FINAL TECHNICAL REPORT: 2000

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APPENDIX 2
Publications supported fully or partially under this operating agreement

Reports and Articles

Malone, Steve, 1999, U.S. Seismic Networks: A time for change, Opinion editorial in Seismological Research Letters V70, N5, 475-477.

Johnson, J.B., Lees, J.M., 2000, Plugs and Chugs-seismic and acoustic observations of degassing explosions at Karymsky, Russia and Sangay, Ecuador. JVGR, 101, 67-82.

Moran, Seth C., David Zimbelman, and Stephen D. Malone, 2000, A model for the magmatic-hydrothermal system at Mount Rainier, Washington from seismic and geochemistry constraints, Bull. Volcan. v61 n7 p425-436.

Univ. of Wash. Geophysics Program, 2000, Quarterly Network Reports; 99-D, 00-A,00-B, and 00-C; Seismicity of Washington and Oregon

Abstracts

Giampiccolo, E., S. Gresta, S. Malone, C. Musumeci, 1999, Focal mechansisms and spectral parameters of earthquakes at Mount St. Helens volcano in the period 1995-1998. EOS V80, N46, p. 665.

Lisi, A., S. Malone, G. Thomas, 2000, Precise relative locations for aftershocks of the 1996 Duvall, WA earthquake, Bull. Seis. Soc. Am. V71, n1 p237.

Musumeci, C., S. Malone, S. Gresta, 1999, Investigating the seismic activity of Mount St. Helens, 1995-1998 through precise relative location of hypocenters, EOS V80, N46, p1147.

Tano, K., S.D. Malone, 2000, Aftershock variability in the Pacific Northwest, Bull. Seis. Soc. Am. V71, n1, p239.

ABSTRACT and NONTECHNICAL SUMMARY

This is the final technical report for USGS Joint Operating Agreement 1434-HQ-98-AG-01937 "*Pacific Northwest Seismograph Network (PNSN) Operations*". This agreement covered network operations in western Washington and Oregon, routine data processing, and preparation of bulletins and reports. The objective of our work under this operating agreement was to gather seismic data, and to analyze and interpret them for use in evaluation of seismic and volcanic hazards in Washington and Oregon. This report includes an update on recent changes in our data acquisition and processing system, a review of station operations during 2000, an overview of our public information program, and a summary of 2000 seismicity.

During 2000, 10 earthquakes were reported felt west of the Cascades in Washington, ranging in magnitude from 1.2 to 3.6. Two earthquakes were felt in Washington east of the Cascades, ranging in magnitude from 3.1 to 3.6. In Oregon, five earthquakes were reported felt, ranging in magnitude from 2.5 to 4.1.

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"PACIFIC NORTHWEST SEISMOGRAPH NETWORK (PNSN) OPERATIONS"

SUMMARY

This is the final technical report for USGS Joint Operating Agreement 1434-HQ-98-AG-01937 *"Pacific Northwest Seismograph Network (PNSN) Operations"*. This agreement covered network operations in western Washington and northern Oregon, routine data processing, and preparation of bulletins and reports. PNSN stations in southern and central Oregon are maintained by the University of Oregon under Cooperative Agreement HQ98AG01928, and this report also covers the work undertaken under that agreement. The objective of our work under this operating agreement was to gather seismic data, and to analyze and interpret them for use in evaluation of seismic and volcanic hazards in Washington and Oregon. This report includes an update on recent changes in our data acquisition and processing system, a review of station operations during 2000, an overview of our public information program, and a summary of 2000 seismicity.

Since 1984, we have issued quarterly bulletins for all of Washington and Oregon. These include catalogs of earthquakes and blasts located in Washington and Oregon, providing up-to-date coverage of seismic and volcanic activity. Appendix 1 contains quarterly bulletins covering 2000.

CURRENT INITIATIVES

Introduction

The PNSN is currently in the process of upgrading operations, including extensive changes to data recording, exchange, and processing systems. Upgrades include enhancement of the emergency information distribution system, installation of seismic sensors that can accurately capture the full range of earthquake amplitudes and frequencies, implementation of a data recording system that fully supports multi-component data, and near-real-time data exchange with neighboring networks.

CREST compatibility

The USGS/NOAA CREST (Consolidated Reporting of EarthquakeS and Tsunamis) project is designed to improve NOAA's ability to assess the likelihood of a tsunami and issue timely warnings in the event of a west coast subduction earthquake. CREST calls for upgrades to regional networks to enable them to provide very rapid and reliable information to the Alaska and Pacific Tsunami Warning Centers. In 1998 the PNSN installed three CREST-compatible (but not CREST equipment) stations (real-time, broad-band, and strong-motion; ERW, ELW, and SP2). Two stations, RWW and GNW, with full CREST equipment were installed in Washington during 1999. An EARTHWORM node at U of O in Eugene began transmitting real-time data from Oregon CREST stations PIN and DBO on February 9, 2000. Those two broad-band stations were upgraded to be CREST compatible by installing strong-motion components. Also during 2000, Battelle's Pacific Northwest National Lab helped install a new CREST station at their Sequim office and provided a telemetry path for the Sequim (SQM) CREST station via their intranet. CREST stations are planned for Eugene, Oregon (through UO), and for Longview, Boistfort Peak, Forks, and Tolt Reservoir in Washington. Four additional sites, directly on the coast and with BPA telemetry, have been identified and permitting discussions are underway.

PNSN Strong Motion Program

Since 1996, the PNSN has installed digital strong-motion instruments, mostly in the Puget Sound urban area. In summer 2000, 22 new instruments were installed, bringing the total number of PNSN strong-motion instruments to 42. Continuous data from these stations are sent to the PNSN via Internet or lease-line modem. Most of the strong-motion instruments (except CREST stations) also have internal memory and are configured to record internally if ground motions exceed a specified threshold. If continuous data transmission fails, the internally recorded data is still available via dial-up retrieval or site visit. Three additional dial-up stations in the Portland area are operated by the USGS.

PNSN RACE (Rapid Alerts for Cascadia Earthquakes) System

RACE is an earthquake notification system for emergency managers and others who need very rapid pager-based notification of earthquake activity. The RACE system is based on the CUBE system developed at Caltech for the Southern California Seismic Network. The RACE system is operating in approximately 10 emergency management and state agencies in Washington and Oregon.

EARTHWORM Progress Report

A new EARTHWORM computer, scossa, was acquired and installed in the year 2000. Scossa was implemented with a full EARTHWORM configuration and in the fourth quarter of 2000 became our primary backup computer. Prior to this, milli served as our main EARTHWORM machine and verme was our primary backup computer. In the fourth quarter of 2000, milli was still our main EARTHWORM and verme became the secondary backup computer.

OPERATIONS

Seismometer Locations and Network Maintenance

Figure 1 shows seismograph stations operated by the PNSN at the end of 2000, when the PNSN EARTHWORM SYSTEM was digitally recording 339 channels of real-time or near-real-time seismic data Stations available include a total of 152 short-period analog stations (17 of them received from other networks via EARTHWORM), 19 broad-band (8 of them from other networks), and 44 strong-motion stations (2 of them from other networks).

The majority of sites have a single short-period vertical component which is telemetered continuously in analog form to the UW. This contract (JOA 1434-HQ-98-AG-01937) supports 95 short-period sites (some with multiple components) and operation of 41 strong motion and 10 broad-band stations, plus horizontal seismometers with Wood-Anderson-response at station SEA on the campus of the University of Washington. The supported stations cover much of western Washington and Oregon, including the volcanos of the central Cascades.

Additional stations funded by other contracts are also used in event locations. Station Tables 1A-1D list the locations of various types of stations. Quarterly reports provide additional details of station operation. Quarterly reports from January 1, 2000 through December, 2000 are included as Appendix 1.

Aside from station outages, normal maintenance includes a visit to each site at least once every two years to replace batteries and do preventive maintenance. In addition seismometers must be replaced every 4-6 years. More than 30 radio telemetry relay sites are also maintained independently of the seismograph stations.

Seismograph Stations used by the PNSN

Table 1A lists short-period, mostly vertical-component stations used in locating seismic events in Washington and Oregon. The first column in the table gives the 3-letter station designator, followed by a symbol designating the funding agency; stations marked by a percent sign (%) were supported by USGS joint operating agreement 1434-HQ-98-AG-01937. A plus (+) indicates support under Pacific Northwest National Laboratory, Battelle contract 259116-A-B3. Stations designated "#" are USGS-maintained stations recorded at the PNSN. Other stations were supported from other sources. Additional columns give station north latitude and west longitude (in degrees, minutes and seconds), station elevation in km, and comments indicating landmarks for which stations were named.

TABLE 1A - Short-period Stations operated by the PNSN at the end of the fourth quarter 2000

STA	F	LAT	LONG	EL	NAME
ASR	%	46 09 09.9	121 36 01.6	1.357	Mt. Adams - Stagman Ridge
AUG	%	45 44 10.0	121 40 50.0	0.865	Augspurger Mtn
BBO	%	42 53 12.6	122 40 46.6	1.671	Butler Butte, Oregon
BHW	%	47 50 12.6	122 01 55.8	0.198	Bald Hill
BLN	%	48 00 26.5	122 58 18.6	0.585	Blyn Mt.
BOW	%	46 28 30.0	123 13 41.0	0.870	Boistfort Mt.
BPO	%	44 39 06.9	121 41 19.2	1.957	Bald Peter, Oregon
BRV	+	46 29 07.2	119 59 28.2	0.920	Black Rock Valley
BVW	+	46 48 39.5	119 52 56.4	0.670	Beverly

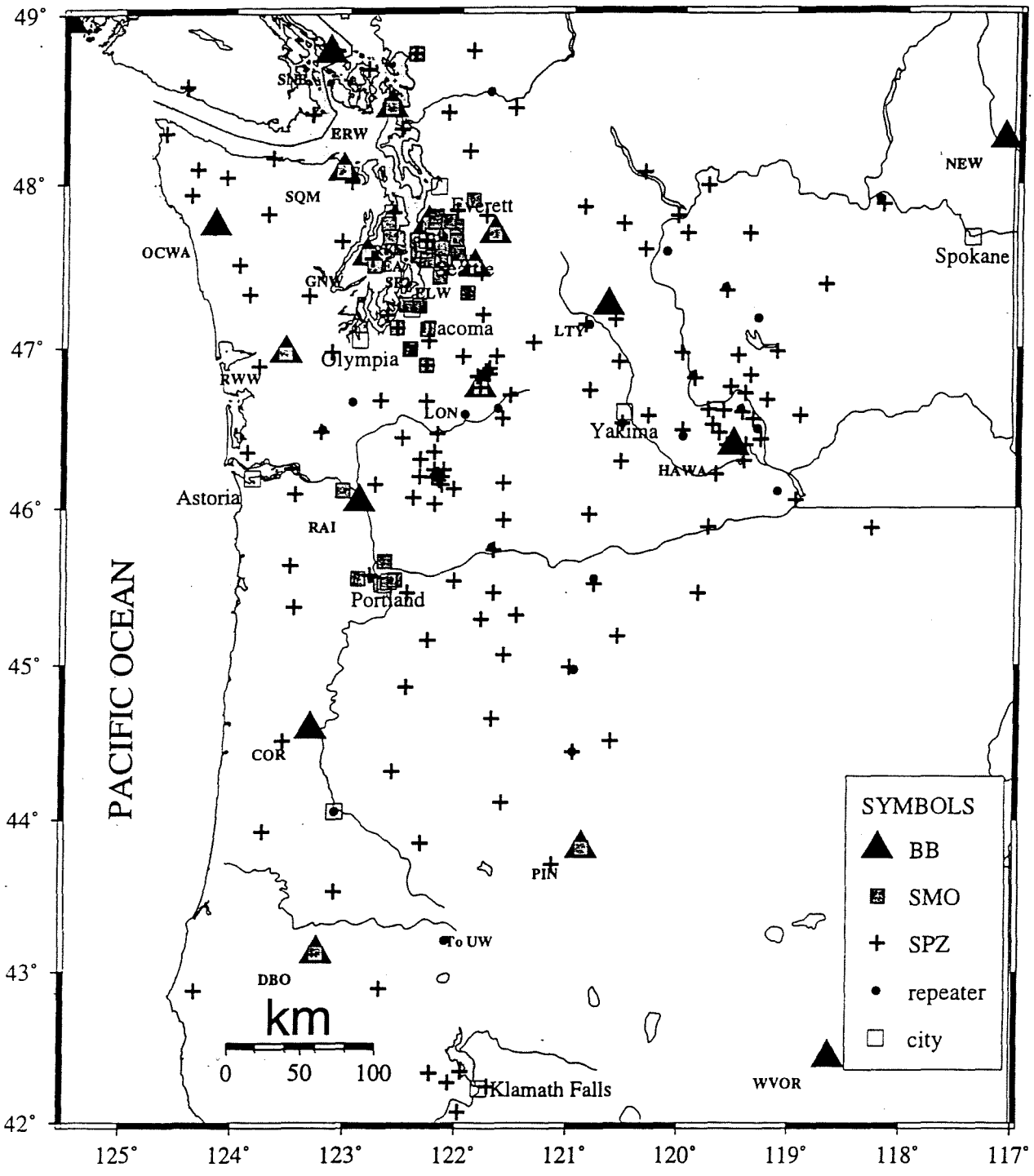

Figure 1. Stations operating at the end of 4th quarter, 2000. Stations shown are short period vertical (SP) or 3-component broadband (BB) or strong motion (SMO).

TABLE 2A continued

STA	F	LAT	LONG	EL	NAME
CBS	+	47 48 17.4	120 02 30.0	1.067	Chelan Butte, South
CDF	%	46 07 01.4	122 02 42.1	0.756	Cedar Flats
CMM	%	46 26 07.0	122 30 21.0	0.620	Crazy Man Mt.
CMW	%	48 25 25.3	122 07 08.4	1.190	Cultus Mtns.
CPW	%	46 58 25.8	123 08 10.8	0.792	Capitol Peak
CRF	+	46 49 30.0	119 23 13.2	0.189	Corfu
DPW	+	47 52 14.3	118 12 10.2	0.892	Davenport
DY2	+	47 59 06.6	119 46 16.8	0.890	Dyer Hill 2
EDM	%	46 11 50.4	122 09 00.0	1.609	East Dome, Mt. St. Helens
ELK	%	46 18 20.0	122 20 27.0	1.270	Elk Rock
ELL	+	46 54 34.8	120 33 58.8	0.789	Ellensburg
EPH	+	47 21 22.8	119 35 45.6	0.661	Ephrata
ET3	+	46 34 38.4	118 56 15.0	0.286	Eltopia (replaces ET2)
ETW	+	47 36 15.6	120 19 56.4	1.477	Entiat
FBO	%	44 18 35.6	122 34 40.2	1.080	Farmers Butte, Oregon
FHE		46 57 06.9	119 29 49.0	0.455	Frenchman Hills East
FL2	%	46 11 47.0	122 21 01.0	1.378	Flat Top 2
FMW	%	46 56 29.6	121 40 11.3	1.859	Mt. Fremont
GBL	+	46 35 54.0	119 27 35.4	0.330	Gable Mountain
GHW	%	47 02 30.0	122 16 21.0	0.268	Garrison Hill
GL2	+	45 57 35.0	120 49 22.5	1.000	New Goldendale
GLK	%	46 33 27.6	121 36 34.3	1.305	Glacier Lake
GMO	%	44 26 20.8	120 57 22.3	1.689	Grizzly Mountain, Oregon
GMW	%	47 32 52.5	122 47 10.8	0.506	Gold Mt.
GSM	%	47 12 11.4	121 47 40.2	1.305	Grass Mt.
GUL	%	45 55 27.0	121 35 44.0	1.189	Guler Mt.
HAM	%	42 04 08.3	121 58 16.0	1.999	Hamaker Mt., Oregon
HBO	%	43 50 39.5	122 19 11.9	1.615	Huckleberry Mt., Oregon
HDW	%	47 38 54.6	123 03 15.2	1.006	Hoodsport
HOG	%	42 14 32.7	121 42 20.5	1.887	Hogback Mtn., Oregon
HSO	%	43 31 33.0	123 05 24.0	1.020	Harness Mountain, Oregon
HSR	%	46 10 28.0	122 10 46.0	1.720	South Ridge, Mt. St. Helens
HTW	%	47 48 14.2	121 46 03.5	0.833	Haystack Lookout
JBO	+	45 27 41.7	119 50 13.3	0.645	Jordan Butte, Oregon
JCW	%	48 11 42.7	121 55 31.1	0.792	Jim Creek
JUN	%	46 08 50.0	122 09 04.4	1.049	June Lake
KMO	%	45 38 07.8	123 29 22.2	0.975	Kings Mt., Oregon
KOS	%	46 27 46.7	122 11 41.3	0.610	Kosmos
LAB	%	42 16 03.3	122 03 48.7	1.774	Little Aspen Butte, Oregon
LCW	%	46 40 14.4	122 42 02.8	0.396	Lucas Creek
LMW	%	46 40 04.8	122 17 28.8	1.195	Ladd Mt.
LNO	+	45 52 18.6	118 17 06.6	0.771	Lincton Mt., Oregon
LO2	%	46 45 00.0	121 48 36.0	0.853	Longmire
LOC	+	46 43 01.2	119 25 51.0	0.210	Locke Island
LVP	%	46 04 06.0	122 24 30.0	1.170	Lakeview Peak
MBW	%	48 47 02.4	121 53 58.8	1.676	Mt. Baker
MCW	%	48 40 46.8	122 49 56.4	0.693	Mt. Constitution
MDW	+	46 36 47.4	119 45 39.6	0.330	Midway
MEW	%	47 12 07.0	122 38 45.0	0.097	McNeil Island
MJ2	+	46 33 27.0	119 21 32.4	0.146	May Junction 2
MOX	+	46 34 38.4	120 17 53.4	0.501	Moxie City
MPO	%	44 30 17.4	123 33 00.6	1.249	Mary's Peak, Oregon
MTM	%	46 01 31.8	122 12 42.0	1.121	Mt. Mitchell
NAC	+	46 43 59.4	120 49 25.2	0.728	Naches
NCO	%	43 42 14.4	121 08 18.0	1.908	Newberry Crater, Oregon
NEL	+	48 04 12.6	120 20 24.6	1.500	Nelson Butte
NLO	%	46 05 21.9	123 27 01.8	0.826	Nicolai Mt., Oregon
OBC	%	48 02 07.1	124 04 39.0	0.938	Olympics - Bonidu Creek
OBH	%	47 19 34.5	123 51 57.0	0.383	Olympics - Burnt Hill
OCP	%	48 17 53.5	124 37 30.0	0.487	Olympics - Cheeka Peak
OD2	+	47 23 15.6	118 42 34.8	0.553	Odessa site 2
OFR	%	47 56 00.0	124 23 41.0	0.152	Olympics - Forest Resource Cen
OHW	%	48 19 24.0	122 31 54.6	0.054	Oak Harbor
ON2	%	46 52 50.8	123 46 51.8	0.257	Olympics - North River
OOW	%	47 44 03.6	124 11 10.2	0.561	Octopus West
OSD	%	47 48 59.2	123 42 13.7	2.008	Olympics - Snow Dome
OSR	%	47 30 20.3	123 57 42.0	0.815	Olympics Salmon Ridge
OT3	+	46 40 08.4	119 13 58.8	0.322	New Othello (replaces OT2 8/26
OTR	%	48 05 00.0	124 20 39.0	0.712	Olympics - Tyee Ridge
PAT	+	45 52 55.2	119 45 08.4	0.262	Paterson
PCMD	%	46 53 20.9	122 18 00.9	0.239	PC Mountain Detachment
PGO	%	45 27 42.6	122 27 11.5	0.253	Gresham, Oregon
PGW	%	47 49 18.8	122 35 57.7	0.122	Port Gamble
PRO	+	46 12 45.6	119 41 08.4	0.553	Prosser
RCM	%	46 50 08.9	121 43 54.4	3.085	Mt. Rainier, Camp Muir
RCS	%	46 52 15.6	121 43 52.0	2.877	Mt. Rainier, Camp Schurman
RER	%	46 49 09.2	121 50 27.3	1.756	Mt. Rainier, Emerald Ridge

TABLE 1A continued

STA	F	LAT	LONG	EL	NAME
RMW	%	47 27 35.0	121 48 19.2	1.024	Rattlesnake Mt. (West)
RNO	%	43 54 58.9	123 43 25.5	0.850	Roman Nose, Oregon
RPW	%	48 26 54.0	121 30 49.0	0.850	Rockport
RSU	%	46 51 12.0	121 45 47.0	4.440	Rainier summit
RSW	+	46 23 40.2	119 35 28.8	1.045	Rattlesnake Mt. (East)
RVC	%	46 56 34.5	121 58 17.3	1.000	Mt. Rainier - Voight Creek
RVN	%	47 01 38.6	121 20 11.9	1.885	Raven Roost (former NEHRP temp
RVW	%	46 08 53.2	122 44 32.1	0.460	Rose Valley
SAW	+	47 42 06.0	119 24 01.8	0.701	St. Andrews
SBES	%	48 46 05.9	122 24 54.2	0.000	Silver Beach ES
SEA	%	47 39 15.8	122 18 29.3	0.030	UW, Seattle (Wood Anderson,BB,
SEP	#	46 12 00.7	122 11 28.1	2.116	September lobe, Mt. St. Helens
SHW	%	46 11 37.1	122 14 06.5	1.425	Mt. St. Helens
SLF	%	47 45 32.0	120 31 40.0	1.750	Sugar Loaf
SMW	%	47 19 10.7	123 20 35.4	0.877	South Mtn.
SOS	%	46 14 38.5	122 08 12.0	1.270	Source of Smith Creek
SSO	%	44 51 21.6	122 27 37.8	1.242	Sweet Springs, Oregon
STD	%	46 14 16.0	122 13 21.9	1.268	Studebaker Ridge
STW	%	48 09 03.1	123 40 11.1	0.308	Striped Peak
TBM	+	47 10 12.0	120 35 52.8	1.006	Table Mt.
TCO	%	44 06 27.6	121 36 02.1	1.975	Three Creek Meadows, Oregon.
TDH	%	45 17 23.4	121 47 25.2	1.541	Tom,Dick,Harry Mt., Oregon
TDL	%	46 21 03.0	122 12 57.0	1.400	Tradedollar Lake
TKO	%	45 22 16.7	123 27 14.0	1.024	Trask Mtn, Oregon
TRW	+	46 17 32.0	120 32 31.0	0.723	Toppenish Ridge
TWW	+	47 08 17.4	120 52 06.0	1.027	Teanaway
VBE	%	45 03 37.2	121 35 12.6	1.544	Beaver Butte, Oregon
VCR	%	44 58 58.2	120 59 17.4	1.015	Criterion Ridge, Oregon
VFP	%	45 19 05.0	121 27 54.3	1.716	Flag Point, Oregon
VG2	%	45 09 20.0	122 16 15.0	0.823	Goat Mt., Oregon
VGB	+	45 30 56.4	120 46 39.0	0.729	Gordon Butte, Oregon
VIP	%	44 30 29.4	120 37 07.8	1.731	Ingram Pt., Oregon
VLL	%	45 27 48.0	121 40 45.0	1.195	Laurance Lk., Oregon
VLM	%	45 32 18.6	122 02 21.0	1.150	Little Larch, Oregon
VRC	%	42 19 47.2	122 13 34.9	1.682	Rainbow Creek, Oregon
VSP	%	42 20 30.0	121 57 00.0	1.539	Spence Mtn, Oregon
VT2	+	46 58 02.4	119 59 57.0	1.270	Vantage2
VTH	%	45 10 52.2	120 33 40.8	0.773	The Trough, Oregon
WA2	+	46 45 19.2	119 33 56.4	0.244	Wahluke Slope
WAT	+	47 41 55.2	119 57 14.4	0.821	Waterville
WG4	+	46 01 49.2	118 51 21.0	0.511	Wallula Gap
WIB	%	46 20 34.8	123 52 30.6	0.503	Willapa Bay
WIW	+	46 25 45.6	119 17 15.6	0.128	Wooded Island
WPO	%	45 34 24.0	122 47 22.4	0.334	West Portland, Oregon
WPW	%	46 41 55.7	121 32 10.1	1.280	White Pass
WRD	+	46 58 12.0	119 08 41.4	0.375	Warden
WRW	%	47 51 26.0	120 52 52.0	1.189	Wenatchee Ridge
YA2	+	46 31 36.0	120 31 48.0	0.652	Yakima
YEL	#	46 12 35.0	122 11 16.0	1.750	Yellow Rock, Mt. St. Helens

Table 1B lists broad-band, three-component stations operating in Washington and Oregon that provide data to the PNSN.

TABLE 1B

Broad-band three-component stations operating at the end of the fourth quarter 2000. Symbols are as in Table 1A.

STA	F	LAT	LONG	EL	NAME
COR		44 35 08.5	123 18 11.5	0.121	Corvallis, Oregon (IRIS station, Operated by OSU)
DBO	%	43 07 09.0	123 14 34.0	0.984	Dodson Butte, Oregon (CREST - operated by UO)
ELW	%	47 29 38.8	121 52 21.6	0.267	Echo Lake, WA (operated by UW)
ERW	%	48 27 14.4	122 37 30.2	0.389	Mt. Erie, WA (operated by UW)
GNW	%	47 33 51.8	122 49 31.0	0.165	Green Mountain, WA (CREST - operated by UW)
HAWA		46 23 32.3	119 31 57.2	0.367	Hanford Nike (USGS-USNSN)
HLID		43 33 45.0	114 24 49.3	1.772	Hailey, ID (USGS-USNSN)
LON	%	46 45 00.0	121 48 36.0	0.853	Longmire (CREST - operated by UW)
LTY	%	47 15 21.2	120 39 53.3	0.970	Liberty, WA (operated by UW)
NEW		48 15 50.0	117 07 13.0	0.760	Newport Observatory (USGS-USNSN)
OCWA		47 44 56.0	124 10 41.2	0.671	Octopus Mtn. (USGS-USNSN)
PIN		43 48 40.0	120 52 19.0	1.865	Pine Mt. Oregon (CREST - operated by UO)
RAI		46 02 25.1	122 53 06.4	1.520	Trojan Plant, Oregon (OSU)
RWW	%	46 57 50.1	123 32 35.9	0.015	Ranney Well (CREST - operated by UW)
SP2	%	47 33 23.3	122 14 52.8	0.030	Seward Park, Seattle (operated by UW)
SQM	%	48 04 39.0	123 02 44.0	0.030	Sequim (operated by UW, telemetered by Battelle)
TTW	%	47 41 40.7	121 41 20.0	0.542	Tolt Reservoir, WA (operated by UW)
WVOR		42 26 02.0	118 38 13.0	1.344	Wildhorse Valley, Oregon (USGS-USNSN)

Table 1C lists strong-motion, three-component stations operating in Washington and Oregon that provide data in real or near-real time to the PNSN. Several of these stations also have broad-band instruments, as noted. The "SENSOR" field designates what type of seismic sensor is used;

- A = Terra-Tech SSA-320 SLN triaxial accelerometer/Terra-Tech IDS24 recording system,
- A20 = Terra-Tech SSA-320 triaxial accelerometer/Terra-Tech IDS20 recording system,
- FBA23 = Kinemetrics FBA23 accelerometers and Reftek recording system,
- EPI = Kinemetrics Episensor accelerometers and Reftek recording system.
- BB = Guralp CMG-40T 3-D broadband velocity sensor.
- BB3 = Guralp CMG3T 3-D broadband velocity sensor.
- BBZ = Broad Band sensor, PMD 2024, vertical component only.
- K2 = Kinemetrics Episensor accelerometers and K2 Recording System

The "TELEMETRY" field indicates the type of telemetry used to recover the data.

- D = dial-up,
- L = continuously telemetered via dedicated lease-line telephone lines,
- L-PPP = continuously telemetered via dedicated lease-line telephone lines using PPP protocol
- I = continuously telemetered via Internet,
- E = continuously telemetered via Internet from a remote EARTHWORM system

TABLE 1C

Strong-motion three-component stations operating at the end of the fourth quarter 2000. Symbols are as in Table 1A.

STA	F	LAT	LONG	EL	NAME	SENSORS	TELEMETRY
ALCT	%	47 38 51.0	122 02 13.2	0.055	Alcott Elementary, Redmond	K2	I
ALST	%	46 6 31.2	123 01 47.4	0.000	Alston, Oregon BPA	A20	L,E,D
BRKS	%	47 45 19.7	122 17 18.4	0.100	Brookside Elementary, Lake Forest Park	K2,BBZ	I
CSEN	%	47 48 04.5	122 13 06.5	0.055	Crystal Springs Elementary	K2	I
CSO	#	45 31 01.0	122 41 22.5	0.036	Canyon Substation, Oregon	FBA23	D
DBO	%	43 07 09.0	123 14 34.0	0.984	Dodson Butte, OR (UO CREST)	EPI,BB3	E,L-PPP
EARN	%	47 44 24.0	122 02 24.0	0.010	East Ridge Elementary	K2	I
ELW	%	47 29 38.8	121 52 21.6	0.267	Echo Lake, WA	A,BB	L,D
ERW	%	48 27 14.4	122 37 30.2	0.389	Mt. Erie, WA	A,BB	L,D
FINN	%	47 43 08.9	122 13 55.0	0.010	Finn Hill Jr High, Juanita	K2	I
GNW	%	47 33 51.8	122 49 31.0	0.165	Green Mountain, WA (CREST)	EPI,BB3	L-PPP
HAO	#	45 30 33.1	122 39 24.0	0.018	Harrison Substation, Oregon	FBA23	D
HOLY	%	47 33 55.3	122 23 02.1	0.106	Holy Rosary	K2	I
KEEL	%	45 33 0.0	122 53 44.4	0.000	Keeler, Oregon BPA	A20	L,E,D
KIMB	%	47 34 30.9	122 18 05.9	0.100	Kimball Elementary, Seattle	K2	I
KIMR	%	47 30 11.7	122 46 01.9	0.123	Kitsap Moderate Risk Waste	K2	I
KINR	%	47 45 06.0	122 38 35.0	0.010	Kitsap North Road Shed	K2	I
KITP	%	47 40 30.0	122 37 47.0	0.100	Kitsap Treatment Plant	K2	I
LAWT	%	47 39 23.4	122 23 21.9	0.111	Lawton Elementary, Seattle	K2	I
LEOT	%	47 46 04.4	122 06 54.3	0.155	Leota Jr High, Woodinville	A	I
LON	%	46 45 00.0	121 48 36.0	0.853	Longmire (CREST)	EPI,BB3	L-PPP,D
MBPA	%	47 53 56.6	121 53 20.2	0.186	Monroe BPA	A20	L,D
MPL	%	47 28 08.2	122 11 06.2	0.122	Maple Valley	A	L,D
NOWS	%	47 41 12.0	122 15 21.2	0.000	NOAA, Bldg 3	A20	I
PCEP	%	47 06 43.0	122 17 24.2	0.160	PC East Precinct	K2	I
PCFR	%	46 59 23.3	122 26 27.4	0.137	PC Training Center	K2	I
PCMD	%	46 53 20.9	122 18 00.9	0.239	PC Mountain Detachment	K2	I
PIN	%	43 48 40.0	120 52 19.0	1.865	Pine Mt., OR (U0 CREST)	EPI,BB3	E,L-PPP
PNLK	%	47 34 50.0	122 01 42.4	0.128	Pine Lake Middle School, Sammamish	K2	I
QAW	%	47 37 53.2	122 21 15.0	0.140	Queen Anne	A	L
RAW	%	47 20 14.0	121 55 57.6	0.208	Raver BPA	A	L,D
RBEN	%	47 26 05.4	122 11 10.2	0.000	Benson Elementary, Renton	K2	I
RBO	#	45 32 27.0	122 33 51.5	0.158	Rocky Butte, Oregon	FBA23	D
RHAZ	%	47 32 25.8	122 11 08.4	0.108	Hazelwood Elementary, Newcastle	A	I
ROSS	%	45 39 46.2	122 39 37.0	0.100	Ross BPA	A20	L,E,D
RWW	%	46 57 50.1	123 32 35.9	0.015	Ranney Well (CREST)	EPI,BB3	L-PPP
SBES	%	48 46 05.9	122 24 54.2	0.000	Silver Beach Elementary, Bellingham	K2	I
SEA	%	47 39 18.0	122 18 30.0	0.030	Seattle	A,BB	L,D
SP2	%	47 33 23.3	122 14 52.8	0.030	Seward Park, Seattle	A,BB	L
SQM	%	48 04 39.0	123 02 44.0	0.030	Sequim, WA (CREST)	EPI,BB	L-PPP
TBPA	%	47 15 28.1	122 22 05.9	0.002	Tacoma WA BPA	A	L,D
TKCO	%	47 32 12.7	122 18 01.5	0.005	King Co EOC	A20	I
UPS	%	47 15 51.4	122 28 56.3	0.113	University of Puget Sound	K2	I
WISC	%	47 36 32.0	122 10 27.8	0.056	Wilburton Instructional Services Center, Bellevue	K2	I

Table 1D shows stations recorded by the PNSN but not initiated in PNSN EARTHWORM nodes during the fourth quarter 2000. Columns as in Table 1A. "Canada" are stations received from the Pacific Geoscience Centre in British Columbia, Canada; PNNL is the Battelle Pacific Northwest National Labs; MT is Montana Bureau of Mines; OSU is Oregon State University; USNSN is the US National Seismic Network; CAL-NET is the USGS Northern California Network.

TABLE 1D

STA	F	LAT	LONG	EL	NAME
BEN		46 31 12.0	119 43 18.0	0.335	PNNL station
CHMT		46 54 51.0	113 15 07.0	-	Chamberlain Mtn, MT
COR		44 35 08.5	123 18 11.5	0.121	Corvallis, Oregon (IRIS-OSU)
DBO	%	43 07 09.0	123 14 34.0	0.984	Dodson Butte, Oregon (UO CREST)
GBB		46 36 31.8	119 37 40.2	0.185	PNNL Station
H2O		46 23 45.0	119 25 22.0	-	Water PNNL Station
HAWA		46 23 32.3	119 31 57.2	0.367	Hanford Nike USGS-USNSN
HLID		43 33 45.0	114 24 49.3	1.772	Hailey, ID USGS-USNSN
KEB		42 52 20.0	124 20 03.0	0.818	CAL-NET
KSX		41 49 51.0	123 52 33.0	-	CAL-NET
KTR		41 54 31.2	123 22 35.4	1.378	CAL-NET
LAM		41 36 35.2	122 37 32.1	1.769	CAL-NET
LCCM		45 50 16.8	111 52 40.8	1.669	Lewis and Clark Caverns, MT
MCMT		44 49 39.6	112 50 55.8	2.323	McKenzie Canyon, MT
NEW		48 15 50.0	117 07 13.0	0.760	Newport Observatory USNSN BB
OCWA		47 44 56.0	124 10 41.2	0.671	Octopus Mtn. (USGS-USNSN)
OZB		48 57 37.1	125 29 34.1	0.671	Canada
PFB		48 34 30.0	124 26 39.8	0.465	P.Renfrew, Canada
PIN	%	43 48 40.0	120 52 19.0	1.865	Pine Mt., Oregon (U0 CREST)
PNT		49 18 57.6	119 36 57.6	0.550	Canada, BB
RED		46 17 51.0	119 26 15.6	0.330	Red Mountain PNNL Station
SNB		48 46 33.6	123 10 16.3	0.408	Canada
SNI		46 27 80.0	119 39 50.0	-	PNNL station
VDB		49 01 34.0	122 06 10.1	0.404	Canada
VGZ		48 24 50.0	123 19 27.8	0.067	Canada
WVOR		42 26 02.0	118 38 13.0	1.344	Wildhorse Valley, Oregon (USGS-USNSN)

Data Processing

The seismograph network operated by the University of Washington consists of over 50 broad-band and strong-motion sensors, plus over 150 short-period, vertical component, real-time-telemetered seismographic stations. Using real-time-telemetry data, the PNSN seismic recording system operates in an 'event triggered' mode, recording data at 100 samples per sec. per channel. Data from stations with other telemetry systems are retrieved and integrated with the event-triggered data. Arrival times, first motion polarities, signal durations, signal amplitudes, locations and focal mechanisms (when possible) are determined in post-processing. Digital data are processed for all teleseisms, regional events, and all locatable local events. Each trace data file has an associated 'pickfile' which includes arrival times, polarities, coda lengths, and other data.

EARTHWORM is our main PNSN data-acquisition system. The old SUNWORM system operates as a digitizer for the analog stations. Analog stations, and most digital stations, are continuously telemetered in real time. Only a few broadband stations (LTY and RAI) and three USGS strong-motion stations in Portland record only on-site. Data are retrieved via dial-up modem, if needed. All of the real-time data is continuously recorded into temporary storage areas called "wave tanks" which can accomodate about 12 hours of continuous data for the entire network. Triggering algorithms create individual event files. Continuous data is kept for only a subset of of the network, usually for about 20 stations, mostly on volcanos. We continue to use our UW2 pickfile and data formats, and analysis tools which have been in place for the past several years.

Unedited network-trigger trace data are stored on ongoing "network-archive" backups. Edited "Master Event" trace data files are kept for all seismic events. These "Master Event" files are also translated to IRIS-SEED format and submitted to the IRIS Data Management Center for archive and distribution.

Through EARTHWORM, we exchange real-time data with the University of Oregon, Pacific Northwest National Labs, the Pacific Geoscience Centre, the Montana Bureau of Mines, and CALNET. In addition, we send real-time data to the Alaska Tsunami Warning Center, the Pacific Tsunami Warning Center, and the National Earthquake Information Center,

The entire PNSN catalog has been contributed to the CNSS composite catalog located at the Northern California Earthquake Data Center. The PNSN section of the CNSS catalog is updated daily.

Publications wholly or partly supported under this operating agreement are listed in Appendix 2.

SEISMICITY, EMERGENCY NOTIFICATION, AND OUTREACH

Seismicity

Figure 2 shows earthquakes of magnitude 2.0 or larger located in Washington and Oregon during this reporting period. Table 2 lists earthquakes recorded by the PNSN during 2000 which were reported felt. For comparison purposes, Table 3 gives information on seismic activity recorded at the PNSN annually since 1980. During this reporting period there were 10 earthquakes reported felt west of the Cascades in Washington, ranging in magnitude from 1.2 to 3.6. Two earthquakes were felt in Washington east of the Cascades, ranging in magnitude from 3.1 to 3.6. In Oregon, five earthquakes were reported felt, ranging in magnitude from 2.5 to 4.1.

The largest earthquake in Washington this year was a coda magnitude 3.6 earthquake on October 15 14:30 UTC. It occurred at a depth of about 49 km, about 32 km west-northwest of Poulsbo, WA. The earthquake was well-recorded by our network of strong-motion instruments. The earthquake was felt across Kitsap and Jefferson counties, including the cities Poulsbo, Brinnon, Silverdale, Sequim, Bainbridge Island, and Mountlake Terrace.

TABLE 2

Felt Earthquakes during 2000

DATE-(UTC)-TIME yy/mm/dd hh:mm:ss	LAT(N) deg.	LON(W) deg.	DEPTH km	MAG	COMMENTS
00/01/16 15:07:58	47.80N	122.74W	17.6	3.0	11.1 km NW of Poulsbo, WA
00/01/30 19:10:23	45.19N	120.12W	0.0	4.1	6.5 km SE of Condon, OR
00/01/30 20:46:06	45.18N	120.10W	0.0	3.4	8.8 km SE of Condon, OR
00/01/30 20:52:28	45.18N	120.10W	1.8	2.8	8.5 km SE of Condon, OR
00/01/31 03:48:29	48.30N	121.62W	4.1	1.2	5.9 km NNW of Darrington, WA
00/02/01 09:25:36	45.18N	120.11W	0.0	2.8	7.7 km SE of Condon, OR
00/02/29 18:36:37	48.18N	120.11W	0.0	2.5	7.4 km SE of Condon, OR
00/04/11 09:09:03	48.40N	122.27W	14.4	3.2	5.2 km ESE of Mount Vernon, WA
00/04/22 06:43:25	46.86N	121.97W	8.8	3.5	16.5 km W of Mount Rainier
00/06/29 19:27:26	48.46N	123.10W	27.6	3.5	10.6 km SW of Friday Harbor, WA
00/09/10 14:53:38	48.42N	123.19W	49.3	3.2	11.6 km E of Victoria, BC
00/10/15 14:30:05	47.84N	123.00W	48.5	3.6	31.9 km WNW of Poulsbo, WA
00/11/01 08:37:17	48.27N	122.53W	21.8	3.3	21.6 km SW of Mount Vernon, WA
00/11/05 13:10:01	49.47N	119.63W	0.0	3.0	4.7 km SW of Penticton, BC
00/11/10 09:12:39	48.45N	123.23W	25.2	2.5	9.5 km ENE of Victoria, BC
00/11/25 10:01:39	48.83N	119.33W	2.0	3.1	55.2 km NNE of Okanogan, WA
00/12/24 17:04:58	47.73N	120.28W	9.4	3.6	9.7 km NNW of Entiat, WA
00/12/31 18:07:44	47.50N	121.67W	12.6	2.9	8.6 km E of North Bend, WA

Emergency Notification

The RACE system, discussed earlier, is a pager-based alarm system that updates earthquake locations on a map displayed on a PC screen. When a "significant" event (magnitude 2.9 or larger) is located by the PNSN automatic systems, a preliminary location and magnitude is sent within minutes to seismologists and the RACE system via pager. The same information is forwarded via fax and e-mail to others with critical need. A set of web-pages on earthquakes magnitude 3.3 and larger are automatically generated and linked to the PNSN web-site. These preliminary messages are rapidly followed by final processing and update of the RACE systems, faxes, e-mail, and web-site, within 20 minutes to an hour.

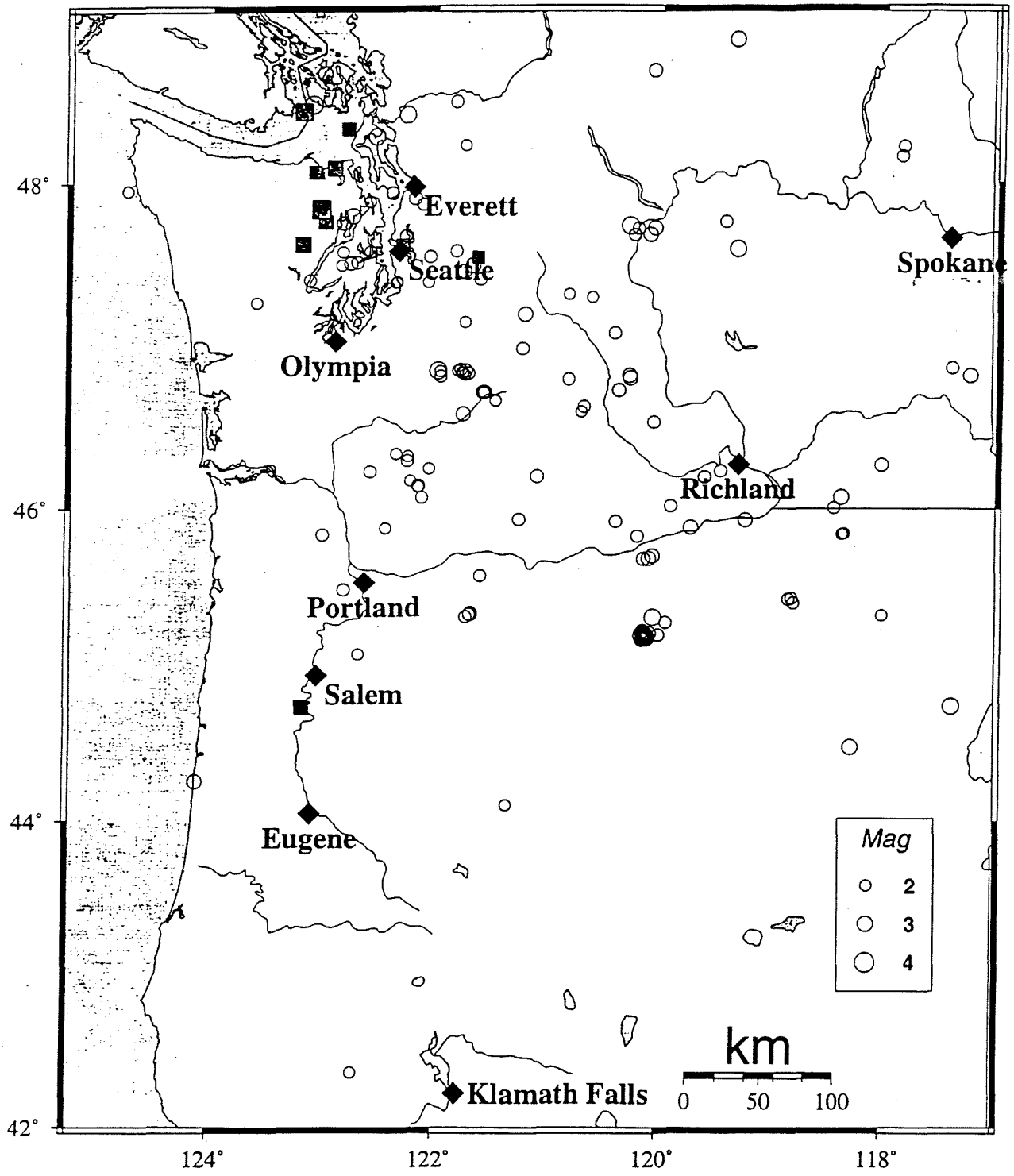

Figure 2. Year 2000 located earthquakes, magnitude >= 2.0. Grey squares indicate earthquakes with depth greater than 30km. Unfilled circles indicate earthquakes with depth <= 30km. Black diamonds indicate cities. Area covered is 117W-125.25W, 42N-49N

TABLE 3

Annual counts of events recorded by the PNSN, 1980-2000

Year	Total #	Out of Net	Inside Net			
			Unlocated	Located		
				Total	EQs(#felt)	Blasts
80	4576	253	1075	3246	2874(18)	372
81	5155	291	1474	3385	2672(29)	713
82	4452	329	1824	2297	1948(20)	349
83	4489	405	2338	1745	1356(15)	389
84	3144	267	1095	1780	1409(16)	371
85	3560	266	1168	2122	1890(16)	232
86	2554	318	452	1776	1594(21)	182
87	1981	537	127	1304	966(22)	338
88	2249	507	114	1624	1263(19)	361
89	2781	501	137	2136	1835(38)	301
90	3433	717	204	2505	2096(26)	409
91	3083	675	315	2085	1687(26)	398
92	3522	891	235	2381	1993(22)	388
93	5594	731	626	4224	3877(35)	347
94	6243	900	1518	3816	3424(28)	392
95	5354	959	1462	2915	2539(16)	376
96	4741	911	1192	2628	2214(39)	414
97	3881	728	904	2239	1992(35)	247
98	7463	831	2174	4430	4176(11)	254
99	4505	803	1483	2187	1965(30)	222
00	5625	1121	1686	2818	2482(18)	341

Public Information and Outreach

Summary lists for all earthquakes located by the PNSN since 1969 are available via anonymous ftp on **ftp.geophys.washington.edu** in the *pub/seis_net* subdirectory. This information is also available via the PNSN **World-Wide-Web(WWW)** site.

http://www.geophys.washington.edu/SEIS/PNSN/

Our web-server contains text about earthquakes in the Pacific Northwest, maps of stations, catalogs and maps of recent earthquake activity, and maps and text about recent interesting sequences. It also contains links into other sources of earthquake information around the country and world.

The PNSN has an educational outreach program to better inform the public, policy makers, and emergency managers about seismicity and natural hazards. We provide information sheets, lab tours, workshops, and media interviews, and have an audio library with several tapes, including a frequently updated "recent earthquakes" message. We organize and participate in special events in addition to our normal background of informational work; including several thousand calls per quarter to our audio library; tours of the PNSN lab by hundreds of students, teachers, and parents; and outreach talks to numerous groups of all types.

This year was a very busy one for the PNSN, with some really memorable events.

- A special one-evening program was held at the UW's Burke Museum on January 26th to commemorate the 300th anniversary of the last great Cascadia Subduction Zone earthquake. (The exact date, January 26, 1700, is known from historic records of a destructive tsunami which struck Japan.) An award from Washington Governor Gary Locke was presented to the Japanese scientist who compiled evidence of this tsunami. More than 40 scientists, including PNSN staff and USGS and NOAA scientists displayed posters on current earthquake research and spoke informally with members of the public. The Burke Museum is working to develop a related exhibit, to open in the summer of 2002.

- "Kingdome SHIPS", the third phase of the U.S. Geological Survey's (USGS) SHIPS (Seismic Hazards in Puget Sound) active seismic experiment took place on Sunday, March 26. On the morning of March 26 the Kingdome, a large concrete sports stadium located on landfill just a few blocks south of downtown Seattle, was demolished by an implosion. The USGS deployed about 200 seismometers, with approximately 1 km grid spacing, throughout the city of Seattle (from Boeing Field in the south to Green Lake in the north) to record the event, which had an estimated magnitude of 2.3. The USGS also set off four small shots in Seattle City Parks the night before, to supplement the data recorded. The PNSN assisted with logistic support and public information activities, including over 100 press contacts, meetings with City of Seattle Public Information Officers, and staffing the PNSN Seismology Lab from 3AM - 10AM on the day of the shots and implosion.
- The PNSN and USGS cohosted several meetings. On Jan. 21 about 15 west-coast network operators and USGS researchers met at the UW to discuss real-time strong motion networks. On Jan. 26, about 40 researchers met to review current research on the Seattle fault. This meeting was the same day as the special evening event at the Burke Museum, and many of the scientists participated in both events. A two-day meeting on March 30 and 31 covered earthquake hazards in Washington and Oregon and was attended by about 75 participants, including engineers, lifeline providers, and scientists.
- The PNSN coordinated an organizational meeting for Pacific Northwest earthquake data users and providers on June 15-16. This group will advise on PNW activities of the Advanced National Seismic System (ANSS).

Our World-Wide-Web site is an important element of our outreach, and we offer many pages on a variety of PNW earthquake-related topics.

ACKNOWLEDGMENTS

Seismic stations, telemetry links, and data acquisition equipment were maintained by Jim Ramey and Allen Strelow at the UW, Patrick McChesney (stationed at CVO in Vancouver, Washington), Pat Ryan (of the University of Oregon in Eugene, Oregon), and Don Hartshorn (of Pacific Northwest National Labs in Richland, WA). Bill Steele provided information to the public, while Sandra Corso handled routine data analysis and archiving of digital trace data in UW2 format from January to July 2000. As of July 2000, the PNSN hired a new data analyst, Amy Tieman. Dr. Peter Lombard and Dr. Steve Malone worked on EARTHWORM. Dr. Tony Qamar worked on instrument calibration, and software development. George Thomas, Amy Lindemuth, and Lynn Hultgrien worked on various projects related to strong motion instrumentation and software. Ruth Ludwin wrote reports, maintained the PNSN web-pages, formatted SEED backups of PNSN data, and handled administrative tasks. Oregon State University (OSU) provided broad-band data from stations COR and RAI, which is archived with PNSN trace-data files. The University of Oregon (UO) provided broad-band data from stations PIN and DBO.

APPENDIX 1

PNSN Quarterly Reports
00-A, 00-B, 00-C, and 00-D

QUARTERLY NETWORK REPORT 2000-A
on
Seismicity of Washington and Oregon

January 1 through March 31, 2000

Pacific Northwest Seismograph Network
Geophysics Program
Box 351650
University of Washington
Seattle, Washington 98195-1650

This report is prepared as a preliminary description of the seismic activity in Washington State and Oregon. Information contained in this report should be considered preliminary, and not cited for publication without checking directly with network staff. The views and conclusions contained in this document should not be interpreted as necessarily representing the official policies, either express or implied, of the U.S. Government.

Seismograph network operation in Washington and Oregon is supported by the following contracts:

U.S. Geological Survey
Joint Operating Agreement 1434-HQ-98-AG-01937

and

Pacific Northwest National Laboratory, operated by Battelle for the U.S. Dept. of Energy
Contract 259116-A-B3

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INTRODUCTION

This is the first quarterly report of 2000 from the University of Washington Geophysics Program *Pacific Northwest Seismograph Network* (PNSN), covering seismicity of Washington and western Oregon.

Comprehensive quarterlies have been produced by the PNSN since the beginning of 1984. Prior to that we published quarterly reports for western Washington in 1983 and for eastern Washington from 1975 to 1983. Annual technical reports covering seismicity in Washington since 1969 are available from the U.W. Geophysics Program. Beginning in 1999, the quarterly PNSN catalog listing changed; earthquakes smaller than magnitude 2.0 are no longer listed in the quarterly reports. The complete PNSN catalog is available on-line, both through our web-site and through the CNSS catalog. We will continue to provide special coverage (figures, counts, listings, etc.) of earthquake swarms, aftershock sequences, etc.

This quarterly report discusses network operations, seismicity of the region, unusual events or findings, and our educational and outreach activities. This report is preliminary, and subject to revision. The PNSN routinely records signals from selected stations in adjoining networks. This improves our ability to locate earthquakes at the edges of our network. However, our earthquake locations may be revised if new data become available, such as P and S readings from Canadian or USGS CALNET seismograph stations. Findings mentioned in these quarterly reports should not be cited for publication.

NETWORK OPERATIONS

Figure 1 shows a map view of stations operating during the quarter, and Table 1 gives approximate periods of time when individual stations were inoperable. Data for Table 1 are compiled from weekly plots of network-wide teleseismic arrivals and automated digital signal checks, plus records of maintenance and repair visits. As is typical, stations began to malfunction during the first quarter, during the worst of the winter weather.

In station news this quarter, the broad-band station at Longmire, WA (LON) was removed. It will be replaced by a CREST station as soon as leased-line telemetry becomes available. Strong-motion equipment from station UPS in Tacoma was moved to Silver Beach Elementary School (SBES) in Bellingham. Long-standing telemetry problems at UPS should be resolved soon, and equipment will be reinstalled there this summer.

Strong-motion Instrumentation and Recording Update

This quarter, the PNSN worked to develop a siting plan for 20 strong-motion instruments to be installed this summer. Web pages regarding the status and plans for this summer's work are located at: **http://www.geophys.washington.edu/SEIS/PNSN/SMO/**. Kinemetrics K2 instruments and internet telemetry have been selected. Most sites now planned will either be located at schools where the Washington state K-20 network is available, or in county buildings using county network connections.

Plans for this summer also include developing educational outreach materials for the schools. Near-real-time webicorders are running for the Silver Beach Elementary School strong motion instrument: **http://www.geophys.washington.edu/SEIS/PNSN/SMO/OUTREACH/SBES.html**

CREST Instrument Update

Last quarter, the PNSN configured and tested an EARTHWORM node for Oregon, named dweezle, to be run at the University of Oregon (UO) by technician Pat Ryan. The new node began transmitting real-time data from Oregon CREST stations PIN and DBO on February 9.

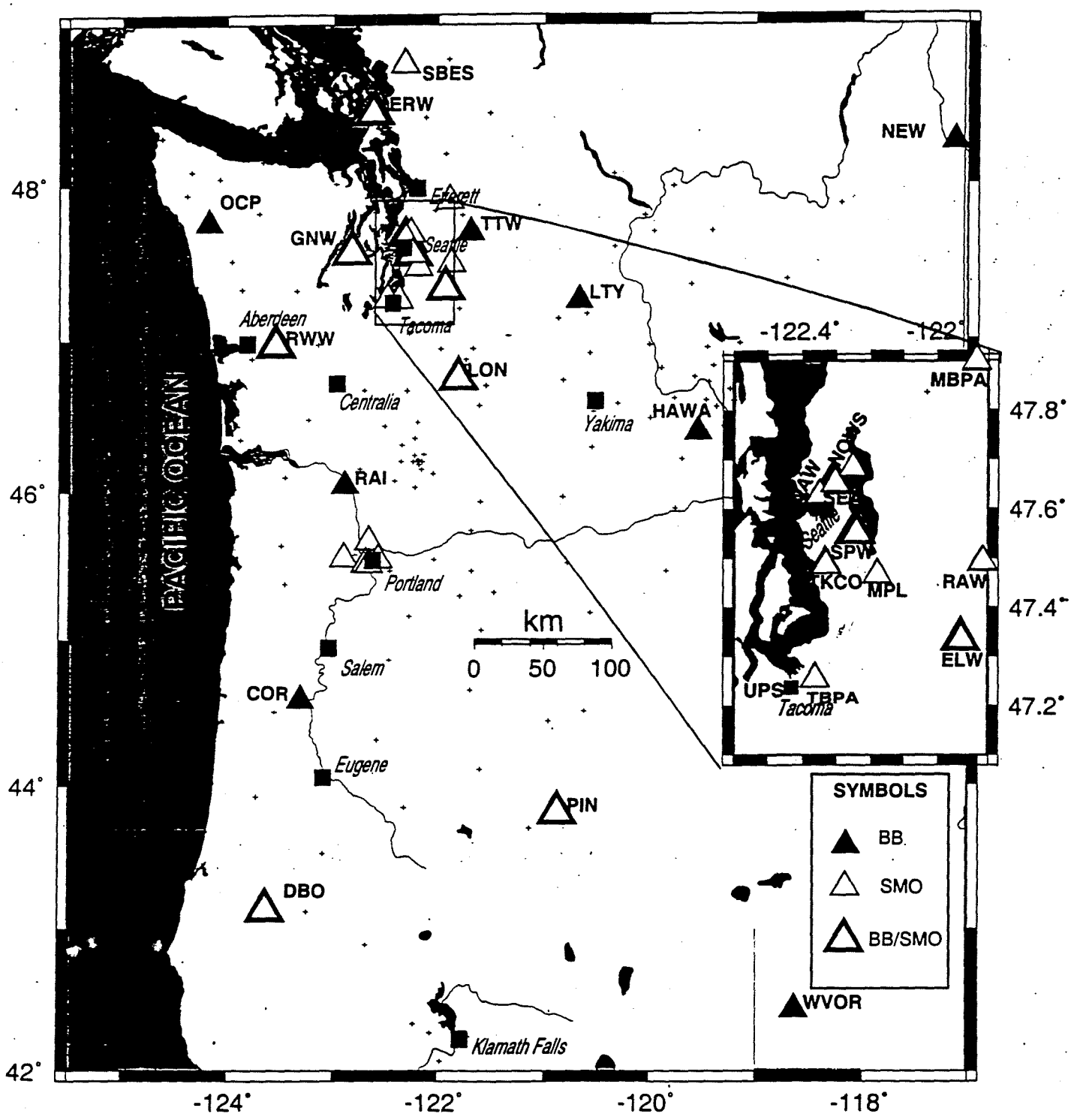

Figure 1: Stations operating at the end of the first quarter, 2000. Small + signs represent short period stations. Cities are shown as squares. Filled triangles represent broad-band stations. Strong motion stations are shown as unfilled triangles. Stations which have both broad-band and strong-motion components are shown as an unfilled triangle with a heavy border.

TABLE 1
Station Outages, Repairs, and Installations 1st quarter 2000

Station	Outage Dates	Comments
ETW	4/2-End	Dead, searching for another site
GBL	10/12-3/12	Repaired - Telemetry reconnected
LON	3/2-End	Sensors added - problem with new telemetry
LCW	4/27/99-End	Dead
MEW	11/16/98-End	Dead - Bad seismometer
NAC	1/20-End	Dead - Winter conditions
NLO	8/97-End	Intermittent
OSD	1/8-End	Dead - Winter conditions
OOW	1/16-End	Dead - Winter conditions
PGW	2/23-End	Intermittent
RCS	11/15-End	Intermittent - Winter conditions
RSU	09/30-End	Dead - Winter conditions
SBES	3/10	INSTALLED: Silver Beach Elementary School
SLF	12/28/99-End	Dead - Winter conditions
TKO	1/4-End	Dead - Winter damage
UPS	2/15	REMOVED - Poor Telemetry
WRW	12/28/99-End	Dead - Winter conditions

STATIONS USED FOR LOCATION OF EVENTS

Table 2A lists short-period, mostly vertical-component stations used in locating seismic events in Washington and Oregon. The first column in the table gives the 3-letter station designator, followed by a symbol designating the funding agency; stations marked by a percent sign (%) were supported by USGS joint operating agreement 1434-HQ-98-AG-01937. A plus (+) indicates support under Pacific Northwest National Laboratory, Battelle contract 259116-A-B3. Stations designated "#" are USGS-maintained stations recorded at the PNSN. "C" indicates USGS Cal-net stations received via EARTHWORM. Other stations were supported from other sources. Additional columns give station north latitude and west longitude (in degrees, minutes and seconds), station elevation in km, and comments indicating landmarks for which stations were named.

TABLE 2A - Short-period Stations operating during the first quarter 2000

STA	F	LAT	LONG	EL	NAME
ASR	%	46 09 09.9	121 36 01.6	1.357	Mt. Adams - Stagman Ridge
AUG	%	45 44 10.0	121 40 50.0	0.865	Augspurger Mtn
BBO	%	42 53 12.6	122 40 46.6	1.671	Butler Butte, Oregon
BHW	%	47 50 12.6	122 01 55.8	0.198	Bald Hill
BLN	%	48 00 26.5	122 58 18.6	0.585	Blyn Mt.
BOW	%	46 28 30.0	123 13 41.0	0.870	Boistfort Mt.
BPO	%	44 39 06.9	121 41 19.2	1.957	Bald Peter, Oregon
BRV	+	46 29 07.2	119 59 28.2	0.920	Black Rock Valley
BVW	+	46 48 39.6	119 52 59.4	0.670	Beverly
CBS	+	47 48 17.4	120 02 30.0	1.067	Chelan Butte, South
CDF	%	46 07 01.4	122 02 42.1	0.756	Cedar Flats
CMW	%	48 25 25.3	122 07 08.4	1.190	Cultus Mtns.
CPW	%	46 58 25.8	123 08 10.8	0.792	Capitol Peak
CRF	+	46 49 30.0	119 23 13.2	0.189	Corfu
DBO		43 07 09.0	123 14 34.0	0.984	Dodson Butte, Oregon
DPW	+	47 52 14.3	118 12 10.2	0.892	Davenport
DY2	+	47 59 06.6	119 46 16.8	0.890	Dyer Hill 2
EDM	%	46 11 50.4	122 09 00.0	1.609	East Dome, Mt. St. Helens
ELK	%	46 18 20.0	122 20 27.0	1.270	Elk Rock
ELL	+	46 54 34.8	120 33 58.8	0.789	Ellensburg
EPH	+	47 21 22.8	119 35 45.6	0.661	Ephrata
ET3	+	46 34 38.4	118 56 15.0	0.286	Eltopia (replaces ET2)
ETW	+	47 36 15.6	120 19 56.4	1.477	Entiat
FBO	%	44 18 35.6	122 34 40.2	1.080	Farmers Butte, Oregon
FL2	%	46 11 47.0	122 21 01.0	1.378	Flat Top 2
FMW	%	46 56 29.6	121 40 11.3	1.859	Mt. Fremont
GBL	+	46 35 54.0	119 27 35.4	0.330	Gable Mountain

TABLE 2A continued

STA	F	LAT	LONG	EL	NAME
GHW	%	47 02 30.0	122 16 21.0	0.268	Garrison Hill
GL2	+	45 57 35.0	120 49 22.5	1.000	New Goldendale
GLK	%	46 33 27.6	121 36 34.3	1.305	Glacier Lake
GMO	%	44 26 20.8	120 57 22.3	1.689	Grizzly Mountain, Oregon
GMW	%	47 32 52.5	122 47 10.8	0.506	Gold Mt.
GSM	%	47 12 11.4	121 47 40.2	1.305	Grass Mt.
GUL	%	45 55 27.0	121 35 44.0	1.189	Guler Mt.
HAM	%	42 04 08.3	121 58 16.0	1.999	Hamaker Mt., Oregon
HBO	%	43 50 39.5	122 19 11.9	1.615	Huckleberry Mt., Oregon
HDW	%	47 38 54.6	123 03 15.2	1.006	Hoodsport
HOG	%	42 14 32.7	121 42 20.5	1.887	Hogback Mtn., Oregon
HSO	%	43 31 33.0	123 05 24.0	1.020	Harness Mountain, Oregon
HSR	%	46 10 28.0	122 10 46.0	1.720	South Ridge, Mt. St. Helens
HTW	%	47 48 14.2	121 46 03.5	0.833	Haystack Lookout
JBO	+	45 27 41.7	119 50 13.3	0.645	Jordan Butte, Oregon
JCW	%	48 11 42.7	121 55 31.1	0.792	Jim Creek
JUN	%	46 08 50.0	122 09 04.4	1.049	June Lake
KEB	C	42 52 20.0	124 20 03.0	0.818	CAL-NET
KMO	%	45 38 07.8	123 29 22.2	0.975	Kings Mt., Oregon
KOS	%	46 27 46.7	122 11 41.3	0.610	Kosmos
KSX	C	41 49 51.0	123 52 33.0		CAL-NET
KTR	C	41 54 31.2	123 22 35.4	1.378	CAL-NET
LAB	%	42 16 03.3	122 03 48.7	1.774	Little Aspen Butte, Oregon
LAM	C	41 36 35.2	122 37 32.1	1.769	CAL-NET
LCW	%	46 40 14.4	122 42 02.8	0.396	Lucas Creek
LMW	%	46 40 04.8	122 17 28.8	1.195	Ladd Mt.
LNO	+	45 52 18.6	118 17 06.6	0.771	Lincton Mt., Oregon
LO2	%	46 45 00.0	121 48 36.0	0.853	Longmire
LOC	+	46 43 01.2	119 25 51.0	0.210	Locke Island
LVP	%	46 04 06.0	122 24 30.0	1.170	Lakeview Peak
MBW	%	48 47 02.4	121 53 58.8	1.676	Mt. Baker
MCW	%	48 40 46.8	122 49 56.4	0.693	Mt. Constitution
MDW	+	46 36 47.4	119 45 39.6	0.330	Midway
MEW	%	47 12 07.0	122 38 45.0	0.097	McNeil Island
MJ2	+	46 33 27.0	119 21 32.4	0.146	May Junction 2
MOX	+	46 34 38.4	120 17 53.4	0.501	Moxie City
MPO	%	44 30 17.4	123 33 00.6	1.249	Mary's Peak, Oregon
MTM	%	46 01 31.8	122 12 42.0	1.121	Mt. Mitchell
NAC	+	46 43 59.4	120 49 25.2	0.728	Naches
NCO	%	43 42 14.4	121 08 18.0	1.908	Newberry Crater, Oregon
NEL	+	48 04 12.6	120 20 24.6	1.500	Nelson Butte
NLO	%	46 05 21.9	123 27 01.8	0.826	Nicolai Mt., Oregon
OBC	%	48 02 07.1	124 04 39.0	0.938	Olympics - Bonidu Creek
OBH	%	47 19 34.5	123 51 57.0	0.383	Olympics - Burnt Hill
OCP		48 17 53.5	124 37 30.0	0.487	Olympics - Cheeka Peak
OD2	+	47 23 15.6	118 42 34.8	0.553	Odessa site 2
OFR	%	47 56 00.0	124 23 41.0	0.152	Olympics - Forest Resource Center
OHW	%	48 19 24.0	122 31 54.6	0.054	Oak Harbor
ONR	%	46 52 37.5	123 46 16.5	0.257	Olympics - North River
OOW	%	47 44 03.6	124 11 10.2	0.561	Octopus West
OSD	%	47 48 59.2	123 42 13.7	2.008	Olympics - Snow Dome
OSR	%	47 30 20.3	123 57 42.0	0.815	Olympics Salmon Ridge
OT3	+	46 40 08.4	119 13 58.8	0.322	New Othello
OTR	%	48 05 00.0	124 20 39.0	0.712	Olympics - Tyee Ridge
PAT	+	45 52 55.2	119 45 08.4	0.262	Paterson
PGO	%	45 27 42.6	122 27 11.5	0.253	Gresham, Oregon
PGW	%	47 49 18.8	122 35 57.7	0.122	Port Gamble
PRO	+	46 12 45.6	119 41 08.4	0.553	Prosser
RCM	%	46 50 08.9	121 43 54.4	3.085	Mt. Rainier, Camp Muir
RCS	%	46 52 15.6	121 43 52.0	2.877	Mt. Rainier, Camp Schurman
RER	%	46 49 09.2	121 50 27.3	1.756	Mt. Rainier, Emerald Ridge
RMW	%	47 27 35.0	121 48 19.2	1.024	Rattlesnake Mt. (West)
RNO	%	43 54 58.9	123 43 25.5	0.850	Roman Nose, Oregon
RPW	%	48 26 54.0	121 30 49.0	0.850	Rockport
RSW	+	46 23 40.2	119 35 28.8	1.045	Rattlesnake Mt. (East)
RSU	%	46 51 12.0	121 45 47.0	4.440	Rainier summit
RVC	%	46 56 34.5	121 58 17.3	1.000	Mt. Rainier - Voight Creek

TABLE 2A continued

STA	F	LAT	LONG	EL	NAME
RVN	%	47 01 38.6	121 20 11.9	1.885	Raven Roost (former NEHRP temp)
RVW	%	46 08 53.2	122 44 32.1	0.460	Rose Valley
SAW	+	47 42 06.0	119 24 01.8	0.701	St. Andrews
SEP	#	46 12 00.7	122 11 28.1	2.116	September lobe, Mt. St. Helens Dome
SHW	%	46 11 37.1	122 14 06.5	1.425	Mt. St. Helens
SLF	%	47 45 32.0	120 31 40.0	1.750	Sugar Loaf
SMW	%	47 19 10.7	123 20 35.4	0.877	South Mtn.
SOS	%	46 14 38.5	122 08 12.0	1.270	Source of Smith Creek
SSO	%	44 51 21.6	122 27 37.8	1.242	Sweet Springs, Oregon
STD	%	46 14 16.0	122 13 21.9	1.268	Studebaker Ridge
STW	%	48 09 03.1	123 40 11.1	0.308	Striped Peak
TBM	+	47 10 12.0	120 35 52.8	1.006	Table Mt.
TCO	%	44 06 27.6	121 36 02.1	1.975	Three Creek Meadows, Oregon
TDH	%	45 17 23.4	121 47 25.2	1.541	Tom,Dick,Harry Mt., Oregon
TDL	%	46 21 03.0	122 12 57.0	1.400	Tradedollar Lake
TKO	%	45 22 16.7	123 27 14.0	1.024	Trask Mtn, Oregon
TRW	+	46 17 32.0	120 32 31.0	0.723	Toppenish Ridge
TWW	+	47 08 17.4	120 52 06.0	1.027	Teanaway
VBE	%	45 03 37.2	121 35 12.6	1.544	Beaver Butte, Oregon
VCR	%	44 58 58.2	120 59 17.4	1.015	Criterion Ridge, Oregon
VFP	%	45 19 05.0	121 27 54.3	1.716	Flag Point, Oregon
VG2	%	45 09 20.0	122 16 15.0	0.823	Goat Mt., Oregon
VGB	+	45 30 56.4	120 46 39.0	0.729	Gordon Butte, Oregon
VIP	%	44 30 29.4	120 37 07.8	1.731	Ingram Pt., Oregon
VLL	%	45 27 48.0	121 40 45.0	1.195	Laurance Lk., Oregon
VLM	%	45 32 18.6	122 02 21.0	1.150	Little Larch, Oregon
VRC	%	42 19 47.2	122 13 34.9	1.682	Rainbow Creek, Oregon
VSP	%	42 20 30.0	121 57 00.0	1.539	Spence Mtn, Oregon
VT2	+	46 58 02.4	119 59 57.0	1.270	Vantage2
VTH	%	45 10 52.2	120 33 40.8	0.773	The Trough, Oregon
WA2	+	46 45 19.2	119 33 56.4	0.244	Wahluke Slope
WAT	+	47 41 55.2	119 57 14.4	0.821	Waterville
WG4	+	46 01 49.2	118 51 21.0	0.511	Wallula Gap
WIB	%	46 20 34.8	123 52 30.6	0.503	Willapa Bay
WIW	+	46 25 45.6	119 17 15.6	0.128	Wooded Island
WPO	%	45 34 24.0	122 47 22.4	0.334	West Portland, Oregon
WPW	%	46 41 55.7	121 32 10.1	1.280	White Pass
WRD	+	46 58 12.0	119 08 41.4	0.375	Warden
WRW	%	47 51 26.0	120 52 52.0	1.189	Wenatchee Ridge
YA2	+	46 31 36.0	120 31 48.0	0.652	Yakima
YEL	#	46 12 35.0	122 11 16.0	1.750	Yellow Rock, Mt. St. Helens

Table 2B lists broad-band, three-component stations operating in Washington and Oregon that provide data to the PNSN.

TABLE 2B

Broad-band three-component stations operating at the end of the first quarter 2000. Symbols are as in Table 2A..

STA	F	LAT	LONG	EL	NAME
COR		44 35 08.5	123 18 11.5	0.121	Corvallis, Oregon (IRIS station. Operated by OSU)
ELW	%	47 29 38.8	121 52 21.6	0.267	Echo Lake, WA (operated by UW)
ERW	%	48 27 14.4	122 37 30.2	0.389	Mt. Erie, WA (operated by UW)
GNW	%	47 33 51.8	122 49 31.0	0.165	Green Mountain, WA (CREST - operated by UW)
HAWA		46 23 32.3	119 31 57.2	0.367	Hanford Nike (USGS-USNSN)
LTY	%	47 15 21.2	120 39 53.3	0.970	Liberty, WA (operated by UW)
NEW		48 15 50.0	117 07 13.0	0.760	Newport Observatory (USGS-USNSN)
OCWA		47 44 56.0	124 10 41.2	0.671	Octopus Mtn. (USGS-USNSN)
PIN		43 48 40.0	120 52 19.0	1.865	Pine Mt. Oregon (operated by UO)
RAI		46 02 25.1	122 53 06.4	1.520	Trojan Plant, Oregon (OSU)
RWW	%	46 57 50.1	123 32 35.9	0.015	Ranney Well (CREST - operated by UW)
SP2	%	47 33 23.3	122 14 52.8	0.030	Seward Park, Seattle (operated by UW)
TTW	%	47 41 40.7	121 41 20.0	0.542	Tolt Reservoir, WA (operated by UW)
WVOR		42 26 02.0	118 38 13.0	1.344	Wildhorse Valley, Oregon (USGS-USNSN)

Table 2C lists strong-motion, three-component stations operating in Washington and Oregon that provide data in real or near-real time to the PNSN. Several of these stations also have broad-band instruments, as noted. The "SENSOR" field designates what type of seismic sensor is used;

- A = Terra-Tech SSA-320 SLN triaxial accelerometer/Terra-Tech IDS24 recording system,
- A20 = Terra-Tech SSA-320 triaxial accelerometer/Terra-Tech IDS20 recording system,
- FBA23 = Kinemetrics FBA23 accelerometers and Reftek recording system,
- EPI = Kinemetrics Episensor accelerometers and Reftek recording system.
- BB = Guralp CMG-40T 3-D broadband velocity sensor.
- BB3 = Guralp CMG3T 3-D broadband velocity sensor.

The "TELEMETRY" field indicates the type of telemetry used to recover the data. • D = dial-up,

- L = continuously telemetered via dedicated lease-line telephone lines,
- L-PPP = continuously telemetered via dedicated lease-line telephone lines using PPP protocol
- I = continuously telemetered via Internet,
- E = continuously telemetered via an Internet earthworm system

TABLE 2C

Strong-motion three-component stations operating at the end of the first quarter 2000. Symbols are as in Table 2A.

STA	F	LAT	LONG	EL	NAME	SENSORS	TELEMETRY
ALST	%	46 6 31.2	123 01 47.4	0.000	Alston, Oregon BPA	A20	E
CSO	#	45 31 01.0	122 41 22.5	0.036	Canyon Substation, Oregon	FBA23	D
ERW	%	48 27 14.4	122 37 30.2	0.389	Mt. Erie, WA	A,BB	L
ELW	%	47 29 38.8	121 52 21.6	0.267	Echo Lake, WA	A,BB	L
GNW	%	47 33 51.8	122 49 31.0	0.165	Green Mountain, WA (CREST)	EPI,BB3	L-PPP
HAO	#	45 30 33.1	122 39 24.0	0.018	Harrison Substation, Oregon	FBA23	D
KEEL	%	45 33 0.0	122 53 44.4	0.000	Keeler, Oregon BPA	A20	E
MBPA	%	47 53 56.6	121 53 20.2	0.186	Monroe BPA	A20	L,D
MPL	%	47 28 08.2	122 11 06.2	0.122	Maple Valley	A	L,D
NOWS	%	47 41 12.0	122 15 21.2	0.000	NOAA, Bldg 3	A20	I
QAW	%	47 37 53.2	122 21 15.0	0.140	Queen Anne	A	L
RAW	%	47 20 14.0	121 55 57.6	0.208	Raver BPA	A	L,D
RBO	#	45 32 27.0	122 33 51.5	0.158	Rocky Butte, Oregon	FBA23	D
ROSS	%	45 39 46.2	122 39 37.0	0.100	Ross BPA	A20	L,E
RWW	%	46 57 50.1	123 32 35.9	0.015	Ranney Well (CREST)	EPI,BB3	L-PPP
SBES	%	48 46 05.9	122 24 54.2	0.000	Silver Beach Elementary School	A	I
SEA	%	47 39 18.0	122 18 30.0	0.030	Seattle	A,BB	L,D
SP2	%	47 33 23.3	122 14 52.8	0.030	Seward Park, Seattle	A,BB	L
TBPA	%	47 15 28.1	122 22 05.9	0.002	Tacoma WA BPA	A	L,D
TKCO	%	47 32 12.7	122 18 01.5	0.005	King Co EOC	A20	I

OUTREACH ACTIVITIES

The PNSN Seismology Lab staff provides an educational outreach program to better inform the public, educators, businesses, policy makers, and the emergency management community about seismicity and natural hazards. Our outreach includes lab tours, lectures, classes and workshops, press conferences, TV and radio news programs and talk shows, field trips, and participation in regional earthquake planning efforts. We provide basic information through information sheets, an audio library, and the Internet on the World-Wide-Web (WWW):

http://www.geophys.washington.edu/SEIS

Special Events

- A special one-evening program was held at the UW's Burke Museum on January 26th to commemorate the 300th anniversary of the last great Cascadia Subduction Zone earthquake. (The exact date, January 26, 1700, is known from historic records of a destructive tsunami which struck Japan.) An award from Washington Governor Gary Locke was presented to the Japanese scientist who compiled evidence of this tsunami. More than 40 scientists, including PNSN staff and USGS and NOAA scientists displayed posters on current earthquake research and spoke informally with members of the public. The Burke Museum is working to develop a related exhibit, to open in the summer of the year 2002.
- The PNSN and USGS cohosted a meeting on Jan. 21 for west-coast for network operators and USGS researchers involved in installing and operating real-time strong motion networks. About 15 people attended.
- Over the course of the quarter, PNSN staff met at various times with county officials, representatives of

utility and private companies, and engineering and emergency management groups regarding rapid earthquake notification and long-term network and strong-motion development plans.

- The PNSN and USGS cohosted a meeting to review current research on the Seattle fault. About 40 researchers from academia and the USGS attended. This meeting was on Jan. 26, the same day as the special evening event at the Burke Museum, and many of the scientists participated in both events. The PNSN assisted mainly with conference planning and logistics.
- Yet another event was cohosted by the PNSN and USGS. A two-day meeting on March 30 and 31 covered earthquake hazards in Washington and Oregon and was attended by about 75 participants, including structural and geotech engineers, lifeline providers, University and government scientists, and earthquake hazard consultants. The PNSN assisted mainly with conference planning and logistics.
- On the morning of March 26 the Kingdome, a large concrete sports stadium located on landfill just a few blocks south of downtown Seattle, was demolished by an implosion. The USGS deployed about 200 seismometers in a grid throughout the city of Seattle to record the event, which had an estimated Richter magnitude of 2.3. This experiment is called "Kingdome SHIPS", and is the third phase of the USGS SHIPS (Seismic Hazards in Puget Sound) project. The USGS also set off four small shots in Seattle City Parks the night before, to optimize the data set. The PNSN assisted with logistic support and public information activities, including over 100 press contacts, meetings with City of Seattle Public Information Officers, and staffing the PNSN Seismology Lab from 3AM - 10AM on Sunday, March 26, the day of the shots and implosion.
- The PNSN continues to contribute to the Seattle, King-Pierce County, and Kitsap County Project Impact Programs. This quarter, Vicky Carwein, Dean of the UW's Tacoma campus, was a signatory to the King-Pierce County Project Impact agreement, and PNSN's Bill Steele is consulting with the Transportation Corridor Vulnerability Project. The PNSN also participated in an event sponsored by Seattle Project Impact on April 1st; "Disaster Saturday" is a bi-annual geologic hazards and mitigation fair that took place at Meany Middle School this time.
- Bill Steele attended meetings of the steering committee of "Reducing Earthquake and Tsunami Hazards in Northwest Ports and Harbors", a pilot program sponsored by Sea Grant with the aim of assessing hazards and developing tsunami mitigation plans. Bill also continued to meet with the Cascadia Regional Earthquake Workgroup (CREW), and is participating in the development of 8/2001 conference of the International Tsunami Society to be held on the campus of the University of Washington.
- The UW's College of Architecture and Urban Planning has launched a new Institute, called the "Institute for Hazard Mitigation Planning and Research". This interdisciplinary institute offers core curricula in hazard mitigation for private, public, and non-governmental organizations, and is intended to serve as a Washington State connection for other academic disaster research and education centers, institutes, and experts. The PNSN often receives inquiries related to hazard mitigation and planning, and now we have a place to refer those inquires: **http://www.depts.washington.edu/mitigate/description.htm**

Press Interviews, Lab Tours, and Workshops

PNSN staff provided more than 100 television, radio, or press interviews this quarter. We provided 19 lab tours for K-12 students this quarter with a total of 400 participants, and only one other public presentation to ~15 people this quarter.

Telephone, Mail, and On-line outreach

The PNSN audio library system received about 500 calls this quarter. We provide several recordings. The most popular is a frequently updated message on current seismic activity. In addition we have a tape describing the seismic hazards in Washington and Oregon, and another on earthquake prediction. Callers often request our one-page information and resource sheet on seismic hazards in Washington and Oregon. Thousands of these have been mailed out or distributed, and we encourage others to reproduce and further distribute this sheet. Our information sheet discussing earthquake prediction is also frequently requested. Callers to the audio library can also choose to be transferred to the Seismology Lab, where additional information is available. This quarter we responded in person to: ~90 calls from emergency management and government, ~100 calls from the media, ~30 calls from educators, ~45 from the business community, and about 150 calls from the general public.

The PNSN recent earthquake list, and much more, is also available through the World-Wide-Web (WWW) at:

http://www.geophys.washington.edu/SEIS/PNSN

The PNSN web-site offers web pages that include maps and lists of the most recent PNW earthquakes, general information on earthquakes and PNW earthquake hazards, information on past damaging PNW earthquakes, and catalogs of earthquake summary cards. Web-pages on seismicity of Cascade Volcanos, and Quarterly summaries of seismicity are also included. "Webicorder" pages allow Web visitors to view continuous data from six PNSN seismographic stations at:

http://www.geophys.washington.edu/SEIS/PNSN/WEBICORDER/

This quarter, we updated our "Recent Earthquakes in the Pacific Northwest" web page to be compatible with similar web pages being provided in California. The new format uses an active map.

For larger earthquakes, the PNSN has a standard set of web pages that are generated automatically using preliminary information, at the same time that the initial page is sent to seismologists. Features offered include a "felt form" that readers can fill out, several maps of the regional area and immediate vicinity of the earthquake, a list of other sizable earthquakes known historically, a list of the nearest strong-motion sites, focal mechanisms, and strong motion trace-data.

In addition to the PNSN web site, the UW Geophysics Program and the PNSN host several other earthquake-related web sites:

- **Volcano Systems Center** is a cooperative effort of the UW and the USGS that links volcano-related activities of the UW Geological Sciences, Geophysics, and Oceanography departments with related USGS activities.

  http://www.vsc.washington.edu

- **Seismosurfing** is a comprehensive listing of sites worldwide that offer substantive seismology data and information. This page is mirrored at two sites in Europe.

  http://www.geophys.washington.edu/seismosurfing.html

- The **Council of National Seismic Systems** (CNSS) site features composite listings and maps of recent U.S. earthquakes, and documentation of the EARTHWORM system.

  http://www.cnss.org

- The **"Tsunami!"** web site offers many pages of information, including an excellent discussion on the physics of tsunamis, and short movie clips. It was developed by Benjamin Cook under the direction of Dr. Catherine Petroff (UW Civil Engineering).

  http://www.geophys.washington.edu/tsunami

- The UW Geophysics Program **Global Positioning System (GPS)** web site provides information on geodetic studies of crustal deformation in Washington and Oregon.

  http://www.geophys.washington.edu/GPS/gps.html

EARTHQUAKE DATA - 2000-A

There were 944 events digitally recorded and processed at the University of Washington between January 1 and March 31, 2000. Locations in Washington, Oregon, or southernmost British Columbia were determined for 507 of these events; 447 were classified as earthquakes and 60 as known or suspected blasts. The remaining 437 processed events include teleseisms (136 events), regional events outside the PNSN (125), and unlocated events within the PNSN. Unlocated events within the PNSN include very small earthquakes and some known blasts. Frequent mining blasts occur near Centralia, Washington and we routinely locate and retrieve broad-band data for some of them.

Table 3 is a listing of all earthquakes reported to have been felt during the this quarter. Table 5, located at the end of this report, is this quarter's catalog of earthquakes and blasts, M 2.0 or greater, located within the network - between 42-49.5 degrees north latitude and 117-125.3 degrees west longitude.

Fig. 2 shows earthquakes with magnitude greater than or equal to 0.0 ($M_c \geq 0$).
Fig. 3 shows blasts and probable blasts ($M_c \geq 0$).
Fig. 4 shows earthquakes located near Mt. Rainier ($M_c \geq 0$).
Fig. 5 shows earthquakes located at Mt. St. Helens ($M_c \geq 0$).

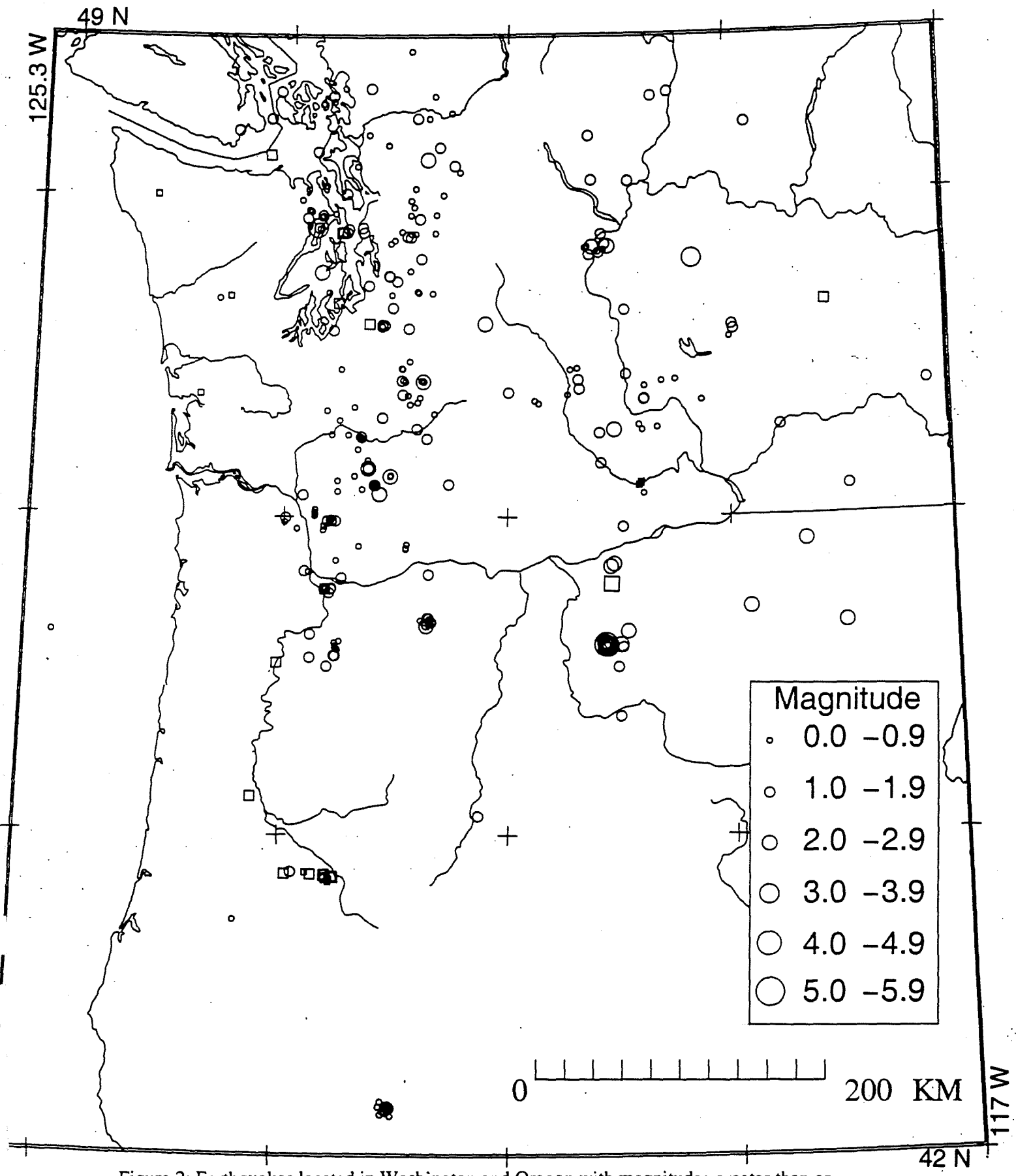

Figure 2: Earthquakes located in Washington and Oregon with magnitudes greater than or equal to 0.0 during the first quarter of 2000. Square symbols indicate events located at depths of 30 km or more.

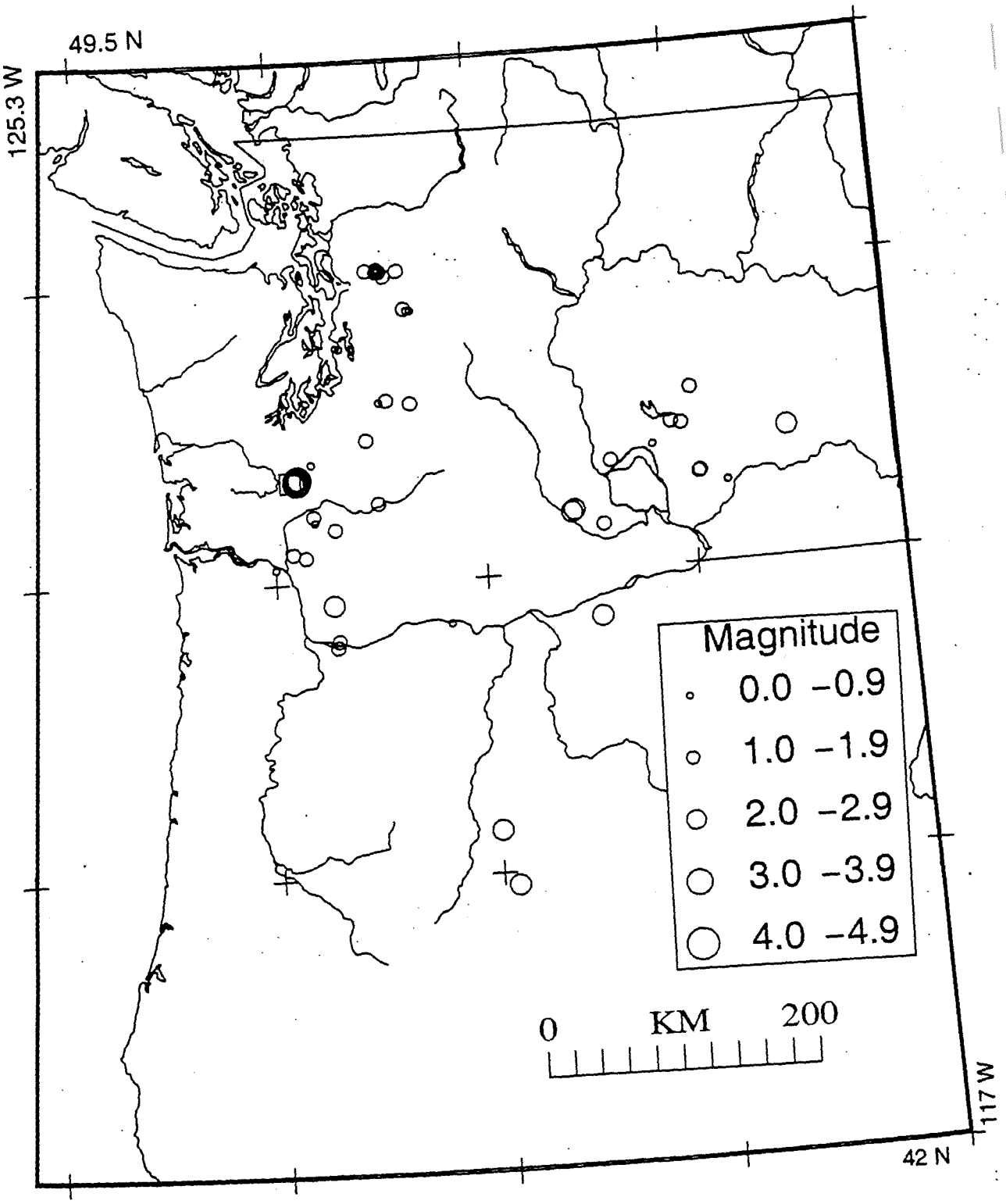

Figure 3: Blasts and probable blasts, first quarter, 2000.

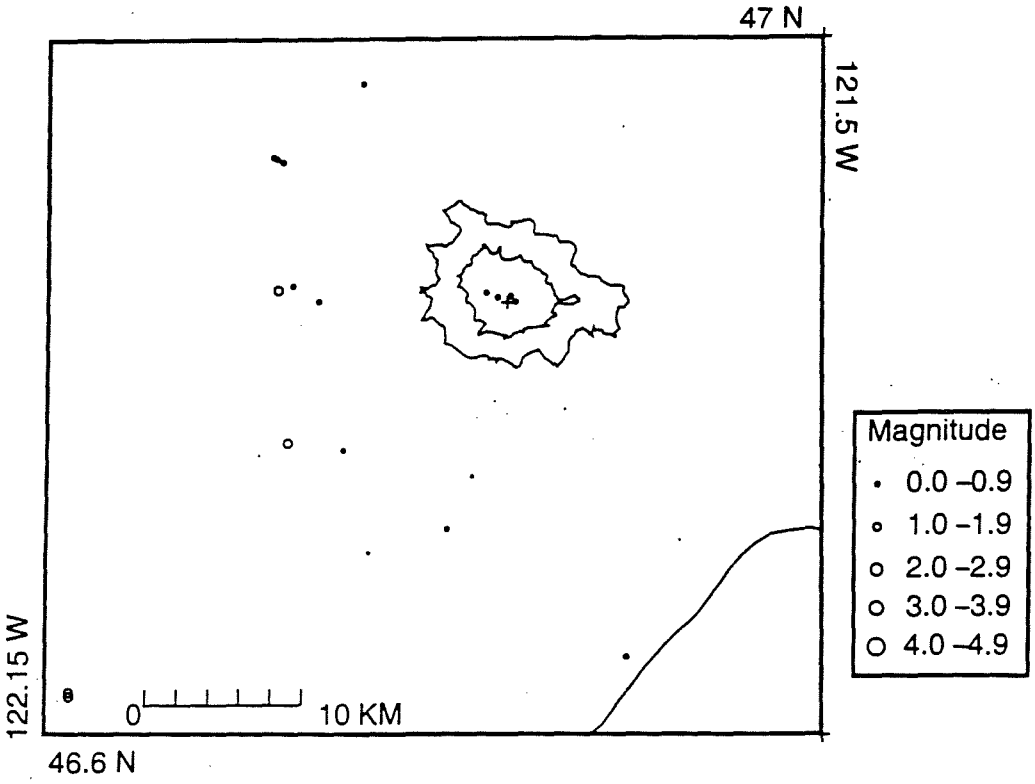

Figure 4: Earthquakes located in the Mt. Rainier area first quarter, 2000. All events shown are greater than magnitude 0.0. Inner contour is the 10,000 foot elevation contour, and the outer is the 7,500 foot contour. "Plus" symbols represent earthquakes shallower than 1 km depth, while circles represent earthquakes at 1 km or deeper.

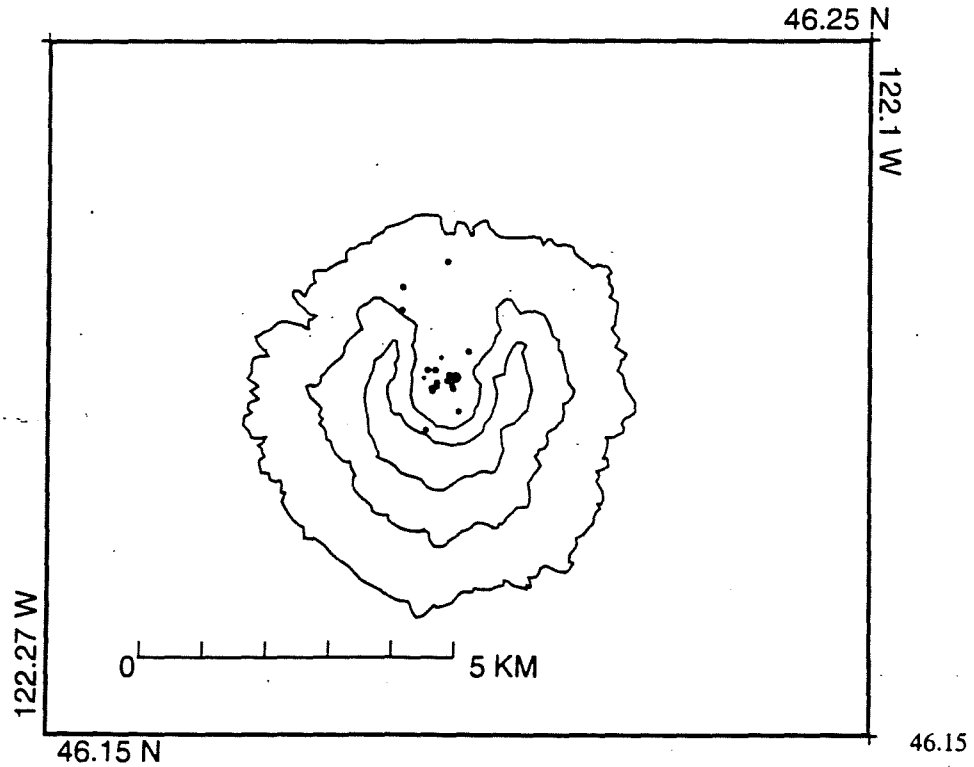

Figure 5: Earthquakes located in the Mt. St. Helens area first quarter, 2000. All events shown are greater than magnitude 0.0. Contours shown are at 5,000, 6,400 and 7,500 feet elevation. "Plus" symbols represent earthquakes shallower than 1 km depth, while circles represent earthquakes at 1 km or deeper. Symbol scaling as in Fig. 4.

TABLE 3 - Felt Earthquakes during the 1st Quarter of 2000

DATE-(UTC)-TIME yy/mm/dd hh:mm:ss	LAT(N) deg.	LON(W) deg.	DEPTH km	MAG	COMMENTS
00/01/16 15:07:58	47.80N	122.74W	17.6	3.0	11.1 km NW of Poulsbo, WA
00/01/30 19:10:23	45.19N	120.12W	0.0	4.1	6.5 km SE of Condon, OR
00/01/30 20:46:06	45.18N	120.10W	0.0	3.4	8.8 km SE of Condon, OR
00/01/30 20:52:28	45.18N	120.10W	1.8	2.8	8.5 km SE of Condon, OR
00/01/31 03:48:29	48.30N	121.62W	4.1	1.2	5.9 km NNW of Darrington, WA
00/02/01 09:25:36	45.18N	120.11W	0.0	2.8	7.7 km SE of Condon, OR
00/02/29 18:36:37	45.18N	120.11W	0.0	2.5	7.4 km SE of Condon, OR

OREGON SEISMICITY

During the first quarter of 2000 a total of 88 earthquakes were located in Oregon between 42.0° and 45.5° north latitude, and between 117° and 125° west longitude. The most interesting activity in Oregon this quarter was a cluster of earthquakes near Condon. Between January 5 and Feb. 29, twenty-three earthquakes magnitude 2.0 or larger were located in the vicinity. The largest event in the sequence was magnitude 4.1. Five of these earthquakes were reported felt near Condon. Table 3 gives details on the felt events.

In the Klamath Falls area, 17 earthquakes were located this quarter. Since 1994, most earthquakes northwest of Klamath Falls have been considered aftershocks of a pair of damaging earthquakes in September of *1993* (Sept. 21, 03:29 and 05:45 UTC; M_c 5.9 and 6.0 respectively). The 1993 earthquakes were followed by a vigorous aftershock sequence which decreased over time.

WESTERN WASHINGTON SEISMICITY

During the first quarter of 2000, 296 earthquakes were located between 45.5° and 49.5° north latitude and between 121° and 125.3° west longitude.

Two earthquakes were felt this quarter in western Washington, The largest was a magnitude 3.0 earthquake that took place on January 16 near Poulsbo, WA. Table 3 gives details.

This quarter, the deepest event recorded by the PNSN was a magnitude 1.6 at a depth of about 54 km. It occurred on February 3 at 21:11 UTC and was located about 13.5 km ESE of Tacoma, WA.

Mount Rainier Area: Figure 4 shows earthquakes near Mount Rainier. The number of events in close proximity to the cone of Mt. Rainier varies over the course of the year, since the source of much of the shallow activity is presumably ice movement or avalanching at the surface, which is seasonal in nature. Events with very low frequency signals (1-3 Hz) believed to be icequakes are assigned type "L" in the catalog. Emergent, very long duration signals, probably due to rockfalls or avalanches, are assigned type "S" (see Key to Earthquake Catalog). "L" and "S" type events are listed in the catalog, but not shown in Figure 4. Although no events flagged "L" or "S" events were located at Mount Rainier this quarter, 24 "L" or "S" events were recorded, but were too small to locate reliably.

A total of 27 tectonic events (7 of these were smaller than magnitude 0.0, and thus are not shown in Fig. 4) were located within the region shown in Fig. 4. Of these, 11 were located in the "Western Rainier Seismic Zone" (WRSZ), a north-south trending lineation of seismicity approximately 15 km west of the summit of Mt. Rainier (for counting purposes, the western zone is defined as 46.6-47 degrees north latitude and 121.83-122 west longitude). The largest tectonic earthquakes near Mt. Rainier this quarter was magnitude 2.1.

This quarter, there were 10 higher-frequency tectonic-style earthquake within 5 km of the summit. The remaining events were scattered around the cone of Rainier as seen in Fig. 4.

TABLE 4 Quarterly (Q) comparison of earthquake counts over several years.

"Total" events are all events located within the PNSN network area; between 42.0-49.5 degrees north latitude and 117-125.3 degrees west longitude. The smallest detectable earthquake varies over the region. "Total" events are subdivided into "Quakes" and "Blasts". The remaining numbers are counts of earthquakes only in western and eastern Washington, and in Oregon. Western Washington earthquakes are those between 45.5 and 49.5 degrees north latitude and 121-125.3 degrees west longitude. Within western Washington, earthquakes at Mt. St. Helens (MSH) are between 46.15-46.25 degrees north latitude and 122.10-122.27 degrees west longitude, and earthquakes near Mt. Rainier are between 46.6-47.0 degrees north latitude and 121.5-122.15 degrees west longitude. "Eastern Washington" earthquake counts are for quakes between 45.5-49.5 degrees north latitude and 117-121 degrees west longitude. "Oregon" earthquakes are located between 42-45.5 degrees north latitude and 117-125 degrees west longitude.

TABLE 4 Comparison of quarterly earthquake counts over several years

Year	Q	Total	Quakes	Blasts	western WA	MSH	Rainier	eastern WA	OR
1993	A	457	380	77	267	34	77	32	72
	B	450	384	66	284	63	62	57	33
	C	727	579	148	368	82	75	65	141
	D	2616	2556	60	355	82	92	39	2157
1994	A	1585	1501	84	232	43	73	44	1222
	B	873	775	98	350	60	130	56	364
	C	822	656	166	379	67	81	62	208
	D	555	506	49	236	52	44	55	211
1995	A	488	426	62	273	18	38	47	101
	B	726	636	90	438	104	91	58	134
	C	1072	924	148	693	318	84	75	138
	D	687	610	77	484	264	41	41	70
1996	A	504	434	70	303	82	56	53	75
	B	967	864	103	752	68	57	39	72
	C	696	544	152	426	83	75	45	67
	D	476	387	89	312	65	59	45	29
1997	A	417	353	64	270	49	47	45	34
	B	525	473	52	386	70	31	65	21
	C	633	568	65	473	183	45	66	28
	D	680	614	66	505	292	47	56	45
1998	A	692	639	53	478	293	35	57	106
	B	1248	1183	65	1048	776	47	74	58
	C	1727	1635	92	1464	1107	76	84	86
	D	1373	729	43	620	349	69	60	49
1999	A	474	449	25	248	122	16	49	148
	B	469	407	62	277	134	31	45	84
	C	592	505	87	391	133	44	55	58
	D	660	610	50	394	148	50	62	118
2000	A	507	447	60	296	95	27	61	88

Mount St. Helens Area: Figure 5 shows volcano-tectonic earthquakes near Mount St. Helens. Low frequency (L) and avalanche or rockfall events (S) are not shown. This quarter 95 earthquakes were located at Mt. St. Helens in the area shown in Fig. 5. Of these 32 were magnitude 0.0 or larger and 18 were deeper than 4 km, including 6 larger than magnitude 0.0. The largest tectonic earthquake at Mount St. Helens this quarter was magnitude 1.3

Twelve type "S" or "L" event were located at Mount St. Helens, and 63 "L" or "S" events too small to locate were recorded.

Mt. St. Helens activity, 1998-2000								
	98-B	98-C	98-D	99-A	99-B	99-C	99-D	2000-A
Located earthquakes	**776**	**1107**	**349**	**122**	**133**	**133**	**148**	**95**
Magnitude 0 or larger	**205**	**302**	**65**	**32**	**25**	**35**	**23**	**32**
Deeper than 4 km and M>0.0	**141**	**232**	**52**	**21**	**10**	**8**	**4**	**6**
Unlocated Crater Rockfalls	**120**	**565**	**115**	**26**	**28**	**409**	**236**	**63**

EASTERN WASHINGTON SEISMICITY

During the first quarter of 2000, 61 earthquakes were located in eastern Washington in the area described in Table 4. The largest earthquake in eastern Washington this quarter occurred about 2 km west of Coulee City, Washington on March 16 at 09:44 UTC. It had a magnitude of 3.2 and a depth of about 2 km and was not reported to have been felt.

Times, locations, and depths of felt earthquakes in the PNSN region are given in Table 3. Table 4 is a summary table of various earthquake counts-per-quarter over several years.

OTHER SOURCES OF EARTHQUAKE INFORMATION

We provide automatic computer-generated alert messages about significant Washington and Oregon earthquakes by e-mail, FAX or via the pager-based RACE system to institutions needing such information, and we regularly exchange phase data via e-mail with other regional seismograph network operators. The "Outreach Activities" section describes how to access PNSN data via e-mail, Internet, and World-Wide-Web. To request additional information by e-mail, contact seis_info@geophys.washington.edu.

Earthquake information in the quarterlies is published in final form by the Washington State Department of Natural Resources as information circulars entitled "Earthquake Hypocenters in Washington and Northern Oregon" covering the period 1970-1989 (see circulars Nos. 53, 56, 64-66, 72, 79, 82-84, and 89). These circulars, plus circular No. 85, "Washington State Earthquake Hazards", are available from Washington Dept. of Natural Resources, Division of Geology and Earth Resources, Post Office Box 47007, Olympia, WA. 98504-7007, or by telephone at (360) 902-1450.

Several excellent maps of Pacific Northwest seismicity are available. A very colorful perspective-view map (18" x 27") entitled "Major Earthquakes of the Pacific Northwest" depicts selected epicenters of strong earthquakes (magnitudes > 5.1) that have occurred in the Pacific Northwest. A more detailed full-color map is called "Earthquakes in Washington and Oregon 1872-1993", by Susan Goter (USGS Open-File Report 94-226A). It is accompanied by a companion pamphlet "Washington and Oregon Earthquake History and Hazards", by Yelin, Tarr, Michael, and Weaver (USGS Open-File Report 94-226B). The pamphlet is also available separately. Maps can be ordered from: "Earthquake Maps", U.S. Geological Survey, Box 25046, Federal Center, MS 967, Denver, CO 80225, phone (303) 273-8477. The price of each map is $12. (including US shipping and handling).

USGS Cascades Volcano Observatory has a video, "Perilous Beauty: The Hidden Dangers of Mount Rainier", about the risk of lahars from Mount Rainier. Copies are available through: Northwest Interpretive Association (NWIA), 909 First Avenue Suite 630, Seattle WA 98104, Telephone: (206) 220-4141, Fax: (206) 220-4143.

Other regional agencies provide earthquake information. These include the Geological Survey of Canada (Pacific Geoscience Centre, Sidney, B.C.; (250) 363-6500, FAX (250) 363-6565), which produces monthly summaries of Canadian earthquakes; the US Geological Survey which produces weekly reports called "Seismicity Reports for Northern California" (USGS, attn: Steve Walter, 345 Middlefield Rd, MS-977, Menlo Park, CA, 94025) and "Weekly Earthquake Report for Southern California" (USGS, attn: Dr. Kate Hutton or Dr. Lucy Jones, CalTech, Pasadena, CA.).

Key to Earthquake Catalog in Table 5

TIME Origin time is calculated for each earthquake on the basis of multi-station arrival times. Time is given in **Coordinated Universal Time** (UTC), in hours:minutes:seconds. To convert to Pacific Standard Time (PST) subtract eight hours, or to Pacific Daylight Time subtract seven hours.

LAT North latitude of the epicenter, in degrees and minutes.

LONG West longitude of the epicenter, in degrees and minutes.

DEPTH The depth, given in kilometers, is usually freely calculated from the arrival-time data. In some instances, the depth must be fixed arbitrarily to obtain a convergent solution. Such depths are noted by an asterisk (*) in the column immediately following the depth. A $ or a # following the depth mean that the maximum number of iterations has been exceeded without meeting convergence tests and both the location and depth have been fixed.

MAG Coda-length magnitude M_c, an estimate of local magnitude M_L (Richter, C.F., 1958, Elementary Seismology: W.H. Freeman and Co., 768p), calculated using the coda-length/magnitude relationship determined for Washington (Crosson, R.S., 1972, Bull. Seism. Soc. Am., v. 62, p. 1133-1171). Where blank, data were insufficient for a reliable magnitude determination. Normally, the only earthquakes with undetermined magnitudes are very small ones. Magnitudes may be revised as we improve our analysis procedure.

NS/NP NS is the number of station observations, and **NP** the number of P and S phases used to calculate the earthquake location. A minimum of three stations and four phases are required. Generally, more observations improve the quality of the solution.

GAP Azimuthal gap. The largest angle (relative to the epicenter) containing no stations.

RMS The root-mean-square residual (observed arrival time minus predicted arrival time) at all stations used to locate the earthquake. It is only useful as a measure of the quality of the solution when 5 or more well-distributed stations are used in the solution. Good solutions are normally characterized by **RMS** values less than about 0.3 sec.

Q Two **Quality factors** indicate the general reliability of the solution (**A** is best quality, **D** is worst). Similar quality factors are used by the USGS for events located with the computer program HYPO71. The first letter is a measure of the hypocenter quality based on travel-time residuals. For example: **A** quality requires an **RMS** less than 0.15 sec while an **RMS** of 0.5 sec or more is **D** quality (estimates of the uncertainty in hypocenter location also affect this quality parameter). The second letter of the quality code depends on the spatial distribution of stations around the epicenter, i.e. number of stations, their azimuthal distribution, and the minimum distance (**DMIN**) from the epicenter to a station. Quality **A** requires a solution with 8 or more phases, **GAP** ≤ 90° and **DMIN** ≤ (5 km or depth, whichever is greater). If the number of phases, **NP**, is 5 or fewer or **GAP** > 180° or **DMIN** > 50 km the solution is assigned quality **D.**

MOD The crustal velocity model used in location calculations.

P3 - Puget Sound model
C3 - Cascade model
S3 - Mt. St. Helens model including Elk Lake
N3 - northeastern model
E3 - southeastern model
O0 - Oregon model
K3 - Southern Oregon, Klamath Falls area model
R0 and J1 - Regional and Offshore models

TYP Events flagged in Table 5 use the following code:

F - earthquake reported to have been felt
P - probable explosion
L - low frequency earthquake (e.g. glacier movement, volcanic activity)
H - handpicked from helicorder records
S - Special event (e.g. rockslide, avalanche, volcanic steam emission, harmonic tremor, sonic boom), not a man-made explosion or tectonic earthquake
X - known explosion

TABLE 5

Earthquakes and Blasts, Magnitude 2.0 or larger, First Quarter, 2000.

Within an area 42-49.5 degrees north latitude and 117-125.3 degrees west longitude.

Jan 2000

DAY	TIME	LAT	LON	DEPTH	M	NS/NP	GAP	RMS	Q	MOD	TYP
4	23:03:47.94	46 42.77	122 46.83	7.20$	2.4	9/09	140	0.15	BC	P3	P
5	00:28:36.37	45 42.24	120 02.96	5.62	2.8	11/14	98	0.76	DC	E3	
6	22:51:55.88	46 52.28	118 03.31	2.29$	2.0	10/12	194	0.59	DD	E3	P
10	23:08:37.54	46 42.46	122 46.84	9.23$	2.3	11/11	111	0.17	BC	P3	P
12	14:03:19.31	47 41.29	120 13.71	0.62	2.1	22/29	57	0.23	BC	N3	
12	19:49:03.06	49 08.36	120 48.45	0.03*	2.1	14/20	255	0.57	DD	C3	
13	23:12:06.07	45 41.45	119 56.08	0.03*	2.6	7/08	130	0.73	DC	E3	P
14	21:44:48.29	45 19.02	121 43.08	5.73	2.2	24/31	81	0.42	CB	O0	
16	15:07:58.77	47 48.37	122 44.89	17.61	3.0	27/31	79	0.10	AA	P3	
18	00:40:47.05	43 54.90	120 51.86	6.86	2.8	6/06	206	0.41	DD	O0	X
19	11:30:41.27	47 31.72	122 42.23	7.52	2.2	25/33	81	0.16	BA	P3	
19	23:07:04.54	46 42.62	122 45.86	6.94	2.7	12/12	177	0.10	AC	P3	P
20	18:29:44.50	45 11.74	120 06.18	0.02*	2.1	11/12	145	0.24	BC	O0	
24	20:34:19.63	45 11.14	120 06.87	0.05*	2.0	11/13	172	0.24	BC	O0	
25	00:00:15.48	46 42.66	122 46.43	7.34	3.1	8/08	176	0.11	AC	P3	P
26	23:54:50.86	45 25.55	118 50.46	26.00	2.1	20/22	212	0.37	CD	O0	
27	19:55:17.76	46 50.95	121 45.79	0.81	2.1	35/39	53	0.13	AA	C3	
29	02:27:34.50	48 13.56	121 44.49	12.21	2.0	22/28	88	0.22	BB	P3	
30	19:10:23.47	45 11.82	120 07.48	0.03*	4.1	29/29	160	0.45	CC	O0	F
30	19:18:03.90	45 11.59	120 06.70	0.04*	2.6	19/22	145	0.28	BC	O0	
30	20:46:06.37	45 10.99	120 06.17	0.03*	3.4	26/29	146	0.27	BC	O0	F
30	20:50:16.16	45 11.42	120 07.00	1.42#	2.4	20/22	145	0.32	CC	O0	
30	20:52:28.05	45 10.90	120 06.55	1.81	2.8	28/33	146	0.37	CC	O0	F
31	01:25:52.67	45 12.59	120 07.25	0.04*	2.1	11/13	201	0.43	CD	O0	
31	03:07:12.90	45 11.67	120 06.82	0.02*	2.0	12/13	145	0.23	BC	O0	

Feb 2000

DAY	TIME	LAT	LON	DEPTH	M	NS/NP	GAP	RMS	Q	MOD	TYP
1	00:11:07.98	45 11.39	120 06.75	0.02*	3.6	28/32	145	0.34	CC	O0	
1	09:25:36.43	45 11.20	120 07.07	0.03*	2.8	23/25	171	0.45	CC	O0	F
1	09:49:29.16	45 10.88	120 05.92	1.39	2.2	11/13	147	0.46	CC	O0	
1	09:54:06.97	45 16.79	119 55.69	25.27$	2.1	5/06	238	0.50	DD	O0	
1	22:18:31.94	46 41.80	122 50.76	30.54	2.7	8/08	178	0.17	CC	P3	P
4	22:14:11.21	46 41.35	122 48.84	2.59	2.7	11/11	155	0.26	BC	P3	P
5	21:44:22.67	46 25.10	120 08.19	0.03*	2.4	19/19	65	0.28	BC	E3	P
9	23:02:46.90	46 42.61	122 46.65	12.91	2.9	12/12	164	0.16	CC	P3	P
12	00:10:51.71	45 11.88	119 59.58	23.76$	2.2	11/13	190	0.68	DD	O0	
14	16:31:50.78	45 11.80	120 05.69	0.04*	2.1	9/10	173	0.40	CC	O0	
15	01:19:35.63	45 41.26	120 04.75	15.84$	2.6	12/13	120	0.66	DB	E3	
15	08:14:44.25	47 12.40	121 12.29	3.09	2.6	54/63	43	0.29	BC	C3	
16	10:35:43.95	45 12.35	120 06.79	0.02*	2.1	9/10	169	0.13	AC	O0	
16	23:03:33.44	46 41.55	122 46.91	13.05	3.3	8/08	244	0.11	BD	P3	P
18	00:16:38.30	46 24.26	120 09.79	0.02*	2.2	14/14	105	0.24	BC	E3	P
18	20:44:56.76	45 19.31	118 00.29	0.13$	2.0	7/07	308	0.06	BD	O0	
21	18:34:36.43	45 34.67	120 04.51	40.89	2.5	10/10	181	0.65	DD	E3	
22	07:06:16.71	46 08.83	122 08.74	12.07	2.4	41/46	47	0.17	BA	S3	
22	23:15:09.32	46 32.72	120 02.47	0.02*	2.1	16/19	82	0.43	CB	E3	
24	18:10:14.72	46 08.76	122 08.89	12.16	2.0	34/45	46	0.15	BA	S3	
25	22:22:17.35	46 42.24	122 47.28	15.57*	2.9	8/08	213	0.09	AD	P3	P
27	20:46:37.49	46 18.38	122 14.91	8.00	2.1	31/35	48	0.11	AA	S3	
28	06:33:49.13	46 15.39	122 03.13	12.75	2.0	32/42	62	0.11	AA	S3	
29	09:39:17.34	45 10.42	120 08.04	0.04*	2.1	11/12	171	0.30	BC	O0	
29	18:31:51.28	45 12.64	120 08.39	0.04*	2.0	10/11	165	0.20	BC	O0	
29	18:36:37.19	45 11.36	120 07.09	0.02*	2.5	17/19	171	0.26	BC	O0	F
29	22:58:12.54	45 12.78	120 08.52	0.03*	2.1	18/20	164	0.43	CC	O0	

Mar 2000

DAY	TIME	LAT	LON	DEPTH	M	NS/NP	GAP	RMS	Q	MOD	TYP
2	23:04:36.87	46 41.74	122 47.68	16.34$	2.9	20/20	86	0.16	BC	P3	P
7	22:13:57.14	46 42.32	122 46.76	16.81	2.7	14/14	122	0.11	BC	P3	P
15	21:12:16.64	44 17.27	120 59.70	0.02*	2.4	6/06	247	0.90	DD	O0	P

QUARTERLY NETWORK REPORT 2000-B
on
Seismicity of Washington and Oregon

April 1 through June 30, 2000

Pacific Northwest Seismograph Network
Geophysics Program
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Seattle, Washington 98195-1650

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DAY	TIME	LAT	LON	DEPTH	M	NS/NP	GAP	RMS	Q	MOD	TYP
16	09:44:44.36	47 36.48	119 18.88	2.20$	3.2	25/26	102	0.19	BC	N3	
20	23:04:35.11	46 42.23	122 46.94	7.00	3.3	19/19	114	0.11	AC	P3	P
21	20:34:38.70	45 51.13	122 27.64	3.87	2.2	12/14	263	0.19	BD	C3	P
21	21:20:34.49	47 41.48	120 05.39	6.60*	2.8	23/27	50	0.13	AB	N3	
27	23:05:24.76	46 42.20	122 47.08	8.16$	2.4	11/11	88	0.24	BC	P3	P
28	23:04:52.46	46 42.43	122 47.80	6.83#	2.4	11/11	96	0.13	AC	P3	P
29	21:29:57.28	45 50.60	118 20.18	0.74	2.0	12/16	259	0.26	BD	E3	

INTRODUCTION

This is the second quarterly report of 2000 from the University of Washington Geophysics Program *Pacific Northwest Seismograph Network* (PNSN), covering seismicity of Washington and western Oregon.

Comprehensive quarterlies have been produced by the PNSN since the beginning of 1984. Prior to that we published quarterly reports for western Washington in 1983 and for eastern Washington from 1975 to 1983. Annual technical reports covering seismicity in Washington since 1969 are available from the U.W. Geophysics Program. Beginning in 1999, the quarterly PNSN catalog listing changed; earthquakes smaller than magnitude 2.0 are no longer listed in the quarterly reports. The complete PNSN catalog is available on-line, both through our web-site and through the CNSS catalog. We will continue to provide special coverage (figures, counts, listings, etc.) of earthquake swarms, aftershock sequences, etc.

This quarterly report discusses network operations, seismicity of the region, unusual events or findings, and our educational and outreach activities. This report is preliminary, and subject to revision. The PNSN routinely records signals from selected stations in adjoining networks. This improves our ability to locate earthquakes at the edges of our network. However, our earthquake locations may be revised if new data become available, such as P and S readings from Canadian seismograph stations. Findings mentioned in these quarterly reports should not be cited for publication.

NETWORK OPERATIONS

Figure 1A show a map view of broad-band and short-period stations operating during the quarter. Figure 1B shows map views of broad-band and strong motion stations operating in the Seattle and Portland urban areas. Table 1 gives approximate periods of time when individual stations were inoperable. Data for Table 1 are compiled from weekly plots of network-wide teleseismic arrivals and automated digital signal checks, plus records of maintenance and repair visits. As is typical, the second quarter is devoted to repairing stations that lost functionality during the winter. Some stations also spontaneously revive after the snow melts, and these are scheduled for a checkup and maintenance visit later in the season.

In station news this quarter, a CREST station was installed at Longmire, WA (LON) after resolution of a leased-line telemetry problem. Telemetry problems at UPS were resolved, and strong-motion equipment was reinstalled there. Station STD was rebuilt and the seismometer moved about 50 meters north. The replacement of EPROMS at stations MBPA, MPL, RAW, ROSS, SP2 and TBPA required a site visit to each station, although no significant down time resulted. Station COR is now received in real-time through the USNSN.

Station RVC was vandalized. We will seek a more secure site for this station, as increasing traffic in the area has been an ongoing problem. Station ONR was temporarily re-sited during logging operations. The north-south component of station OBH went off center, and was removed and reinstalled.

The PNNL (Pacific Northwest National Laboratory; operated by Battelle) began operation of an EARTHWORM node at the Hanford Reservation in eastern Washington. This allows us to receive signals from additional stations in eastern Washington. Table 2D lists stations that the PNSN receives through EARTHWORM nodes outside the PNSN.

Strong-motion Instrumentation and Recording Update

This quarter, the PNSN continued finalization of siting plans for 20 strong-motion instruments to be installed this summer. Most sites will either be located at schools where the Washington State K-20 network is available, or in county buildings using county network connections. Software was provided by the USGS EARTHWORM team to integrate the real-time signals from these Kinemetrics K2 instruments with the UW's EARTHWORM system. We are also beginning development of educational outreach materials for the schools. Web pages regarding the status and plans for this summer's work are located at:

http://www.geophys.washington.edu/SEIS/PNSN/SMO/

The PNSN's George Thomas, along with technical staff from the University of Utah, went to Menlo Park to train and to participate in the installation of a free-field strong-motion station located near Stanford University.

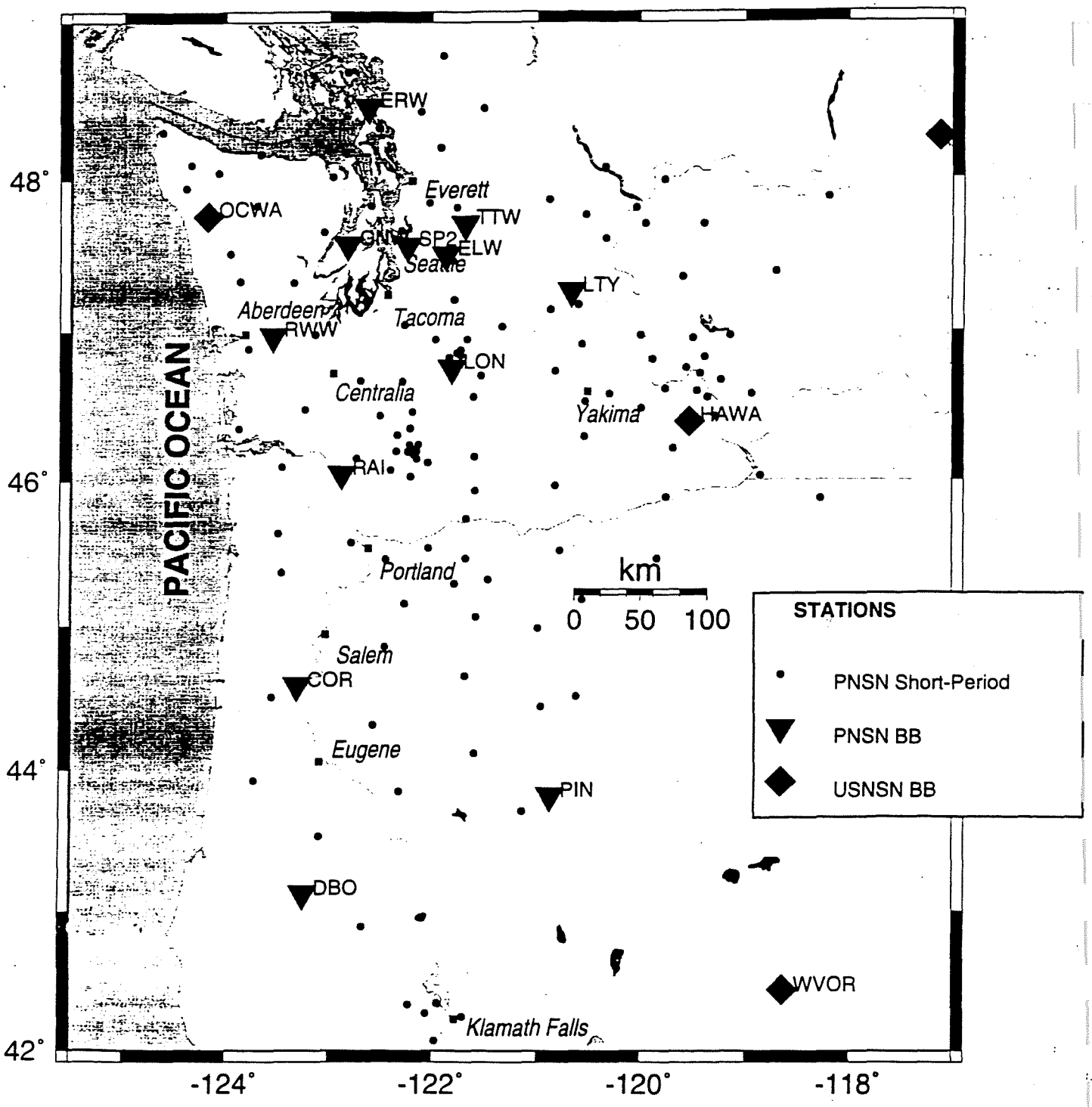

Figure 1a. Broad-band and short-period seismograph stations operating in Washington and Oregon at the end of the second quarter, 2000.

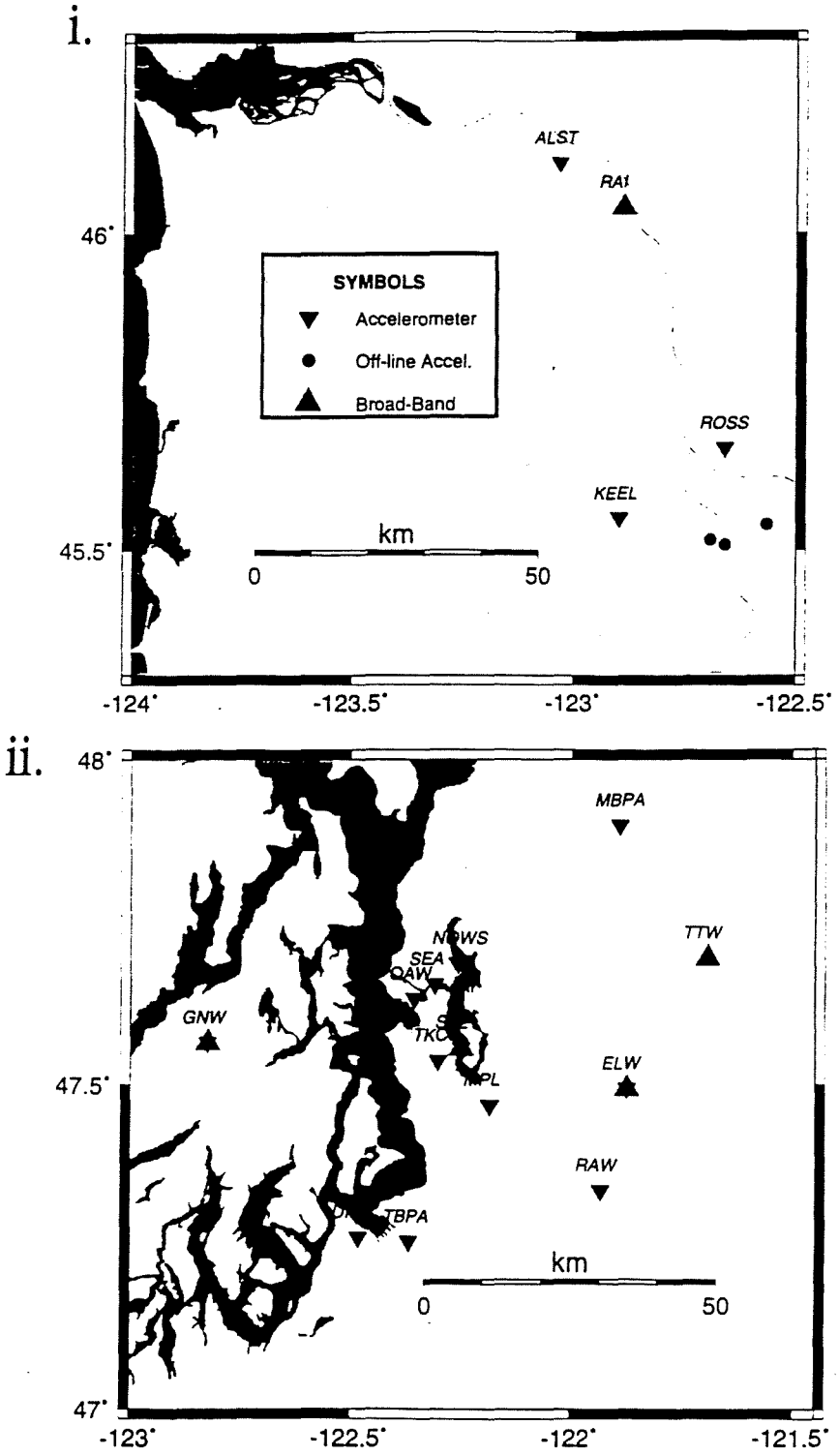

Figure 1B. Maps showing PNSN strong-motion and broad-band stations operating at the end of the second quarter 2000 in the Portland (i.) and Seattle (ii.) area.

CREST Instrument Update

Last quarter the "dweezle" EARTHWORM node at the University of Oregon in Eugene, OR began transmitting real-time data from the broad-band components of Oregon CREST stations PIN and DBO. This quarter, strong-motion components were installed at the stations. Plans are ongoing to site additional CREST stations in central Oregon out of UO and in northern Oregon out of UW.

TABLE 1
Station Outages, Repairs, and Installations 2nd quarter 2000

Station	Outage Dates	Comments
DBO.SL*	5/17	INSTALLED Strong motion episensor component
ETW	4/2-XXXX	Dead, searching for another site
LON	3/2-5/10	Telemetry problem resolved
LCW	4/27/99-6/30	Seismometer replaced
MEW	11/16/98-6/21	Seismometer replaced
NAC	1/20-4/5	Revived with improved weather
NLO	8/97-????	Intermittent
OFR.EHZ	6/2-End	Dead
OSD	1/8-4/8	Revived with improved weather
OOW	1/16-4/5	Batteries replaced
OTR	1/1-4/6	Intermittent or dead; Severed solar panel cable
PIN.SL*	6/7	INSTALLED Strong motion episensor component
PGW	2/23-4/18	Intermittent: Batteries replaced
RCS	11/15-4/11	Revived with improved weather
RSU	09/30/99-End	Dead
RVC	2/13-End	REMOVED - Vandalized
SLF	12/28/99-End	Dead - Winter damage
SMW	1/1-5/25	Intermittent
TKO	1/4-End	REMOVED - planned CREST station
TTW	1/1-End	Bad Time - GPS clock drifting
UPS	2/15-6/8	REINSTALLED with new Telemetry path
VIP	6/1-6/27	Batteries Replaced
VLL	3/7-5/30	Power cable severed during logging
WRW	12/28/99-End	Dead - Winter damage

STATIONS USED FOR LOCATION OF EVENTS

Table 2A lists short-period, mostly vertical-component stations used in locating seismic events in Washington and Oregon. The second column in the table gives the 3-letter station designator, followed by a symbol designating the funding agency; stations marked by a percent sign (%) were supported by USGS joint operating agreement 1434-HQ-98-AG-01937. A plus (+) indicates support under Pacific Northwest National Laboratory, Battelle contract 259116-A-B3. Stations designated "#" are USGS-maintained stations recorded at the PNSN. Other stations were supported from other sources. Additional columns give station north latitude and west longitude (in degrees, minutes and seconds), station elevation in km, and comments indicating landmarks for which stations were named.

TABLE 2A - Short-period Stations operated by the PNSN during the second quarter 2000

STA	F	LAT	LONG	EL	NAME
ASR	%	46 09 09.9	121 36 01.6	1.357	Mt. Adams - Stagman Ridge
AUG	%	45 44 10.0	121 40 50.0	0.865	Augspurger Mtn
BBO	%	42 53 12.6	122 40 46.6	1.671	Butler Butte, Oregon
BHW	%	47 50 12.6	122 01 55.8	0.198	Bald Hill
BLN	%	48 00 26.5	122 58 18.6	0.585	Blyn Mt.
BOW	%	46 28 30.0	123 13 41.0	0.870	Boistfort Mt.
BPO	%	44 39 06.9	121 41 19.2	1.957	Bald Peter, Oregon
BRV	+	46 29 07.2	119 59 28.2	0.920	Black Rock Valley

TABLE 2A continued

STA	F	LAT	LONG	EL	NAME
BVW	+	46 48 39.5	119 52 56.4	0.670	Beverly
CBS	+	47 48 17.4	120 02 30.0	1.067	Chelan Butte, South
CDF	%	46 07 01.4	122 02 42.1	0.756	Cedar Flats
CMM	%	46 26 07.0	122 30 21.0	0.620	Crazy Man Mt.
CMW	%	48 25 25.3	122 07 08.4	1.190	Cultus Mtns.
CPW	%	46 58 25.8	123 08 10.8	0.792	Capitol Peak
CRF	+	46 49 30.0	119 23 13.2	0.189	Corfu
DPW	+	47 52 14.3	118 12 10.2	0.892	Davenport
DY2	+	47 59 06.6	119 46 16.8	0.890	Dyer Hill 2
EDM	%	46 11 50.4	122 09 00.0	1.609	East Dome, Mt. St. Helens
ELK	%	46 18 20.0	122 20 27.0	1.270	Elk Rock
ELL	+	46 54 34.8	120 33 58.8	0.789	Ellensburg
EPH	+	47 21 22.8	119 35 45.6	0.661	Ephrata
ET3	+	46 34 38.4	118 56 15.0	0.286	Eltopia (replaces ET2)
ETW	+	47 36 15.6	120 19 56.4	1.477	Entiat
FBO	%	44 18 35.6	122 34 40.2	1.080	Farmers Butte, Oregon
FHE		46 57 06.9	119 29 49.0	0.455	Frenchman Hills East
FL2	%	46 11 47.0	122 21 01.0	1.378	Flat Top 2
FMW	%	46 56 29.6	121 40 11.3	1.859	Mt. Fremont
GBL	+	46 35 54.0	119 27 35.4	0.330	Gable Mountain
GHW	%	47 02 30.0	122 16 21.0	0.268	Garrison Hill
GL2	+	45 57 35.0	120 49 22.5	1.000	New Goldendale
GLK	%	46 33 27.6	121 36 34.3	1.305	Glacier Lake
GMO	%	44 26 20.8	120 57 22.3	1.689	Grizzly Mountain, Oregon
GMW	%	47 32 52.5	122 47 10.8	0.506	Gold Mt.
GSM	%	47 12 11.4	121 47 40.2	1.305	Grass Mt.
GUL	%	45 55 27.0	121 35 44.0	1.189	Guler Mt.
HAM	%	42 04 08.3	121 58 16.0	1.999	Hamaker Mt., Oregon
HBO	%	43 50 39.5	122 19 11.9	1.615	Huckleberry Mt., Oregon
HDW	%	47 38 54.6	123 03 15.2	1.006	Hoodsport
HOG	%	42 14 32.7	121 42 20.5	1.887	Hogback Mtn., Oregon
HSO	%	43 31 33.0	123 05 24.0	1.020	Harness Mountain, Oregon
HSR	%	46 10 28.0	122 10 46.0	1.720	South Ridge, Mt. St. Helens
HTW	%	47 48 14.2	121 46 03.5	0.833	Haystack Lookout
JBO	+	45 27 41.7	119 50 13.3	0.645	Jordan Butte, Oregon
JCW	%	48 11 42.7	121 55 31.1	0.792	Jim Creek
JUN	%	46 08 50.0	122 09 04.4	1.049	June Lake
KMO	%	45 38 07.8	123 29 22.2	0.975	Kings Mt., Oregon
KOS	%	46 27 46.7	122 11 41.3	0.610	Kosmos
LAB	%	42 16 03.3	122 03 48.7	1.774	Little Aspen Butte, Oregon
LCW	%	46 40 14.4	122 42 02.8	0.396	Lucas Creek
LMW	%	46 40 04.8	122 17 28.8	1.195	Ladd Mt.
LNO	+	45 52 18.6	118 17 06.6	0.771	Lincton Mt., Oregon
LO2	%	46 45 00.0	121 48 36.0	0.853	Longmire
LOC	+	46 43 01.2	119 25 51.0	0.210	Locke Island
LVP	%	46 04 06.0	122 24 30.0	1.170	Lakeview Peak
MBW	%	48 47 02.4	121 53 58.8	1.676	Mt. Baker
MCW	%	48 40 46.8	122 49 56.4	0.693	Mt. Constitution
MDW	+	46 36 47.4	119 45 39.6	0.330	Midway
MEW	%	47 12 07.0	122 38 45.0	0.097	McNeil Island
MJ2	+	46 33 27.0	119 21 32.4	0.146	May Junction 2
MOX	+	46 34 38.4	120 17 53.4	0.501	Moxie City
MPO	%	44 30 17.4	123 33 00.6	1.249	Mary's Peak, Oregon
MTM	%	46 01 31.8	122 12 42.0	1.121	Mt. Mitchell
NAC	+	46 43 59.4	120 49 25.2	0.728	Naches
NCO	%	43 42 14.4	121 08 18.0	1.908	Newberry Crater, Oregon
NEL	+	48 04 12.6	120 20 24.6	1.500	Nelson Butte
NLO	%	46 05 21.9	123 27 01.8	0.826	Nicolai Mt., Oregon
OBC	%	48 02 07.1	124 04 39.0	0.938	Olympics - Bonidu Creek
OBH	%	47 19 34.5	123 51 57.0	0.383	Olympics - Burnt Hill
OCP	%	48 17 53.5	124 37 30.0	0.487	Olympics - Cheeka Peak
OD2	+	47 23 15.6	118 42 34.8	0.553	Odessa site 2
OFR	%	47 56 00.0	124 23 41.0	0.152	Olympics - Forest Resource Cen
OHW	%	48 19 24.0	122 31 54.6	0.054	Oak Harbor
ON2	%	46 52 50.8	123 46 51.8	0.257	Olympics - North River
OOW	%	47 44 03.6	124 11 10.2	0.561	Octopus West
OSD	%	47 48 59.2	123 42 13.7	2.008	Olympics - Snow Dome
OSR	%	47 30 20.3	123 57 42.0	0.815	Olympics Salmon Ridge
OT3	+	46 40 08.4	119 13 58.8	0.322	New Othello (replaces OT2 8/26
OTR	%	48 05 00.0	124 20 39.0	0.712	Olympics - Tyee Ridge
PAT	+	45 52 55.2	119 45 08.4	0.262	Paterson
PGO	%	45 27 42.6	122 27 11.5	0.253	Gresham, Oregon
PGW	%	47 49 18.8	122 35 57.7	0.122	Port Gamble
PRO	+	46 12 45.6	119 41 08.4	0.553	Prosser
RCM	%	46 50 08.9	121 43 54.4	3.085	Mt. Rainier, Camp Muir
RCS	%	46 52 15.6	121 43 52.0	2.877	Mt. Rainier, Camp Schurman
RER	%	46 49 09.2	121 50 27.3	1.756	Mt. Rainier, Emerald Ridge
RMW	%	47 27 35.0	121 48 19.2	1.024	Rattlesnake Mt. (West)

TABLE 2A continued

STA	F	LAT	LONG	EL	NAME
RNO	%	43 54 58.9	123 43 25.5	0.850	Roman Nose, Oregon
RPW	%	48 26 54.0	121 30 49.0	0.850	Rockport
RSU	%	46 51 12.0	121 45 47.0	4.440	Rainier summit
RSW	+	46 23 40.2	119 35 28.8	1.045	Rattlesnake Mt. (East)
RVC	%	46 56 34.5	121 58 17.3	1.000	Mt. Rainier - Voight Creek
RVN	%	47 01 38.6	121 20 11.9	1.885	Raven Roost (former NEHRP temp
RVW	%	46 08 53.2	122 44 32.1	0.460	Rose Valley
SAW	+	47 42 06.0	119 24 01.8	0.701	St. Andrews
SEA	%	47 39 15.8	122 18 29.3	0.030	UW, Seattle (Wood Anderson.BB.
SEP	#	46 12 00.7	122 11 28.1	2.116	September lobe, Mt. St. Helens
SHW	%	46 11 37.1	122 14 06.5	1.425	Mt. St. Helens
SLF	%	47 45 32.0	120 31 40.0	1.750	Sugar Loaf
SMW	%	47 19 10.7	123 20 35.4	0.877	South Mtn.
SOS	%	46 14 38.5	122 08 12.0	1.270	Source of Smith Creek
SSO	%	44 51 21.6	122 27 37.8	1.242	Sweet Springs, Oregon
STD	%	46 14 16.0	122 13 21.9	1.268	Studebaker Ridge
STW	%	48 09 03.1	123 40 11.1	0.308	Striped Peak
TBM	+	47 10 12.0	120 35 52.8	1.006	Table Mt.
TCO	%	44 06 27.6	121 36 02.1	1.975	Three Creek Meadows, Oregon.
TDH	%	45 17 23.4	121 47 25.2	1.541	Tom,Dick,Harry Mt., Oregon
TDL	%	46 21 03.0	122 12 57.0	1.400	Tradedollar Lake
TKO	%	45 22 16.7	123 27 14.0	1.024	Trask Mtn, Oregon
TRW	+	46 17 32.0	120 32 31.0	0.723	Toppenish Ridge
TWW	+	47 08 17.4	120 52 06.0	1.027	Teanaway
VBE	%	45 03 37.2	121 35 12.6	1.544	Beaver Butte, Oregon
VCR	%	44 58 58.2	120 59 17.4	1.015	Criterion Ridge, Oregon
VFP	%	45 19 05.0	121 27 54.3	1.716	Flag Point, Oregon
VG2	%	45 09 20.0	122 16 15.0	0.823	Goat Mt., Oregon
VGB	+	45 30 56.4	120 46 39.0	0.729	Gordon Butte, Oregon
VIP	%	44 30 29.4	120 37 07.8	1.731	Ingram Pt., Oregon
VLL	%	45 27 48.0	121 40 45.0	1.195	Laurance Lk., Oregon
VLM	%	45 32 18.6	122 02 21.0	1.150	Little Larch, Oregon
VRC	%	42 19 47.2	122 13 34.9	1.682	Rainbow Creek, Oregon
VSP	%	42 20 30.0	121 57 00.0	1.539	Spence Mtn, Oregon
VT2	+	46 58 02.4	119 59 57.0	1.270	Vantage2
VTH	%	45 10 52.2	120 33 40.8	0.773	The Trough, Oregon
WA2	+	46 45 19.2	119 33 56.4	0.244	Wahluke Slope
WAT	+	47 41 55.2	119 57 14.4	0.821	Waterville
WG4	+	46 01 49.2	118 51 21.0	0.511	Wallula Gap
WIB	%	46 20 34.8	123 52 30.6	0.503	Willapa Bay
WIW	+	46 25 45.6	119 17 15.6	0.128	Wooded Island
WPO	%	45 34 24.0	122 47 22.4	0.334	West Portland, Oregon
WPW	%	46 41 55.7	121 32 10.1	1.280	White Pass
WRD	+	46 58 12.0	119 08 41.4	0.375	Warden
WRW	%	47 51 26.0	120 52 52.0	1.189	Wenatchee Ridge
YA2	+	46 31 36.0	120 31 48.0	0.652	Yakima
YEL	#	46 12 35.0	122 11 16.0	1.750	Yellow Rock, Mt. St. Helens

Table 2B lists broad-band, three-component stations operating in Washington and Oregon that provide data to the PNSN.

TABLE 2B

Broad-band three-component stations operating at the end of the second quarter 2000. Symbols are as in Table 2A.

STA	F	LAT	LONG	EL	NAME
COR		44 35 08.5	123 18 11.5	0.121	Corvallis, Oregon (IRIS station, Operated by OSU)
DBO	%	43 07 09.0	123 14 34.0	0.984	Dodson Butte, Oregon (CREST - operated by UO)
ELW	%	47 29 38.8	121 52 21.6	0.267	Echo Lake, WA (operated by UW)
ERW	%	48 27 14.4	122 37 30.2	0.389	Mt. Erie, WA (operated by UW)
GNW	%	47 33 51.8	122 49 31.0	0.165	Green Mountain, WA (CREST - operated by UW)
HAWA		46 23 32.3	119 31 57.2	0.367	Hanford Nike (USGS-USNSN)
LON	%	46 45 00.0	121 48 36.0	0.853	Longmire (CREST - operated by UW)
LTY	%	47 15 21.2	120 39 53.3	0.970	Liberty, WA (operated by UW)
NEW		48 15 50.0	117 07 13.0	0.760	Newport Observatory (USGS-USNSN)
OCWA		47 44 56.0	124 10 41.2	0.671	Octopus Mtn. (USGS-USNSN)
PIN		43 48 40.0	120 52 19.0	1.865	Pine Mt. Oregon (CREST - operated by UO)
RAI		46 02 25.1	122 53 06.4	1.520	Trojan Plant, Oregon (OSU)
RWW	%	46 57 50.1	123 32 35.9	0.015	Ranney Well (CREST - operated by UW)
SP2	%	47 33 23.3	122 14 52.8	0.030	Seward Park, Seattle (operated by UW)
TTW	%	47 41 40.7	121 41 20.0	0.542	Tolt Reservoir, WA (operated by UW)
WVOR		42 26 02.0	118 38 13.0	1.344	Wildhorse Valley, Oregon (USGS-USNSN)

Table 2C lists strong-motion, three-component stations operating in Washington and Oregon that provide data in real or near-real time to the PNSN. Several of these stations also have broad-band instruments, as noted. The "SENSOR" field designates what type of seismic sensor is used;

- A = Terra-Tech SSA-320 SLN triaxial accelerometer/Terra-Tech IDS24 recording system,
- A20 = Terra-Tech SSA-320 triaxial accelerometer/Terra-Tech IDS20 recording system,
- FBA23 = Kinemetrics FBA23 accelerometers and Reftek recording system,
- EPI = Kinemetrics Episensor accelerometers and Reftek recording system.
- BB = Guralp CMG-40T 3-D broadband velocity sensor.
- BB3 = Guralp CMG3T 3-D broadband velocity sensor.
- K2 = Kinemetrics Episensor accelerometers and K2 Recording System

The "TELEMETRY" field indicates the type of telemetry used to recover the data.

- D = dial-up,
- L = continuously telemetered via dedicated lease-line telephone lines,
- L-PPP = continuously telemetered via dedicated lease-line telephone lines using PPP protocol
- I = continuously telemetered via Internet,
- E = continuously telemetered via an Internet EARTHWORM system

TABLE 2C

Strong-motion three-component stations operating at the end of the second quarter 2000. Symbols are as in Table 2A.

STA	F	LAT	LONG	EL	NAME	SENSORS	TELEMETRY
ALST	%	46 6 31.2	123 01 47.4	0.000	Alston, Oregon BPA	A20	L.E.D
CSO	#	45 31 01.0	122 41 22.5	0.036	Canyon Substation, Oregon	FBA23	D
DBO	%	43 07 09.0	123 14 34.0	0.984	Dodson Butte, OR (UO CREST)	EPI.BB3	E
ERW	%	48 27 14.4	122 37 30.2	0.389	Mt. Erie, WA	A.BB	L.D
ELW	%	47 29 38.8	121 52 21.6	0.267	Echo Lake, WA	A.BB	L.D
GNW	%	47 33 51.8	122 49 31.0	0.165	Green Mountain, WA (CREST)	EPI.BB3	L-PPP
HAO	#	45 30 33.1	122 39 24.0	0.018	Harrison Substation, Oregon	FBA23	L.E.D
KEEL	%	45 33 0.0	122 53 44.4	0.000	Keeler, Oregon BPA	A20	E
LON	%	46 45 00.0	121 48 36.0	0.853	Longmire (CREST)	EPI.BB3	L-PPP.D
MBPA	%	47 53 56.6	121 53 20.2	0.186	Monroe BPA	A20	L.D
MPL	%	47 28 08.2	122 11 06.2	0.122	Maple Valley	A	L.D
NOWS	%	47 41 12.0	122 15 21.2	0.000	NOAA, Bldg 3	A20	I
PIN	%	43 48 40.0	120 52 19.0	1.865	Pine Mt., OR (U0 CREST)	EPI.BB3	E
QAW	%	47 37 53.2	122 21 15.0	0.140	Queen Anne	A	L
RAW	%	47 20 14.0	121 55 57.6	0.208	Raver BPA	A	L.D
RBO	#	45 32 27.0	122 33 51.5	0.158	Rocky Butte, Oregon	FBA23	D
ROSS	%	45 39 46.2	122 39 37.0	0.100	Ross BPA	A20	L.E.D
RWW	%	46 57 50.1	123 32 35.9	0.015	Ranney Well (CREST)	EPI.BB3	L-PPP
SBES	%	48 46 05.9	122 24 54.2	0.000	Silver Beach Elementary School	A	I
SEA	%	47 39 18.0	122 18 30.0	0.030	Seattle	A.BB	L.D
SP2	%	47 33 23.3	122 14 52.8	0.030	Seward Park, Seattle	A.BB	L
TBPA	%	47 15 28.1	122 22 05.9	0.002	Tacoma WA BPA	A	L.D
TKCO	%	47 32 12.7	122 18 01.5	0.005	King Co EOC	A20	I
UPS	%	47 15 51.4	122 28 56.3	0.113	University of Puget Sound	K2	I

Table 2D shows stations recorded but not initiated in PNSN EARTHWORM nodes during the second quarter 2000. Columns as in Table 2A. PNNL is the Battelle Pacific Northwest National Labs, MT is Montana Bureau of Mines, OSU is Oregon State University, USNSN is the US National Seismic Network, CAL-NET is the USGS Northern California Network.

TABLE 2D

STA	F	LAT	LONG	EL	NAME
BEN		46 31 12.0	119 43 18.0	0.335	PNNL station
CHMT		46 54 51.0	113 15 07.0	-	Chamberlain Mtn, MT
COR		44 35 08.5	123 18 11.5	0.121	Corvallis, Oregon (OSU BB)
DBO	%	43 07 09.0	123 14 34.0	0.984	Dodson Butte, Oregon (UO CREST)
GBB		46 36 31.8	119 37 40.2	0.185	PNNL Station
H2O		46 23 45.0	119 25 22.0	-	Water PNNL Station
HAWA		46 23 32.3	119 31 57.2	0.367	Hanford Nike (USNSN BB)
HLID		43 33 45.0	114 24 49.3	1.772	Hailey, ID (USNSN BB)
KEB		42 52 20.0	124 20 03.0	0.818	CAL-NET
KSX		41 49 51.0	123 52 33.0	-	CAL-NET
KTR		41 54 31.2	123 22 35.4	1.378	CAL-NET
LAM		41 36 35.2	122 37 32.1	1.769	CAL-NET
LCCM		45 50 16.8	111 52 40.8	1.669	Lewis and Clark Caverns, MT
MCMT		44 49 39.6	112 50 55.8	2.323	McKenzie Canyon, MT
NEW		48 15 50.0	117 07 13.0	0.760	Newport Observatory (USNSN BB)
OCWA		47 44 56.0	124 10 41.2	0.671	Octopus Mtn. (USNSN BB)
PIN	%	43 48 40.0	120 52 19.0	1.865	Pine Mt., Oregon (U0 CREST)
RED		46 17 51.0	119 26 15.6	0.330	Red Mountain PNNL Station
SNI		46 27 80.0	119 39 50.0	-	PNNL station
WVOR		42 26 02.0	118 38 13.0	1.344	Wildhorse Valley, Oregon (USNSN BB)

OUTREACH ACTIVITIES

The PNSN Seismology Lab staff provides an educational outreach program to better inform the public, educators, businesses, policy makers, and the emergency management community about seismicity and natural hazards. Our outreach includes lab tours, lectures, classes and workshops, press conferences, TV and radio news programs and talk shows, field trips, and participation in regional earthquake planning efforts. We provide basic information through information sheets, an audio library, and the Internet on the World-Wide-Web (WWW):

http://www.geophys.washington.edu/SEIS

Special Events

- Over the course of the quarter, PNSN staff met at various times with county officials, representatives of utility and private companies, and engineering and emergency management groups regarding rapid earthquake notification and long-term network and strong-motion development plans.

On April 28th, Ruth Ludwin and Bill Steele attended a meeting with representatives of the Union Pacific Foundation. For several years, the Union Pacific Foundation has awarded the PNSN $10,000 annually to support improvements in automatic processing of earthquake data and notification systems. Ruth and Bill updated UP Foundation representatives on the progress and future plans for early notification systems, and received the Y2K award.

- Bill Steele made two Rotary Club presentations this quarter and met with the Sammamish City Emergency Planning Committee to discuss hazards issues.
- Bill Steele traveled to Memphis, TN to present information on the PNSN's earthquake information services at a workshop hosted by CERI (Center for Earthquake Research and Information, University of Memphis). Bill is cooperating with Gary Patterson, CERI (Center for Earthquake Research and Information, University of Memphis) Director of Information Services on information-related projects.
- The PNSN Staffed a booth at the Western Washington Emergency Network (WWEN)/ Washington Emergency Management Conference, from April 24 to 26th. Bill Steele gave a presentation on the hazard mapping project of Seattle's Project Impact Program.
- The PNSN hosted board-of-directors meetings for CPARM (Contingency Planners and Recovery Managers) with membership from both Washington and Oregon, and CREW (the Cascadia Region Earthquake Working Group) with membership from British Columbia, Washington, Oregon, and California.
- The PNSN continued to work with regional Project Impact communities in the Region including Seattle, King and Pierce County, Kitsap County, and Benton County Oregon. PNSN staffed a booth at an event sponsored by Seattle Project Impact on April 1st; "Disaster Saturday" is a bi-annual geologic hazards and mitigation fair that took place at Meany Middle School this time.
- On June 15-16, the PNSN coordinated a planning meeting for the nascent Pacific Northwest regional group of the Advanced National Seismic System (ANSS). The meeting was hosted by the Bank of America and the Cascadia Regional Earthquake Workgroup (CREW). Attendees were divided between seismographic network operators from the Pacific Northwest and adjacent regions, and "end-users" of seismic data; such as engineers, lifeline providers, financial and industrial concerns, and emergency managers. A steering committee was formed to provide direction during the planned expansion of the strong-motion network and development of strong-motion information products.
- Steve Malone gave several radio, TV, and newspaper interviews in relation to the 20th anniversary of the May 18, 1980 catastrophic eruption of Mount St. Helens.

Press Interviews, Lab Tours, and Workshops

PNSN staff provided about 20 television, radio, or press interviews this quarter. We provided 19 lab tours for K-12 students this quarter with a total of 400 participants.

Telephone, Mail, and On-line outreach

The PNSN audio library system received about 500 calls this quarter. We provide several recordings. The most popular is a frequently updated message on current seismic activity. In addition we have a tape describing the seismic hazards in Washington and Oregon, and another on earthquake prediction. Callers often request our one-page information and resource sheet on seismic hazards in Washington and Oregon.

Thousands of these have been mailed out or distributed, and we encourage others to reproduce and further distribute this sheet. Our information sheet discussing earthquake prediction is also frequently requested. Callers to the audio library can also choose to be transferred to the Seismology Lab, where additional information is available. This quarter we responded in person to: ~40 calls from emergency management and government, ~70 calls from the media, ~20 calls from educators, ~26 from the business community, and about 200 calls from the general public.

The PNSN recent earthquake list, and much more, is also available through the World-Wide-Web (WWW) at:

http://www.geophys.washington.edu/SEIS/PNSN

The PNSN web-site offers web pages that include maps and lists of the most recent PNW earthquakes, general information on earthquakes and PNW earthquake hazards, information on past damaging PNW earthquakes, and catalogs of earthquake summary cards. Web-pages on seismicity of Cascade Volcanos, and Quarterly summaries of seismicity are also included. "Webicorder" pages allow Web visitors to view continuous data from six PNSN seismographic stations at:

http://www.geophys.washington.edu/SEIS/PNSN/WEBICORDER/

In addition to the PNSN web site, the UW Geophysics Program and the PNSN host several other earthquake-related web sites:

- **Volcano Systems Center** is a cooperative effort of the UW and the USGS that links volcano-related activities of the UW Geological Sciences, Geophysics, and Oceanography departments with related USGS activities.

  http://www.vsc.washington.edu

- **Seismosurfing** is a comprehensive listing of sites worldwide that offer substantive seismology data and information. This page is mirrored at two sites in Europe.

  http://www.geophys.washington.edu/seismosurfing.html

- The **Council of National Seismic Systems** (CNSS) site features composite listings and maps of recent U.S. earthquakes, and documentation of the EARTHWORM system.

  http://www.cnss.org

- The "**Tsunami!**" web site offers many pages of information, including an excellent discussion on the physics of tsunamis, and short movie clips. It was developed by Benjamin Cook under the direction of Dr. Catherine Petroff (UW Civil Engineering).

  http://www.geophys.washington.edu/tsunami

- The UW Geophysics Program **Global Positioning System (GPS)** web site provides information on geodetic studies of crustal deformation in Washington and Oregon.

  http://www.geophys.washington.edu/GPS/gps.html

EARTHQUAKE DATA - 2000-B

There were 1191 events digitally recorded and processed at the University of Washington between April 1 and June 30, 2000. Locations in Washington, Oregon, or southernmost British Columbia were determined for 513 of these events; 447 were classified as earthquakes and 66 as known or suspected blasts. The remaining 678 processed events include teleseisms (183 events), regional events outside the PNSN (114), and unlocated events within the PNSN. Unlocated events within the PNSN include very small earthquakes and some known blasts. Frequent mining blasts occur near Centralia, Washington and we routinely locate and retrieve broad-band data for some of them.

Table 3 is a listing of all earthquakes reported to have been felt during the this quarter. Table 5, located at the end of this report, is this quarter's catalog of earthquakes and blasts, M 2.0 or greater, located within the network - between 42-49.5 degrees north latitude and 117-125.3 degrees west longitude.

Fig. 2 shows earthquakes with magnitude greater than or equal to 0.0 ($M_c \geq 0$).
Fig. 3 shows blasts and probable blasts ($M_c \geq 0$).
Fig. 4 shows earthquakes located near Mt. Rainier ($M_c \geq 0$).
Fig. 5 shows earthquakes located at Mt. St. Helens ($M_c \geq 0$).

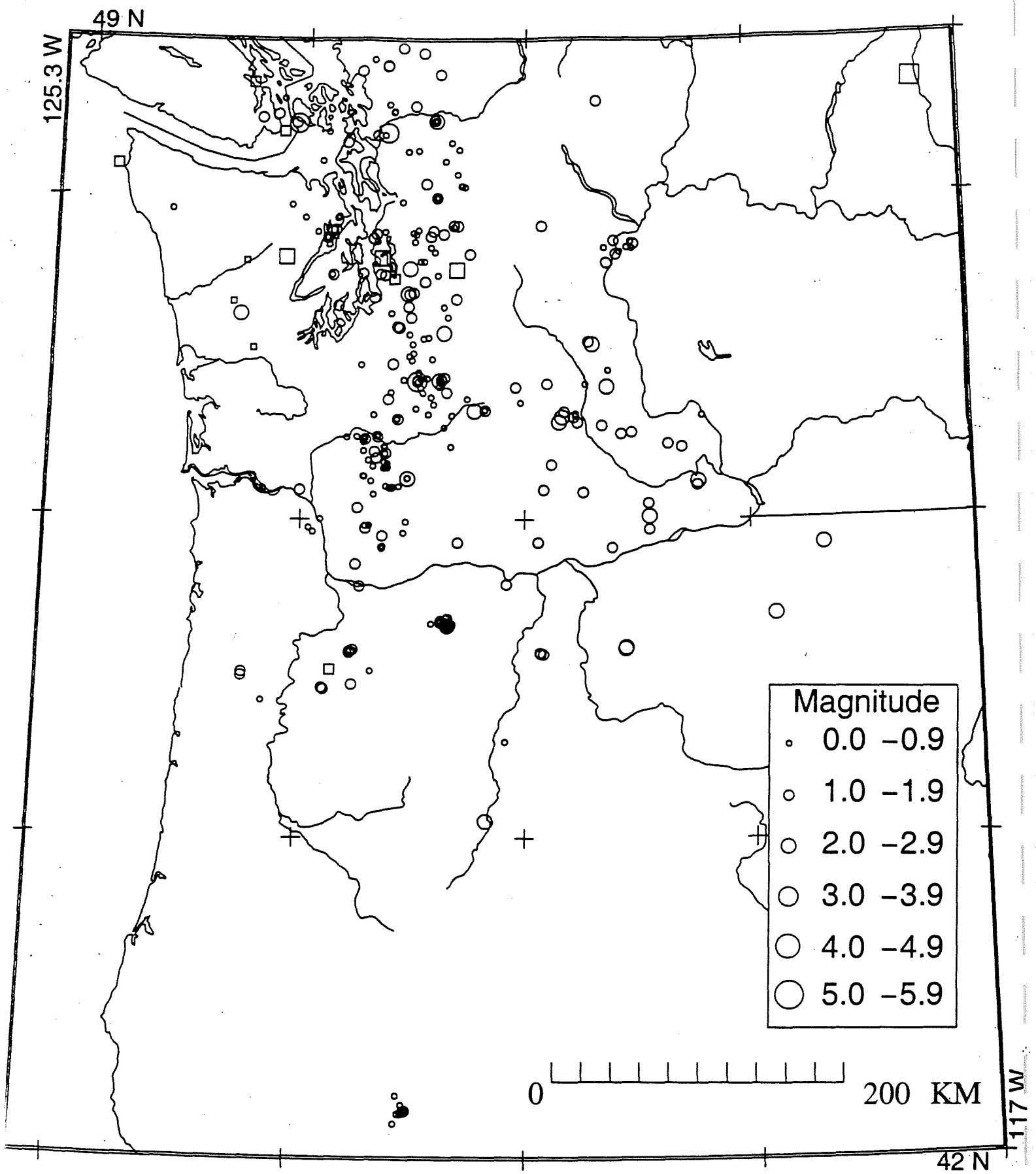

Figure 2: Earthquakes located in Washington and Oregon with magnitudes greater than or equal to 0.0 during the second quarter of 2000. Square symbols indicate events located at depths of 30 km or more.

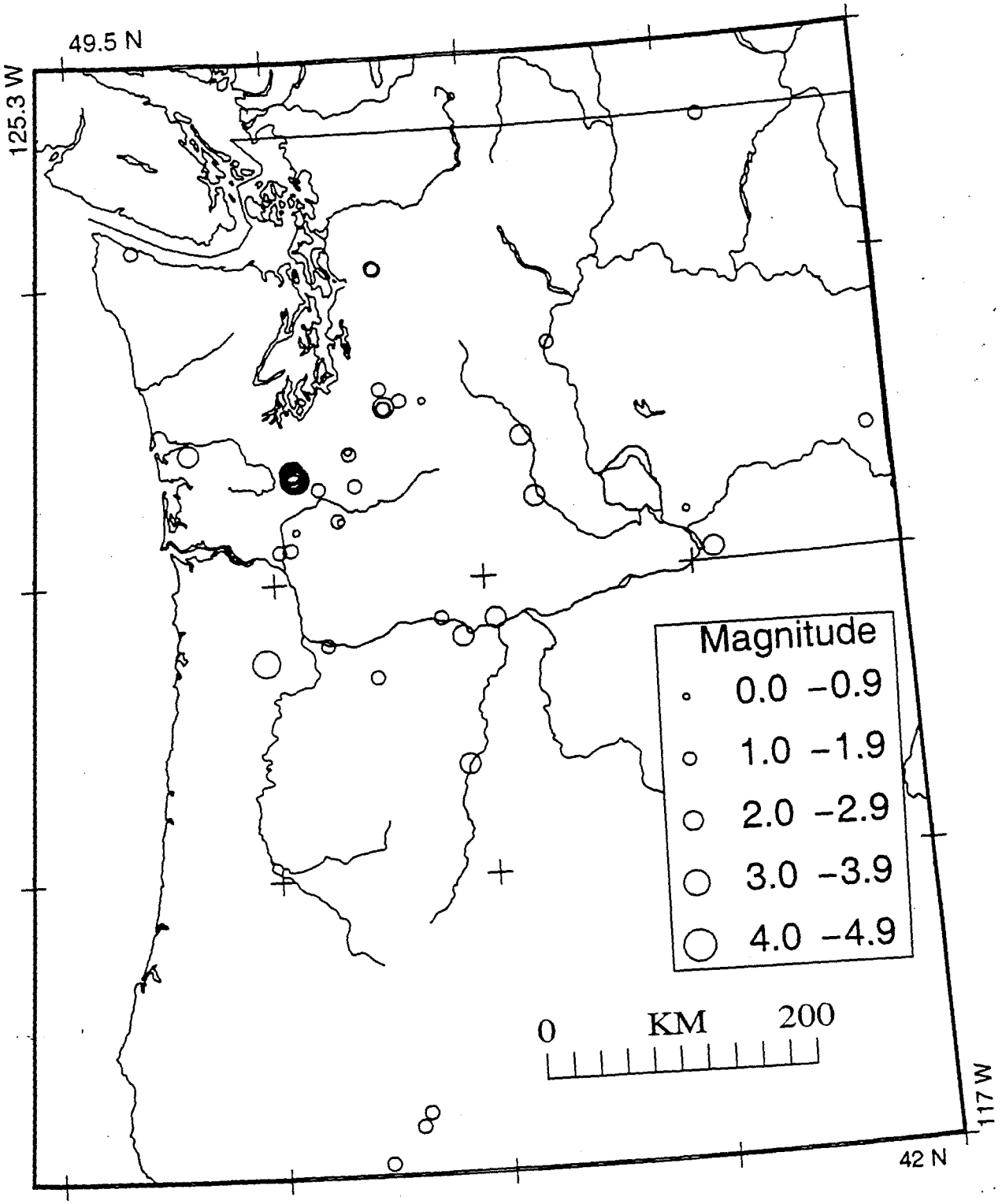

Figure 3: Blasts and probable blasts, second quarter, 2000.

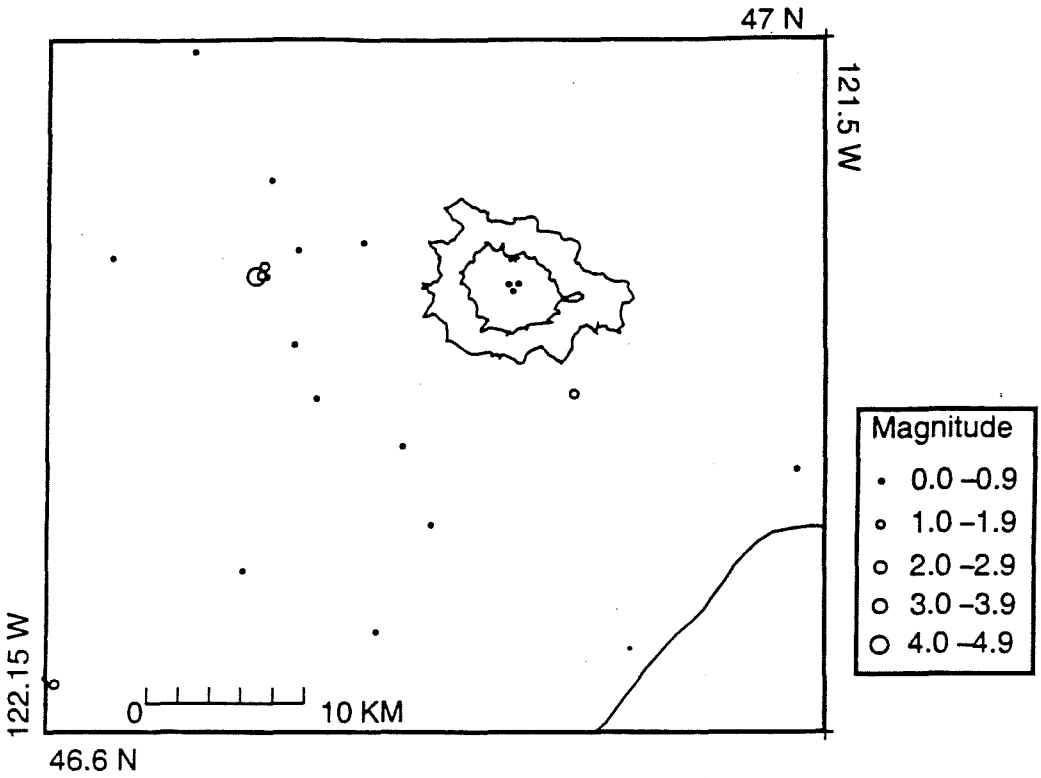

Figure 4: Earthquakes located in the Mt. Rainier area second quarter, 2000. All events shown are greater than magnitude 0.0. Inner contour is the 10,000 foot elevation contour, and the outer is the 7,500 foot contour. "Plus" symbols represent earthquakes shallower than 1 km depth, while circles represent earthquakes at 1 km or deeper.

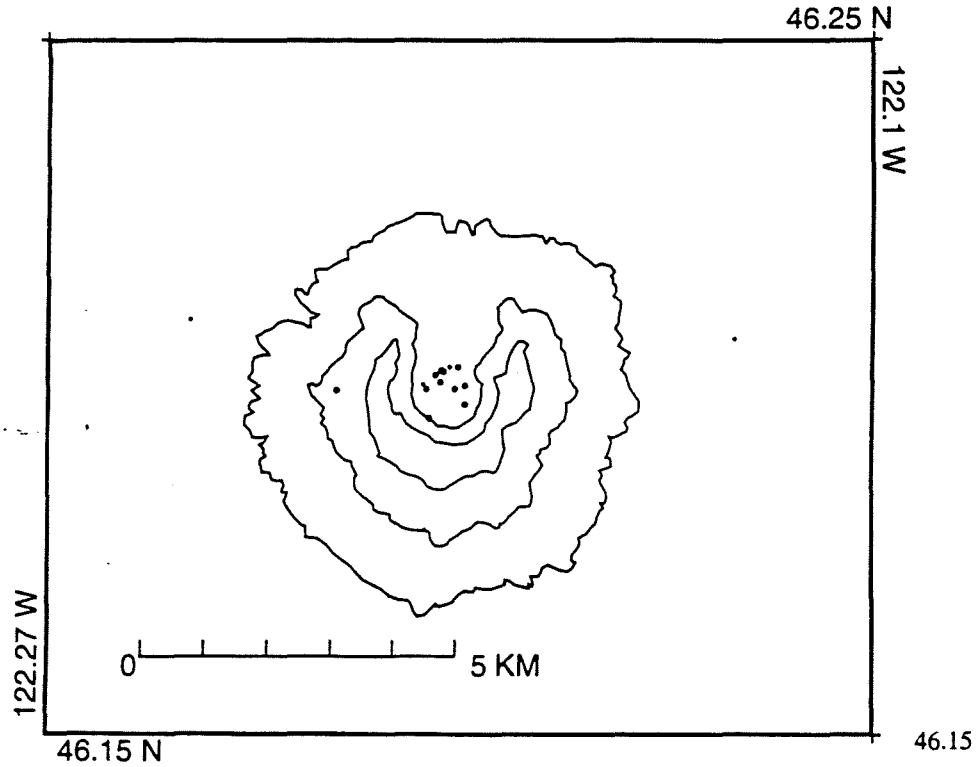

Figure 5: Earthquakes located in the Mt. St. Helens area second quarter, 2000. All events shown are greater than magnitude 0.0. Contours shown are at 5,000, 6,400 and 7,500 feet elevation. "Plus" symbols represent earthquakes shallower than 1 km depth, while circles represent earthquakes at 1 km or deeper. Symbol scaling as in Fig. 4.

TABLE 3 - Felt Earthquakes during the 2nd Quarter of 2000

DATE-(UTC)-TIME yy/mm/dd hh:mm:ss	LAT(N) deg.	LON(W) deg.	DEPTH km	MAG	COMMENTS
00/04/11 09:09:03	48.40N	122.27W	14.4	3.2	5.2 km ESE of Mount Vernon, WA
00/04/22 06:43:25	46.86N	121.97W	8.8	3.6	16.5 km W of Mount Rainier
00/06/29 19:27:26	48.46N	123.10W	27.6	3.5	10.6 km SW of Friday Harbor, WA

OREGON SEISMICITY

During the second quarter of 2000 a total of 63 earthquakes were located in Oregon between 42.0° and 45.5° north latitude, and between 117° and 125° west longitude. The most interesting activity in Oregon this quarter was a swarm of earthquakes near Mt. Hood. The sequence began on May 14 with a magnitude 2.1 earthquake, at a depth of about 7 km. This was followed by 21 similarly shallow quakes between May 14 (10 events on May 14) and May 26. No events were reported felt in Oregon this quarter.

In the Klamath Falls area, 15 earthquakes were located this quarter. Since 1994, most earthquakes northwest of Klamath Falls have been considered aftershocks of a pair of damaging earthquakes in September of *1993* (Sept. 21, 03:29 and 05:45 UTC; M_c 5.9 and 6.0 respectively). The 1993 earthquakes were followed by a vigorous aftershock sequence which decreased over time.

WESTERN WASHINGTON SEISMICITY

During the second quarter of 2000, 338 earthquakes were located between 45.5° and 49.5° north latitude and between 121° and 125.3° west longitude.

Three earthquakes were felt this quarter in western Washington, The largest was an a magnitude 3.6 earthquake in the "Western Rainier Seismic Zone" on April 22. Details are given in Table 3. The felt event was preceded by a possible foreshock (M 0.2) on April 20, and followed by three small aftershocks on April 22 (Magnitudes 1.2, -0.3 and -0.5).

This quarter, the deepest event recorded by the PNSN was a magnitude 2.0 at a depth of about 89 km. It occurred on June 2 at 05:44 UTC and was located about 13 km ENE of North Bend, WA.

Mount Rainier Area: Figure 4 shows earthquakes near Mount Rainier. The number of events in close proximity to the cone of Mt. Rainier varies over the course of the year, since the source of much of the shallow activity is presumably ice movement or avalanching at the surface, which is seasonal in nature. Events with very low frequency signals (1-3 Hz) believed to be icequakes are assigned type "L" in the catalog. Emergent, very long duration signals, probably due to rockfalls or avalanches, are assigned type "S" (see Key to Earthquake Catalog). "L" and "S" type events are listed in the catalog, but not shown in Figure 4. Three events flagged "L" or "S" events were located at Mount Rainier this quarter, and an additional 183 "L" or "S" events were recorded, but were too small to locate reliably.

A total of 51 tectonic events (22 of these were smaller than magnitude 0.0, and thus are not shown in Fig. 4) were located within the region shown in Fig. 4. Of these, 23 were located in the "Western Rainier Seismic Zone" (WRSZ), a north-south trending lineation of seismicity approximately 15 km west of the summit of Mt. Rainier (for counting purposes, the western zone is defined as 46.6-47 degrees north latitude and 121.83-122 west longitude). The largest tectonic earthquakes near Mt. Rainier this quarter was the felt magnitude 3.6 earthquake on April 22 (UTC) mentioned above.

This quarter, there were 14 higher-frequency tectonic-style earthquake within 5 km of the summit. The remaining events were scattered around the cone of Rainier as seen in Fig. 4.

Mount St. Helens Area: Figure 5 shows volcano-tectonic earthquakes near Mount St. Helens. Low frequency (L) and avalanche or rockfall events (S) are not shown. This quarter 69 earthquakes were located at Mt. St. Helens in the area shown in Fig. 5. Of these 15 were magnitude 0.0 or larger and 19 were deeper than 4 km, none larger than magnitude 0.0. The largest tectonic earthquake at Mount St. Helens this quarter was magnitude 0.8

Two type "S" or "L" event were located at Mount St. Helens, and 94 "L" or "S" events too small to locate were recorded.

EASTERN WASHINGTON SEISMICITY

During the second quarter of 2000, 44 earthquakes were located in eastern Washington in the area described in Table 4. The largest earthquake in eastern Washington this quarter was a poorly located magnitude 3.3 earthquake about 40 km east north-east of Colville.

Times, locations, and depths of felt earthquakes in the PNSN region are given in Table 3. Table 4 is a summary table of various earthquake counts-per-quarter over several years.

TABLE 4 Quarterly (Q) comparison of earthquake counts over several years.

"Total" events are all events located within the PNSN network area; between 42.0-49.5 degrees north latitude and 117-125.3 degrees west longitude. The smallest detectable earthquake varies over the region. "Total" events are subdivided into "Quakes" and "Blasts". The remaining numbers are counts of earthquakes only in western and eastern Washington, and in Oregon. Western Washington earthquakes are those between 45.5 and 49.5 degrees north latitude and 121-125.3 degrees west longitude. Within western Washington, earthquakes at Mt. St. Helens (MSH) are between 46.15-46.25 degrees north latitude and 122.10-122.27 degrees west longitude, and earthquakes near Mt. Rainier are between 46.6-47.0 degrees north latitude and 121.5-122.15 degrees west longitude. "Eastern Washington" earthquake counts are for quakes between 45.5-49.5 degrees north latitude and 117-121 degrees west longitude. "Oregon" earthquakes are located between 42-45.5 degrees north latitude and 117-125 degrees west longitude.

TABLE 4 Comparison of quarterly earthquake counts over several years									
Year	**Q**	**Total**	Quakes	Blasts	**western WA**	MSH	Rainier	**eastern WA**	**OR**
1993	A	**457**	380	77	**267**	34	77	**32**	**72**
	B	**450**	384	66	**284**	63	62	**57**	**33**
	C	**727**	579	148	**368**	82	75	**65**	**141**
	D	**2616**	2556	60	**355**	82	92	**39**	**2157**
1994	A	**1585**	1501	84	**232**	43	73	**44**	**1222**
	B	**873**	775	98	**350**	60	130	**56**	**364**
	C	**822**	656	166	**379**	67	81	**62**	**208**
	D	**555**	506	49	**236**	52	44	**55**	**211**
1995	A	**488**	426	62	**273**	18	38	**47**	**101**
	B	**726**	636	90	**438**	104	91	**58**	**134**
	C	**1072**	924	148	**693**	318	84	**75**	**138**
	D	**687**	610	77	**484**	264	41	**41**	**70**
1996	A	**504**	434	70	**303**	82	56	**53**	**75**
	B	**967**	864	103	**752**	68	57	**39**	**72**
	C	**696**	544	152	**426**	83	75	**45**	**67**
	D	**476**	387	89	**312**	65	59	**45**	**29**
1997	A	**417**	353	64	**270**	49	47	**45**	**34**
	B	**525**	473	52	**386**	70	31	**65**	**21**
	C	**633**	568	65	**473**	183	45	**66**	**28**
	D	**680**	614	66	**505**	292	47	**56**	**45**
1998	A	**692**	639	53	**478**	293	35	**57**	**106**
	B	**1248**	1183	65	**1048**	776	47	**74**	**58**
	C	**1727**	1635	92	**1464**	1107	76	**84**	**86**
	D	**1373**	729	43	**620**	349	69	**60**	**49**
1999	A	**474**	449	25	**248**	122	16	**49**	**148**
	B	**469**	407	62	**277**	134	31	**45**	**84**
	C	**592**	505	87	**391**	133	44	**55**	**58**
	D	**660**	610	50	**394**	148	50	**62**	**118**
2000	A	**507**	447	60	**296**	95	27	**61**	**88**
	B	**513**	447	66	**338**	67	51	**44**	**63**

OTHER SOURCES OF EARTHQUAKE INFORMATION

We provide automatic computer-generated alert messages about significant Washington and Oregon earthquakes by e-mail, FAX or via the pager-based RACE system to institutions needing such information, and we regularly exchange phase data via e-mail with other regional seismograph network operators. The "Outreach Activities" section describes how to access PNSN data via e-mail, Internet, and World-Wide-Web. To request additional information by e-mail, contact seis_info@geophys.washington.edu.

Earthquake information in the quarterlies is published in final form by the Washington State Department of Natural Resources as information circulars entitled "Earthquake Hypocenters in Washington and Northern Oregon" covering the period 1970-1989 (see circulars Nos. 53, 56, 64-66, 72, 79, 82-84, and 89). These circulars, plus circular No. 85, "Washington State Earthquake Hazards", are available from Washington Dept. of Natural Resources, Division of Geology and Earth Resources, Post Office Box 47007, Olympia, WA. 98504-7007, or by telephone at (360) 902-1450.

Several excellent maps of Pacific Northwest seismicity are available. A very colorful perspective-view map (18" x 27") entitled "Major Earthquakes of the Pacific Northwest" depicts selected epicenters of strong earthquakes (magnitudes > 5.1) that have occurred in the Pacific Northwest. A more detailed full-color map is called "Earthquakes in Washington and Oregon 1872-1993", by Susan Goter (USGS Open-File Report 94-226A). It is accompanied by a companion pamphlet "Washington and Oregon Earthquake History and Hazards", by Yelin, Tarr, Michael, and Weaver (USGS Open-File Report 94-226B). The pamphlet is also available separately. Maps can be ordered from: "Earthquake Maps", U.S. Geological Survey, Box 25046, Federal Center, MS 967, Denver, CO 80225, phone (303) 273-8477. The price of each map is $12. (including US shipping and handling).

USGS Cascades Volcano Observatory has a video, "Perilous Beauty: The Hidden Dangers of Mount Rainier", about the risk of lahars from Mount Rainier. Copies are available through: Northwest Interpretive Association (NWIA), 909 First Avenue Suite 630, Seattle WA 98104, Telephone: (206) 220-4141, Fax: (206) 220-4143.

Other regional agencies provide earthquake information. These include the Geological Survey of Canada (Pacific Geoscience Centre, Sidney, B.C.; (250) 363-6500, FAX (250) 363-6565), which produces monthly summaries of Canadian earthquakes; the US Geological Survey which produces weekly reports called "Seismicity Reports for Northern California" (USGS, attn: Steve Walter, 345 Middlefield Rd, MS-977, Menlo Park, CA, 94025) and "Weekly Earthquake Report for Southern California" (USGS, attn: Dr. Kate Hutton or Dr. Lucy Jones, CalTech, Pasadena, CA.).

Key to Earthquake Catalog in Table 5

TIME Origin time is calculated for each earthquake on the basis of multi-station arrival times. Time is given in **Coordinated Universal Time** (UTC), in hours:minutes:seconds. To convert to Pacific Standard Time (PST) subtract eight hours, or to Pacific Daylight Time subtract seven hours.

LAT North latitude of the epicenter, in degrees and minutes.

LONG West longitude of the epicenter, in degrees and minutes.

DEPTH The depth, given in kilometers, is usually freely calculated from the arrival-time data. In some instances, the depth must be fixed arbitrarily to obtain a convergent solution. Such depths are noted by an asterisk (*) in the column immediately following the depth. A **$** or a # following the depth mean that the maximum number of iterations has been exceeded without meeting convergence tests and both the location and depth have been fixed.

MAG Coda-length magnitude M_c, an estimate of local magnitude M_L (Richter, C.F., 1958, Elementary Seismology: W.H. Freeman and Co., 768p), calculated using the coda-length/magnitude relationship determined for Washington (Crosson, R.S., 1972, Bull. Seism. Soc. Am., v. 62, p. 1133-1171). Where blank, data were insufficient for a reliable magnitude determination. Normally, the only earthquakes with undetermined magnitudes are very small ones. Magnitudes may be revised as we improve our analysis procedure.

NS/NP **NS** is the number of station observations, and **NP** the number of P and S phases used to calculate the earthquake location. A minimum of three stations and four phases are required. Generally, more observations improve the quality of the solution.

GAP Azimuthal gap. The largest angle (relative to the epicenter) containing no stations.

RMS The root-mean-square residual (observed arrival time minus predicted arrival time) at all stations used to locate the earthquake. It is only useful as a measure of the quality of the solution when 5 or more well-distributed stations are used in the solution. Good solutions are normally characterized by **RMS** values less than about 0.3 sec.

Q Two **Quality factors** indicate the general reliability of the solution (**A** is best quality, **D** is worst). Similar quality factors are used by the USGS for events located with the computer program HYPO71. The first letter is a measure of the hypocenter quality based on travel-time residuals. For example: **A** quality requires an **RMS** less than 0.15 sec while an **RMS** of 0.5 sec or more is **D** quality (estimates of the uncertainty in hypocenter location also affect this quality parameter). The second letter of the quality code depends on the spatial distribution of stations around the epicenter, i.e. number of stations, their azimuthal distribution, and the minimum distance (**DMIN**) from the epicenter to a station. Quality **A** requires a solution with 8 or more phases, **GAP** ≤ 90° and **DMIN** ≤ (5 km or depth, whichever is greater). If the number of phases, **NP**, is 5 or fewer or **GAP** > 180° or **DMIN** > 50 km the solution is assigned quality **D.**

MOD The crustal velocity model used in location calculations.

P3 - Puget Sound model
C3 - Cascade model
S3 - Mt. St. Helens model including Elk Lake
N3 - northeastern model
E3 - southeastern model
O0 - Oregon model
K3 - Southern Oregon, Klamath Falls area model
R0 and J1 - Regional and Offshore models

TYP Events flagged in Table 5 use the following code:

F - earthquake reported to have been felt
P - probable explosion
L - low frequency earthquake (e.g. glacier movement, volcanic activity)
H - handpicked from helicorder records
S - Special event (e.g. rockslide, avalanche, volcanic steam emission, harmonic tremor, sonic boom), not a man-made explosion or tectonic earthquake
X - known explosion

TABLE 5

Earthquakes and Blasts. Magnitude 2.0 or larger. Second Quarter, 2000.

Within an area 42-49.5 degrees north latitude and 117-125.3 degrees west longitude.

Apr 2000

DAY	TIME	LAT	LON	DEPTH	M	NS/NP	GAP	RMS	Q	MOD	TYP
5	00:55:01.47	47 37.99	123 11.16	47.11	2.8	39/46	44	0.31	CA	P3	
5	22:04:32.46	46 41.64	122 45.97	13.99*	2.6	18/19	83	0.29	BC	P3	P
10	18:38:35.74	45 36.31	121 13.35	6.27S	2.1	7/07	104	0.62	DC	C3	P
11	09:09:03.83	48 24.39	122 16.26	14.35	3.2	26/34	86	0.29	BA	P3	F
13	21:59:49.28	46 42.66	122 46.62	11.65	3.0	10/10	140	0.11	BC	P3	P
17	21:17:17.45	46 45.68	122 48.00	5.69	2.7	13/13	101	0.16	BC	P3	P
17	21:57:48.71	44 06.31	121 20.33	0.04*	2.0	8/10	110	0.27	BC	O0	
18	18:13:55.58	45 24.13	118 47.78	26.07	2.1	11/14	263	0.42	CD	O0	
21	01:18:58.82	45 11.80	120 06.02	0.02*	2.0	12/13	146	0.23	BC	O0	
21	15:32:14.06	45 11.29	120 06.30	1.31	2.2	17/19	146	0.16	BC	O0	
22	06:43:25.68	46 51.74	121 58.54	8.79	3.6	47/48	46	0.14	AB	C3	F
25	22:12:28.42	46 38.36	120 39.92	0.03*	2.3	7/07	143	0.25	BC	E3	
28	21:10:33.18	46 42.55	122 46.64	7.50#	3.0	11/11	140	0.15	BC	P3	P
28	23:38:56.59	44 44.62	121 13.19	0.04*	2.7	15/15	106	0.43	CC	O0	P

May 2000

DAY	TIME	LAT	LON	DEPTH	M	NS/NP	GAP	RMS	Q	MOD	TYP
3	22:03:56.82	46 45.20	122 48.00	6.97#	2.7	29/29	81	0.26	BC	P3	P
3	22:16:15.17	47 09.91	121 52.61	0.02*	2.1	11/11	240	0.27	BD	P3	P
4	01:30:52.11	46 15.40	122 03.21	12.01	2.0	31/34	62	0.12	AA	S3	
4	19:47:27.44	46 36.38	120 41.48	2.62	2.0	8/08	187	0.23	BD	E3	
4	20:38:17.84	46 45.01	122 48.91	8.68S	2.1	15/15	89	0.11	AC	P3	P
5	08:15:17.05	47 05.47	120 23.80	0.52	2.2	21/21	62	0.34	CC	N3	
5	18:23:01.66	46 05.38	118 47.11	0.04*	2.2	15/15	119	0.32	CB	E3	P
5	21:54:30.80	46 14.34	119 27.23	0.02*	2.1	16/16	146	0.30	BC	E3	
5	22:02:35.96	46 42.33	122 47.14	4.59S	2.8	32/32	77	0.23	BC	P3	P
7	19:18:29.45	48 42.29	117 25.96	75.56S	3.3	5/05	331	0.23	DD	N3	R
9	22:49:51.24	46 42.58	122 46.99	6.94*	2.8	14/14	84	0.13	AC	P3	P
10	00:43:44.23	47 09.73	121 44.33	0.05*	2.0	13/15	116	0.55	DB	C3	
10	22:10:30.83	46 42.59	122 46.81	6.54*	2.5	10/10	84	0.12	AC	P3	P
14	08:09:49.19	45 19.95	121 41.17	6.98*	2.1	26/30	63	0.31	CB	O0	
15	22:53:48.08	46 53.39	123 47.93	0.05#	2.0	6/07	168	0.90	DC	P3	P
16	20:57:29.18	46 45.73	122 46.88	3.91	2.2	6/06	154	0.21	BC	P3	P
17	21:33:43.06	46 43.04	122 46.07	0.04*	2.3	12/12	164	0.26	BC	P3	P
18	22:04:11.96	46 45.17	122 48.86	0.02*	2.7	11/11	113	0.18	BC	P3	P
20	21:35:34.82	45 42.98	120 54.49	0.03*	2.4	7/07	87	0.21	BC	C3	P
28	23:24:39.32	47 33.60	122 03.30	12.38	2.2	42/50	46	0.15	BB	P3	
31	21:09:52.25	46 45.24	122 47.85	0.02*	2.9	11/12	114	0.25	BC	P3	P

June 2000

DAY	TIME	LAT	LON	DEPTH	M	NS/NP	GAP	RMS	Q	MOD	TYP
2	05:44:24.58	47 33.18	121 37.80	89.26	2.0	42/52	54	0.22	BA	P3	
5	22:19:31.24	46 44.63	122 47.81	7.96	2.5	14/14	257	0.12	BD	P3	P
6	19:12:59.34	46 40.65	121 27.48	4.71	2.0	37/48	87	0.24	BB	C3	
6	21:13:55.84	46 42.65	122 46.33	7.73S	2.8	13/13	157	0.09	AC	P3	P
7	13:53:50.63	48 28.81	121 49.75	2.43S	2.3	25/29	107	0.55	DC	P3	
7	16:03:29.45	45 28.48	123 05.65	16.00	3.4	23/23	101	0.37	CB	O0	X
9	04:00:22.63	47 16.66	123 35.53	0.03*	2.0	29/35	86	0.66	DC	P3	
9	17:59:15.02	46 31.12	120 28.17	0.03*	2.3	10/10	90	0.19	BA	E3	P
25	07:42:05.05	47 37.86	122 18.33	31.85	2.2	49/53	38	0.27	BA	P3	
26	18:43:11.11	45 50.37	118 21.53	0.03*	2.0	9/09	191	0.31	CD	E3	
26	20:45:23.52	46 55.75	120 34.15	0.87S	2.2	12/15	74	0.35	CA	E3	P
26	22:10:20.72	46 42.13	122 46.64	6.54	2.8	21/21	73	0.25	BC	P3	P
26	22:38:32.07	46 44.97	122 48.39	7.08S	2.5	37/37	68	0.43	CC	P3	P
27	22:32:34.11	46 44.89	122 48.18	1.46S	2.2	21/21	75	0.24	CC	P3	P
27	22:48:51.20	46 49.80	120 15.87	4.47	2.7	35/43	31	0.38	CC	E3	
28	11:58:31.67	47 24.20	122 04.06	12.97	2.0	36/42	89	0.19	BA	P3	

June 2000 cont'd

DAY	TIME	LAT	LON	DEPTH	M	NS/NP	GAP	RMS	Q	MOD	TYP
28	20:00:03.99	46 45.27	122 48.43	5.00#	2.3	31/31	82	0.23	BC	P3	P
28	22:14:06.88	46 42.36	122 45.63	13.79$	3.2	16/16	84	0.21	CC	P3	P
29	18:48:59.65	46 01.14	119 53.11	0.27*	2.2	22/25	57	0.24	BC	E3	
29	19:27:26.76	48 28.01	123 06.24	27.61$	3.5	25/32	139	0.21	BC	P3	F
29	22:08:10.63	46 45.33	122 48.38	3.65$	2.3	17/17	75	0.45	CC	P3	P
30	22:19:02.44	46 44.97	122 48.38	7.20*	2.7	25/25	66	0.19	BC	P3	P

QUARTERLY NETWORK REPORT 2000-C
on
Seismicity of Washington and Oregon

July 1 through Sept. 30, 2000

Pacific Northwest Seismograph Network
Geophysics Program
Box 351650
University of Washington
Seattle, Washington 98195-1650

This report is prepared as a preliminary description of the seismic activity in Washington State and Oregon. Information contained in this report should be considered preliminary, and not cited for publication without checking directly with network staff. The views and conclusions contained in this document should not be interpreted as necessarily representing the official policies, either express or implied, of the U.S. Government.

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Joint Operating Agreement 1434-HQ-98-AG-01937

and

Pacific Northwest National Laboratory, operated by Battelle for the U.S. Dept. of Energy
Contract 259116-A-B3

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INTRODUCTION

This is the third quarterly report of 2000 from the University of Washington Geophysics Program *Pacific Northwest Seismograph Network* (PNSN), covering seismicity of Washington and western Oregon.

Comprehensive quarterlies have been produced by the PNSN since the beginning of 1984. Prior to that we published quarterly reports for western Washington in 1983 and for eastern Washington from 1975 to 1983. Annual technical reports covering seismicity in Washington since 1969 are available from the U.W. Geophysics Program. Beginning in 1999, the quarterly PNSN catalog listing changed; earthquakes smaller than magnitude 2.0 are no longer listed in the quarterly reports. The complete PNSN catalog is available on-line, both through our web-site and through the CNSS catalog. We will continue to provide special coverage (figures, counts, listings, etc.) of earthquake swarms, aftershock sequences, etc.

This quarterly report discusses network operations, seismicity of the region, unusual events or findings, and our educational and outreach activities. This report is preliminary, and subject to revision. The PNSN routinely records signals from selected stations in adjoining networks. This improves our ability to locate earthquakes at the edges of our network. However, our earthquake locations may be revised if new data become available, such as P and S readings from Canadian seismograph stations. Findings mentioned in these quarterly reports should not be cited for publication.

NETWORK OPERATIONS

Figure 1A shows a map view of broad-band and short-period stations operating during the quarter. Figure 1B is a map view showing stations in the Puget Lowland, including many newly installed strong motion accelerometers. Table 1 gives approximate periods of time when individual stations were inoperable. Data for Table 1 are compiled from weekly plots of network-wide teleseismic arrivals and automated digital signal checks, plus records of maintenance and repair visits. As is typical, the third quarter is devoted to repairing stations that lost functionality during the winter. Some stations also spontaneously revive after the snow melts, and these are scheduled for a checkup and maintenance visit later in the season.

The PNSN welcomed a new data analyst this quarter. Amy Tieman joined the PNSN at the end of July. Amy has a B.S. in geology from Indiana University with work experience in geotech. Sandra Corso, our data analyst since fall 1993, left at the end of June. Guy Medema, an incoming graduate student, gave us a much appreciated hand with data analysis during July.

In addition to the typical summer maintenance routine, a few stations required special attention. RVW needed a site visit after a bear rolled the station box, damaging the batteries. Repairs were made to two stations damaged by vandalism. Station LMW was vandalized at the end of last summer (1999), and provisionally patched last fall to get it through the winter. This quarter it was properly repaired, which required the installation of a new antenna tower. RVC was removed last quarter due to vandalism, but was promptly reinstalled at a more secure nearby site.

Station RSU, at the summit of Mount Rainier, was installed last year, but functioned only briefly. This summer it was repaired by graduate student Jeff Johnson, who climbed to the summit twice to make the repair. RSU ran through the end of the quarter.

The PNNL (Pacific Northwest National Laboratory; operated by Battelle) began operation of an EARTHWORM node at the Hanford Reservation in eastern Washington. This allows us to receive signals from additional stations in eastern Washington. Table 2D lists stations that the PNSN receives through EARTHWORM nodes outside the PNSN.

Data Recording and EARTHWORM Update

This quarter was remarkable for the many hardware problems we experienced. It started out with a lightning strike that blew up "huge1", a large disk used for intermediate term data archiving. Not a big problem. Next, our main Central Data serial interface went belly-up on Sept 11. Although we were able to bring the affected broad-band and strong motion stations back on line within a day, it took until Sept. 22 to order, receive, and install the replacement multiport terminal server.

Overlapping with that failure, on September 16 a major disk failure on our main data aquisition machine (milli) caused us to switch to a backup system for nearly a week (Sept. 16-21) while a new disk was acquired and rebuilt. Fortunately a new SUN Enterprise 350 computer (scossa), which will eventually

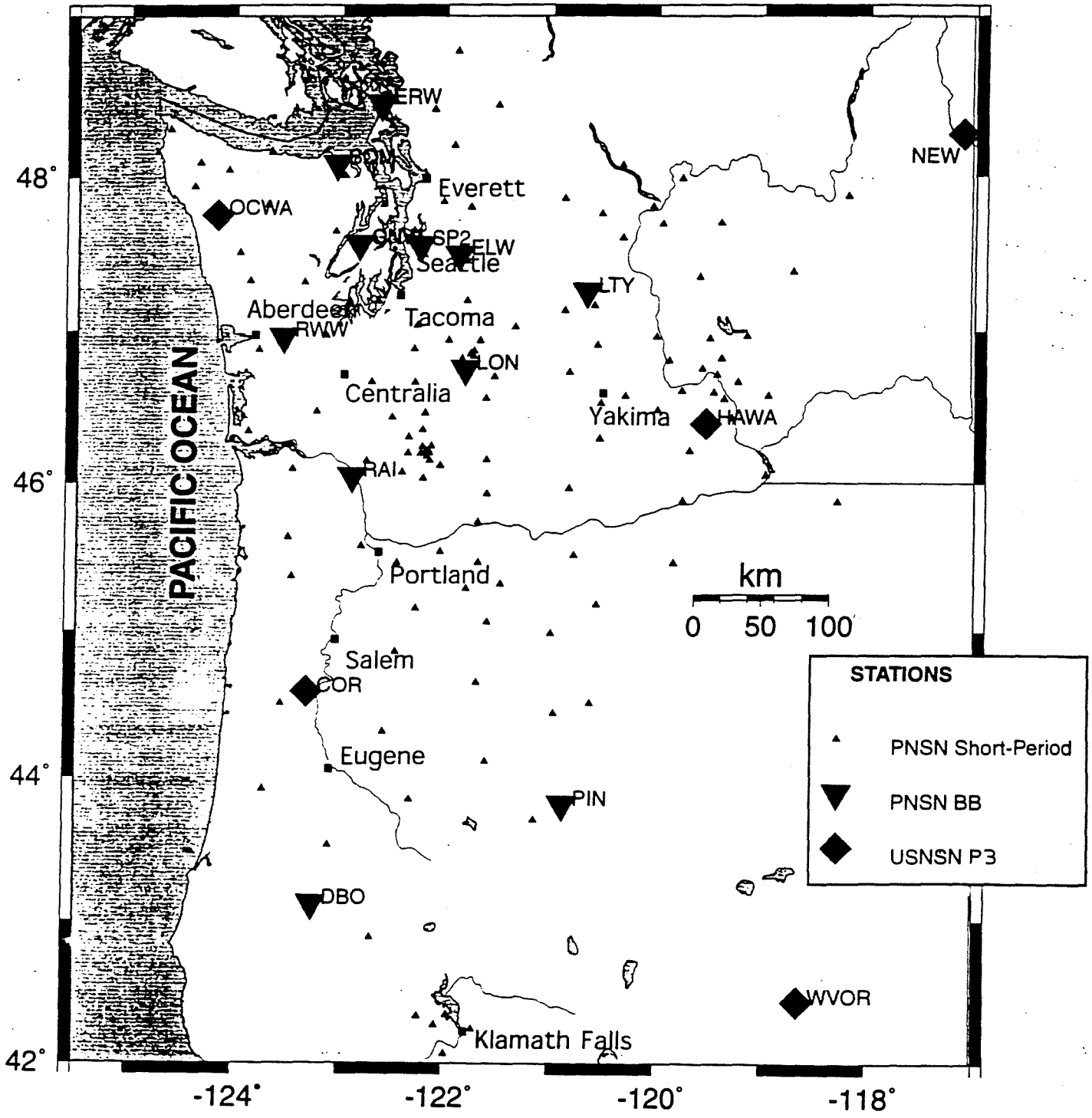

Figure 1a. Broad-band and short-period seismograph stations operating in Washington and Oregon at the end of the third quarter, 2000.

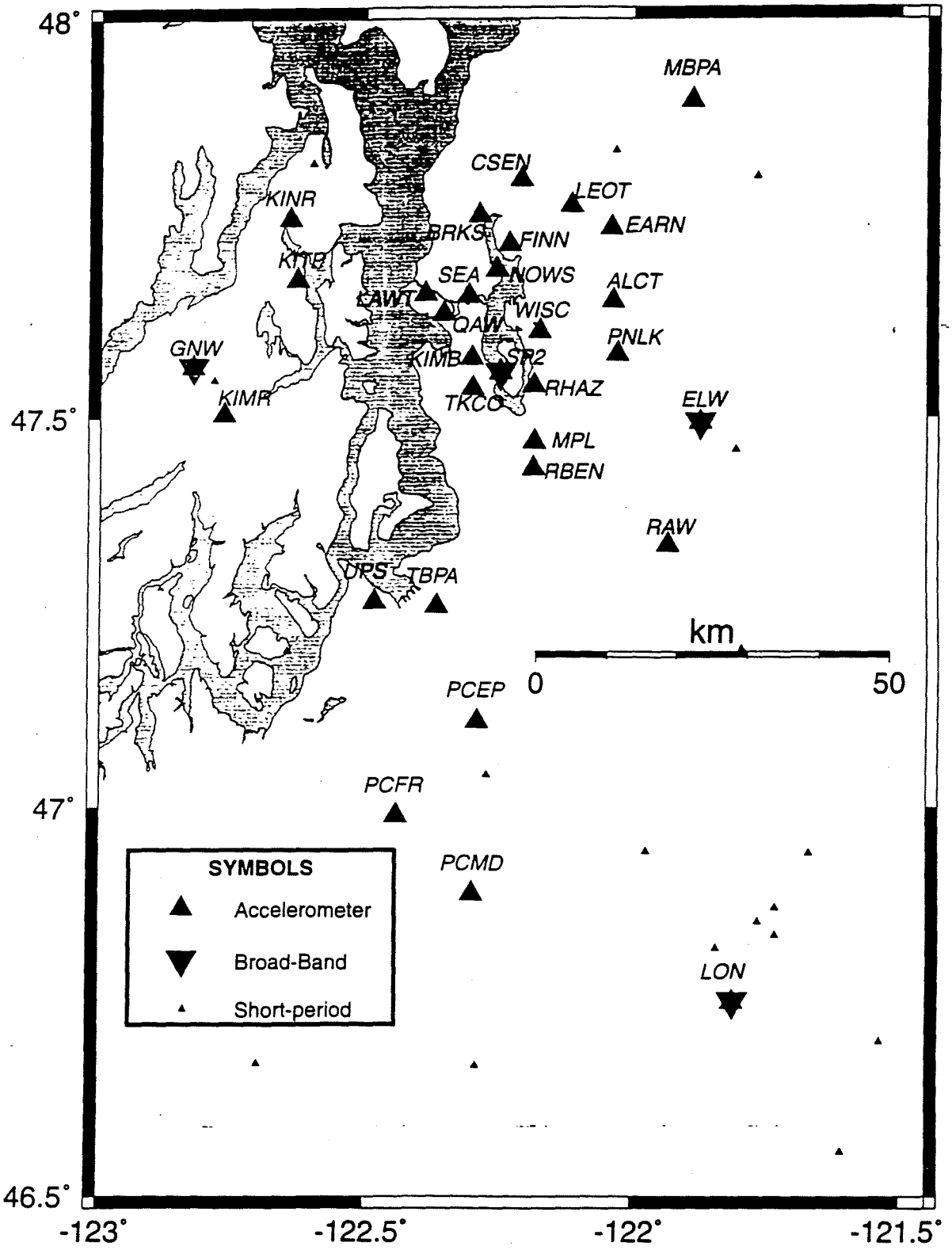

Figure 1b. Maps showing PNSN strong-motion and broad-band stations operating at the end of the third quarter 2000 in the Seattle area. Station SBES is north of the area shown here.

be our main data acquisition machine, had been delivered, and we were able to bring that up as a backup within 12 hours. The outage occured on a Saturday morning, and Pete Lombard spent the entire weekend resolving data acquisition and internal internet issues. Although the backup systems got most of the data, some strong motion data (from the newly installed K-20 internet network) was lost.

Strong-motion Instrumentation and Recording Update

During the summer field season the PNSN installed 20 new digital strong motion stations. This was an ambitious project, more than doubling the number of strong motion sensors. Eighteen stations are "reference" sites where the instrument was located on the ground floor of a small building. Two stations are true "free-field" sites where the instrument is located in a utility enclosure away from major structures. As of 9/30/00, data was being acquired in real-time from 17 of the new stations. George Thomas led the strong motion installation effort, assisted by two full-time temporary employees, Amy Lindemuth and Lynn Hultgrien, who helped with siting and installation. Tracy Zager, a graduate student in education, began developing curriculum materials as part of an informal support agreement with several school districts which are hosting many of these new strong motion instruments.

The new stations use the Kinemetrics K2 seismograph with an internal Episensor accelerometer. The two free field sites also have additional Mark L4 short period sensors. Since the K2 was a new instrument to the PNSN, a new EARTHWORM module, developed by Pete Lombard of the USGS EARTHWORM team, was needed to acquire the K2 data and incorporate it into our data recording scheme.

All of the new station telemetry was via IP over combinations of Intranets and the commercial Internet. Advantages of this telemetry were ease of start-up, minimal communications hardware, and no monthly operational costs. Initial analysis indicates that the data recovery from IP sites is as good or better (>98%) than other telemetry methods for PNSN digital seismographs. All of the K2 seismographs and communications hardware are on back-up power systems. In addition to sending continuous data the seismographs are configured to save triggered data to internal memory in the event of a communications failure.

Schools on the state K20 network were an obvious choice when looking for sites with IP connections. The school personnel were often very enthusiastic about the idea of seismographs in their facilities and this project will provide many opportunities to enhance the outreach efforts between the University and local schools.

Thirteen stations were installed in schools in various districts. Three stations were installed in Pierce County Sheriff Offices, including the free field site at Mountain Detachment in Eatonville (station PCMD). Three stations were installed in Kitsap County Facilities, helping to increase monitoring on the west side of Puget Sound. A free field site, station MURR, was installed at Washington State Department of Emergency Management, but is not yet being telemetered.

In addition to two full-time PNSN staff and one full-time USGS staff the installations were assisted greatly by many people. This included school district personnel such as carpenters, facilities managers, custodians, and network managers. The county sites were provided by the highly motivated Departments of Emergency Management of Pierce and Kitsap Counties. The two free field sites in Pierce County were made possible by Earl Brown, a volunteer from Search and Rescue who donated his time, a cement mixer, and a water buffalo (a 400 gallon water tank). Additional UW personnel included seismology grad students and student helpers in the Seismology Lab.

The PNSN Strong-Motion web pages were expanded considerably this quarter. They are available at:
http://www.geophys.washington.edu/SEIS/PNSN/SMO/

CREST Instrument Update

Last quarter the University of Oregon (UO) upgraded broad-band stations PIN and DB0 to be CREST compatible by installing strong motion components. This quarter, Battelle's Pacific Northwest National Lab helped install a new CREST station at their Sequim office and provided a telemetry path for the Sequim (SQM) CREST station via their intranet.

CREST stations are planned for Eugene Oregon (through UO), and for Longview, Boistfort Peak, Forks, and Tolt Reservoir in Washington. Four additional sites, directly on the coast, with BPA telemetry have been identified, and permitting discussions are underway.

TABLE 1
Station Outages, Repairs, and Installations 3rd quarter 2000

Station	Outage Dates	Comments
FBO	8/1-End	REMOVED
GHW	8/1-8/17	VCO Replaced
LONB	8/1-8/18	Problem with GPS clock; GPS card replaced
RPW	7/24-8/15	Batteries replaced
RSU	9/30/99-7/23/00	Repaired - Batteries replaced
RVC	5/14-8/2	RESITED, had been removed - vandalized
SLF	12/28/99-7/1/00	Revived with improved weather
SQM	8/1	INSTALLED CREST station,via Battelle EARTHWORM node
TTW	1/1-End	Bad time - GPS clock drifting
WRW	12/28/99-7/1/00	Revived with improved weather

ANSS STRONG MOTION INSTALLATIONS- 3rd quarter 2000

Station	Install Date	Comments
ALCT	7/6	INSTALLED ANSS station
BRKS	9/13	INSTALLED ANSS station
CSEN	7/11	INSTALLED ANSS station
EARN	7/12	INSTALLED ANSS station
KIMB	8/3	INSTALLED ANSS station
KIMR	8/16	INSTALLED ANSS station
KINR	8/15	INSTALLED ANSS station
KITP	8/13	INSTALLED ANSS station
LAWT	8/8	INSTALLED ANSS station
LEOT	8/10	INSTALLED ANSS station
PCEP	8/2	INSTALLED ANSS station
PCFR	8/1	INSTALLED ANSS station
PCMD	9/22	INSTALLED ANSS station with L4
PNLK	7/18	INSTALLED ANSS station
RBEN	9/26	INSTALLED ANSS station
RHAZ	8/8	INSTALLED ANSS station
WISC	7/17	INSTALLED ANSS station

STATIONS USED FOR LOCATION OF EVENTS

Table 2A lists short-period, mostly vertical-component stations used in locating seismic events in Washington and Oregon. The second column in the table gives the 3-letter station designator, followed by a symbol designating the funding agency; stations marked by a percent sign (%) were supported by USGS joint operating agreement 1434-HQ-98-AG-01937. A plus (+) indicates support under Pacific Northwest National Laboratory, Battelle contract 259116-A-B3. Stations designated "#" are USGS-maintained stations recorded at the PNSN. Other stations were supported from other sources. Additional columns give station north latitude and west longitude (in degrees, minutes and seconds), station elevation in km, and comments indicating landmarks for which stations were named.

TABLE 2A - Short-period Stations operated by the PNSN during the third quarter 2000

STA	F	LAT	LONG	EL	NAME
ASR	%	46 09 09.9	121 36 01.6	1.357	Mt. Adams - Stagman Ridge
AUG	%	45 44 10.0	121 40 50.0	0.865	Augspurger Mtn
BBO	%	42 53 12.6	122 40 46.6	1.671	Butler Butte, Oregon
BHW	%	47 50 12.6	122 01 55.8	0.198	Bald Hill
BLN	%	48 00 26.5	122 58 18.6	0.585	Blyn Mt.
BOW	%	46 28 30.0	123 13 41.0	0.870	Boistfort Mt.
BPO	%	44 39 06.9	121 41 19.2	1.957	Bald Peter, Oregon
BRV	+	46 29 07.2	119 59 28.2	0.920	Black Rock Valley
BVW	+	46 48 39.5	119 52 56.4	0.670	Beverly
CBS	+	47 48 17.4	120 02 30.0	1.067	Chelan Butte, South
CDF	%	46 07 01.4	122 02 42.1	0.756	Cedar Flats
CMM	%	46 26 07.0	122 30 21.0	0.620	Crazy Man Mt.
CMW	%	48 25 25.3	122 07 08.4	1.190	Cultus Mtns.
CPW	%	46 58 25.8	123 08 10.8	0.792	Capitol Peak
CRF	+	46 49 30.0	119 23 13.2	0.189	Corfu
DPW	+	47 52 14.3	118 12 10.2	0.892	Davenport
DY2	+	47 59 06.6	119 46 16.8	0.890	Dyer Hill 2
EDM	%	46 11 50.4	122 09 00.0	1.609	East Dome, Mt. St. Helens
ELK	%	46 18 20.0	122 20 27.0	1.270	Elk Rock
ELL	+	46 54 34.8	120 33 58.8	0.789	Ellensburg
EPH	+	47 21 22.8	119 35 45.6	0.661	Ephrata
ET3	+	46 34 38.4	118 56 15.0	0.286	Eltopia (replaces ET2)
ETW	+	47 36 15.6	120 19 56.4	1.477	Entiat

TABLE 2A continued

STA	F	LAT	LONG	EL	NAME
FBO	%	44 18 35.6	122 34 40.2	1.080	Farmers Butte, Oregon
FHE		46 57 06.9	119 29 49.0	0.455	Frenchman Hills East
FL2	%	46 11 47.0	122 21 01.0	1.378	Flat Top 2
FMW	%	46 56 29.6	121 40 11.3	1.859	Mt. Fremont
GBL	+	46 35 54.0	119 27 35.4	0.330	Gable Mountain
GHW	%	47 02 30.0	122 16 21.0	0.268	Garrison Hill
GL2	+	45 57 35.0	120 49 22.5	1.000	New Goldendale
GLK	%	46 33 27.6	121 36 34.3	1.305	Glacier Lake
GMO	%	44 26 20.8	120 57 22.3	1.689	Grizzly Mountain, Oregon
GMW	%	47 32 52.5	122 47 10.8	0.506	Gold Mt.
GSM	%	47 12 [illegible]	121 47 40.2	1.305	Grass Mt.
GUL	%	45 55 27.0	121 35 44.0	1.189	Guler Mt.
HAM	%	42 04 08.3	121 58 16.0	1.999	Hamaker Mt., Oregon
HBO	%	43 50 39.5	122 19 11.9	1.615	Huckleberry Mt., Oregon
HDW	%	47 38 54.6	123 03 15.2	1.006	Hoodsport
HOG	%	42 14 32.7	121 42 20.5	1.887	Hogback Mtn., Oregon
HSO	%	43 31 33.0	123 05 24.0	1.020	Harness Mountain, Oregon
HSR	%	46 10 28.0	122 10 46.0	1.720	South Ridge, Mt. St. Helens
HTW	%	47 48 14.2	121 46 03.5	0.833	Haystack Lookout
JBO	+	45 27 41.7	119 50 13.3	0.645	Jordan Butte, Oregon
JCW	%	48 11 42.7	121 55 31.1	0.792	Jim Creek
JUN	%	46 08 50.0	122 09 04.4	1.049	June Lake
KMO	%	45 38 07.8	123 29 22.2	0.975	Kings Mt., Oregon
KOS	%	46 27 46.7	122 11 41.3	0.610	Kosmos
LAB	%	42 16 03.3	122 03 48.7	1.774	Little Aspen Butte, Oregon
LCW	%	46 40 14.4	122 42 02.8	0.396	Lucas Creek
LMW	%	46 40 04.8	122 17 28.8	1.195	Ladd Mt.
LNO	+	45 52 18.6	118 17 06.6	0.771	Lincton Mt., Oregon
LO2	%	46 45 00.0	121 48 36.0	0.853	Longmire
LOC	+	46 43 01.2	119 25 51.0	0.210	Locke Island
LVP	%	46 04 06.0	122 24 30.0	1.170	Lakeview Peak
MBW	%	48 47 02.4	121 53 58.8	1.676	Mt. Baker
MCW	%	48 40 46.8	122 49 56.4	0.693	Mt. Constitution
MDW	+	46 36 47.4	119 45 39.6	0.330	Midway
MEW	%	47 12 07.0	122 38 45.0	0.097	McNeil Island
MJ2	+	46 33 27.0	119 21 32.4	0.146	May Junction 2
MOX	+	46 34 38.4	120 17 53.4	0.501	Moxie City
MPO	%	44 30 17.4	123 33 00.6	1.249	Mary's Peak, Oregon
MTM	%	46 01 31.8	122 12 42.0	1.121	Mt. Mitchell
NAC	+	46 43 59.4	120 49 25.2	0.728	Naches
NCO	%	43 42 14.4	121 08 18.0	1.908	Newberry Crater, Oregon
NEL	+	48 04 12.6	120 20 24.6	1.500	Nelson Butte
NLO	%	46 05 21.9	123 27 01.8	0.826	Nicolai Mt., Oregon
OBC	%	48 02 07.1	124 04 39.0	0.938	Olympics - Bonidu Creek
OBH	%	47 19 34.5	123 51 57.0	0.383	Olympics - Burnt Hill
OCP	%	48 17 53.5	124 37 30.0	0.487	Olympics - Cheeka Peak
OD2	+	47 23 15.6	118 42 34.8	0.553	Odessa site 2
OFR	%	47 56 00.0	124 23 41.0	0.152	Olympics - Forest Resource Cen
OHW	%	48 19 24.0	122 31 54.6	0.054	Oak Harbor
ON2	%	46 52 50.8	123 46 51.8	0.257	Olympics - North River
OOW	%	47 44 03.6	124 11 10.2	0.561	Octopus West
OSD	%	47 48 59.2	123 42 13.7	2.008	Olympics - Snow Dome
OSR	%	47 30 20.3	123 57 42.0	0.815	Olympics Salmon Ridge
OT3	+	46 40 08.4	119 13 58.8	0.322	New Othello (replaces OT2 8/26
OTR	%	48 05 00.0	124 20 39.0	0.712	Olympics - Tyee Ridge
PAT	+	45 52 55.2	119 45 08.4	0.262	Paterson
PCMD	%	46 53 20.9	122 18 00.9	0.239	PC Mountain Detachment
PGO	%	45 27 42.6	122 27 11.5	0.253	Gresham, Oregon
PGW	%	47 49 18.8	122 35 57.7	0.122	Port Gamble
PRO	+	46 12 45.6	119 41 08.4	0.553	Prosser
RCM	%	46 50 08.9	121 43 54.4	3.085	Mt. Rainier, Camp Muir
RCS	%	46 52 15.6	121 43 52.0	2.877	Mt. Rainier, Camp Schurman
RER	%	46 49 09.2	121 50 27.3	1.756	Mt. Rainier, Emerald Ridge
RMW	%	47 27 35.0	121 48 19.2	1.024	Rattlesnake Mt. (West)
RNO	%	43 54 58.9	123 43 25.5	0.850	Roman Nose, Oregon
RPW	%	48 26 54.0	121 30 49.0	0.850	Rockport
RSU	%	46 51 12.0	121 45 47.0	4.440	Rainier summit
RSW	+	46 23 40.2	119 35 28.8	1.045	Rattlesnake Mt. (East)
RVC	%	46 56 34.5	121 58 17.3	1.000	Mt. Rainier - Voight Creek
RVN	%	47 01 38.6	121 20 11.9	1.885	Raven Roost (former NEHRP temp
RVW	%	46 08 53.2	122 44 32.1	0.460	Rose Valley
SAW	+	47 42 06.0	119 24 01.8	0.701	St. Andrews
SEA	%	47 39 15.8	122 18 29.3	0.030	UW, Seattle (Wood Anderson.BB,
SEP	#	46 12 00.7	122 11 28.1	2.116	September lobe, Mt. St. Helens
SHW	%	46 11 37.1	122 14 06.5	1.425	Mt. St. Helens

TABLE 2A continued

STA	F	LAT	LONG	EL	NAME
SLF	%	47 45 32.0	120 31 40.0	1.750	Sugar Loaf
SMW	%	47 19 10.7	123 20 35.4	0.877	South Mtn.
SOS	%	46 14 38.5	122 08 12.0	1.270	Source of Smith Creek
SSO	%	44 51 21.6	122 27 37.8	1.242	Sweet Springs, Oregon
STD	%	46 14 16.0	122 13 21.9	1.268	Studebaker Ridge
STW	%	48 09 03.1	123 40 11.1	0.308	Striped Peak
TBM	+	47 10 12.0	120 35 52.8	1.006	Table Mt.
TCO	%	44 06 27.6	121 36 02.1	1.975	Three Creek Meadows, Oregon.
TDH	%	45 17 23.4	121 47 25.2	1.541	Tom,Dick,Harry Mt., Oregon
TDL	%	46 21 03.0	122 12 57.0	1.400	Tradedollar Lake
TKO	%	45 22 16.7	123 27 14.0	1.024	Trask Mtn, Oregon
TRW	+	46 17 32.0	120 32 31.0	0.723	Toppenish Ridge
TWW	+	47 08 17.4	120 52 06.0	1.027	Teanaway
VBE	%	45 03 37.2	121 35 12.6	1.544	Beaver Butte, Oregon
VCR	%	44 58 58.2	120 59 17.4	1.015	Criterion Ridge, Oregon
VFP	%	45 19 05.0	121 27 54.3	1.716	Flag Point, Oregon
VG2	%	45 09 20.0	122 16 15.0	0.823	Goat Mt., Oregon
VGB	+	45 30 56.4	120 46 39.0	0.729	Gordon Butte, Oregon
VIP	%	44 30 29.4	120 37 07.8	1.731	Ingram Pt., Oregon
VLL	%	45 27 48.0	121 40 45.0	1.195	Laurance Lk., Oregon
VLM	%	45 32 18.6	122 02 21.0	1.150	Little Larch, Oregon
VRC	%	42 19 47.2	122 13 34.9	1.682	Rainbow Creek, Oregon
VSP	%	42 20 30.0	121 57 00.0	1.539	Spence Mtn, Oregon
VT2	+	46 58 02.4	119 59 57.0	1.270	Vantage2
VTH	%	45 10 52.2	120 33 40.8	0.773	The Trough, Oregon
WA2	+	46 45 19.2	119 33 56.4	0.244	Wahluke Slope
WAT	+	47 41 55.2	119 57 14.4	0.821	Waterville
WG4	+	46 01 49.2	118 51 21.0	0.511	Wallula Gap
WIB	%	46 20 34.8	123 52 30.6	0.503	Willapa Bay
WIW	+	46 25 45.6	119 17 15.6	0.128	Wooded Island
WPO	%	45 34 24.0	122 47 22.4	0.334	West Portland, Oregon
WPW	%	46 41 55.7	121 32 10.1	1.280	White Pass
WRD	+	46 58 12.0	119 08 41.4	0.375	Warden
WRW	%	47 51 26.0	120 52 52.0	1.189	Wenatchee Ridge
YA2	+	46 31 36.0	120 31 48.0	0.652	Yakima
YEL	#	46 12 35.0	122 11 16.0	1.750	Yellow Rock, Mt. St. Helens

Table 2B lists broad-band, three-component stations operating in Washington and Oregon that provide data to the PNSN.

TABLE 2B

Broad-band three-component stations operating at the end of the third quarter 2000. Symbols are as in Table 2A.

STA	F	LAT	LONG	EL	NAME
COR		44 35 08.5	123 18 11.5	0.121	Corvallis, Oregon (IRIS station, Operated by OSU)
DBO	%	43 07 09.0	123 14 34.0	0.984	Dodson Butte, Oregon (CREST - operated by UO)
ELW	%	47 29 38.8	121 52 21.6	0.267	Echo Lake, WA (operated by UW)
ERW	%	48 27 14.4	122 37 30.2	0.389	Mt. Erie, WA (operated by UW)
GNW	%	47 33 51.8	122 49 31.0	0.165	Green Mountain, WA (CREST - operated by UW)
HAWA		46 23 32.3	119 31 57.2	0.367	Hanford Nike (? SGS-USNSN)
HLID		43 33 45.0	114 24 49.3	1.772	Hailey, ID (USGS-USNSN)
LON	%	46 45 00.0	121 48 36.0	0.853	Longmire (CREST - operated by UW)
LTY	%	47 15 21.2	120 39 53.3	0.970	Liberty, WA (operated by UW)
NEW		48 15 50.0	117 07 13.0	0.760	Newport Observatory (USGS-USNSN)
OCWA		47 44 56.0	124 10 41.2	0.671	Octopus Mtn. (USGS-USNSN)
PIN		43 48 40.0	120 52 19.0	1.865	Pine Mt. Oregon (CREST - operated by UO)
RAI		46 02 25.1	122 53 06.4	1.520	Trojan Plant, Oregon (OSU)
RWW	%	46 57 50.1	123 32 35.9	0.015	Ranney Well (CREST - operated by UW)
SP2	%	47 33 23.3	122 14 52.8	0.030	Seward Park, Seattle (operated by UW)
SQM	%	48 04 39.0	123 02 44.0	0.030	Sequim (operated by UW, telemetered by Battelle)
TTW	%	47 41 40.7	121 41 20.0	0.542	Tolt Reservoir, WA (operated by UW)
WVOR		42 26 02.0	118 38 13.0	1.344	Wildhorse Valley, Oregon (USGS-USNSN)

Table 2C lists strong-motion, three-component stations operating in Washington and Oregon that provide data in real or near-real time to the PNSN. Several of these stations also have broad-band instruments, as noted. The "SENSOR" field designates what type of seismic sensor is used;

- A = Terra-Tech SSA-320 SLN triaxial accelerometer/Terra-Tech IDS24 recording system,
- A20 = Terra-Tech SSA-320 triaxial accelerometer/Terra-Tech IDS20 recording system,
- FBA23 = Kinemetrics FBA23 accelerometers and Reftek recording system,
- EPI = Kinemetrics Episensor accelerometers and Reftek recording system.
- BB = Guralp CMG-40T 3-D broadband velocity sensor.
- BB3 = Guralp CMG3T 3-D broadband velocity sensor.
- K2 = Kinemetrics Episensor accelerometers and K2 Recording System

The "TELEMETRY" field indicates the type of telemetry used to recover the data.

- D = dial-up,
- L = continuously telemetered via dedicated lease-line telephone lines,
- L-PPP = continuously telemetered via dedicated lease-line telephone lines using PPP protocol
- I = continuously telemetered via Internet,
- E = continuously telemetered via an Internet EARTHWORM system

TABLE 2C

Strong-motion three-component stations operating at the end of the third quarter 2000. Symbols are as in Table 2A.

STA	F	LAT	LONG	EL	NAME	SENSORS	TELEMETRY
ALCT	%	47 38 51.0	122 02 13.2	0.055	Alcott Elementary, Redmond	K2	I
ALST	%	46 6 31.2	123 01 47.4	0.000	Alston, Oregon BPA	A20	L,E,D
BRKS	%	47 45 19.7	122 17 18.4	0.100	Brookside Elementary, Lake Forest Park	K2	I
CSEN	%	47 48 04.5	122 13 06.5	0.055	Crystal Springs Elementary, Bothell	K2	I
CSO	#	45 31 01.0	122 41 22.5	0.036	Canyon Substation, Oregon	FBA23	D
DBO	%	43 07 09.0	123 14 34.0	0.984	Dodson Butte, OR (UO CREST)	EPI,BB3	E
EARN	%	47 44 24.0	122 02 24.0	0.010	East Ridge Elementary, Woodinville	K2	I
ELW	%	47 29 38.8	121 52 21.6	0.267	Echo Lake, WA	A,BB	L,D
ERW	%	48 27 14.4	122 37 30.2	0.389	Mt. Erie, WA	A,BB	L,D
FINN	%	47 43 08.9	122 13 55.0	0.010	Finn Hill Jr High, Juanita	K2	I
GNW	%	47 33 51.8	122 49 31.0	0.165	Green Mountain, WA (CREST)	EPI,BB3	L-PPP
HAO	#	45 30 33.1	122 39 24.0	0.018	Harrison Substation, Oregon	FBA23	L,E,D
HOLY	%	47 33 55.3	122 23 02.1	0.106	Holy Rosary	K2	I
KEEL	%	45 33 0.0	122 53 44.4	0.000	Keeler, Oregon BPA	A20	L,E,D
KIMB	%	47 34 30.9	122 18 05.9	0.100	Kimball Elementary, Seattle	K2	I
KIMR	%	47 30 11.7	122 46 01.9	0.123	Kitsap Moderate Risk Waste	K2	I
KINR	%	47 45 06.0	122 38 35.0	0.010	Kitsap North Road Shed	K2	I
KITP	%	47 40 30.0	122 37 47.0	0.100	Kitsap Treatment Plant	K2	I
LAWT	%	47 39 23.4	122 23 21.9	0.111	Lawton Elementary, Seattle	K2	I
LEOT	%	47 46 04.4	122 06 54.3	0.155	Leota Jr High, Woodinville	K2	I
LON	%	46 45 00.0	121 48 36.0	0.853	Longmire (CREST)	EPI,BB3	L-PPP,D
MBPA	%	47 53 56.6	121 53 20.2	0.186	Monroe BPA	A20	L,D
MPL	%	47 28 08.2	122 11 06.2	0.122	Maple Valley	A	L,D
NOWS	%	47 41 12.0	122 15 21.2	0.000	NOAA, Bldg 3	A20	I
PCEP	%	47 06 43.0	122 17 24.2	0.160	PC East Precinct	K2	I
PCFR	%	46 59 23.3	122 26 27.4	0.137	PC Training Center	K2	I
PCMD	%	46 53 20.9	122 18 00.9	0.239	PC Mor ain Detachment	K2	I
PIN	%	43 48 40.0	120 52 19.0	1.865	Pine Mt., OR (U0 CREST)	EPI,BB3	E
PNLK	%	47 34 50.0	122 01 42.4	0.128	Pine Lake Middle School, Issaquah	K2	I
QAW	%	47 37 53.2	122 21 15.0	0.140	Queen Anne	A	L
RAW	%	47 20 14.0	121 55 57.6	0.208	Raver BPA	A	L,D
RBEN	%	47 26 05.4	122 11 10.2	0.000	Benson Elementary, Renton	K2	I
RBO	#	45 32 27.0	122 33 51.5	0.158	Rocky Butte, Oregon	FBA23	D
RHAZ	%	47 32 25.8	122 11 08.4	0.108	Hazelwood Elementary, Newcastle	K2	I
ROSS	%	45 39 46.2	122 39 37.0	0.100	Ross BPA	A20	L,E,D
RWW	%	46 57 50.1	123 32 35.9	0.015	Ranney Well (CREST)	EPI,BB3	L-PPP
SBES	%	48 46 05.9	122 24 54.2	0.000	Silver Beach Elementary, Bellingham	A	I
SEA	%	47 39 18.0	122 18 30.0	0.030	Seattle	A,BB	L,D
SP2	%	47 33 23.3	122 14 52.8	0.030	Seward Park, Seattle	A,BB	L
SQM	%	48 04 39.0	123 02 44.0	0.030	Sequim, WA (CREST)	EPI,BB3	L-PPP
TBPA	%	47 15 28.1	122 22 05.9	0.002	Tacoma WA BPA	A	L,D
TKCO	%	47 32 12.7	122 18 01.5	0.005	King Co EOC	A20	I
UPS	%	47 15 51.4	122 28 56.3	0.113	University of Puget Sound	K2	I
WISC	%	47 36 32.0	122 10 27.8	0.056	Wilburton Intructional Services Center, Bellevue	K2	I

Table 2D shows stations recorded by the PNSN but not initiated in PNSN EARTHWORM nodes during the third quarter 2000. Columns as in Table 2A. PNNL is the Battelle Pacific Northwest National Labs, MT is Montana Bureau of Mines, OSU is Oregon State University, USNSN is the US National Seismic Network, CAL-NET is the USGS Northern California Network.

TABLE 2D

STA	F	LAT	LONG	EL	NAME
BEN		46 31 12.0	119 43 18.0	0.335	PNNL station
CHMT		46 54 51.0	113 15 07.0	-	Chamberlain Mtn, MT
COR		44 35 08.5	123 18 11.5	0.121	Corvallis, Oregon (OSU BB)
DBO	%	43 07 09.0	123 14 34.0	0.984	Dodson Butte, Oregon (UO CREST
GBB		46 36 31.8	119 37 40.2	0.185	PNNL Station
H2O		46 23 45.0	119 25 22.0	-	Water PNNL Station
HAWA		46 23 32.3	119 31 57.2	0.367	Hanford Nike (USNSN BB)
HLID		43 33 45.0	114 24 49.3	1.772	Hailey, ID (USNSN BB)
KEB		42 52 20.0	124 20 03.0	0.818	CAL-NET
KSX		41 49 51.0	123 52 33.0	-	CAL-NET
KTR		41 54 31.2	123 22 35.4	1.378	CAL-NET
LAM		41 36 35.2	122 37 32.1	1.769	CAL-NET
LCCM		45 50 16.8	111 52 40.8	1.669	Lewis and Clark Caverns, MT
MCMT		44 49 39.6	112 50 55.8	2.323	McKenzie Canyon, MT
NEW		48 15 50.0	117 07 13.0	0.760	Newport Observatory (USNSN BB)
OCWA		47 44 56.0	124 10 41.2	0.671	Octopus Mtn. (USNSN BB)
PIN	%	43 48 40.0	120 52 19.0	1.865	Pine Mt., Oregon (U0 CREST)
RED		46 17 51.0	119 26 15.6	0.330	Red Mountain PNNL Station
SNI		46 27 80.0	119 39 50.0	-	PNNL station
SQM	%	48 04 39.0	123 02 44.0	0.030	PNNL - Sequim BB SMO
WVOR		42 26 02.0	118 38 13.0	1.344	Wildhorse Valley, Oregon (USNS

OUTREACH ACTIVITIES

The PNSN Seismology Lab staff provides an educational outreach program to better inform the public, educators, businesses, policy makers, and the emergency management community about seismicity and natural hazards. Our outreach includes lab tours, lectures, classes and workshops, press conferences, TV and radio news programs and talk shows, field trips, and participation in regional earthquake planning efforts. We provide basic information through information sheets, an audio library, and the Internet on the World-Wide-Web (WWW):

http://www.geophys.washington.edu/SEIS/PNSN

The development of the real-time strong motion network has become a major focus of PNSN Outreach activities. Expansion of information services to include strong-motion outreach materials is a current priority.

The installation of strong-motion instruments is also encouraging the formation of research relationships with a wide range of organizations who are interested in the data collected, and the potential for useful data products. These organizations, in turn, can provide the PNSN with station sites and/or telemetry. Conversations with business and industry, utilities, K-12 education providers, and local Federal, and State governmental agencies have advanced this quarter. We anticipate that cooperative efforts will contribute to more robust and diversified network telemetry, additional non-federally funded strong motion seismograph stations, and increased support for critical staff.

Special Events

- Over the course of the quarter, PNSN staff met at various times with county officials, representatives of utility and private companies, and engineering and emergency management groups regarding rapid earthquake notification and long-term network and strong-motion development plans.
- Bill Steele assisted in organization of, and presented a workshop at the Association of Contingency Planners' (ACP) national conference in Bellevue this August. "The Challenge of Changes in Hazards Assessment" focused on the impacts of the high hazard "bubble" over the central Puget Sound area on the USGS probabilistic shaking map, and the impact of the PNSN modernization on mitigation planning and disaster response. The PNSN staffed a booth to answer questions and distribute materials.
- Steve Malone attended national-level meetings of the ANSS Interim Steering Committee and Technical Integration Committee.
- Steve Malone presented an invited talk at the Western States Seismic Policy Council's National Earthquake Risk Management Conference "Understanding the Hazards and Reducing the Risks". His talk was entitled "Progress in the Development of a Regional ANSS Network". The PNSN also staffed a

booth at the conference and worked with local media.

- The PNSN continued its active involvement with Benton Co. Oregon, King and Pierce Counties, Washington, and the City of Seattle Project Impact Programs. Bill Steele signed a memorandum of agreement with Kitsap County this quarter, the fourth Project Impact partnership the PNSN has entered into.
- The PNSN hosted a board meeting of the Cascadia Region Earthquake Workgroup (CREW) and continues to be actively involved in the Contingency Planners and Recovery Managers (CPARM), and the Washington Emergency Managers Association (WSEMA).
- Bill Steele participated in the "Seattle Geologic Hazards" field trip for city officials organized by Derek Booth and Kathy Troost of the Seattle Geologic Mapping Project. (http://gneiss.geology.washington.edu/sea-geo/)
- Managers from the Washington State Patrol (WSP) visited the Seismology Lab and met with PNSN representatives to discuss a allowing the PNSN to utilize some of the excess bandwidth on the extensive WSP microwave network.
- Steve Malone and PNSN staff hosted Washington Department of Transportation management (WSDOT) on August 9th at a four-hour workshop to discuss the capabilities of densely arrayed strong motion urban networks. WSDOT expressed interest in participating in development of the strong motion network and in obtaining strong motion data from a number of bridge structures they operate.

To test the feasibility of using excess capacity of WSDOT information systems to transmit seismic data, the PNSN will try to transmit data from a K-2 instrument (located on an abutment of the I-5 Ship Canal Bridge and operated by the National Strong Motion Program) to UW via WSDOT telemetry. Future meetings with WSDOT are planned to design collaborative research activities.

- This summer, excavation of a church parking lot in Bellevue, Washington exposed a probable east-west trending fault scarp that was noticed by Brian Sherrod of the USGS. The exposure was mapped and examined by Brian and other USGS geologists and geophysicists who concluded the feature was produced by faulting. Bill Steele organized a meeting with Bellevue and King County officials to brief them on the preliminary findings and answer questions. Bill has worked with the city's public information officer to coordinate a press conference scheduled for November, where the newly uncovered fault scarp will be discussed.
- George Thomas presented a talk titled "Remote Real-Time Seismic Data Collection Using the K20 Network" at a workshop on *Cosmic Ray Physics with School-Based Detector Networks*. The workshop was hosted by the UW Physics Department.

Press Interviews, Lab Tours, and Workshops

PNSN staff provided about 10 television, radio, or press interviews this quarter. We provided 3 lab tours for K-12 students this quarter with a total of 60 participants.

Telephone, Mail, and On-line outreach

The PNSN audio library system received about 300 calls this quarter. We provide several recordings. The most popular is a frequently updated message on current seismic activity. In addition we have a tape describing the seismic hazards in Washington and Oregon, and another on earthquake prediction. Callers often request our one-page information and resource sheet on seismic hazards in Washington and Oregon. Thousands of these have been mailed out or distributed, and we encourage others to reproduce and further distribute this sheet. Our information sheet discussing earthquake prediction is also frequently requested. Callers to the audio library can also choose to be transferred to the Seismology Lab, where additional information is available. This quarter we responded in person to: ~75 calls from emergency management and government, ~55 calls from the media, ~45 calls from educators, ~70 from the business community, and about 120 calls from the general public.

The PNSN recent earthquake list, and much more, is also available through the World-Wide-Web (WWW) at:

http://www.geophys.washington.edu/SEIS/PNSN

This quarter we shifted our web-reports of felt earthquakes to the USGS "Community Intensity Internet Map (CIIM)". Their data-entry form is a big improvement over the previous form, and both parsing of the data and presentation of results is considerably simplified.

http://pasadena.wr.usgs.gov/shake/pnw/html/background.html

The PNSN web-site offers web pages that include maps and lists of the most recent PNW earthquakes, general information on earthquakes and PNW earthquake hazards, information on past damaging PNW earthquakes, and catalogs of earthquake summary cards. Web-pages on seismicity of Cascade Volcanos, and Quarterly summaries of seismicity are also included. "Webicorder" pages allow Web visitors to view continuous data from PNSN seismographic stations at:

http://www.geophys.washington.edu/SEIS/PNSN/WEBICORDER/

In addition to the PNSN web site, the UW Geophysics Program and the PNSN host several other earthquake-related web sites:

- **Volcano Systems Center** is a cooperative effort of the UW and the USGS that links volcano-related activities of the UW Geological Sciences, Geophysics, and Oceanography departments with related USGS activities.

  http://www.vsc.washington.edu

- **Seismosurfing** is a comprehensive listing of sites worldwide that offer substantive seismology data and information. This page is mirrored at two sites in Europe.

  http://www.geophys.washington.edu/seismosurfing.html

- The **Council of National Seismic Systems** (CNSS) site features composite listings and maps of recent U.S. earthquakes, and documentation of the EARTHWORM system.

  http://www.cnss.org

- The "**Tsunami!**" web site offers many pages of information, including an excellent discussion on the physics of tsunamis, and short movie clips. It was developed by Benjamin Cook under the direction of Dr. Catherine Petroff (UW Civil Engineering).

  http://www.geophys.washington.edu/tsunami

- The UW Geophysics Program **Global Positioning System (GPS)** web site provides information on geodetic studies of crustal deformation in Washington and Oregon.

  http://www.geophys.washington.edu/GPS/gps.html

EARTHQUAKE DATA - 2000-C

There were 2,031 events digitally recorded and processed at the University of Washington between July 1 and September 30, 2000. Locations in Washington, Oregon, or southernmost British Columbia were determined for 939 of these events; 843 were classified as earthquakes and 96 as known or suspected blasts. The remaining 1,092 processed events include teleseisms (271 events), regional events outside the PNSN (53), and unlocated events within the PNSN. Unlocated events within the PNSN include very small earthquakes and some known blasts. Frequent mining blasts occur near Centralia, Washington and we routinely locate and retrieve broad-band data for some of them.

Table 3 is a listing of all earthquakes reported to have been felt during the this quarter. Table 5, located at the end of this report, is this quarter's catalog of earthquakes and blasts, M 2.0 or greater, located within the network - between 42-49.5 degrees north latitude and 117-125.3 degrees west longitude.

Fig. 2 shows earthquakes with magnitude greater than or equal to 0.0 ($M_c \geq 0$).

Fig. 3 shows blasts and probable blasts ($M_c \geq 0$).

Fig. 4 shows earthquakes located near Mt. Rainier ($M_c \geq 0$).

Fig. 5 shows earthquakes located at Mt. St. Helens ($M_c \geq 0$).

TABLE 3 - Felt Earthquakes during the 3rd Quarter of 2000

DATE-(UTC)-TIME yy/mm/dd hh:mm:ss	LAT(N) deg.	LON(W) deg.	DEPTH km	MAG	COMMENTS
00/09/10 14:53:38	48.42N	123.19W	49.3	3.2	11.6 km E of Victoria, BC

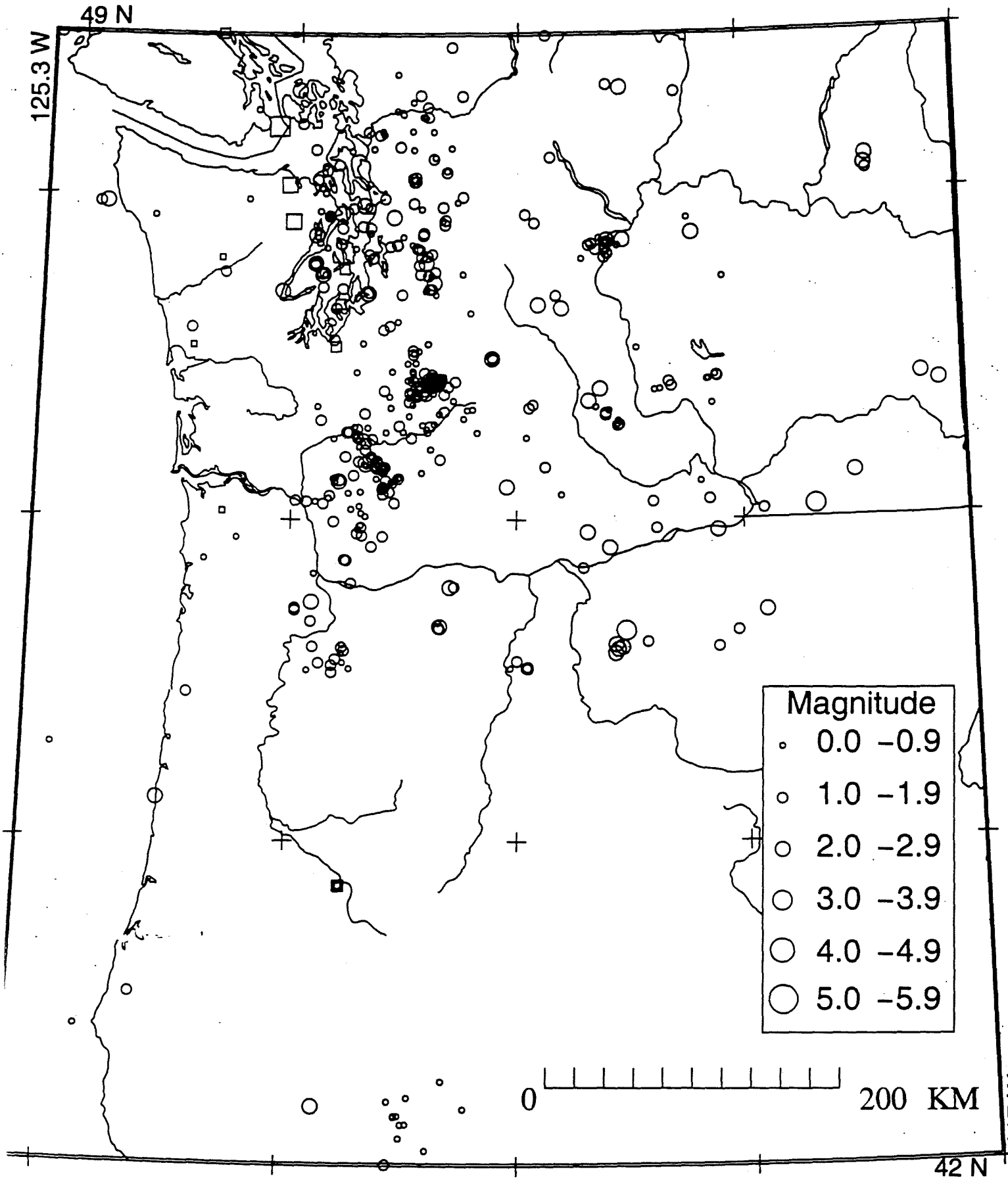

Figure 2: Earthquakes located in Washington and Oregon with magnitudes greater than or equal to 0.0 during the third quarter of 2000. Square symbols indicate events located at depths of 30 km or more.

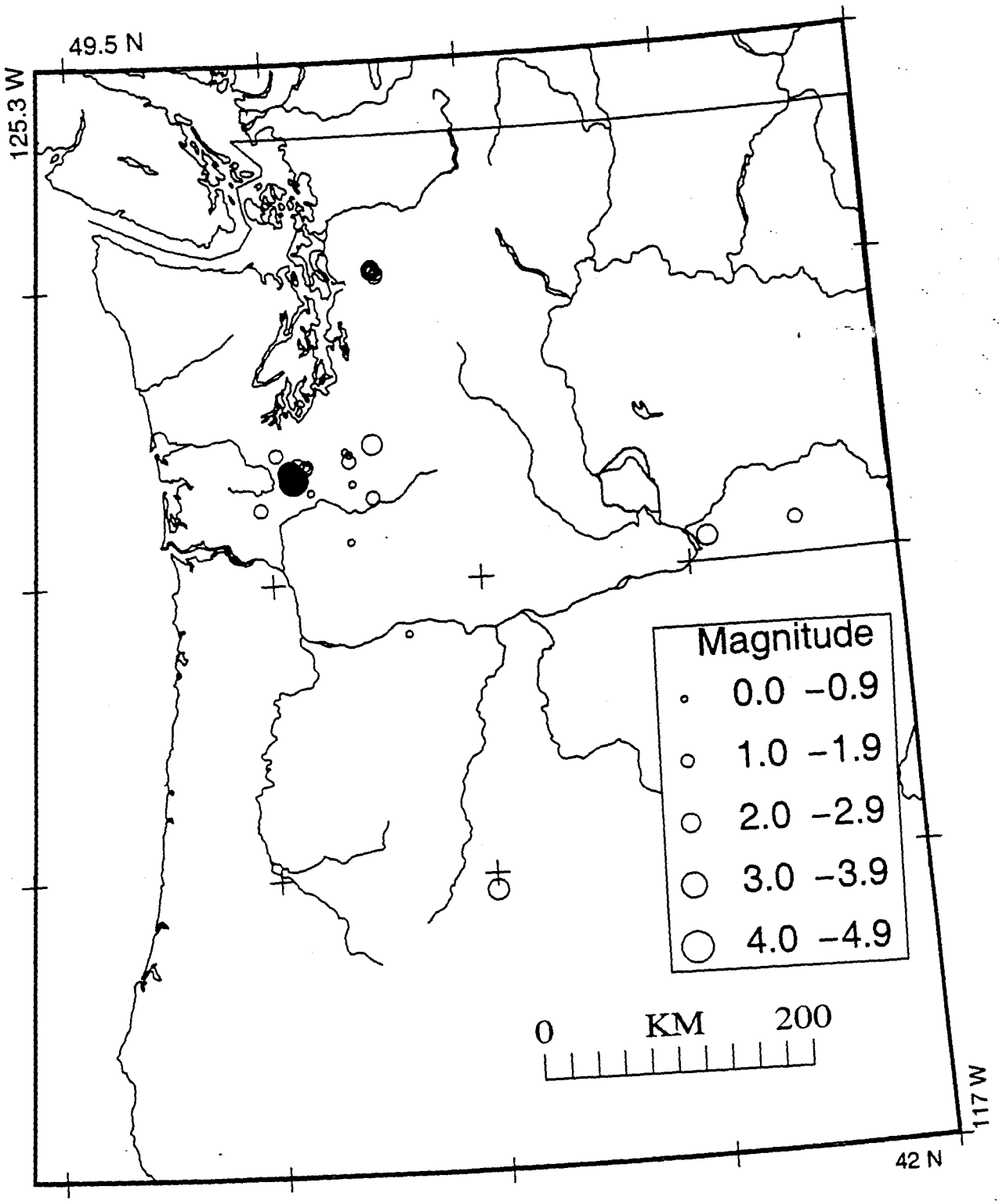

Figure 3: Blasts and probable blasts, third quarter, 2000.

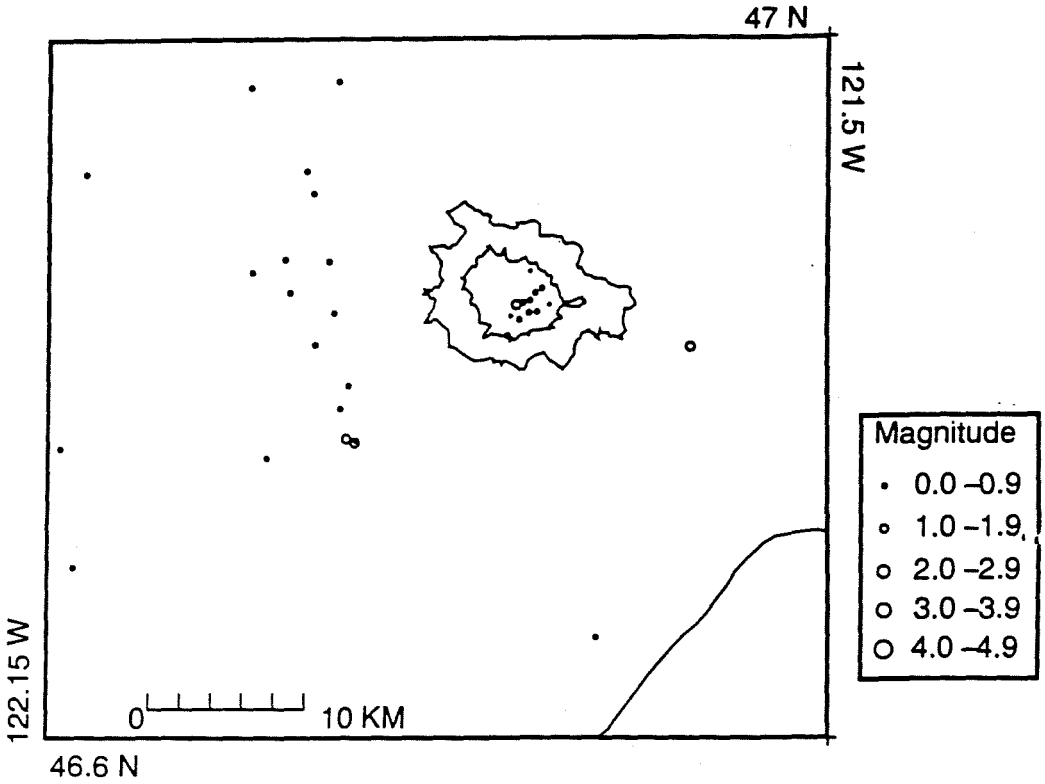

Figure 4: Earthquakes located in the Mt. Rainier area third quarter, 2000. All events shown are greater than magnitude 0.0. Inner contour is the 10,000 foot elevation contour, and the outer is the 7,500 foot contour. "Plus" symbols represent earthquakes shallower than 1 km depth, while circles represent earthquakes at 1 km or deeper.

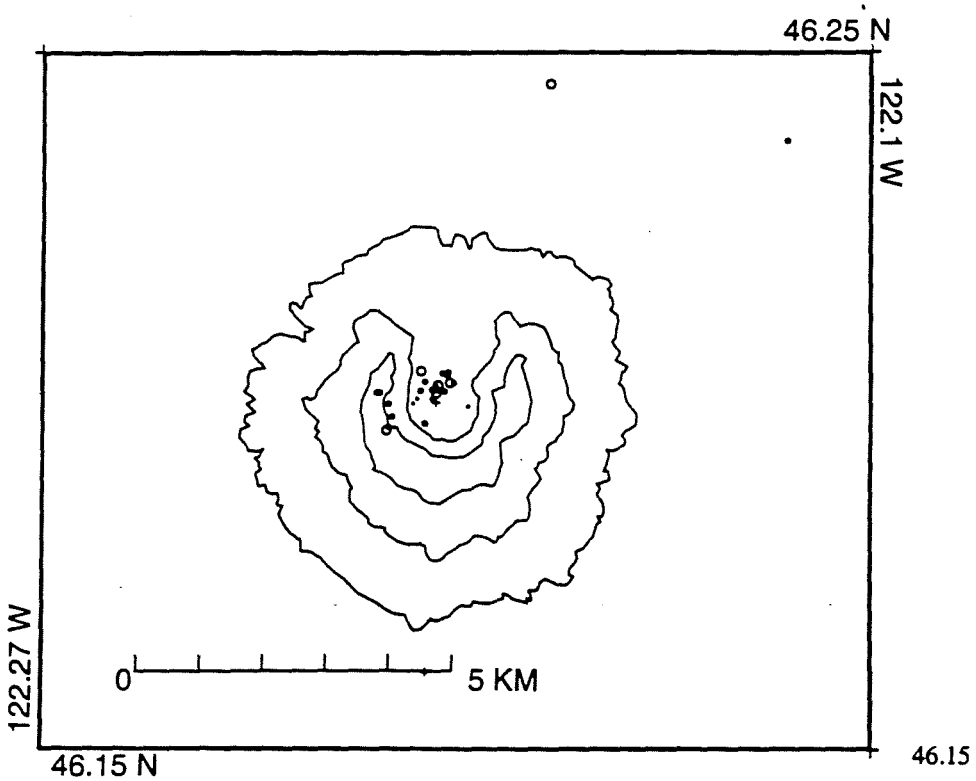

Figure 5: Earthquakes located in the Mt. St. Helens area third quarter, 2000. All events shown are greater than magnitude 0.0. Contours shown are at 5,000, 6,400 and 7,500 feet elevation. "Plus" symbols represent earthquakes shallower than 1 km depth, while circles represent earthquakes at 1 km or deeper. Symbol scaling as in Fig. 4.

OREGON SEISMICITY

During the third quarter of 2000 a total of 61 earthquakes were located in Oregon between 42.0° and 45.5° north latitude, and between 117° and 125° west longitude. The most interesting activity in Oregon this quarter were 5 events that occurred on August 14 about 59 km SE of Eugene. All were very close together, and all located at about 43 km, a very unusual depth for this part of Oregon -- much deeper than typical Oregon crustal earthquakes. Other interesting Oregon activity this quarter included five events larger than magnitude 2 that occurred 10 km or so east of Condon; the largest was magnitude 3.2 on 8/17 at 01:58 UTC. In eastern Oregon, within 50 km of Baker, two events larger than magnitude 3. were recorded; on 7/13 at 22:30 UTC and on 8/27 at 21:20 UTC. No events were reported felt in Oregon this quarter.

In the Klamath Falls area, 14 earthquakes were located this quarter. Since 1994, most earthquakes northwest of Klamath Falls have been considered aftershocks of a pair of damaging earthquakes in September of *1993* (Sept. 21, 03:29 and 05:45 UTC; M_c 5.9 and 6.0 respectively). The 1993 earthquakes were followed by a vigorous aftershock sequence which decreased over time.

WESTERN WASHINGTON SEISMICITY

During the third quarter of 2000, 699 earthquakes were located between 45.5° and 49.5° north latitude and between 121° and 125.3° west longitude.

One earthquake was felt this quarter in western Washington. That earthquake, on September 10, was actually located in British Columbia, but was felt in Washington in Friday Harbor, and the San Juan Islands, in Port Townsend, Bellingham, Stanwood and as far as Anacortes. Details are given in Table 3. This event, at about 49 km, was also the deepest quake this quarter.

Mount Rainier Area: Figure 4 shows earthquakes near Mount Rainier. The number of events in close proximity to the cone of Mt. Rainier varies over the course of the year, since the source of much of the shallow activity is presumably ice movement or avalanching at the surface, which is seasonal in nature. Events with very low frequency signals (1-3 Hz) believed to be icequakes are assigned type "L" in the catalog. Emergent, very long duration signals, probably due to rockfalls or avalanches, are assigned type "S" (see Key to Earthquake Catalog). "L" and "S" type events are listed in the catalog, but not shown in Fig. 4.

The repair of summit station RSU had a big effect on the event counts at Mount Rainier this quarter. The summit station provided data that allowed much smaller events near the summit (mostly shallow low frequency events) to be located. Because of RSU, 215 events flagged "L" or "S" events were located at Mount Rainier this quarter and an additional 334 "L" or "S" events were recorded, but were too small to locate reliably. Without RSU most of these events would have simply failed to trigger our system. The change in event counts is due simply to the operation of RSU.

A total of 51 tectonic events (18 of these were smaller than magnitude 0.0, and thus are not shown in Fig. 4) were located within the region shown in Fig. 4. Of these, 28 were tectonic events located in the "Western Rainier Seismic Zone" (WRSZ), a north-south trending lineation of seismicity approximately 15 km west of the summit of Mt. Rainier (for counting purposes, the western zone is defined as 46.6-47 degrees north latitude and 121.83-122 west longitude). No tectonic earthquakes larger than magnitude 1.8 were located near Mt. Rainier this quarter.

This quarter, there were 14 higher-frequency tectonic-style earthquake within 5 km of the summit. The remaining events were scattered around the cone of Rainier as seen in Fig. 4.

Mount St. Helens Area: Figure 5 shows volcano-tectonic earthquakes near Mount St. Helens. Low frequency (L) and avalanche or rockfall events (S) are not shown. This quarter 144 earthquakes were located at Mt. St. Helens in the area shown in Fig. 5. Of these 32 were magnitude 0.0 or larger and 14 were deeper than 4 km. One of these deep events was magnitude 1.3, and the others were magnitude 0.5 or smaller. The largest tectonic earthquake at Mount St. Helens this quarter was a magnitude 1.9 event near Spirit Lake.

Eight type "S" or "L" event were located at Mount St. Helens, and 363 "L" or "S" events too small to locate were recorded.

EASTERN WASHINGTON SEISMICITY

During the third quarter of 2000, 82 earthquakes were located in eastern Washington in the area described in Table 4. The largest earthquake in eastern Washington this quarter was a very shallow (location less than 1 km deep) magnitude 3.0 earthquake about 3 km west north-west of Walla Walla.

Times, locations, and depths of felt earthquakes in the PNSN region are given in Table 3. Table 4 is a summary table of various earthquake counts-per-quarter over several years.

OTHER SOURCES OF EARTHQUAKE INFORMATION

We provide automatic computer-generated alert messages about significant Washington and Oregon earthquakes by e-mail, FAX or via the pager-based RACE system to institutions needing such information, and we regularly exchange phase data via e-mail with other regional seismograph network operators. The "Outreach Activities" section describes how to access PNSN data via e-mail, Internet, and World-Wide-Web. To request additional information by e-mail, contact seis_info@geophys.washington.edu.

Earthquake information in the quarterlies is published in final form by the Washington State Department of Natural Resources as information circulars entitled "Earthquake Hypocenters in Washington and Northern Oregon" covering the period 1970-1989 (see circulars Nos. 53, 56, 64-66, 72, 79, 82-84, and 89). These circulars, plus circular No. 85, "Washington State Earthquake Hazards", are available from Washington Dept. of Natural Resources, Division of Geology and Earth Resources, Post Office Box 47007, Olympia, WA. 98504-7007, or by telephone at (360) 902-1450.

Several excellent maps of Pacific Northwest seismicity are available. A very colorful perspective-view map (18" x 27") entitled "Major Earthquakes of the Pacific Northwest" depicts selected epicenters of strong earthquakes (magnitudes > 5.1) that have occurred in the Pacific Northwest. A more detailed full-color map is called "Earthquakes in Washington and Oregon 1872-1993", by Susan Goter (USGS Open-File Report 94-226A). It is accompanied by a companion pamphlet "Washington and Oregon Earthquake History and Hazards", by Yelin, Tarr, Michael, and Weaver (USGS Open-File Report 94-226B). The pamphlet is also available separately. Maps can be ordered from: "Earthquake Maps", U.S. Geological Survey, Box 25046, Federal Center, MS 967, Denver, CO 80225, phone (303) 273-8477. The price of each map is $12. (including US shipping and handling).

USGS Cascades Volcano Observatory has a video, "Perilous Beauty: The Hidden Dangers of Mount Rainier", about the risk of lahars from Mount Rainier. Copies are available through: Northwest Interpretive Association (NWIA), 909 First Avenue Suite 630, Seattle WA 98104, Telephone: (206) 220-4141, Fax: (206) 220-4143.

Other regional agencies provide earthquake information. These include the Geological Survey of Canada (Pacific Geoscience Centre, Sidney, B.C.; (250) 363-6500, FAX (250) 363-6565), which produces monthly summaries of Canadian earthquakes; the US Geological Survey which produces weekly reports called "Seismicity Reports for Northern California" (USGS, attn: Steve Walter, 345 Middlefield Rd, MS-977, Menlo Park, CA, 94025) and "Weekly Earthquake Report for Southern California" (USGS, attn: Dr. Kate Hutton or Dr. Lucy Jones, CalTech, Pasadena, CA.).

TABLE 4 Quarterly (Q) comparison of earthquake counts over several years.

"Total" events are all events located within the PNSN network area; between 42.0-49.5 degrees north latitude and 117-125.3 degrees west longitude. The smallest detectable earthquake varies over the region. "Total" events are subdivided into "Quakes" and "Blasts". The remaining numbers are counts of earthquakes only in western and eastern Washington, and in Oregon. Western Washington earthquakes are those between 45.5 and 49.5 degrees north latitude and 121-125.3 degrees west longitude. Within western Washington, earthquakes at Mt. St. Helens (MSH) are between 46.15-46.25 degrees north latitude and 122.10-122.27 degrees west longitude, and earthquakes near Mt. Rainier are between 46.6-47.0 degrees north latitude and 121.5-122.15 degrees west longitude. "Eastern Washington" earthquake counts are for quakes between 45.5-49.5 degrees north latitude and 117-121 degrees west longitude. "Oregon" earthquakes are located between 42-45.5 degrees north latitude and 117-125 degrees west longitude.

Year	Q	Total	Quakes	Blasts	western WA	MSH	Rainier	eastern WA	OR
1993	A	**457**	380	77	**267**	34	77	**32**	**72**
	B	**450**	384	66	**284**	63	62	**57**	**33**
	C	**727**	579	148	**368**	82	75	**65**	**141**
	D	**2616**	2556	60	**355**	82	92	**39**	**2157**
1994	A	**1585**	1501	84	**232**	43	73	**44**	**1222**
	B	**873**	775	98	**350**	60	130	**56**	**364**
	C	**822**	656	166	**379**	67	81	**62**	**208**
	D	**555**	506	49	**236**	52	44	**55**	**211**
1995	A	**488**	426	62	**273**	18	38	**47**	**101**
	B	**726**	636	90	**438**	104	91	**58**	**134**
	C	**1072**	924	148	**693**	318	84	**75**	**138**
	D	**687**	610	77	**484**	264	41	**41**	**70**
1996	A	**504**	434	70	**303**	82	56	**53**	**75**
	B	**967**	864	103	**752**	68	57	**39**	**72**
	C	**696**	544	152	**426**	83	75	**45**	**67**
	D	**476**	387	89	**312**	65	59	**45**	**29**
1997	A	**417**	353	64	**270**	49	47	**45**	**34**
	B	**525**	473	52	**386**	70	31	**65**	**21**
	C	**633**	568	65	**473**	183	45	**66**	**28**
	D	**680**	614	66	**505**	292	47	**56**	**45**
1998	A	**692**	639	53	**478**	293	35	**57**	**106**
	B	**1248**	1183	65	**1048**	776	47	**74**	**58**
	C	**1727**	1635	92	**1464**	1107	76	**84**	**86**
	D	**1373**	729	43	**620**	349	69	**60**	**49**
1999	A	**474**	449	25	**248**	122	16	**49**	**148**
	B	**469**	407	62	**277**	134	31	**45**	**84**
	C	**592**	505	87	**391**	133	44	**55**	**58**
	D	**660**	610	50	**394**	148	50	**62**	**118**
2000	A	**507**	447	60	**296**	95	27	**61**	**88**
	B	**513**	447	66	**338**	67	54	**44**	**63**
	C	**939(710)***	843(614)	96	**699(472)***	144(136)*	266(52)*	**82**	**61**

* The much larger number of events for western Washington (and Mount Rainier) in 2000C is due to improved recording at Mount Rainier, where summit station RSU allowed the recording and location of many tiny events. There was no noticable increase in seismicity in 2000C, either at Rainier, or elsewhere in western Washington. Numbers given in parenthesis are the number of tectonic events.

Key to Earthquake Catalog in Table 5

TIME Origin time is calculated for each earthquake on the basis of multi-station arrival times. Time is given in **Coordinated Universal Time** (UTC), in hours:minutes:seconds. To convert to Pacific Standard Time (PST) subtract eight hours, or to Pacific Daylight Time subtract seven hours.

LAT North latitude of the epicenter, in degrees and minutes.

LONG West longitude of the epicenter, in degrees and minutes.

DEPTH The depth, given in kilometers, is usually freely calculated from the arrival-time data. In some instances, the depth must be fixed arbitrarily to obtain a convergent solution. Such depths are noted by an asterisk (*) in the column immediately following the depth. A **$** or a # following the depth mean that the maximum number of iterations has been exceeded without meeting convergence tests and both the location and depth have been fixed.

MAG Coda-length magnitude M_c, an estimate of local magnitude M_L (Richter, C.F., 1958, Elementary Seismology: W.H. Freeman and Co., 768p), calculated using the coda-length/magnitude relationship determined for Washington (Crosson, R.S., 1972, Bull. Seism. Soc. Am., v. 62, p. 1133-1171). Where blank, data were insufficient for a reliable magnitude determination. Normally, the only earthquakes with undetermined magnitudes are very small ones. Magnitudes may be revised as we improve our analysis procedure.

NS/NP **NS** is the number of station observations, and **NP** the number of P and S phases used to calculate the earthquake location. A minimum of three stations and four phases are required. Generally, more observations improve the quality of the solution.

GAP Azimuthal gap. The largest angle (relative to the epicenter) containing no stations.

RMS The root-mean-square residual (observed arrival time minus predicted arrival time) at all stations used to locate the earthquake. It is only useful as a measure of the quality of the solution when 5 or more well-distributed stations are used in the solution. Good solutions are normally characterized by **RMS** values less than about 0.3 sec.

Q Two **Quality factors** indicate the general reliability of the solution (**A** is best quality, **D** is worst). Similar quality factors are used by the USGS for events located with the computer program HYPO71. The first letter is a measure of the hypocenter quality based on travel-time residuals. For example: **A** quality requires an **RMS** less than 0.15 sec while an **RMS** of 0.5 sec or more is **D** quality (estimates of the uncertainty in hypocenter location also affect this quality parameter). The second letter of the quality code depends on the spatial distribution of stations around the epicenter, i.e. number of stations, their azimuthal distribution, and the minimum distance (**DMIN**) from the epicenter to a station. Quality **A** requires a solution with 8 or more phases, **GAP** ≤ 90° and **DMIN** ≤ (5 km or depth, whichever is greater). If the number of phases, **NP**, is 5 or fewer or **GAP** > 180° or **DMIN** > 50 km the solution is assigned quality **D**.

MOD The crustal velocity model used in location calculations.

P3 - Puget Sound model
C3 - Cascade model
S3 - Mt. St. Helens model including Elk Lake
N3 - northeastern model
E3 - southeastern model
O0 - Oregon model
K3 - Southern Oregon, Klamath Falls area model
R0 and J1 - Regional and Offshore models

TYP Events flagged in Table 5 use the following code:

F - earthquake reported to have been felt
P - probable explosion
L - low frequency earthquake (e.g. glacier movement, volcanic activity)
H - handpicked from helicorder records
S - Special event (e.g. rockslide, avalanche, volcanic steam emission, harmonic tremor, sonic boom), not a man-made explosion or tectonic earthquake
X - known explosion

TABLE 5

Earthquakes and Blasts, Magnitude 2.0 or larger, Third Quarter, 2000.

Within an area 42-49.5 degrees north latitude and 117-125.3 degrees west longitude.

July 2000

DAY	TIME	LAT	LON	DEPTH	M	NS/NP	GAP	RMS	Q	MOD	TYP
1	21:15:09.06	46 45.20	122 47.80	1.49	2.6	17/17	133	0.18	BC	P3	P
2	21:09:49.67	46 45.08	122 47.16	1.77	2.4	27/27	133	0.22	BC	P3	P
3	21:19:35.10	46 45.33	122 48.11	1.20	2.7	26/27	87	0.18	BC	P3	P
5	22:06:56.83	46 42.33	122 46.63	0.05*	2.4	11/11	177	0.18	BC	P3	P
6	22:20:35.73	46 42.77	122 45.92	0.79	2.1	10/10	175	0.11	AC	P3	P
6	23:47:02.36	42 21.48	122 41.56	34.35	2.0	6/07	133	0.35	CC	K3	
7	10:42:12.47	47 31.28	122 45.76	21.02	2.4	45/46	26	0.26	BA	P3	
7	22:09:37.95	46 42.04	122 46.57	0.90	3.2	28/28	79	0.27	BB	P3	P
8	22:05:17.86	46 42.39	122 46.79	1.10	2.4	30/30	63	0.29	BB	P3	P
10	22:06:59.13	46 45.05	122 47.22	6.65*	2.4	25/25	76	0.24	BB	P3	P
11	18:15:44.71	46 16.65	118 00.61	7.14	2.5	16/20	228	0.24	BD	E3	
11	18:53:52.87	46 45.11	122 48.84	0.10	2.7	17/17	157	0.14	AC	P3	P
11	21:29:13.89	46 45.37	122 47.99	0.71	2.4	25/25	67	0.26	BC	P3	P
13	00:12:18.70	45 29.36	122 48.01	27.01	2.2	28/38	78	0.26	BA	O0	
13	21:17:13.89	46 45.14	122 47.34	8.17	2.0	16/16	133	0.41	CB	P3	P
13	22:29:57.66	44 28.81	118 16.31	19.35$	3.1	18/20	269	0.39	CD	O0	
14	21:05:43.07	46 42.42	122 46.44	0.85	2.7	20/20	91	0.27	BB	P3	P
15	06:03:33.84	45 11.78	120 06.66	0.03*	2.3	14/14	145	0.38	CC	O0	
16	19:27:18.18	47 56.67	122 23.83	24.19	2.2	25/28	59	0.15	AA	P3	
16	21:15:37.08	46 42.37	122 46.73	1.39	2.3	15/15	123	0.13	AB	P3	P
17	21:49:45.61	46 44.88	122 47.98	4.17$	2.5	22/22	68	0.28	BC	P3	P
17	21:58:42.16	44 15.52	124 06.24	28.69	2.6	10/11	190	0.31	CD	O0	
18	15:27:28.26	43 53.25	120 59.98	21.90	2.5	4/04	131	0.00	AD	O0	P
19	21:29:13.36	46 42.48	122 45.71	1.78	2.6	16/16	117	0.24	BB	P3	P
20	21:09:22.76	48 38.78	123 00.62	18.97	2.8	25/25	180	0.33	CC	P3	
20	21:35:05.12	46 42.13	122 46.58	1.96	2.6	14/15	118	0.28	BB	P3	P
22	20:12:56.79	46 42.55	122 46.10	1.36	2.2	15/15	93	0.11	AB	P3	P
25	05:36:06.78	47 18.60	120 35.98	1.27	2.0	28/34	58	0.41	CC	C3	
25	11:22:51.37	45 20.22	121 40.55	6.06	2.6	35/37	48	0.30	CB	O0	
25	20:25:57.25	46 42.59	122 46.06	1.27	2.9	12/12	144	0.17	BC	P3	P
26	22:01:43.38	46 43.03	122 46.32	0.45	3.2	10/10	197	0.13	BD	P3	P
28	00:24:08.89	46 48.89	120 15.34	5.33	2.6	26/26	44	0.25	BC	E3	
28	07:16:31.74	45 10.20	120 08.10	4.01$	2.6	29/31	145	0.45	CC	O0	
28	21:43:42.10	46 45.95	122 48.83	4.96$	2.4	27/27	116	0.17	BC	P3	P
29	20:34:06.38	46 45.60	122 49.22	5.97	2.2	19/19	134	0.22	BC	P3	P
30	10:20:29.84	46 20.15	122 14.51	11.02	2.0	29/32	52	0.11	AA	S3	
30	14:49:56.80	45 55.78	119 13.73	0.03*	2.7	30/36	127	0.24	BC	E3	
31	03:12:50.64	47 28.10	121 44.96	17.76	2.7	47/72	58	0.22	BA	P3	
31	22:10:28.42	46 45.24	122 48.14	7.08	2.3	11/11	143	0.11	AC	P3	P

Aug 2000

DAY	TIME	LAT	LON	DEPTH	M	NS/NP	GAP	RMS	Q	MOD	TYP
2	00:00:50.74	47 43.94	120 03.00	0.97$	2.8	22/26	47	0.35	CB	N3	
2	12:13:26.75	47 35.54	121 49.42	16.61	2.2	39/51	57	0.30	BA	P3	
2	21:26:29.12	46 42.71	122 45.80	1.36	2.0	11/11	137	0.10	AC	P3	P
3	18:05:59.91	46 55.74	121 59.38	0.03*	2.1	14/14	187	0.16	BD	C3	P
3	21:15:12.80	45 12.52	120 04.40	3.71$	2.8	25/30	140	0.45	DC	O0	
4	22:17:06.58	46 51.70	121 47.81	0.02#	2.0	4/04	287	0.32	CD	C3	S
5	18:46:30.58	47 35.35	122 49.68	19.85	2.0	18/27	55	0.13	AA	P3	
5	20:10:00.16	46 45.50	122 49.36	6.20$	2.5	18/18	158	0.25	BC	P3	P
7	22:04:07.14	46 46.12	122 47.95	4.20$	2.4	23/23	114	0.22	BC	P3	P
8	21:43:01.84	46 44.85	122 47.68	0.04*	2.3	22/22	80	0.18	BC	P3	P
9	01:12:26.95	46 14.27	122 34.70	17.71	2.2	40/49	102	0.19	BB	C3	
9	23:28:06.88	46 51.08	121 45.49	0.03*	2.0	5/05	109	0.23	BD	C3	S
11	21:38:45.68	46 42.26	122 46.72	0.04*	3.1	28/28	91	0.22	BB	P3	P
12	20:11:26.86	46 42.36	122 46.71	0.56	2.6	23/23	84	0.21	BB	P3	P
15	12:05:40.03	47 52.47	122 07.37	27.97	2.2	28/40	58	0.19	BA	P3	
15	21:44:33.10	46 42.33	122 46.60	0.22	2.7	9/09	177	0.13	BC	P3	P
16	12:30:06.90	46 51.08	121 45.11	0.44	2.0	5/05	107	0.03	AD	C3	S
16	21:25:19.56	45 34.73	121 35.34	5.46	2.3	11/13	106	0.21	BC	O0	
17	01:58:23.98	45 18.72	120 02.48	15.07	3.2	30/39	141	0.34	CC	O0	
17	13:21:22.07	47 46.21	119 25.55	0.03*	2.3	15/16	175	0.24	BC	N3	

Aug 2000 cont'd

DAY	TIME	LAT	LON	DEPTH	M	NS/NP	GAP	RMS	Q	MOD	TYP
20	03:28:32.56	47 57.46	124 44.89	14.04$	2.0	13/13	236	0.53	DD	P3	
21	11:00:38.60	47 50.63	123 02.23	44.86	2.6	48/55	52	0.23	BA	P3	
24	21:38:46.55	46 45.24	122 47.79	0.02*	2.0	21/21	68	0.27	BC	P3	P
27	21:20:22.23	44 44.69	117 22.22	0.03*	3.3	12/14	150	0.24	BD	O0	
28	21:31:56.75	46 45.01	122 48.30	1.45	2.6	26/26	81	0.23	BC	P3	P
29	17:27:16.80	46 12.30	121 05.34	0.02*	2.4	17/21	65	0.36	CC	C3	
31	19:19:23.28	45 25.90	118 48.79	27.12	2.1	26/30	194	0.45	CD	O0	
31	20:13:32.45	48 09.41	117 50.83	0.05*	2.1	7/07	170	0.20	BC	N3	
31	21:32:08.14	46 44.88	122 47.87	0.03*	2.0	17/19	77	0.20	BC	P3	P

Sept 2000

DAY	TIME	LAT	LON	DEPTH	M	NS/NP	GAP	RMS	Q	MOD	TYP
1	21:52:26.41	46 44.94	122 48.62	0.02*	2.0	15/15	82	0.23	BC	P3	P
1	23:10:24.07	46 52.52	117 23.25	0.04*	2.2	13/17	204	0.49	CD	E3	
4	22:16:31.00	46 49.70	117 13.73	0.02*	2.6	12/14	249	0.35	CD	E3	
5	21:46:23.02	46 42.49	122 46.75	0.78	3.0	24/25	76	0.22	BB	P3	P
6	06:54:16.69	46 04.53	118 21.87	0.05*	3.0	24/25	175	0.18	BC	E3	
6	22:03:38.82	47 19.73	120 48.52	0.60	2.0	5/05	124	0.38	CD	C3	
7	21:49:01.15	46 42.68	122 46.58	1.07	2.4	13/13	84	0.15	BB	P3	P
8	21:56:52.67	46 42.40	122 46.72	1.52	2.2	14/14	84	0.12	AB	P3	P
10	14:53:38.16	48 25.43	123 11.41	49.35	3.2	35/36	140	0.23	BC	P3	F
11	22:04:04.19	46 42.30	122 46.98	1.32	2.3	15/15	84	0.23	BB	P3	P
12	01:53:38.72	45 49.70	120 10.77	13.17	2.2	25/29	99	0.17	BC	E3	
12	18:02:15.07	46 42.07	122 46.64	1.41	2.0	9/09	140	0.09	AC	P3	P
14	21:41:29.01	46 46.08	122 48.67	5.35	2.4	9/09	105	0.11	AC	P3	P
15	02:30:44.39	46 10.16	118 48.63	2.04*	2.1	15/15	125	0.22	BC	E3	P
15	18:57:34.55	46 42.42	122 46.47	1.44	2.3	10/10	84	0.12	AB	P3	P
16	20:06:17.96	48 39.71	120 04.29	0.02*	2.5	10/12	290	0.12	AD	N3	
18	21:59:01.15	46 42.68	122 46.32	0.04*	2.9	12/12	158	0.35	CC	P3	P
19	07:36:20.27	47 24.38	122 21.00	17.50	2.0	32/42	53	0.13	AB	P3	
19	18:11:22.40	47 24.22	122 21.23	17.50	2.0	27/36	54	0.14	AB	P3	
19	22:02:56.44	46 42.26	122 46.05	0.43	2.7	18/18	61	0.23	BB	P3	P
20	20:54:02.41	46 44.40	120 21.43	0.28*	2.5	13/14	101	0.38	CC	E3	
20	21:24:14.76	46 42.40	122 47.11	0.03*	2.9	15/15	141	0.19	BC	P3	P
21	21:06:08.21	45 55.35	120 22.35	27.95$	2.3	10/10	135	0.39	CB	E3	
21	22:05:14.25	46 42.61	122 46.58	1.03	2.6	12/12	166	0.14	AC	P3	P
21	22:29:53.63	47 43.74	120 11.59	0.53	2.2	21/23	64	0.33	CC	N3	
21	23:48:26.42	45 13.59	120 07.85	0.22*	2.4	10/13	142	0.20	BC	O0	
22	20:56:45.68	46 42.69	122 46.05	1.07	2.4	17/17	117	0.17	BB	P3	P
23	04:57:54.64	48 03.92	123 04.79	47.24	2.2	22/24	92	0.13	AB	P3	
24	07:07:50.46	46 20.83	122 20.98	18.04	2.0	27/34	75	0.12	AA	S3	
24	12:04:35.95	47 45.85	122 49.68	26.49	2.4	30/33	102	0.25	BB	P3	
25	08:52:22.09	47 25.03	123 07.22	0.04*	2.1	13/17	132	0.18	BC	P3	
25	21:58:45.25	46 42.55	122 46.26	1.68	2.5	12/12	166	0.10	AC	P3	P
27	04:46:53.16	46 59.95	121 13.41	3.91	2.1	32/38	76	0.39	CB	C3	
27	19:15:18.12	45 13.30	120 46.32	86.70	2.3	5/05	283	0.80	DD	O0	
27	19:27:25.12	48 12.91	117 49.99	1.97	2.2	7/10	179	0.37	CD	N3	
27	21:30:54.12	46 42.23	122 46.17	1.68	2.9	21/21	145	0.22	BC	P3	P
28	06:58:23.42	47 53.68	122 35.91	16.58	2.0	22/30	62	0.11	AA	P3	
28	21:28:57.51	46 42.40	122 46.64	1.20	3.0	25/25	62	0.17	BB	P3	P
29	20:04:35.98	46 42.52	122 45.56	1.20	3.2	25/25	61	0.17	BB	P3	P

QUARTERLY NETWORK REPORT 2000-D
on
Seismicity of Washington and Oregon

October 1 through December 31, 2000

Pacific Northwest Seismograph Network
Geophysics Program
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INTRODUCTION

This is the fourth quarterly report of 2000 from the University of Washington Geophysics Program *Pacific Northwest Seismograph Network* (PNSN), covering seismicity of Washington and western Oregon.

Comprehensive quarterlies have been produced by the PNSN since the beginning of 1984. Prior to that we published quarterly reports for western Washington in 1983 and for eastern Washington from 1975 to 1983. Annual technical reports covering seismicity in Washington since 1969 are available from the U.W. Geophysics Program. Beginning in 1999, the quarterly PNSN catalog listing changed; earthquakes smaller than magnitude 2.0 are no longer listed in the quarterly reports. The complete PNSN catalog is available on-line, both through our web-site and through the CNSS catalog. We will continue to provide special coverage (figures, counts, listings, etc.) of earthquake swarms, aftershock sequences, etc.

This quarterly report discusses network operations, seismicity of the region, unusual events or findings, and our educational and outreach activities. This report is preliminary, and subject to revision. The PNSN routinely records signals from selected stations in adjoining networks. This improves our ability to locate earthquakes at the edges of our network. However, our earthquake locations may be revised if new data become available, such as P and S readings from Canadian seismograph stations. Findings mentioned in these quarterly reports should not be cited for publication.

NETWORK OPERATIONS

Figure 1 shows a map view of broad-band and short-period stations operating during the quarter. Table 1 gives approximate periods of time when individual stations were inoperable. Data for Table 1 are compiled from weekly plots of network-wide teleseismic arrivals and automated digital signal checks, plus records of maintenance and repair visits.

As is typical, we began to lose a few stations during the winter. Station VRC was vandalized by gunfire in early October. The station was pulled out on 11/2/00.

Station RSU, at the summit of Mount Rainier, was installed in 1999, but functioned only briefly. It was repaired this year and produced data from July 23 until the end of September, when it stopped working due to weather conditions at the summit.

Communications hardware at our new Olympic Peninsula station (SQM), was upgraded to improve performance.

Data Recording and EARTHWORM Update

A new EARTHWORM computer, scossa, was acquired and installed last quarter. This quarter we implemented a full EARTHWORM configuration on scossa, which now serves as our primary backup computer. Milli continues to be our main EARTHWORM, and verme has now become the secondary backup, and is also primary computer for data acquisition from many of the digital stations.

This quarter, we began receiving real-time data from the Canadian Pacific Geoscience Center (PGC) in Sidney, B.C. In addition to data from the PGC, we receive real-time data from the University of Oregon, Pacific Northwest Regional Labs (Hanford, WA area), the Montana Bureau of Mines and Geology, the USGS northern California network, and the US National Seismic Network. Table 2D lists stations that are received from outside the PNSN network.

Strong-motion Instrumentation and Recording Update

After the intense installation effort of last quarter, this quarter's activities were much more routine. Communication links for a few stations were finalized and changes were made to many on-line web pages, including the establishment of a special page of webicorders showing strong-motion components operating at Puget Sound schools. We also modified and improved some of the strong-motion data processing procedures.

During the quarter, two felt earthquakes larger than magnitude 3.0 occurred in the Puget Sound (on October 15 and Nov. 1) both were well recorded on the strong-motion network. One of these events was used to compute station timing adjustments for the strong motion instruments. These timing adjustments generally reflect the local geology at the site that slow down or speed up the earthquake waves. These adjustments are applied to arrival times at the stations by our earthquake location program.

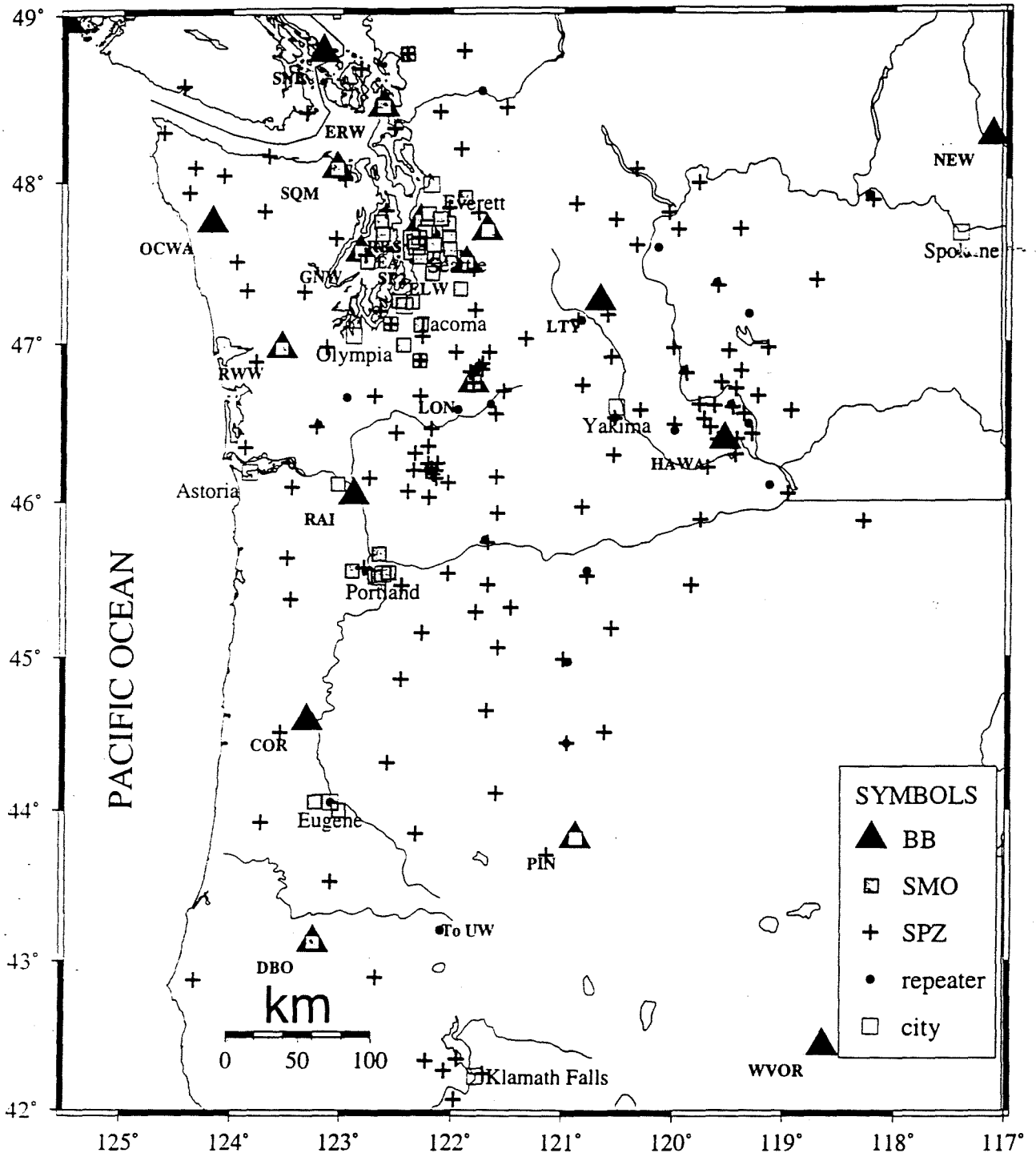

Figure 1. Stations operating at the end of 4th quarter, 2000. Stations shown are short period vertical (SP) or 3-component broadband (BB) or strong motion (SMO).

The USGS has authorized funding for the installation of 20 additional ANSS (Advanced National Seismic System) strong motion instruments in the greater Puget Sound Region in calendar year 2001. Site evaluations were conducted for numerous locations last year, and this winter and spring we will be reviewing those notes, and beginning the next round of siting.

CREST Instrument Update

CREST (Consolidated Reporting of EarthquakeS and Tsunamis) stations are planned for Eugene Oregon (through UO), and for Longview, Boistfort Peak, Forks, and Tolt Reservoir in Washington. Four additional sites, directly on the coast, with BPA telemetry have been identified, and permitting discussions are underway.

TABLE 1
Station Outages, Repairs, and Installations 4th quarter 2000

Station	Outage Dates	Comments
BRKS	10/17	Started telemetry of Broad-band vertical component (has SMOs too)
ETW	12/1-End	Crosstalk onto WAT
HBO	12/1-End	Dead
RSU	9/30-End	Dead
RVN	11/1-End	Possible intermittent crosstalk on FMW
SLF	12/1-End	Dead - winter damage
TKO	1/4/99-End	REMOVED
TTW	1/1-End	Bad time - GPS clock drifting
TWW	12/1-End	Bad time
VGB	10/5	Changed seismometer
VRC	10/1-End	Dead/VCO was shot with a gun, pulled out 11/2

STATIONS USED FOR LOCATION OF EVENTS

Table 2A lists short-period, mostly vertical-component stations used in locating seismic events in Washington and Oregon. The first column in the table gives the 3-letter station designator, followed by a symbol designating the funding agency; stations marked by a percent sign (%) were supported by USGS joint operating agreement 1434-HQ-98-AG-01937. A plus (+) indicates support under Pacific Northwest National Laboratory, Battelle contract 259116-A-B3. Stations designated "#" are USGS-maintained stations recorded at the PNSN. Other stations were supported from other sources. Additional columns give station north latitude and west longitude (in degrees, minutes and seconds), station elevation in km, and comments indicating landmarks for which stations were named.

TABLE 2A - Short-period Stations operated by the PNSN during the fourth quarter 2000

STA	F	LAT	LONG	EL	NAME
ASR	%	46 09 09.9	121 36 01.6	1.357	Mt. Adams - Stagman Ridge
AUG	%	45 44 10.0	121 40 50.0	0.865	Augspurger Mtn
BBO	%	42 53 12.6	122 40 46.6	1.671	Butler Butte, Oregon
BHW	%	47 50 12.6	122 01 55.8	0.198	Bald Hill
BLN	%	48 00 26.5	122 58 18.6	0.585	Blyn Mt.
BOW	%	46 28 30.0	123 13 41.0	0.870	Boistfort Mt.
BPO	%	44 39 06.9	121 41 19.2	1.957	Bald Peter, Oregon
BRV	+	46 29 07.2	119 59 28.2	0.920	Black Rock Valley
BVW	+	46 48 39.5	119 52 56.4	0.670	Beverly
CBS	+	47 48 17.4	120 02 30.0	1.067	Chelan Butte, South
CDF	%	46 07 01.4	122 02 42.1	0.756	Cedar Flats
CMM	%	46 26 07.0	122 30 21.0	0.620	Crazy Man Mt.
CMW	%	48 25 25.3	122 07 08.4	1.190	Cultus Mtns.
CPW	%	46 58 25.8	123 08 10.8	0.792	Capitol Peak
CRF	+	46 49 30.0	119 23 13.2	0.189	Corfu
DPW	+	47 52 14.3	118 12 10.2	0.892	Davenport
DY2	+	47 59 06.6	119 46 16.8	0.890	Dyer Hill 2
EDM	%	46 11 50.4	122 09 00.0	1.609	East Dome, Mt. St. Helens
ELK	%	46 18 20.0	122 20 27.0	1.270	Elk Rock
ELL	+	46 54 34.8	120 33 58.8	0.789	Ellensburg
EPH	+	47 21 22.8	119 35 45.6	0.661	Ephrata
ET3	+	46 34 38.4	118 56 15.0	0.286	Eltopia (replaces ET2)
ETW	+	47 36 15.6	120 19 56.4	1.477	Entiat

TABLE 2A continued

STA	F	LAT	LONG	EL	NAME
FBO	%	44 18 35.6	122 34 40.2	1.080	Farmers Butte, Oregon
FHE		46 57 06.9	119 29 49.0	0.455	Frenchman Hills East
FL2	%	46 11 47.0	122 21 01.0	1.378	Flat Top 2
FMW	%	46 56 29.6	121 40 11.3	1.859	Mt. Fremont
GBL	+	46 35 54.0	119 27 35.4	0.330	Gable Mountain
GHW	%	47 02 30.0	122 16 21.0	0.268	Garrison Hill
GL2	+	45 57 35.0	120 49 22.5	1.000	New Goldendale
GLK	%	46 33 27.6	121 36 34.3	1.305	Glacier Lake
GMO	%	44 26 20.8	120 57 22.3	1.689	Grizzly Mountain, Oregon
GMW	%	47 32 52.5	122 47 10.8	0.506	Gold Mt.
GSM	%	47 12 11.4	121 47 40.2	1.305	Grass Mt.
GUL	%	45 55 27.0	121 35 44.0	1.189	Guler Mt.
HAM	%	42 04 08.3	121 58 16.0	1.999	Hamaker Mt., Oregon
HBO	%	43 50 39.5	122 19 11.9	1.615	Huckleberry Mt., Oregon
HDW	%	47 38 54.6	123 03 15.2	1.006	Hoodsport
HOG	%	42 14 32.7	121 42 20.5	1.887	Hogback Mtn., Oregon
HSO	%	43 31 33.0	123 05 24.0	1.020	Harness Mountain, Oregon
HSR	%	46 10 28.0	122 10 46.0	1.720	South Ridge, Mt. St. Helens
HTW	%	47 48 14.2	121 46 03.5	0.833	Haystack Lookout
JBO	+	45 27 41.7	119 50 13.3	0.645	Jordan Butte, Oregon
JCW	%	48 11 42.7	121 55 31.1	0.792	Jim Creek
JUN	%	46 08 50.0	122 09 04.4	1.049	June Lake
KMO	%	45 38 07.8	123 29 22.2	0.975	Kings Mt., Oregon
KOS	%	46 27 46.7	122 11 41.3	0.610	Kosmos
LAB	%	42 16 03.3	122 03 48.7	1.774	Little Aspen Butte, Oregon
LCW	%	46 40 14.4	122 42 02.8	0.396	Lucas Creek
LMW	%	46 40 04.8	122 17 28.8	1.195	Ladd Mt.
LNO	+	45 52 18.6	118 17 06.6	0.771	Lincton Mt., Oregon
LO2	%	46 45 00.0	121 48 36.0	0.853	Longmire
LOC	+	46 43 01.2	119 25 51.0	0.210	Locke Island
LVP	%	46 04 06.0	122 24 30.0	1.170	Lakeview Peak
MBW	%	48 47 02.4	121 53 58.8	1.676	Mt. Baker
MCW	%	48 40 46.8	122 49 56.4	0.693	Mt. Constitution
MDW	+	46 36 47.4	119 45 39.6	0.330	Midway
MEW	%	47 12 07.0	122 38 45.0	0.097	McNeil Island
MJ2	+	46 33 27.0	119 21 32.4	0.146	May Junction 2
MOX	+	46 34 38.4	120 17 53.4	0.501	Moxie City
MPO	%	44 30 17.4	123 33 00.6	1.249	Mary's Peak, Oregon
MTM	%	46 01 31.8	122 12 42.0	1.121	Mt. Mitchell
NAC	+	46 43 59.4	120 49 25.2	0.728	Naches
NCO	%	43 42 14.4	121 08 18.0	1.908	Newberry Crater, Oregon
NEL	+	48 04 12.6	120 20 24.6	1.500	Nelson Butte
NLO	%	46 05 21.9	123 27 01.8	0.826	Nicolai Mt., Oregon
OBC	%	48 02 07.1	124 04 39.0	0.938	Olympics - Bonidu Creek
OBH	%	47 19 34.5	123 51 57.0	0.383	Olympics - Burnt Hill
OCP	%	48 17 53.5	124 37 30.0	0.487	Olympics - Cheeka Peak
OD2	+	47 23 15.6	118 42 34.8	0.553	Odessa site 2
OFR	%	47 56 00.0	124 23 41.0	0.152	Olympics - Forest Resource Cen
OHW	%	48 19 24.0	122 31 54.6	0.054	Oak Harbor
ON2	%	46 52 50.8	123 46 51.8	0.257	Olympics - North River
OOW	%	47 44 03.6	124 11 10.2	0.561	Octopus West
OSD	%	47 48 59.2	123 42 13.7	2.008	Olympics - Snow Dome
OSR	%	47 30 20.3	123 57 42.0	0.815	Olympics Salmon Ridge
OT3	+	46 40 08.4	119 13 58.8	0.322	New Othello (replaces OT2 8/26
OTR	%	48 05 00.0	124 20 39.0	0.712	Olympics - Tyee Ridge
PAT	+	45 52 55.2	119 45 08.4	0.262	Paterson
PCMD	%	46 53 20.9	122 18 00.9	0.239	PC Mountain Detachment
PGO	%	45 27 42.6	122 27 11.5	0.253	Gresham, Oregon
PGW	%	47 49 18.8	122 35 57.7	0.122	Port Gamble
PRO	+	46 12 45.6	119 41 08.4	0.553	Prosser
RCM	%	46 50 08.9	121 43 54.4	3.085	Mt. Rainier, Camp Muir
RCS	%	46 52 15.6	121 43 52.0	2.877	Mt. Rainier, Camp Schurman
RER	%	46 49 09.2	121 50 27.3	1.756	Mt. Rainier, Emerald Ridge
RMW	%	47 27 35.0	121 48 19.2	1.024	Rattlesnake Mt. (West)
RNO	%	43 54 58.9	123 43 25.5	0.850	Roman Nose, Oregon
RPW	%	48 26 54.0	121 30 49.0	0.850	Rockport
RSU	%	46 51 12.0	121 45 47.0	4.440	Rainier summit
RSW	+	46 23 40.2	119 35 28.8	1.045	Rattlesnake Mt. (East)
RVC	%	46 56 34.5	121 58 17.3	1.000	Mt. Rainier - Voight Creek
RVN	%	47 01 38.6	121 20 11.9	1.885	Raven Roost (former NEHRP temp
RVW	%	46 08 53.2	122 44 32.1	0.460	Rose Valley
SAW	+	47 42 06.0	119 24 01.8	0.701	St. Andrews
SBES	%	48 46 05.9	122 24 54.2	0.000	Silver Beach ES
SEA	%	47 39 15.8	122 18 29.3	0.030	UW, Seattle (Wood Anderson.BB,
SEP	#	46 12 00.7	122 11 28.1	2.116	September lobe, Mt. St. Helens
SHW	%	46 11 37.1	122 14 06.5	1.425	Mt. St. Helens

TABLE 2A continued

STA	F	LAT	LONG	EL	NAME
SLF	%	47 45 32.0	120 31 40.0	1.750	Sugar Loaf
SMW	%	47 19 10.7	123 20 35.4	0.877	South Mtn.
SOS	%	46 14 38.5	122 08 12.0	1.270	Source of Smith Creek
SSO	%	44 51 21.6	122 27 37.8	1.242	Sweet Springs, Oregon
STD	%	46 14 16.0	122 13 21.9	1.268	Studebaker Ridge
STW	%	48 09 03.1	123 40 11.1	0.308	Striped Peak
TBM	+	47 10 12.0	120 35 52.8	1.006	Table Mt.
TCO	%	44 06 27.6	121 36 02.1	1.975	Three Creek Meadows, Oregon.
TDH	%	45 17 23.4	121 47 25.2	1.541	Tom,Dick,Harry Mt., Oregon
TDL	%	46 21 03.0	122 12 57.0	1.400	Tradedollar Lake
TKO	%	45 22 16.7	123 27 14.0	1.024	Trask Mtn, Oregon
TRW	+	46 17 32.0	120 32 31.0	0.723	Toppenish Ridge
TWW	+	47 08 17.4	120 52 06.0	1.027	Teanaway
VBE	%	45 03 37.2	121 35 12.6	1.544	Beaver Butte, Oregon
VCR	%	44 58 58.2	120 59 17.4	1.015	Criterion Ridge, Oregon
VFP	%	45 19 05.0	121 27 54.3	1.716	Flag Point, Oregon
VG2	%	45 09 20.0	122 16 15.0	0.823	Goat Mt., Oregon
VGB	+	45 30 56.4	120 46 39.0	0.729	Gordon Butte, Oregon
VIP	%	44 30 29.4	120 37 07.8	1.731	Ingram Pt., Oregon
VLL	%	45 27 48.0	121 40 45.0	1.195	Laurance Lk., Oregon
VLM	%	45 32 18.6	122 02 21.0	1.150	Little Larch, Oregon
VRC	%	42 19 47.2	122 13 34.9	1.682	Rainbow Creek, Oregon
VSP	%	42 20 30.0	121 57 00.0	1.539	Spence Mtn, Oregon
VT2	+	46 58 02.4	119 59 57.0	1.270	Vantage2
VTH	%	45 10 52.2	120 33 40.8	0.773	The Trough, Oregon
WA2	+	46 45 19.2	119 33 56.4	0.244	Wahluke Slope
WAT	+	47 41 55.2	119 57 14.4	0.821	Waterville
WG4	+	46 01 49.2	118 51 21.0	0.511	Wallula Gap
WIB	%	46 20 34.8	123 52 30.6	0.503	Willapa Bay
WIW	+	46 25 45.6	119 17 15.6	0.128	Wooded Island
WPO	%	45 34 24.0	122 47 22.4	0.334	West Portland, Oregon
WPW	%	46 41 55.7	121 32 10.1	1.280	White Pass
WRD	+	46 58 12.0	119 08 41.4	0.375	Warden
WRW	%	47 51 26.0	120 52 52.0	1.189	Wenatchee Ridge
YA2	+	46 31 36.0	120 31 48.0	0.652	Yakima
YEL	#	46 12 35.0	122 11 16.0	1.750	Yellow Rock, Mt. St. Helens

Table 2B lists broad-band, three-component stations operating in Washington and Oregon that provide data to the PNSN.

TABLE 2B

Broad-band three-component stations operating at the end of the fourth quarter 2000. Symbols are as in Table 2A.

STA	F	LAT	LONG	EL	NAME
COR		44 35 08.5	123 18 11.5	0.121	Corvallis, Oregon (IRIS station, Operated by OSU)
DBO	%	43 07 09.0	123 14 34.0	0.984	Dodson Butte, Oregon (CREST - operated by UO)
ELW	%	47 29 38.8	121 52 21.6	0.267	Echo Lake, WA (operated by UW)
ERW	%	48 27 14.4	122 37 30.2	0.389	Mt. Erie, WA (operated by UW)
GNW	%	47 33 51.8	122 49 31.0	0.165	Green Mountain, WA (CREST - operated by UW)
HAWA		46 23 32.3	119 31 57.2	0.367	Hanford Nike (USGS-USNSN)
HLID		43 33 45.0	114 24 49.3	1.772	Hailey, ID (USGS-USNSN)
LON	%	46 45 00.0	121 48 36.0	0.853	Longmire (CREST - operated by UW)
LTY	%	47 15 21.2	120 39 53.3	0.970	Liberty, WA (operated by UW)
NEW		48 15 50.0	117 07 13.0	0.760	Newport Observatory (USGS-USNSN)
OCWA		47 44 56.0	124 10 41.2	0.671	Octopus Mtn. (USGS-USNSN)
PIN		43 48 40.0	120 52 19.0	1.865	Pine Mt. Oregon (CREST - operated by UO)
RAI		46 02 25.1	122 53 06.4	1.520	Trojan Plant, Oregon (OSU)
RWW	%	46 57 50.1	123 32 35.9	0.015	Ranney Well (CREST - operated by UW)
SP2	%	47 33 23.3	122 14 52.8	0.030	Seward Park, Seattle (operated by UW)
SQM	%	48 04 39.0	123 02 44.0	0.030	Sequim (operated by UW, telemetered by Battelle)
TTW	%	47 41 40.7	121 41 20.0	0.542	Tolt Reservoir, WA (operated by UW)
WVOR		42 26 02.0	118 38 13.0	1.344	Wildhorse Valley, Oregon (USGS-USNSN)

Table 2C lists strong-motion, three-component stations operating in Washington and Oregon that provide data in real or near-real time to the PNSN. Several of these stations also have broad-band instruments, as noted. The "SENSOR" field designates what type of seismic sensor is used;

- A = Terra-Tech SSA-320 SLN triaxial accelerometer/Terra-Tech IDS24 recording system,
- A20 = Terra-Tech SSA-320 triaxial accelerometer/Terra-Tech IDS20 recording system,
- FBA23 = Kinemetrics FBA23 accelerometers and Reftek recording system,
- EPI = Kinemetrics Episensor accelerometers and Reftek recording system.
- BB = Guralp CMG-40T 3-D broadband velocity sensor.
- BB3 = Guralp CMG3T 3-D broadband velocity sensor.
- BBZ = Broad Band sensor, PMD 2024, vertical component only.
- K2 = Kinemetrics Episensor accelerometers and K2 Recording System

The "TELEMETRY" field indicates the type of telemetry used to recover the data.

- D = dial-up,
- L = continuously telemetered via dedicated lease-line telephone lines,
- L-PPP = continuously telemetered via dedicated lease-line telephone lines using PPP protocol
- I = continuously telemetered via Internet,
- E = continuously telemetered via Internet from a remote EARTHWORM system

TABLE 2C

Strong-motion three-component stations operating at the end of the fourth quarter 2000. Symbols are as in Table 2A.

STA	F	LAT	LONG	EL	NAME	SENSORS	TELEMETRY
ALCT	%	47 38 51.0	122 02 13.2	0.055	Alcott Elementary, Redmond	K2	I
ALST	%	46 6 31.2	123 01 47.4	0.000	Alston, Oregon BPA	A20	L.E.D
BRKS	%	47 45 19.7	122 17 18.4	0.100	Brookside Elementary, Lake Forest Park	K2.BBZ	I
CSEN	%	47 48 04.5	122 13 06.5	0.055	Crystal Springs Elementary, Bothell	K2	I
CSO	#	45 31 01.0	122 41 22.5	0.036	Canyon Substation, Oregon	FBA23	D
DBO	%	43 07 09.0	123 14 34.0	0.984	Dodson Butte, OR (UO CREST)	EPI.BB3	E.L-PPP
EARN	%	47 44 24.0	122 02 24.0	0.010	East Ridge Elementary, Woodinville	K2	I
ELW	%	47 29 38.8	121 52 21.6	0.267	Echo Lake, WA	A.BB	L.D
ERW	%	48 27 14.4	122 37 30.2	0.389	Mt. Erie, WA	A.BB	L.D
FINN	%	47 43 08.9	122 13 55.0	0.010	Finn Hill Jr High, Juanita	K2	I
GNW	%	47 33 51.8	122 49 31.0	0.165	Green Mountain, WA (CREST)	EPI.BB3	L-PPP
HAO	#	45 30 33.1	122 39 24.0	0.018	Harrison Substation, Oregon	FBA23	D
HOLY	%	47 33 55.3	122 23 02.1	0.106	Holy Rosary	K2	I
KEEL	%	45 33 0.0	122 53 44.4	0.000	Keeler, Oregon BPA	A20	L.E.D
KIMB	%	47 34 30.9	122 18 05.9	0.100	Kimball Elementary, Seattle	K2	I
KIMR	%	47 30 11.7	122 46 01.9	0.123	Kitsap Moderate Risk Waste	K2	I
KINR	%	47 45 06.0	122 38 35.0	0.010	Kitsap North Road Shed	K2	I
KITP	%	47 40 30.0	122 37 47.0	0.100	Kitsap Treatment Plant	K2	I
LAWT	%	47 39 23.4	122 23 21.9	0.111	Lawton Elementary, Seattle	K2	I
LEOT	%	47 46 04.4	122 06 54.3	0.155	Leota Jr High, Woodinville	A	I
LON	%	46 45 00.0	121 48 36.0	0.853	Longmire (CREST)	EPI.BB3	L-PPP.D
MBPA	%	47 53 56.6	121 53 20.2	0.186	Monroe BPA	A20	L.D
MPL	%	47 28 08.2	122 11 06.2	0.122	Maple Valley	A	L.D
NOWS	%	47 41 12.0	122 15 21.2	0.000	NOAA, Bldg 3	A20	I
PCEP	%	47 06 43.0	122 17 24.2	0.160	PC East Precinct	K2	I
PCFR	%	46 59 23.3	122 26 27.4	0.137	PC Training Center	K2	I
PCMD	%	46 53 20.9	122 18 00.9	0.239	PC Mountain Detachment	K2	I
PIN	%	43 48 40.0	120 52 19.0	1.865	Pine Mt., OR (U0 CREST)	EPI.BB3	E.L-PPP
PNLK	%	47 34 50.0	122 01 42.4	0.128	Pine Lake Middle School, Issaquah	K2	I
QAW	%	47 37 53.2	122 21 15.0	0.140	Queen Anne	A	L
RAW	%	47 20 14.0	121 55 57.6	0.208	Raver BPA	A	L.D
RBEN	%	47 26 05.4	122 11 10.2	0.000	Benson Elementary, Renton	K2	I
RBO	#	45 32 27.0	122 33 51.5	0.158	Rocky Butte, Oregon	FBA23	D
RHAZ	%	47 32 25.8	122 11 08.4	0.108	Hazelwood Elementary, Newcastle	A	I
ROSS	%	45 39 46.2	122 39 37.0	0.100	Ross BPA	A20	L.E.D
RWW	%	46 57 50.1	123 32 35.9	0.015	Ranney Well (CREST)	EPI.BB3	L-PPP
SBES	%	48 46 05.9	122 24 54.2	0.000	Silver Beach Elementary, Bellingham	K2	I
SEA	%	47 39 18.0	122 18 30.0	0.030	Seattle	A.BB	L.D
SP2	%	47 33 23.3	122 14 52.8	0.030	Seward Park, Seattle	A.BB	L
SQM	%	48 04 39.0	123 02 44.0	0.030	Sequim, WA (CREST)	EPI.BB	L-PPP
TBPA	%	47 15 28.1	122 22 05.9	0.002	Tacoma WA BPA	A	L.D
TKCO	%	47 32 12.7	122 18 01.5	0.005	King Co EOC	A20	I
UPS	%	47 15 51.4	122 28 56.3	0.113	University of Puget Sound	K2	I
WISC	%	47 36 32.0	122 10 27.8	0.056	Wilburton Instructional Services Center, Bellevue	K2	I

Table 2D shows stations recorded by the PNSN but not initiated in PNSN EARTHWORM nodes during the fourth quarter 2000. Columns as in Table 2A. "Canada" are stations received from the Pacific Geoscience Centre in British Columbia, Canada; PNNL is the Battelle Pacific Northwest National Labs; MT is Montana Bureau of Mines; OSU is Oregon State University; USNSN is the US National Seismic Network; CAL-NET is the USGS Northern California Network.

TABLE 2D

STA	F	LAT	LONG	EL	NAME
BEN		46 31 12.0	119 43 18.0	0.335	PNNL station
CHMT		46 54 51.0	113 15 07.0	-	Chamberlain Mtn, MT
COR		44 35 08.5	123 18 11.5	0.121	Corvallis, Oregon (IRIS-OSU)
DBO	%	43 07 09.0	123 14 34.0	0.984	Dodson Butte, Oregon (UO CREST)
GBB		46 36 31.8	119 37 40.2	0.185	PNNL Station
H2O		46 23 45.0	119 25 22.0	-	Water PNNL Station
HAWA		46 23 32.3	119 31 57.2	0.367	Hanford Nike USGS-USNSN
HLID		43 33 45.0	114 24 49.3	1.772	Hailey, ID USGS-USNSN
KEB		42 52 20.0	124 20 03.0	0.818	CAL-NET
KSX		41 49 51.0	123 52 33.0	-	CAL-NET
KTR		41 54 31.2	123 22 35.4	1.378	CAL-NET
LAM		41 36 35.2	122 37 32.1	1.769	CAL-NET
LCCM		45 50 16.8	111 52 40.8	1.669	Lewis and Clark Caverns, MT
MCMT		44 49 39.6	112 50 55.8	2.323	McKenzie Canyon, MT
NEW		48 15 50.0	117 07 13.0	0.760	Newport Observatory USNSN BB
OCWA		47 44 56.0	124 10 41.2	0.671	Octopus Mtn. (USGS-USNSN)
OZB		48 57 37.1	125 29 34.1	0.671	Canada
PFB		48 34 30.0	124 26 39.8	0.465	P.Renfrew, Canada
PIN	%	43 48 40.0	120 52 19.0	1.865	Pine Mt., Oregon (U0 CREST)
PNT		49 18 57.6	119 36 57.6	0.550	Canada, BB
RED		46 17 51.0	119 26 15.6	0.330	Red Mountain PNNL Station
SNB		48 46 33.6	123 10 16.3	0.408	Canada
SNI		46 27 80.0	119 39 50.0	-	PNNL station
VDB		49 01 34.0	122 06 10.1	0.404	Canada
VGZ		48 24 50.0	123 19 27.8	0.067	Canada
WVOR		42 26 02.0	118 38 13.0	1.344	Wildhorse Valley, Oregon (USGS-USNSN)

OUTREACH ACTIVITIES

The PNSN Seismology Lab staff provides an educational outreach program to better inform the public, educators, businesses, policy makers, and the emergency management community about seismicity and natural hazards. Our outreach includes lab tours, lectures, classes and workshops, press conferences, TV and radio news programs and talk shows, field trips, and participation in regional earthquake planning efforts. We provide basic information through information sheets, an audio library, and the Internet on the World-Wide-Web (WWW):

http://www.geophys.washington.edu/SEIS/PNSN

The development of the real-time strong motion network has become a major focus of PNSN Outreach activities. Expansion of information services to include strong-motion outreach materials is a current priority.

The installation of strong-motion instruments is also encouraging the formation of research relationships with a wide range of organizations who are interested in the data collected, and the potential for useful data products. These organizations, in turn, can provide the PNSN with station sites and/or telemetry. Conversations with business and industry, utilities, K-12 education providers, and local Federal, and State governmental agencies have advanced this quarter. We anticipate that cooperative efforts will contribute to more robust and diversified network telemetry, additional non-federally funded strong motion seismograph stations, and increased support for critical staff.

Special Events

- Over the course of the quarter, PNSN staff met at various times with county officials, representatives of utility and private companies, and engineering and emergency management groups regarding rapid earthquake notification and long-term network and strong-motion development plans.
- As part of a developing collaboration with Washington State DOT, the PNSN has installed a RACE System at the WSDOT Seattle Operations Center. We are continuing to explore working agreements with both WSDOT and Washington State Patrol.
- The University of Washington has received a FEMA grant and has organized a "Disaster Resistant University" (DRU) project as a new Project Impact Community. Bill Steele has been appointed to the DRU

Steering Committee chaired by Assistant Vice-President for Business Services, Sandra Leir.

- Ruth Ludwin attended a meeting in Golden Colorado to help fine-tune the recently launched web pages for the USGS Earthquake Hazards Program (http://earthquake.usgs.gov/) and to discuss coordination and information sharing between regional and national information centers.
- On November 29, most of the PNSN staff attended a one-day meeting in Seattle on USGS earthquake and landslide hazard studies in the Puget Sound. Steve Malone presented an overview of recent and planned network upgrades.
- Bill Steele gave a class about changes in earthquake hazards assessments in Washington State and the development of new information products to the Washington State Emergency Managers Association (WSEMA) at their annual conference in Oak Harbor. The PNSN also staffed a booth during the three-day conference.
- Steve Malone attended national-level meetings of the ANSS Technical Integration Committee.
- Steve Malone made presentations at the Western States Seismic Policy Council (WSSPC) meeting entitled "The National Earthquake Risk Management Conference" in Seattle (Sept. 17-22). Bill Steele staffed a booth and worked with local media.
- Steve Malone participated in a conference in Reading, CA on Volcanic hazards in National Parks.
- The PNSN continued its active involvement with Project Impact Communities, including Benton Co. Oregon, Kitsap, King and Pierce Counties, Washington, and the City of Seattle.
- The PNSN hosted several meeting of the CREW (Cascadia Regional Earthquake Workgroup) Board of Directors.

Press Interviews, Lab Tours, and Workshops

PNSN Staff provided over 35 television, radio, or print press interviews this quarter. Bill Steele managed the public release of information concerning the mapping of a new exposure of the Seattle Fault discovered by Brian Sherrod of the USGS in Bellevue, Washington. Three meetings were held over the quarter with King County and City of Bellevue officials to discuss the findings and construct a communications plan that satisfied all. Brian Sherrod presented these new findings at the workshop "Partnerships, Earthquakes, Landslides; USGS Earthquake and Landslide Hazards Studies in Puget Sound", sponsored by USGS and Seattle's Project Impact. Print, television and radio media were well represented at the meeting.

We provided 8, hour-long Seismology Lab tours/lectures this quarter for ~200 K-12 students and 3 to UW classes.

Telephone, Mail, and On-line outreach

The PNSN audio library system received about 300 calls this quarter. We provide several recordings. The most popular is a frequently updated message on current seismic activity. In addition we have a tape describing the seismic hazards in Washington and Oregon, and another on earthquake prediction. Callers often request our one-page information and resource sheet on seismic hazards in Washington and Oregon. Thousands of these have been mailed out or distributed, and we encourage others to reproduce and further distribute this sheet. Our information sheet discussing earthquake prediction is also frequently requested. Callers to the audio library can also choose to be transferred to the Seismology Lab, where additional information is available. This quarter we responded in person to: ~75 calls from management and government, ~20 calls from the media, ~50 calls from educators ~30 calls from the business community, and about 90 calls from the general public.

The PNSN recent earthquake list, and much more, is also available through the World-Wide-Web (WWW) at:

http://www.geophys.washington.edu/SEIS/PNSN

The PNSN upgraded our web-server this quarter. The new server has a much faster connection to the Internet, and should improve access to our web pages. We also reconfigured the PNSN Seismology Lab to include a terminal displaying PNSN Webicorders. "Webicorder" pages allow Web visitors (and us) to view continuous data from PNSN seismographic stations at:

http://www.geophys.washington.edu/SEIS/PNSN/WEBICORDER/

This quarter the PNSN imported ShakeMap from the Southern California TriNet project and began adapting it to our region. ShakeMap generates maps showing instrumentally measured shaking effects.

During the quarter, two felt earthquakes larger than magnitude 3.0 occurred in the Puget Sound (on October 15 and Nov. 1) both were well recorded on the strong-motion network, and Shake Maps were made.

Shake Maps:**http://spike.geophys.washington.edu/shake/index.html**

Last quarter the PNSN shifted the collection and storage of "felt" reports to the USGS "Community Intensity Internet Map (CIIM)". "Felt" reports are reports from people about how intense the shaking was. The CIIM map turns the "felt" reports into a numeric Intensity value, and shows average intensity by zip code. This quarter there were three earthquakes with enough felt reports to generate CIIM maps; the October 15 and Nov. 1 Puget Sound events mentioned above; and a third event near Entiat on Dec. 24.

CIIM Maps: **http://pasadena.wr.usgs.gov/shake/pnw/**

The PNSN web-site offers many web pages, including maps and lists of the most recent PNW earthquakes, general information on earthquakes and PNW earthquake hazards, information on past damaging PNW earthquakes, and catalogs of earthquake summary cards. Web-pages on seismicity of Cascade Volcanos, and Quarterly summaries of seismicity are also included.

In addition to the PNSN web site, the UW Geophysics Program and the PNSN host several other earthquake-related web sites:

- **Volcano Systems Center** is a cooperative effort of the UW and the USGS that links volcano-related activities of the UW Geological Sciences, Geophysics, and Oceanography departments with related USGS activities.

  http://www.vsc.washington.edu

- **Seismosurfing** is a comprehensive listing of sites worldwide that offer substantive seismology data and information. This page is mirrored at two sites in Europe.

  http://www.geophys.washington.edu/seismosurfing.html

- The **Council of the National Seismic Systems** (CNSS) site features composite listings and maps of recent U.S. earthquakes, and documentation of the EARTHWORM system.

  http://www.cnss.org

- The "**Tsunami!**" web site offers many pages of information, including an excellent discussion on the physics of tsunamis, and short movie clips. It was developed by Benjamin Cook under the direction of Dr. Catherine Petroff (UW Civil Engineering).

  http://www.geophys.washington.edu/tsunami

- The UW Geophysics Program **Global Positioning System (GPS)** web site provides information on geodetic studies of crustal deformation in Washington and Oregon.

  http://www.geophys.washington.edu/GPS/gps.html

EARTHQUAKE DATA - 2000-D

There were 1,455 events digitally recorded and processed at the University of Washington between October 1 and December 31, 2000. Locations in Washington, Oregon, or southernmost British Columbia were determined for 863 of these events; 746 were classified as earthquakes and 117 as known or suspected blasts. The remaining 592 processed events include teleseisms (172 events), regional events outside the PNSN (65), and unlocated events within the PNSN. Unlocated events within the PNSN include very small earthquakes and some known blasts. Frequent mining blasts occur near Centralia, Washington and we routinely locate only some of them.

Table 3 is a listing of all earthquakes reported to have been felt during this quarter. Table 5, located at the end of this report, is this quarter's catalog of earthquakes M 2.0 or greater, located within the network - between 42-49.5 degrees north latitude and 117-125.3 degrees west longitude.

Fig. 2 shows earthquakes with magnitude greater than or equal to 0.0 ($M_c \geq 0$).

Fig. 3 shows blasts and probable blasts ($M_c \geq 0$).

Fig. 4 shows earthquakes located near Mt. Rainier ($M_c \geq 0$).

Fig. 5 shows earthquakes located at Mt. St. Helens ($M_c \geq 0$).

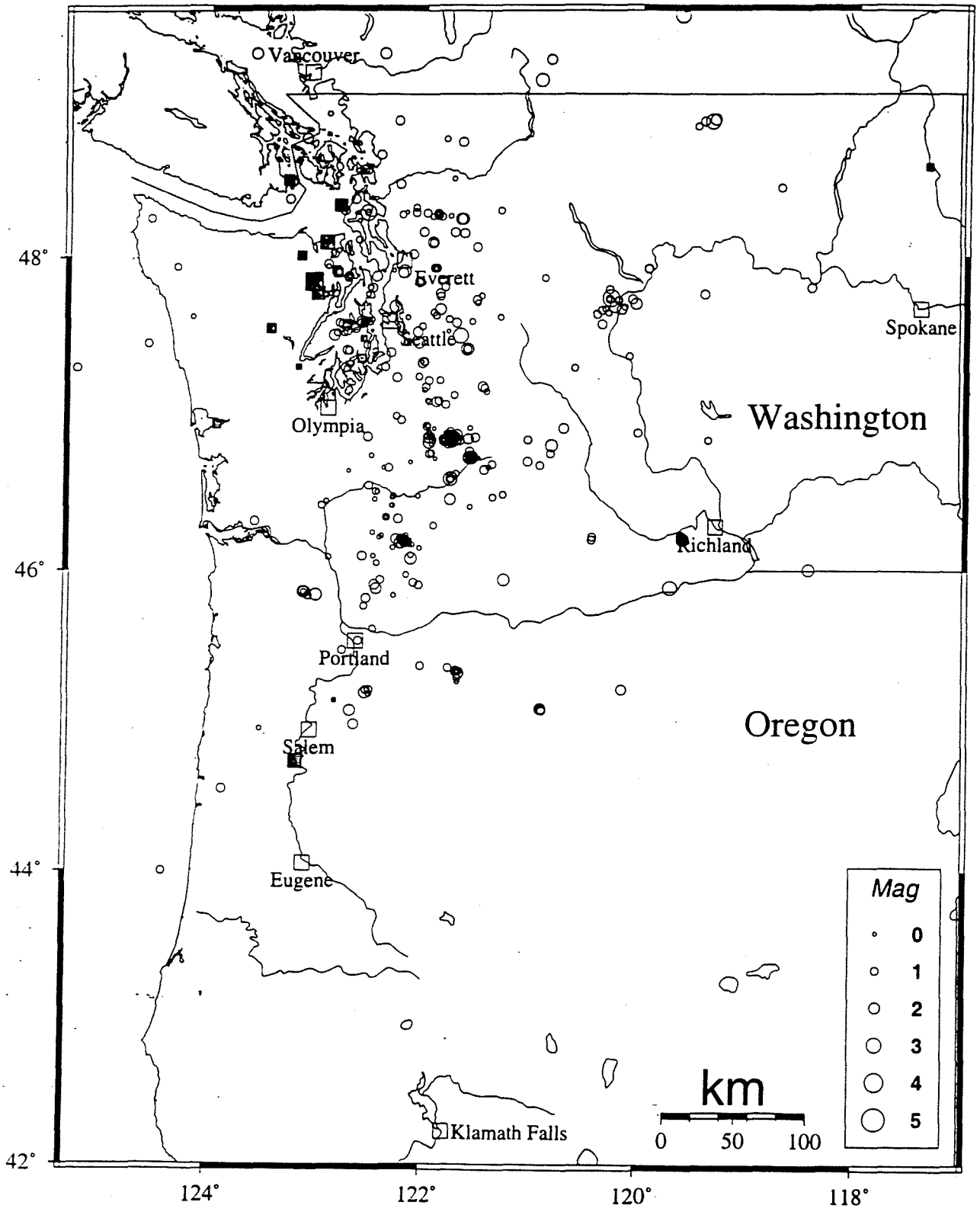

Figure 2. 4th quarter, 2000. Located earthquakes, magnitude >= 0.0. Filled squares indicate earthquakes with depth greater than 30km. Unfilled squares represent cities.

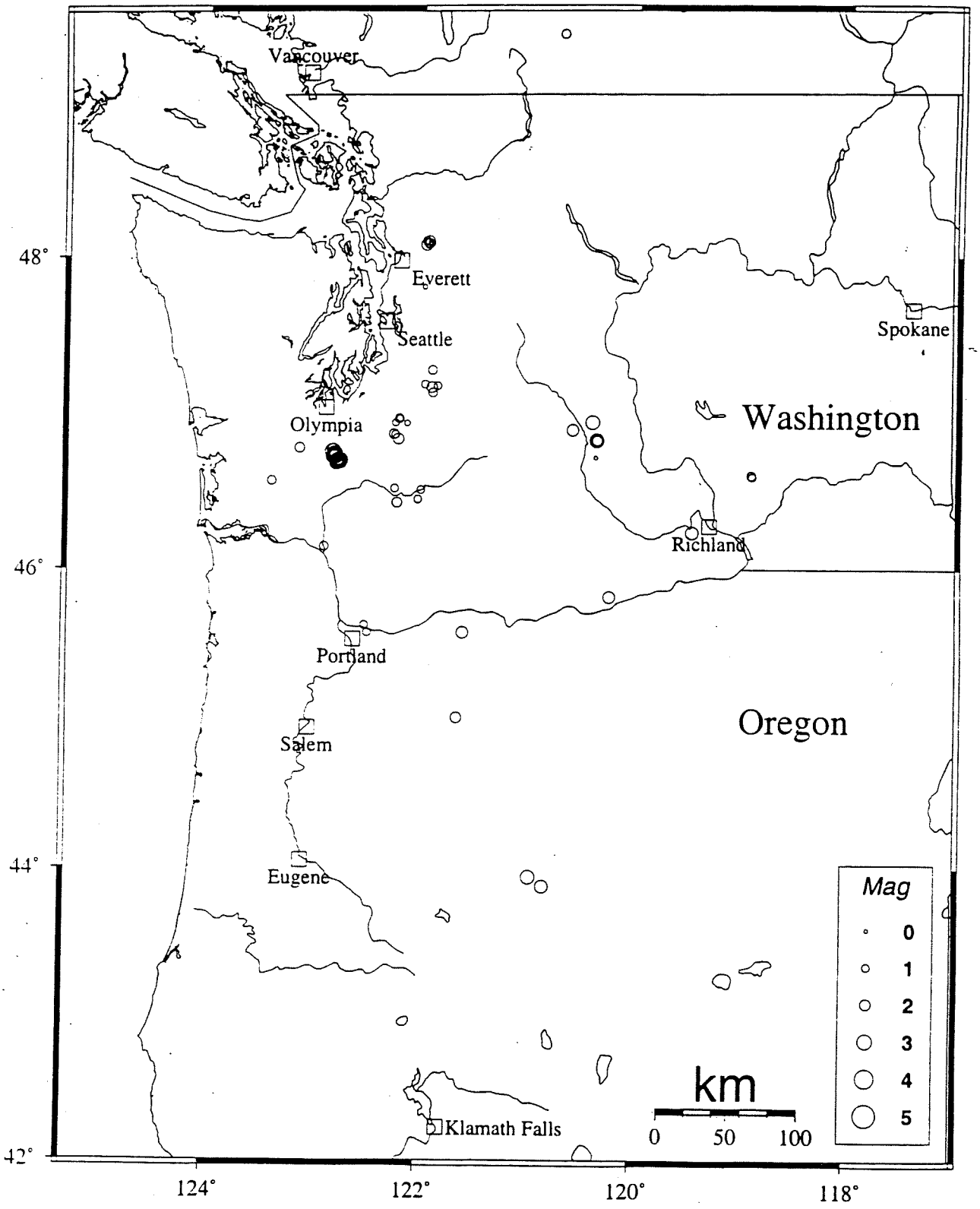

Figure 3. Blasts and probable blasts 4th quarter, 2000. Unfilled squares represent cities.

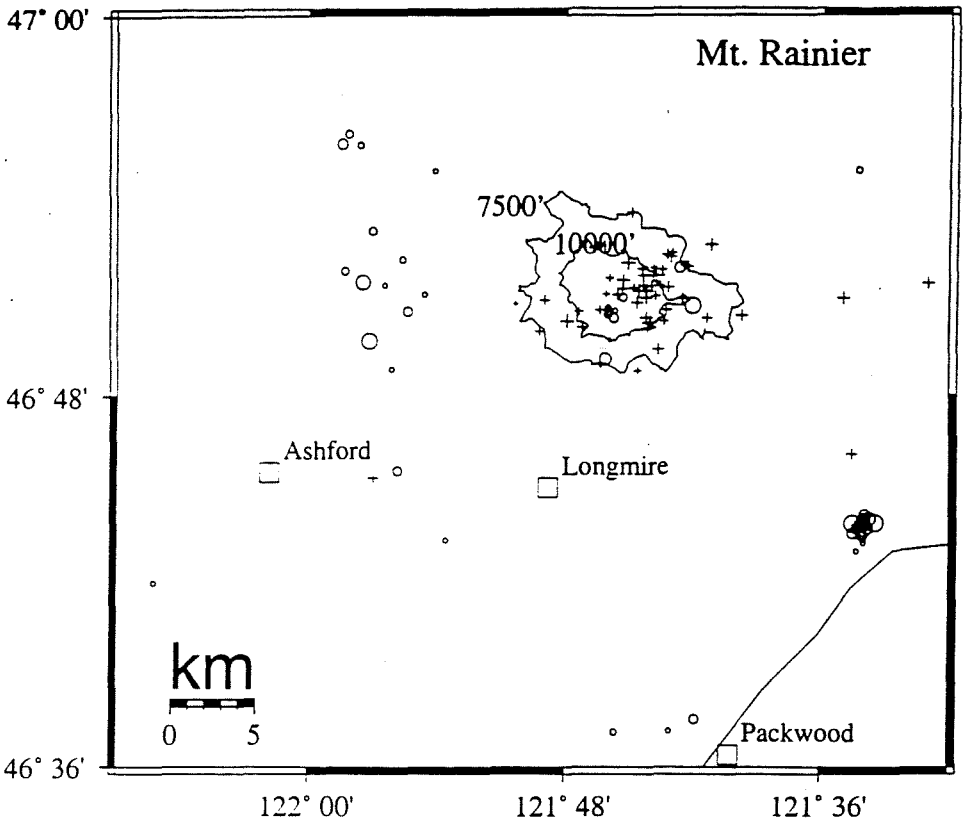

Figure 4. Earthquakes near Mt. Rainier M > 0, 4th quarter, 2000. 'Plus' symbols indicate depth less than 1 km. Circles indicate depth greater than 1 km. Elevation contours shown in feet.

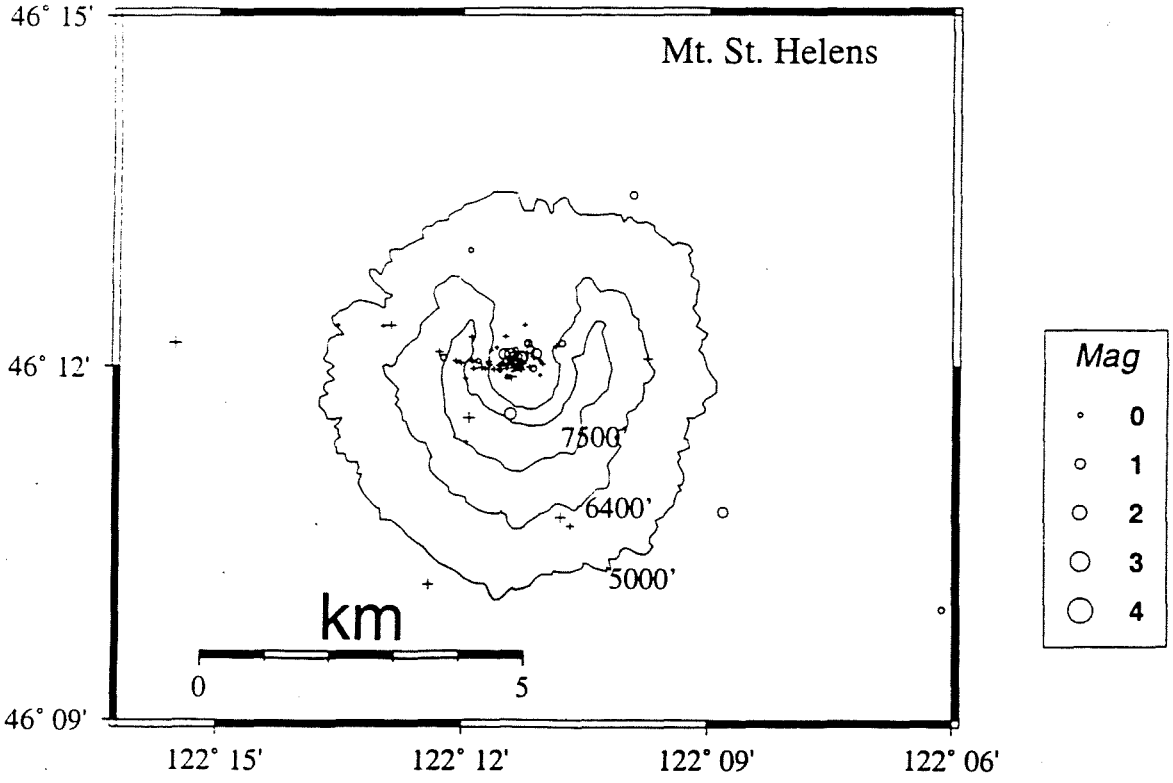

Figure 5. Earthquakes near Mt. St. Helens M > 0, 4th quarter, 2000. 'Plus' symbols indicate depth less than 1 km. Circles indicate depth greater than 1 km. Elevation contours shown in feet.

TABLE 3 - Felt Earthquakes during the 4th Quarter of 2000

DATE-(UTC)-TIME yy/mm/dd hh:mm:ss	LAT(N) deg.	LON(W) deg.	DEPTH km	MAG	COMMENTS	CIIM	ShakeMap
00/10/15 14:30:05	47.84	123.00	48.5	3.6	31.9 km WNW of Poulsbo, WA	x	x
00/11/01 08:37:17	48.27	122.53	21.8	3.3	21.6 km SW of Mount Vernon, WA	x	x
00/11/05 13:10:01	49.47	119.63	0.0	3.0	4.7 km SW of Penticton, BC		
00/11/10 09:12:39	48.45	123.23	25.2	2.5	9.5 km ENE of Victoria, BC		
00/11/25 10:01:39	48.83	119.33	2.0	3.1	55.2 km NNE of Okanogan, WA		
00/12/24 17:04:58	47.73	120.28	9.4	3.6	9.7 km NNW of Entiat, WA	x	
00/12/31 18:07:44	47.50	121.67	12.6	2.9	8.6 km E of North Bend, WA		

OREGON SEISMICITY

During the fourth quarter of 2000 a total of 29 earthquakes were located in Oregon between 42.0° and 45.5° north latitude, and between 117° and 125° west longitude. The most interesting activity in Oregon this quarter was a deep earthquake that occurred on December 30 about 25 km SSW of Salem. The magnitude 2.6 earthquake was located at about 62 km, which is an unusual depth for this part of Oregon. The earthquake was presumably located within the Juan de Fuca plate; the focal mechanism was indicative of a normal fault which is not surprising because the Juan de Fuca plate beneath Washington and Oregon appears to be under tension as it sinks into the mantle. October 21 provided a day of interesting activity. About 20 felt reports were received from Oregon coastal areas including Coos Bay, Bandon, Lincoln City, Waldport, North Bend, and Newport. These were actually due to military overflights and not earthquake activity. An interesting note this quarter: no earthquakes occurred in the Klamath Falls area. This is the first quarter that no earthquakes have occurred. Since 1994, most earthquakes in the Klamath Falls area have been considered aftershocks of a pair of damaging earthquakes in September of 1993. The 1993 earthquakes were followed by a vigorous aftershock sequence which decreased over time.

WESTERN WASHINGTON SEISMICITY

During the fourth quarter of 2000, 642 earthquakes were located between 45.5° and 49.5° north latitude and between 121° and 125.3° west longitude. Four earthquakes were felt this quarter in western Washington. Details are in Table 3.

The first felt earthquake was on October 15, located about 32 km WNW of Poulsbo, WA. The magnitude 3.6 earthquake was was well-recorded by our network of strong-motion instruments. The earthquake was felt across Kitsap and Jefferson counties, including the cities Poulsbo, Brinnon, Silverdale, Sequim, Bainbridge Island, and Mountlake Terrace.

On November 1 an earthquake was located about 21 km SW of Mount Vernon, WA with a magnitude of 3.3. This event was felt in areas around Whidbey Island, Camano Island, San Juan Islands, Stanwood, Marysville, and also Victoria, BC. It was well-recorded by our network of strong-motion instruments. The third felt earthquake this quarter occurred on November 10 and was actually located 10 km ENE of Victoria, BC. The PGC reported a magnitude of 2.5 and received felt reports across greater Victoria, BC. The last felt earthquake in western Washington for this quarter occurred on December 31 about 9 km E of North Bend, WA. The magnitude 2.9 earthquake was reported felt by several people in North Bend.

Mount Rainier Area: Figure 4 shows earthquakes near Mount Rainier. The number of events in close proximity to the cone of Mt. Rainier varies over the course of the year, since the source of much of the shallow activity is presumably ice movement or avalanching at the surface, which is seasonal in nature. Events with very low frequency signals (1-3 Hz) believed to be icequakes are assigned type "L" in the catalog. Emergent, very long duration signals, probably due to rockfalls or avalanches, are assigned type "S" (see Key to Earthquake Catalog). The third quarter of 2000 showed a large increase in the number of "L" and "S" events because of improved recording at Mount Rainier, where summit station RSU allowed the recording of many small events. Station RSU is no longer operating; however, having the improved recording for the time we did helped us to refine our classification system. We are still paying close attention to the "L" and "S" events and are careful in our classification of these events. Consequently, the number of "L" and "S" events from this quarter and following quarters will seem greater than in previous quarters. 90

events flagged "L" or "S" events were located at Mount Rainier this quarter and an additional 143 "L" or "S" events were recorded, but were too small to locate reliably. "L" and "S" type events are listed in the catalog, but not shown in Fig. 4.

A total of 85 tectonic events (25 of these were smaller than magnitude 0.0, and thus are not shown in Fig. 4) were located within the region shown in Fig. 4. Of these, 31 were tectonic events located in the "Western Rainier Seismic Zone" (WRSZ), a north-south trending lineation of seismicity approximately 15 km west of the summit of Mt. Rainier (for counting purposes, the western zone is defined as 46.6-47 degrees north latitude and 121.83-122 west longitude). The largest tectonic earthquake located near Mt. Rainier this quarter was a magnitude 2.5 and was located about 20 km SE of Mt. Rainier at a depth of 3.7. This earthquake was one of 29 events in this area 20 km SE of Mt. Rainier that occurred between November 11 and November 22, 2000. The cluster of earthquakes began on November 11 with a magnitude 2.4 earthquake. The magnitudes ranged from -0.3 to 2.5, with 16 events having a magnitude >= 1.0. This cluster can be seen in Fig. 4.

This quarter, there were 20 higher-frequency tectonic-style earthquake within 5 km of the summit. The remaining events were scattered around the cone of Rainier as seen in Fig. 4.

Mount St. Helens Area: Figure 5 shows volcano-tectonic earthquakes near Mount St. Helens. Low frequency (L) and avalanche or rockfall events (S) are not shown. This quarter 227 earthquakes were located at Mt. St. Helens in the area shown in Fig. 5. Of these 85 were magnitude 0.0 or larger and 14 were deeper than 4 km. One of these deep events occurred on December 5 and was a rare deep, low-frequency event. The event was located about 4 km ESE of Mount St. Helens at a depth of 30 km and had a magnitude of 1.1. The largest tectonic earthquake at Mount St. Helens this quarter was a magnitude 1.6 event located 0.4 km NE of Mount St. Helens.

Three type "S" or "L" event were located at Mount St. Helens, and 65 "L" or "S" events too small to locate were recorded.

EASTERN WASHINGTON SEISMICITY

During the fourth quarter of 2000, 73 earthquakes were located in eastern Washington in the area described in Table 4. The fourth quarter of 2000 presented some interesting seismicity in eastern Washington: A small cluster of earthquakes, visible in Fig. 2, began on December 21, 2000 about 18 miles west of the Tri-Cities (Richland, Pasco, and Kennewick, WA). The epicenters are near the north end of the Horse Heaven Hills, 8 miles east of Prosser and 25 km WSW of Richland. The cluster occurred between December 12, 2000 through December 18, 2000, and included 28 located earthquakes with magnitudes between -0.5 and 2.1. Earthquakes in this part of the Columbia Plateau are common and often occur in swarms. More than 90 percent of swarm earthquakes near the Tri-Cities region are very shallow, at less than 8 km depth. However, the depths of this quarter's swarm are 8-10 km below the surface. Focal mechanisms of Columbia Plateau earthquakes usually indicate a north-south compressive thrust regime perpendicular to, and consistent with, the east-west trend of the anticlines of the Yakima fold belt. This quarter's earthquakes occur within a NE trending zone of earthquakes in the Horse Heaven Hills. However, the mechanisms of the earthquakes in the current cluster determined by P-wave first motions, and the spatial pattern of the hypocenter locations suggest that the earthquakes are occurring on a fault perpendicular to this trend, possibly on a northwest striking reverse fault.

The other interesting seismicity in eastern Washington were two felt earthquakes. The first was located 55 km north-northeast of Okanogan, WA. The magnitude 3.1 earthquake was reported felt by residents living 50 miles north of Okanogan. The second felt earthquake occurred near Entiat, WA. The magnitude 3.6 earthquake occurred on December 24, 2000 at 1705 UTC time. It was located about 10 km north-northwest of Entiat at a depth of about 9 km. The felt reports included areas around Entiat, Wenatchee, and Chelan. This area is a very persistent temporal and spatial cluster of earthquake activity. Instrumental coverage was not very good in the Chelan cluster area until around 1976. Since 1976, the rate of seismicity has been quite steady, with between 27 and 69 earthquakes of magnitude 1.0 or larger each year. An earthquake occurred on November 5 in Penticton, B.C. The PGC reported a magnitude 2.6 and received reports that it was felt in the Penticton area.

Times, locations, and depths of felt earthquakes in the PNSN region are given in Table 3. Table 4 is a summary table of various earthquake counts-per-quarter over several years.

TABLE 4 Quarterly (Q) comparison of earthquake counts over several years.

"Total" events are all events located within the PNSN network area; between 42.0-49.5 degrees north latitude and 117-125.3 degrees west longitude. The smallest detectable earthquake varies over the region. "Total" events are subdivided into "Quakes", "Blasts" and "L or S"(low frequency or surficial). The remaining numbers are counts of tectonic (no L or S)earthquakes in western and eastern Washington, and in Oregon. Western Washington earthquakes are those between 45.5 and 49.5 degrees north latitude and 121-125.3 degrees west longitude. Within western Washington, earthquakes counted as "Rainier" are between 46.6-47.0 degrees north latitude and 121.5-122.15 degrees west longitude (same area as Figure 4), and at Mt. St. Helens (MSH) counted events are between 46.15-46.25 degrees north latitude and 122.10-122.27 degrees west longitude (same area as Figure 5). "Eastern Washington" earthquake counts are for quakes between 45.5-49.5 degrees north latitude and 117-121 degrees west longitude. "Oregon" earthquakes are located between 42-45.5 degrees north latitude and 117-125 degrees west longitude.

TABLE 4 Comparison of quarterly earthquake counts over several years										
Year	**Q**	**Total**	Quakes	Blasts	L or S	**western WA**	MSH	Rainier	**eastern WA**	**OR**
1995	A	**488**	424	62	2	**271**	18	36	**47**	**101**
	B	**726**	631	90	5	**433**	104	87	**58**	**134**
	C	**1072**	919	148	5	**689**	316	82	**75**	**138**
	D	**687**	609	77	1	**483**	264	41	**41**	**70**
1996	A	**504**	433	70	1	**302**	82	55	**53**	**75**
	B	**967**	860	103	4	**748**	68	54	**39**	**72**
	C	**696**	535	152	9	**417**	83	66	**45**	**67**
	D	**476**	381	89	6	**306**	65	53	**45**	**29**
1997	A	**417**	353	64	0	**270**	49	47	**45**	**34**
	B	**525**	472	52	1	**385**	70	30	**65**	**21**
	C	**633**	562	65	6	**468**	181	42	**66**	**28**
	D	**680**	606	66	8	**497**	286	45	**56**	**45**
1998	A	**692**	636	53	3	**475**	293	33	**57**	**106**
	B	**1248**	1180	65	3	**1045**	776	44	**74**	**58**
	C	**1728**	1622	93	13	**1450**	1100	70	**84**	**86**
	D	**772**	721	43	8	**612**	349	62	**59**	**49**
1999	A	**475**	449	25	1	**247**	122	15	**50**	**148**
	B	**465**	404	60	1	**275**	133	30	**45**	**83**
	C	**593**	493	87	13	**379**	134	33	**55**	**58**
	D	**661**	607	50	4	**391**	147	48	**62**	**153**
2000	A	**507**	435	60	12	**284**	83	27	**61**	**88**
	B	**514**	440	68	6	**333**	67	48	**44**	**63**
	C	**939**	614	96	229	**472**	136	51	**82**	**61**
	D	**863**	692	117	54	**589**	224	85	**73**	**29**

OTHER SOURCES OF EARTHQUAKE INFORMATION

We provide automatic computer-generated alert messages about significant Washington and Oregon earthquakes by e-mail, FAX or via the pager-based RACE system to institutions needing such information, and we regularly exchange phase data via e-mail with other regional seismograph network operators. The "Outreach Activities" section describes how to access PNSN data via e-mail, Internet, and World-Wide-Web. To request additional information by e-mail, contact seis_info@geophys.washington.edu.

Earthquake information in the quarterlies has been published in final form by the Washington State Department of Natural Resources as information circulars entitled "Earthquake Hypocenters in Washington and Northern Oregon" covering the period 1970-1989 (see circulars Nos. 53, 56, 64-66, 72, 79, 82-84, and 89). These circulars, plus circular No. 85, "Washington State Earthquake Hazards", are available from Washington Dept. of Natural Resources, Division of Geology and Earth Resources, Post Office Box 47007, Olympia, WA. 98504-7007, or by telephone at (360) 902-1450.

Several excellent maps of Pacific Northwest seismicity are available. A very colorful perspective-view map (18" x 27") entitled "Major Earthquakes of the Pacific Northwest" depicts selected epicenters of strong earthquakes (magnitudes > 5:1) that have occurred in the Pacific Northwest. A more detailed full-color map is called "Earthquakes in Washington and Oregon 1872-1993", by Susan Goter (USGS Open-File Report 94-226A). It is accompanied by a companion pamphlet "Washington and Oregon Earthquake History and Hazards", by Yelin, Tarr, Michael, and Weaver (USGS Open-File Report 94-226B). The pamphlet is also available separately. Maps can be ordered from: "Earthquake Maps", U.S. Geological Survey, Box 25046, Federal Center, MS 967, Denver, CO 80225, phone (303) 273-8477. The price of each map is $12. (including US shipping and handling).

USGS Cascades Volcano Observatory has a video, "Perilous Beauty: The Hidden Dangers of Mount Rainier", about the risk of lahars from Mount Rainier. Copies are available through: North west Interpretive Association (NWIA), 909 First Avenue Suite 630, Seattle WA 98104, Telephon e: (206) 220-4141, Fax: (206) 220-4143.

Other regional agencies provide earthquake information. These include the Geological Survey of Canada (Pacific Geoscience Centre, Sidney, B.C.; (250) 363-6500, FAX (250) 363-6565), which produces monthly summaries of Canadian earthquakes; the US Geological Survey which produces weekly reports called "Seismicity Reports for Northern California" (USGS, attn: Steve Walter, 345 Middlefield Rd, MS-977, Menlo Park, CA, 94025) and "Weekly Earthquake Report for Southern California" (USGS, attn: Dr. Kate Hutton or Dr. Lucy Jones, CalTech, Pasadena, CA.).

Key to Earthquake Catalog in Table 5

TIME Origin time is calculated for each earthquake on the basis of multi-station arrival times. Time is given in **Coordinated Universal Time** (UTC), in hours:minutes:seconds. To convert to Pacific Standard Time (PST) subtract eight hours, or to Pacific Daylight Time subtract seven hours.

LAT North latitude of the epicenter, in degrees and minutes.

LONG West longitude of the epicenter, in degrees and minutes.

DEPTH The depth, given in kilometers, is usually freely calculated from the arrival-time data. In some instances, the depth must be fixed arbitrarily to obtain a convergent solution. Such depths are noted by an asterisk (*) in the column immediately following the depth. A **$** or a **#** following the depth mean that the maximum number of iterations has been exceeded without meeting convergence tests and both the location and depth have been fixed.

MAG Coda-length magnitude M_c, an estimate of local magnitude M_L (Richter, C.F., 1958, Elementary Seismology: W.H. Freeman and Co., 768p), calculated using the coda-length/magnitude relationship determined for Washington (Crosson, R.S., 1972, Bull. Seism. Soc. Am., v. 62, p. 1133-1171). Where blank, data were insufficient for a reliable magnitude determination. Normally, the only earthquakes with undetermined magnitudes are very small ones. Magnitudes may be revised as we improve our analysis procedure.

NS/NP **NS** is the number of station observations, and **NP** the number of P and S phases used to calculate the earthquake location. A minimum of three stations and four phases are required. Generally, more observations improve the quality of the solution.

GAP Azimuthal gap. The largest angle (relative to the epicenter) containing no stations.

RMS The root-mean-square residual (observed arrival time minus predicted arrival time) at all stations used to locate the earthquake. It is only useful as a measure of the quality of the solution when 5 or more well-distributed stations are used in the solution. Good solutions are normally characterized by **RMS** values less than about 0.3 sec.

Q Two **Quality factors** indicate the general reliability of the solution (**A** is best quality, **D** is worst). Similar quality factors are used by the USGS for events located with the computer program HYPO71. The first letter is a measure of the hypocenter quality based on travel-time residuals. For example: **A** quality requires an **RMS** less than 0.15 sec while an **RMS** of 0.5 sec or more is **D** quality (estimates of the uncertainty in hypocenter location also affect this quality parameter). The second letter of the quality code depends on the spatial distribution of stations around the epicenter, i.e. number of stations, their azimuthal distribution, and the minimum distance (**DMIN**) from the epicenter to a station. Quality **A** requires a solution with 8 or more phases, **GAP** $\leq 90^\circ$ and **DMIN** $\leq$ (5 km or depth, whichever is greater). If the number of phases, **NP**, is 5 or fewer or **GAP** $> 180^\circ$ or **DMIN** > 50 km the solution is assigned quality **D.**

MOD The crustal velocity model used in location calculations.

P3 - Puget Sound model
C3 - Cascade model
S3 - Mt. St. Helens model including Elk Lake
N3 - northeastern model
E3 - southeastern model
O0 - Oregon model
K3 - Southern Oregon, Klamath Falls area model
R0 and J1 - Regional and Offshore models

TYP Events flagged in Table 5 use the following code:

F - earthquake reported to have been felt
P - probable explosion
L - low frequency earthquake (e.g. glacier movement, volcanic activity)
H - handpicked from helicorder records
S - Special event (e.g. rockslide, avalanche, volcanic steam emission, harmonic tremor, sonic boom), not a man-made explosion or tectonic earthquake
X - known explosion

TABLE 5

Tectonic Earthquakes, Magnitude 2.0 or larger, Fourth Quarter, 2000.

Within an area 42-49.5 degrees north latitude and 117-125.3 degrees west longitude.

Oct 2000

DAY	TIME	LAT	LON	DEPTH	M	NS/NP	GAP	RMS	Q	MOD	TYP
3	00:03:44.69	46 49.74	121 57.13	9.45	2.1	32/39	32	0.14	AA	C3	
4	23:49:08.89	45 56.06	121 14.76	0.19	2.2	16/20	108	0.23	BC	C3	
10	12:10:52.86	46 04.46	122 06.84	16.13	2.2	31/41	61	0.13	AA	S3	
12	00:57:01.62	47 46.24	122 59.40	49.59	2.5	43/48	50	0.14	AA	P3	
13	17:23:47.73	49 14.79	122 23.36	12.47*	2.0	7/10	272	0.11	AD	P3	
14	02:11:53.72	47 41.39	122 16.64	3.76	2.1	37/39	35	0.19	BA	P3	
14	10:50:05.99	46 48.54	120 48.41	5.57	2.2	32/37	56	0.28	BB	C3	
15	14:30:05.98	47 50.66	123 01.86	49.95	3.6	74/76	33	0.16	BA	P3	F
15	21:51:25.51	48 05.47	122 54.58	56.07	2.7	51/56	29	0.31	CA	P3	
19	08:40:47.48	46 51.58	121 57.45	8.84	2.0	45/53	37	0.16	BB	C3	
30	11:24:15.52	48 19.31	122 47.55	50.91	2.2	14/16	71	0.11	AA	P3	

Nov 2000

DAY	TIME	LAT	LON	DEPTH	M	NS/NP	GAP	RMS	Q	MOD	TYP
1	08:37:17.02	48 16.76	122 32.40	21.75	3.3	34/41	35	0.19	BA	P3	F
5	13:10:01.69	49 28.48	119 38.13	0.03*	3.0	9/10	241	0.28	BD	N3	F
8	00:00:07.05	47 54.70	122 11.92	24.42	2.5	41/45	53	0.27	BA	P3	
8	02:45:54.30	46 00.33	118 25.70	7.89S	2.2	14/15	170	0.41	DC	E3	
11	15:32:29.22	46 43.82	121 33.47	4.03	2.4	30/34	64	0.13	AA	C3	
11	20:46:18.42	45 52.83	122 26.10	2.14	2.0	14/16	178	0.19	BC	C3	
13	21:12:59.44	49 14.82	123 34.53	12.77	2.0	14/17	242	0.24	BD	P3	
17	02:52:57.24	46 43.63	121 33.99	4.39	2.0	25/34	63	0.15	AA	C3	
18	09:18:25.49	46 43.81	121 34.53	3.69	2.5	42/51	45	0.22	BA	C3	
19	01:00:01.97	45 50.16	122 59.31	16.25	2.1	40/44	96	0.20	BC	C3	
25	00:53:36.18	46 35.66	121 45.03	12.34	2.7	56/60	37	0.16	BA	C3	
25	10:01:39.64	48 50.25	119 20.66	2.05	3.1	13/15	162	0.18	BD	N3	F
28	19:51:03.81	47 30.62	122 50.35	18.40	2.0	37/42	72	0.12	AA	P3	
30	15:22:02.73	45 04.57	122 40.09	16.34	2.0	24/25	167	0.27	BC	O0	
30	18:07:56.43	49 05.19	120 55.63	6.98S	2.4	15/17	239	0.48	DD	C3	

Dec 2000

DAY	TIME	LAT	LON	DEPTH	M	NS/NP	GAP	RMS	Q	MOD	TYP
12	03:28:26.80	47 25.29	121 36.00	13.78	2.2	38/42	44	0.21	BB	P3	
12	14:48:03.41	46 12.09	119 35.41	10.16*	2.1	25/27	83	0.17	BA	E3	
12	19:40:53.15	46 12.22	119 35.59	9.94	2.1	30/38	82	0.20	BA	E3	
16	17:41:52.09	47 35.64	122 35.14	25.75	2.2	46/52	47	0.17	BA	P3	
24	17:04:58.39	47 44.69	120 15.94	8.56S	3.5	37/37	62	0.71	DB	N3	F
29	23:01:45.53	45 53.21	119 42.50	0.02*	2.6	19/19	101	0.31	CB	E3	
30	01:52:59.71	44 44.20	123 10.17	60.56	2.6	17/18	116	0.18	BB	O0	
31	18:07:44.83	47 30.33	121 40.11	12.57	2.9	53/53	51	0.28	BA	P3	F

APPENDIX 2

Publications supported fully or partially under this operating agreement

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