	1803 55.25	46N2117	122W3062	11.00	0.6	5/007	143	9	0.10	1.4	BD	S
820613	1243 9.07	45N5022	122W1610	14.79	1.4	18/021	92	21	0.14	0.9	AB	S
820621	2148 61.11	44N5657	120W4325	2.54	1.9	10/010	145	20	0.10	0.7	AC	C
820622	0305 22.83	45N5996	122W3746	16.95*	1.2	15/019	117	18	0.21	1.4	BB	P
820623	2159 18.01	45N5370	122W1354	1.36#	0.9	14/014	204	14	0.14	4.7	BD	S
820625	1148 18.76	45N5991	122W3768	18.37	1.1	9/012	131	18	0.16	0.8	AB	C
820625	1732 9.64	45N5332	122W1186	3.16	0.4	14/014	115	15	0.23	1.3	AC	S
820714	1856 67.05	45N2587	121W3385	5.50	1.7	7/007	130	13	0.24	2.5	BC	C
820725	1359 2.81	45N0974	120W5037	16.58	1.1	5/008	26	21	0.17	1.4	BD	C
820725	1544 26.87	45N1001	120W5016	16.27	1.3	7/009	80	21	0.17	1.2	AB	C
820730	0752 48.56	46N0725	122W3498	9.56	0.8	14/017	85	12	0.12	0.5	AB	S
820803	2217 17.72	45N4171	121W3165	7.58	1.3	10/010	99	12	0.20	1.1	BB	C
820809	0412 57.73	45N2231	121W4131	0.07*	0.8	7/008	104	5	0.15	1.7	BB	C
820809	2041 59.59	45N3790	123W2334	4.12	1.9	24/024	157	43	0.17	0.6	AC	P
820811	1240 36.80	44N5717	122W3418	14.30	1.1	7/007	239	16	0.12	2.7	CD	C
820815	0722 36.99	46N0603	122W3132	16.81	1.2	17/019	83	9	0.13	0.6	AA	P
820819	1758 4.01	45N2549	119W5981	1.05$	2.0	19/020	155	51	0.50	6.5	CD	E
820825	0927 11.28	45N0598	122W4245	18.92	1.6	15/017	215	34	0.32	1.6	BD	C
820825	1111 15.32	46N0722	122W4123	12.82	1.0	19/024	140	5	0.13	0.3	AC	P
820911	0414 56.21	46N0178	122W4339	15.09	1.2	15/019	131	13	0.15	0.7	AB	P
820922	2205 19.58	45N2910	121W3521	1.13	1.8	7/007	133	18	0.23	4.2	BC	C

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820923	0933 10.95	45N1133	120W5247	7.03	1.5	8/010	101	24	0.20	1.8	BC	C
820929	1042 11.70	45N1055	120W5159	10.00	1.4	8/009	107	23	0.10	2.2	BC	C
821003	0459 39.87	45N3920	120W1570	0.02*	1.4	3/005	305	47	0.30	17.8	DD	C
821011	1943 45.97	45N2929	121W3273	5.09	1.5	5/005	128	20	0.16	2.7	BD	C
821024	1318 43.67	45N4554	122W3134	12.48	1.1	20/024	101	28	0.15	2.8	BC	P