QUARTERLY NETWORK REPORT 2003-A

on

Seismicity of Washington and Oregon

January 1 through March 31, 2003

Pacific Northwest Seismograph Network

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INTRODUCTION

This is the first quarterly report of 2003 from the , Pacific Northwest Seismograph Network (PNSN), at the University of Washington Dept. of Earth and Space Sciences, 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. Dept. of Earth and Space Sciences. The complete PNSN catalog is available on-line, both through our web-site and through the CNSS catalog. In these reports we 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. Findings mentioned in these quarterly reports should not be cited for publication.

NETWORK OPERATIONS

Figure 1A shows a map view of stations operating during the quarter. Figure 1B is a more detailed view of stations in the Puget Sound area. 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 and manual digital and analog signal checks, plus records of maintenance and repair visits.

Strong Motion Instrumentation and Recording Update

Significant progress was made in troubleshooting. In early February the Guralp CMG5TD seismographs began to not update the internal clock from the GPS receiver, leading to systemic timing drift. The problem was isolated to a power setting in the GPS receiver. The CMG5TD's were reconfigured to solve the problem, with less than 3 weeks of bad timing.

Additional progress was made in identifying sources of problems with the MSS100 terminal servers, used in Internet telemetry for digital stations. Terminal servers connected to switches are nearly problem free, but the terminal servers connected to hubs would repeatedly fail and require power cycles to become operational. It was found that placing a pocket switch between hubs and terminal servers reduced the failure rate. As an example, staton RHAZ could not maintain a connection to the Earthworm data acquisition system until a switch was installed.

Data Recording and EARTHWORM Update

This quarter, ***scossa*** remained our main EARTHWORM computer, with ***milli*** serving as our primary backup and ***verme*** as the secondary backup. ***Milli*** and ***verme*** still serve as the principal computers for data acquisition for many of the digital stations. We are currently running EARTHWORM-V6.1. On January 21, 2003, ***milli*** was reconfigured and restarted due to an update to EARTHWORM-V6.1.

Pigia, our Intel-based EARTHWORM digitizer running under Windows NT, is the primary digitizer for ***verme*** while ***waggles***, a sunworm digitizer, remained the primary digitizer for ***scossa*** and ***milli***.

The first mini-worm (Wintel machines that act as separate earthworm nodes) was installed 4th quarter of 2002 in Klamath Falls, OR at the Oregon Institute of Technology. The second mini-worm is being tested and is scheduled to be installed in early April 2003 in Forks, WA. An additional mini-worm is available for installation in Bend, OR to assist in monitoring the Three Sisters area. It is scheduled to be installed in summer 2003, unless needed earlier. The mini-worms digitize signals from the analog stations in their respective regions and remove the need for leased telephone lines to the University of Washington. The mini-worms send the data back to us via public internet and also keep a local copy in case of the internet telemetry going down.

Other Station News

Station RWW is not currently installed. We are still looking into the potential of reinstalling the station at a nearby location, possibly the BPA Satsop substation. Plans are underway to renovate Johnson Hall, next door to the PNSN. The renovation will require relocation of station SEA, which has operated in the basement of Johnson Hall since 1966. It will be moved nearby with improved telemetry. Renovation plans also include improvements to our hallway seismometer and earthquake info display.

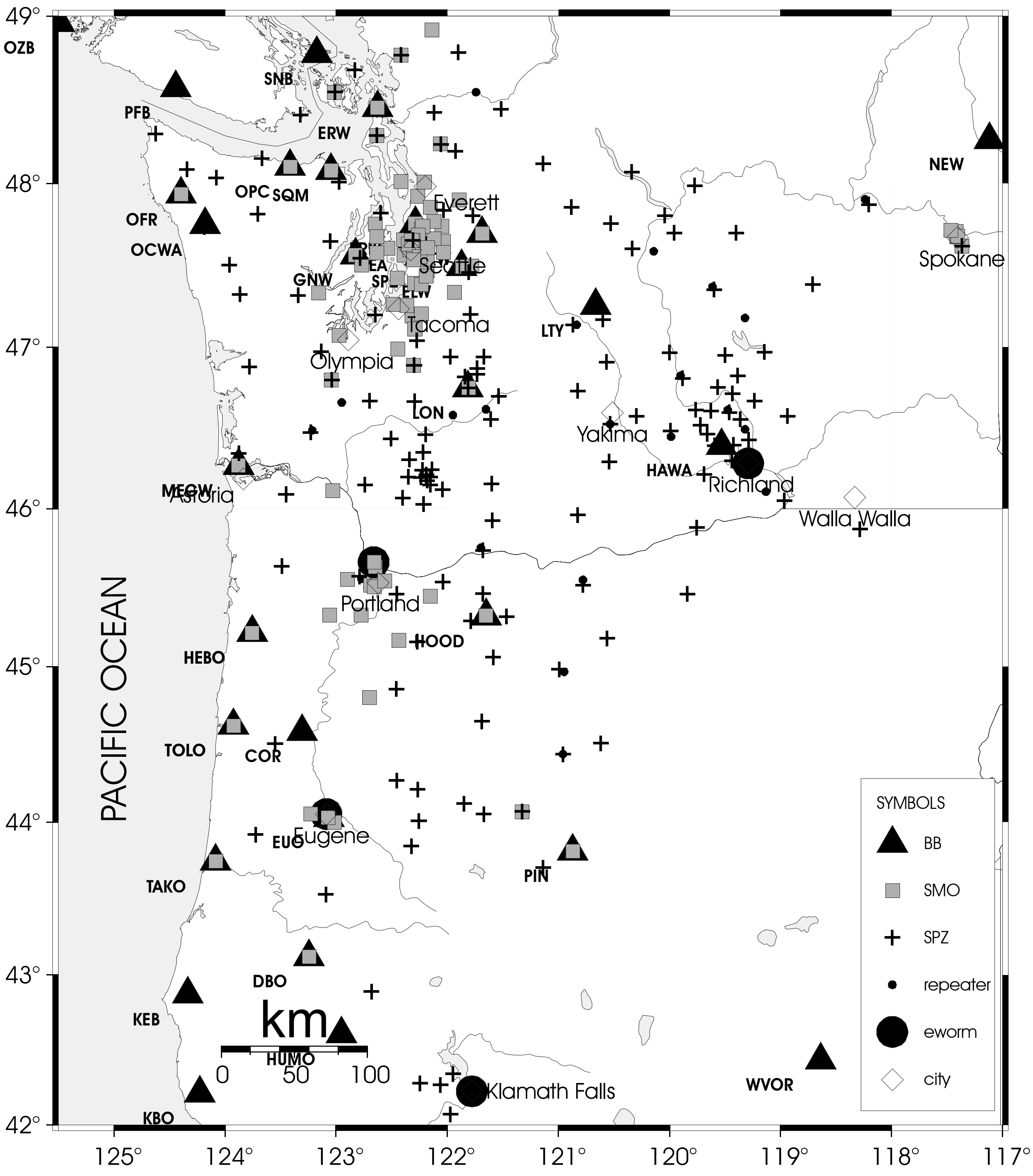

Figure 1 A. Stations operating at the end of the quarter.Stations shown are short period vertical (SP), 3-component broadband (BB), or strong motion (SMO)

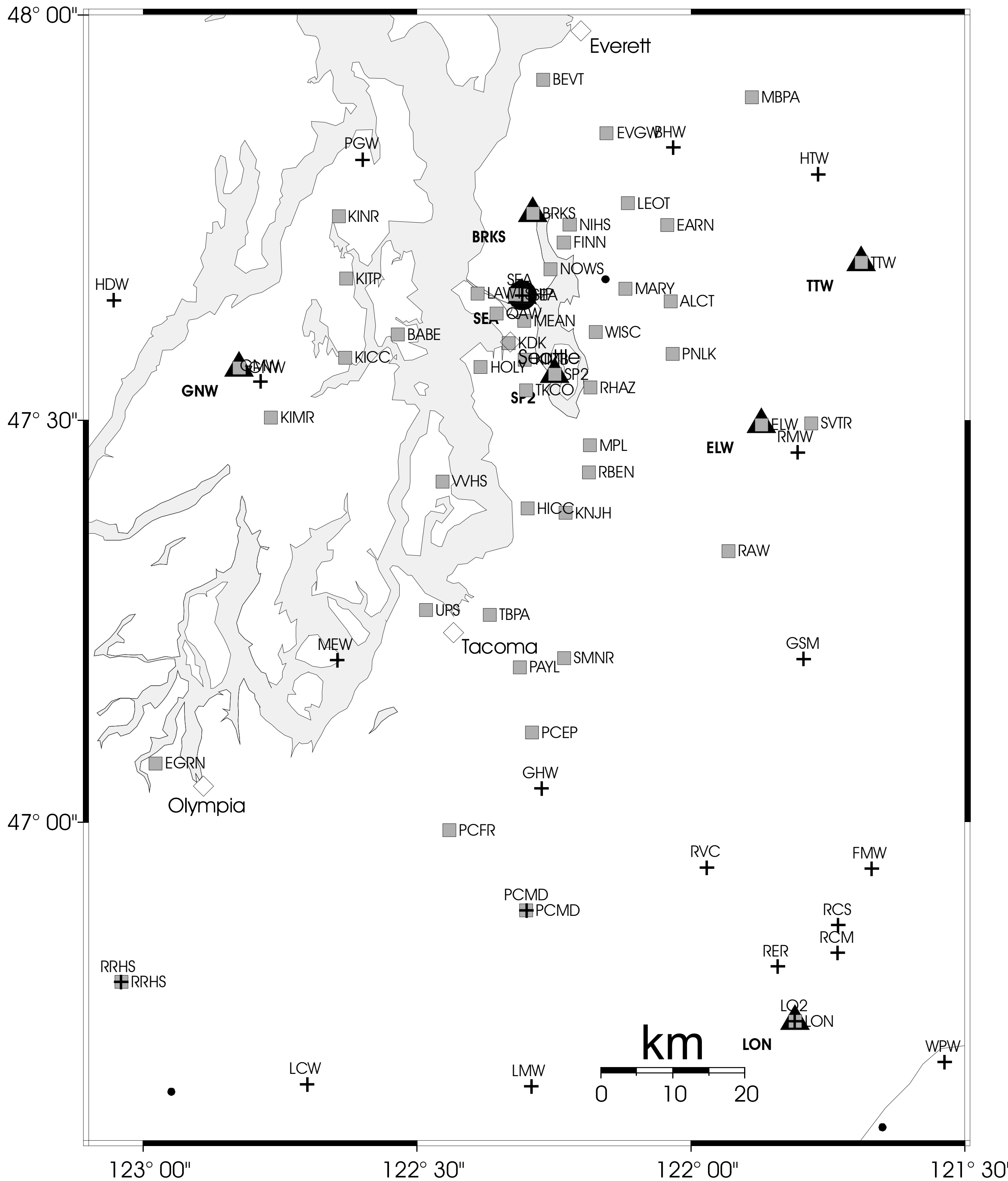

Figure 1 B. Puget Sound stations; detail of Fig. 1A.

TABLE 1 - Station outages and installations

Station	Outage Dates	Comment
ATES	3/6/2003	Installed short period instrument
BEN	12/24/02-01/23/03	Dead
BULL	2/25/2003	Installed (SMO)
BULL	3/7/2003-End	No communications
CDF	12/20/02-End	Dead
CMW	02/27/03-End	Temporarily turned off
COLT	01/22/03-02/26/03	No communications
EARN	01/30/03-03/02/03	Removed for repair
EDM	12/20/02-01/08/03	Dead because of power failure at MTM repeater
EVCC	12/20/02-01/15/03	No communications
EYES	02/08/03-02/25/03	Bad timing
GLK	12/11/02-01/07/03	Down for winter/suspect power failure
HICC	03/04/03-End	Down because of building construction
HSR	12/20/02-01/08/03	Dead because of power failure at MTM repeater
HUBA	02/08/03-02/25/03	Bad timing
LAB	10/12/02-End	Dead
MEAN	09/19/02-01/16/03	Bad timing (no GPS)
MPL	12/11-02-01/16/03	Removed for repair
MTM	12/20/02-01/08/03	Dead because of power failure
NOWS	01/30/03-03/05/03	Removed for repair
OBC	12/20/02-01/10/03	Dead
OBH	01/31/02-End	Temp. removed for logging
OOW	12/20/02-02/04/03	Dead, replaced solar panel
OSD	12/20/02-02/04/03	Dead because of station OOW
PCMD	01/31/03-02/12/03	No communications, bad surge protector
PCMD	03/18/03-End	Removed for repair due to flooding
RHAZ	02/13/03-03/20/03	No communications
RWW	10/24/02-End	Temporarily Removed
SHIP	02/08/03-02/25/03	Bad timing
SHIP	03/09/03-End	No communications
SHW	11/27/02-01/10/03	Very noisy
SLF	12/21/02-01/01/03	Intermittent for winter
SMNR	01/15/03-01/29/03	Dead, K2 problem
SOPS	08/27/02-End	K2 flash problem
SOS	10/16/02-03/10/03	Noisy
SQM.SN?	12/04/02-01/19/03	Removed for repair
SQM	3/27/2003	Replaced seismometer
SVTR	09/20/02-02/12/03	Misaligned sensor
SVTR	02/08/03-02/25/03	Bad timing
TBPA	08/14/02-End	Removed for repair
TRW	07/14/02-End	Destroyed by fire, to be moved
VG2	1/16/2003	Replaced seismometer
WIB	12/04/02-End	Intermittent
WRW	12/21/02-01/01/03	Intermittent for winter

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 01-HQ-AG-0011. A plus

(+) indicates support under Pacific Northwest National Laboratory, Battelle contract 259116-A-B3. Stations designated "#" are USGS-maintained stations recorded at the PNSN. Stations designated by letters are operated by other networks, and telemetered to the PNSN. "M" stations are received from the Montana Bureau of Mines and Geology, "C" stations from the Canadian Pacific Geoscience Center, "U" stations from the US Geological Survey (usually USNSN stations), "N" stations from the USGS Northern California Network, and "H" stations from the Hanford Reservation via the Pacific Northwest National Labs. Other designations indicate support 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

STA	F	LAT	LONG	EL	NAME
ASR	%	46 09 09.9	121 36 01.6	1.357	Mt. Adams - Stagman Ridge
ATES	%	48 14 10.9	122 03 33.0	0.062	Arlington Trafton ES ANSS-SMO
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
BEN	H	46 31 12.0	119 43 18.0	0.335	PNNL station
BEND	%	44 04 00.8	121 19 36.0	-	UO Bend Office, DOGAMI SMO
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	0.87	Boistfort Mt.
BPO	%	44 39 06.9	121 41 19.2	1.957	Bald Peter, Oregon
BRO	%	44 16 02.5	122 27 07.1	0.135	Big Rock Lookout, Oregon
BRV	+	46 29 07.2	119 59 28.2	0.92	Black Rock Valley
BSMT	M	47 51 04.8	114 47 13.2	1.95	Bassoo Peak, MT
BUO	%	42 16 42.5	122 14 43.1	1.797	Burton Butte, Oregon
BVW	+	46 48 39.5	119 52 56.4	0.67	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
CHMT	M	46 54 51.0	113 15 07.0	-	Chamberlain Mtn, MT
CMM	%	46 26 07.0	122 30 21.0	0.62	Crazy Man Mt.
CMW	%	48 25 25.3	122 07 08.4	1.19	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	0.89	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	1.27	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
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
FRIS	%	44 12 44.0	122 16 01.8	1.642	Frissel Point, OR
GBB	H	46 36 31.8	119 37 40.2	0.185	PNNL Station
GBL	+	46 35 54.0	119 27 35.4	0.33	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	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.
GPW	%	48 07 05.0	121 08 12.0	2.354	Glacier Peak
GSM	%	47 12 11.4	121 47 40.2	1.305	Grass Mt.

TABLE 2A - Short-period Stations

STA	F	LAT	LONG	EL	NAME
GUL	%	45 55 27.0	121 35 44.0	1.189	Guler Mt.
H2O	H	46 23 44.5	119 25 22.7	0.175	Water PNNL Station
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	1.02	Harness Mountain, Oregon
HSR	%	46 10 28.0	122 10 46.0	1.72	South Ridge, Mt. St. Helens
HTW	%	47 48 14.2	121 46 03.5	0.833	Haystack Lookout
HUO	%	44 07 10.9	121 50 53.5	2.037	Husband OR (UO)
IRO	%	44 00 19.0	122 15 15.4	1.642	Indian Ridge, OR
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	0.61	Kosmos
KTR	N	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
LCCM	M	45 50 16.8	111 52 40.8	1.669	Lewis and Clark Caverns, MT
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	0.21	Locke Island
LVP	%	46 03 58.0	122 24 02.6	1.13	Lakeview Peak
MBW	%	48 47 02.4	121 53 58.8	1.676	Mt. Baker
MCMT	M	44 49 39.6	112 50 55.8	2.323	McKenzie Canyon, MT
MCW	%	48 40 46.8	122 49 56.4	0.693	Mt. Constitution
MDW	+	46 36 47.4	119 45 39.6	0.33	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
MOON	%	44 03 05.5	121 40 05.5	2.27	Moon Mt, OR
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	1.5	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
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
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 ANSS-SMO

TABLE 2A - Short-period Stations

STA	F	LAT	LONG	EL	NAME
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
RED	H	46 17 51.0	119 26 15.6	0.33	Red Mountain PNNL Station
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	0.85	Roman Nose, Oregon
RPW	%	48 26 54.0	121 30 49.0	0.85	Rockport
RRHS	%	46 47 58.6	123 02 25.4	0.047	Rochester HS ANSS-SMO
RSW	+	46 23 40.2	119 35 28.8	1.045	Rattlesnake Mt. (East)
RVC	%	46 56 34.5	121 58 17.3	1	Mt. Rainier - Voight Creek
RVW	%	46 08 53.2	122 44 32.1	0.46	Rose Valley
SAW	+	47 42 06.0	119 24 01.8	0.701	St. Andrews
SBES	%	48 46 05.9	122 24 54.2	0.119	Silver Beach ES SMO
SEA	%	47 39 15.8	122 18 29.3	0.03	UW, Seattle
SEP	#	46 12 00.7	122 11 28.1	2.116	September lobe, Mt. St. Helens
SFER	%	47 37 10.4	117 21 55.7	0.715	Spokane Schools, Ferris H.S.
SHW	%	46 11 37.1	122 14 06.5	1.425	Mt. St. Helens
SLF	%	47 45 32.0	120 31 40.0	1.75	Sugar Loaf
SMW	%	47 19 10.7	123 20 35.4	0.877	South Mtn.
SNI	H	46 27 50.4	119 39 35.1	0.323	Snively PNNL station
SOS	%	46 14 38.5	122 08 12.0	1.27	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
SVOH	%	48 17 21.8	122 37 54.8	0.022	Skagit Valley CC ANSS-SMO
TBM	+	47 10 12.0	120 35 52.8	1.006	Table Mt.
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	1.4	Tradedollar Lake
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
UWFH	%	48 32 46.0	123 00 43.0	0.01	UW Friday Harbor ANSS-SMO
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
VDB	C	49 01 34.0	122 06 10.1	0.404	Canada
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
VGZ	C	48 24 50.0	123 19 27.8	0.067	Canada
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	1.15	Little Larch, Oregon
VSP	%	42 20 30.0	121 57 00.0	1.539	Spence Mtn, Oregon
VT2	+	46 58 02.4	119 59 57.0	1.27	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
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

TABLE 2A - Short-period Stations

STA	F	LAT	LONG	EL	NAME
WPO	%	45 34 24.0	122 47 22.4	0.334	West Portland, Oregon
WPW	%	46 41 55.7	121 32 10.1	1.28	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	1.75	Yellow Rock, Mt. St. Helens
YPT	+	46 02 55.8	118 57 44.0	0.325	Yellepit
LAM	N	41 36 35.2	122 37 32.1	1.769	CAL-NET

Table 2B lists broad-band stations used in locating seismic events in Washington and Oregon, and Table 2C lists strong-motion stations. The format for station locations is the same for all station tables, as described above.

TABLE 2B - Broad-band stations

STA	F	LAT	LONG	EL	NAME
BRKS	%	47 45 19.1	122 17 17.9	0.02	Brookside ANSS-SMO
COR	U	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)
ELW	%	47 29 39.4	121 52 17.2	0.267	EchoLakeBPA BB-SMO-IDS20
ERW	%	48 27 14.4	122 37 30.2	0.389	Mt. Erie SMO-IDS24 BB
EUO	%	44 01 45.7	123 04 08.2	0.16	Eugene,OR U0 CREST BB SMO
GNW	%	47 33 51.8	122 49 31.0	0.165	Green Mt CREST BB SMO
HAWA	U	46 23 32.3	119 31 57.2	0.367	Hanford Nike USNSN BB
HEBO	%	45 12 49.2	123 45 15.0	0.875	Mt. Hebo, OR CREST BB SMO
HLID	U	43 33 45.0	114 24 49.3	1.772	Hailey, ID USNSN BB
HOOD	%	45 19 17.8	121 39 07.8	1.52	Mt Hood Meadows, OR CREST BB SMO
HUMO		42 36 25.6	122 57 24.1	0.555	Hull Mountain,OR BB from UCB
KBO	N	42 12 45.0	124 13 33.3	1.008	Bosley Butte, OR CREST BB
KEB	N	42 52 20.0	124 20 03.0	0.818	Edson Butte, OR CREST BB
KRMB	N	41 31 23.0	123 54 29.0	1.265	Red Mtn, OR CREST BB
KSXB	N	41 49 51.0	123 52 33.0	-	Camp Six, OR CREST BB
LON	%	46 45 00.0	121 48 36.0	0.853	Longmire CREST BB SMO
LTY	%	47 15 21.2	120 39 53.3	0.97	Liberty (BB)
MEGW	%	46 15 57.4	123 52 38.2	0.332	Megler, WA CREST BB SMO
MOD		41 54 08.9	120 18 10.6	1.555	Modoc Plateau, CA from UCB
NEW	U	48 15 50.0	117 07 13.0	0.76	Newport Observatory USNSN BB
OCWA	U	47 44 56.0	124 10 41.2	0.671	Octopus Mtn. USNSN BB
OFR	%	47 56 00.0	124 23 41.0	0.152	Olympics, Forest Resource Cntr
OPC	%	48 06 01.0	123 24 41.8	0.09	Olympic Penn College CREST BB
OZB	C	48 57 37.1	125 29 34.1	0.671	Canada
PIN	%	43 48 40.0	120 52 19.0	1.865	Pine Mt., Oregon (U0 CREST, BB)
PFB	C	48 34 30.0	124 26 39.8	0.465	P.Renfrew, Canada
PNT	C	49 18 57.6	119 36 57.6	0.55	Canada, BB
SEA	%	47 39 15.8	122 18 29.3	0.03	UW, Seattle (Wood Anderson BB)
SNB	C	48 46 33.6	123 10 16.3	0.408	Canada BB
SP2	%	47 33 23.3	122 14 52.8	0.03	Seward Park, Seattle SMO-IDS24
SQM	%	48 04 39.0	123 02 44.0	0.03	Sequim, WA (CREST BB SMO)
TAKO	%	43 44 36.6	124 04 52.5	0.046	Tahkenitch, OR CREST BB SMO
TOLO	%	44 37 19.3	123 55 16.6	0.021	Toledo BPA, OR CREST BB SMO
TTW	%	47 41 40.7	121 41 20.0	0.542	Tolt Res, WA CREST BB SMO
WVOR	U	42 26 02.0	118 38 13.0	1.344	Wildhorse Valley, Oregon (USNSN)
YBH		41 43 55.3	122 42 37.4	1.06	Yreka, CA from UCB

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
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,
E = continuously telemetered via Internet from a remote EARTHWORM system
I = continuously telemetered via Internet
L = continuously telemetered via dedicated lease-line telephone lines
P = continuously telemetered via dedicated lease-line telephone lines using PPP protocol
M = continuously telemetered via BPA microwave
R = continuously telemetered via spread-spectrum radio

TABLE 2C - Strong-motion three-component stations

STA	F	LAT	LONG	EL	NAME	SENSOR	TEL.
ALCT	%	47 38 48.8	122 2 15.7	0.055	Alcott Elementary	K2	I
ALST	%	46 6 32.3	123 1 58.5	0.198	Alston	A20	E,M
ALVY	%	43 59 53.2	123 0 57.0	0.155	Alvey	K2	E,M
ATES	%	48 14 10.9	122 3 33.0	0.062	Trafton Elementary	K2	I
BABE	%	47 36 21.0	122 32 7.0	0.083	Blakely Elementary	K2	I
BEND	%	44 4 0.8	121 19 36.0	0	U of O Bend Field Office	K2	I
BEVT	%	47 55 12.0	122 16 12.0	0.17	Boeing Plant Everett	K2	I
BRKS	%	47 45 19.1	122 17 17.9	0.02	Brookside Elementary	K2,BBZ	I
BULL	%	45 26 45.8	122 9 16.9	0.222	Bull Run Dam	A	I
COLT	%	45 10 13.1	122 26 12.8	0.213	Colton High School	CMG5T	I
CSO	#	45 31 1.0	122 41 22.5	0.036	Canyon	FBA23	D
DBO	%	43 7 9.0	123 14 34.0	0.984	Dodson Butte (CREST)	EPI,BB3	E,L-PPP
EARN	%	47 44 27.2	122 2 37.7	0.159	East Ridge Elementary	K2	I
EGRN	%	47 4 24.0	122 58 41.0	0.057	Evergreen State College	K2	I
ELW	%	47 29 39.4	121 52 17.2	0.267	Echo Lake	A,BB	D,M,L
ERW	%	48 27 14.4	122 37 30.2	0.389	Mount Erie	A,BB	D,L,M
EUO	%	44 1 45.7	123 4 8.2	0.16	Eugene Golf Course (CREST)	EPI,BB	E,L-PPP
EVCC	%	48 0 27.0	122 12 15.3	0.03	Everett Community College	K2	I
EVGW	%	47 51 15.8	122 9 12.2	0.122	Gateway Middle School	K2	I
EYES	%	45 19 46.5	123 3 23.5	0.061	Ewing Young Elementary	CMG5T	I
FINN	%	47 43 10.2	122 13 55.9	0.121	Finn Hill Junior High	K2	I
GNW	%	47 33 51.8	122 49 31.0	0.165	Green Mountain (CREST)	EPI,BB3	L-PPP
HAO	#	45 30 33.1	122 39 24.0	0.018	Harrison	FBA23	D
HEBO	%	45 12 49.2	123 45 15.0	0.875	Mt. Hebo (CREST)	EPI,BB	M,E
HICC	%	47 23 24.4	122 17 52.4	0.115	Highline Community College	K2	I
HOLY	%	47 33 55.4	122 23 1.0	0.106	Holy Rosary School	K2	I
HOOD	%	45 19 17.8	121 39 7.8	1.52	Hood Meadows (CREST)	EPI,BB	L-PPP,I
HUBA	%	45 37 51.0	122 39 4.9	0.023	Hudson's Bay High School	CMG5T	I
KDK	%	47 35 42.7	122 19 56.0	0.004	King Dome	K2	I

TABLE 2C - Strong-motion three-component stations

STA	F	LAT	LONG	EL	NAME	SENSOR	TEL.
KEEL	%	45 33 0.8	122 53 42.4	0.067	Keeler	A20	D,E,M
KICC	%	47 34 37.9	122 37 52.4	0.017	Kitsap County Central Communications	K2	I
KIMB	%	47 34 29.3	122 18 10.1	0.069	Kimball Elementary	K2	I
KIMR	%	47 30 11.0	122 46 2.0	0.123	Moderate Risk Waste Collection Facility	K2	I
KINR	%	47 45 6.0	122 38 35.0	0.008	North Road Shed	K2	I
KITP	%	47 40 30.0	122 37 47.0	0.076	Wastewater Treatment Plant	K2	I
KNJH	%	47 23 5.0	122 13 42.0	0.014	Kent Junior High	K2	I
LANE	%	44 3 6.5	123 13 54.8	0.12	Lane	K2	E,M
LAWT	%	47 39 23.4	122 23 21.9	0.05	Lawton Elementary	SLN-320	I
LEOT	%	47 46 4.4	122 6 56.2	0.115	Leota Junior High	K2	I
LON	%	46 45 0.0	121 48 36.0	0.853	Longmire Springs (CREST)	EPI,BB3	L-PPP
LTY	%	47 15 21.2	120 39 53.4	0.97	Liberty Heights Mine (CREST)	BB3	I
MARY	%	47 39 45.7	122 7 11.6	0.011	Marymoor Park	K2	I
MBKE	%	48 55 2.0	122 8 29.0	1.01	Kendall Elementary	K2	I
MBPA	%	47 53 54.7	121 53 20.2	0.186	Monroe	A20	D,M,L
MEAN	%	47 37 21.7	122 18 18.7	0.037	Meany Middle School	K2	I
MEGW	%	46 15 57.4	123 52 38.2	0.332	Megler (CREST)	EPI,BB	M,E
MPL	%	47 28 7.0	122 11 4.5	0.122	Maple Valley	A	D,M,L
MRIN	%	44 48 1.4	122 41 53.8	0.187	Marion	K2	M,E
MURR	%	47 7 12.0	122 33 36.0	0.082	Camp Murray	K2	None
NIHS	%	47 44 29.2	122 13 17.1	0.137	Inglemoore High School	K2	I
NOWS	%	47 41 12.0	122 15 21.2	0.002	NOAA Sand Point	A20	I
OFR	%	47 56 0.0	124 23 41.0	0.152	Olympic Natural Resources Center (CREST)	EPI,BB	I,E
OHC	%	47 20 2.0	123 9 29.0	0.006	Hood Canal Junior High	K2	I
OPC	%	48 6 1.0	123 24 41.8	0.09	Peninsula College (CREST)	EPI,BB	I
PAYL	%	47 11 34.0	122 18 46.0	0.009	Aylen Junior High	K2	I
PCEP	%	47 6 41.8	122 17 24.0	0.16	Puyallup East Sheriff Precinct	K2	I
PCFR	%	46 59 23.3	122 26 27.4	0.137	Roy Training Center	K2	I
PCMD	%	46 53 20.9	122 18 0.9	0.239	Mountain Detachment	K2	I
PERL	%	45 19 42.0	122 46 40.2	0.068	Pearl	K2	M,E
PIN	%	43 48 40.0	120 52 19.0	1.865	Pine Mtn. (CREST)	EPI,BB3	E,L-PPP
PNLK	%	47 34 54.5	122 2 1.0	0.128	Pine Lake Middle School	K2	I
QAW	%	47 37 54.3	122 21 15.5	0.14	Queen Anne	A20	L
RAW	%	47 20 14.0	121 55 53.2	0.208	Raver	A20	M,L
RBEN	%	47 26 6.7	122 11 10.0	0.152	Benson Hill Elementary	K2	I
RBO	#	45 32 27.0	122 33 51.5	0.158	Rocky Butte	FBA23	D
RHAZ	%	47 32 24.7	122 11 1.3	0.108	Hazelwood Elementary	A20	I
ROSS	%	45 39 43.0	122 39 25.0	0.061	Ross	A20	E
RRHS	%	46 47 58.6	123 2 25.4	0.047	Rochester High School	K2	I
RWW	%	46 57 53.7	123 32 31.7	0.015	Ranney Well (CREST)	EPI,BB3	L-PPP
SBES	%	48 46 5.9	122 24 54.2	0.119	Silver Beach Elementary School	K2	I
SEA	%	47 39 15.8	122 18 29.3	0.03	University of Washington	A20,PMD2023	L
SFER	%	47 37 10.4	117 21 55.7	0.715	Ferris High School	K2	I
SGAR	%	47 40 37.8	117 24 50.3	0.579	Garfield Elementary	K2	I
SHIP	%	47 39 19.0	122 19 14.4	0.005	WashDOT Lake Union Shop	CMG5T	I,R
SHLY	$	47 42 30.4	117 24 57.7	0.626	Spokane Temp	K2	None
SMNR	%	47 12 16.6	122 13 53.4	0.022	Sumner High School	K2	I
SNIO	$	47 40 46.0	117 24 18.0	0.584	Spokane NIOSH	K2	None
SOPS	$	47 43 40.8	117 18 46.5	0.707	Orchard Prairie Elementary	K2	I
SP2	%	47 33 23.3	122 14 52.8	0.03	Seward Park	A,BB	L
SQM	%	48 4 39.0	123 2 44.0	0.03	Sequim Battelle Properties (CREST)	EPI,BB	I,R

TABLE 2C - Strong-motion three-component stations

STA	F	LAT	LONG	EL	NAME	SENSOR	TEL.
SVOH	%	48 17 21.8	122 37 54.8	0.022	Skagit Valley College Oak Harbor	K2	I
SVTR	%	47 29 45.4	121 46 49.3	0.146	Two Rivers School	CMG5T	I
SWES	%	47 42 51.0	117 27 53.2	0.623	Westview Elementary	K2	I
SWID	%	48 0 31.0	122 24 42.0	0.062	South Whidbey Primary School	K2	I
TAKO	%	43 44 36.6	124 4 52.5	0.046	Tahkenitch (CREST)	EPI,BB	M,E
TBPA	%	47 15 29.0	122 22 1.0	0.002	Tacoma	A20	M,L,D
TKCO	%	47 32 12.7	122 18 1.5	0.005	King County Airport	A20	I
TOLO	%	44 37 19.3	123 55 16.6	0.021	Toledo (CREST)	EPI,BB	M,E
TTW	%	47 41 40.7	121 41 20.0	0.542	Tolt Reservoir (CREST)	EPI,BB3	I
UPS	%	47 15 50.2	122 29 1.1	0.113	University of Puget Sound	K2	I
UWFH	%	48 32 46.0	123 0 43.0	0.01	Friday Harbor Laboratories	K2	I
VVHS	%	47 25 25.1	122 27 13.1	0.095	Vashon High School	K2	I
WISC	%	47 36 32.0	122 10 27.8	0.056	Wilburton Instructional Services Center	K2	I

EARTHQUAKE DATA - 2003-A

There were 1,035 events digitally recorded and processed at the University of Washington between January 1 and March 31, 2003. Locations in Washington, Oregon, or southernmost British Columbia were determined for 575 of these events; 465 were classified as earthquakes and 110 as known or suspected blasts. The remaining 460 processed events include teleseisms (128 events), regional events outside the PNSN (86), and unlocated events within the PNSN. Unlocated events within the PNSN include surficial events on Mt. St. Helens and Mt. Rainier, very small earthquakes, and blasts. Frequent mining blasts occur near Centralia, Washington and we routinely locate them.

Table 3A is a listing of all earthquakes reported to have been felt during this quarter. Events with ShakeMaps or Community Internet Intensity Maps (CIIM) are indicated. ShakeMap **http://www.ess.washington.edu/shake/index.html** shows instrumentally measured shaking using data from accelerometers in the network. Peak ground acceleration (PGA) values are modeled using information from accelerometers, local geology, and distance to the epicenter. CIIM maps **http://pasadena.wr.usgs.gov/shake/pnw/** are made using "felt" reports relayed via Internet. The "felt" reports are converted into numeric intensity values, and the CIIM map shows the average intensity by zip code.

Table 3B is a listing of earthquakes magnitude 2.5 or greater and in some cases include parameters for focal mechanisms from P-wave first motions. Table 4 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.

Figure 2. Earthquakes with magnitude greater than or equal to 0.0 (M_c >=0).

Figure 3. Blasts and probable blasts (M_c >=0).

Figure 4. Earthquakes located near Mt. St. Helens (M_c >=0).

Figure 5. Earthquakes located near Mt. Rainier (M_c >=0).

Figure 6. Focal mechanisms computed for earthquakes M 2.5 or larger.

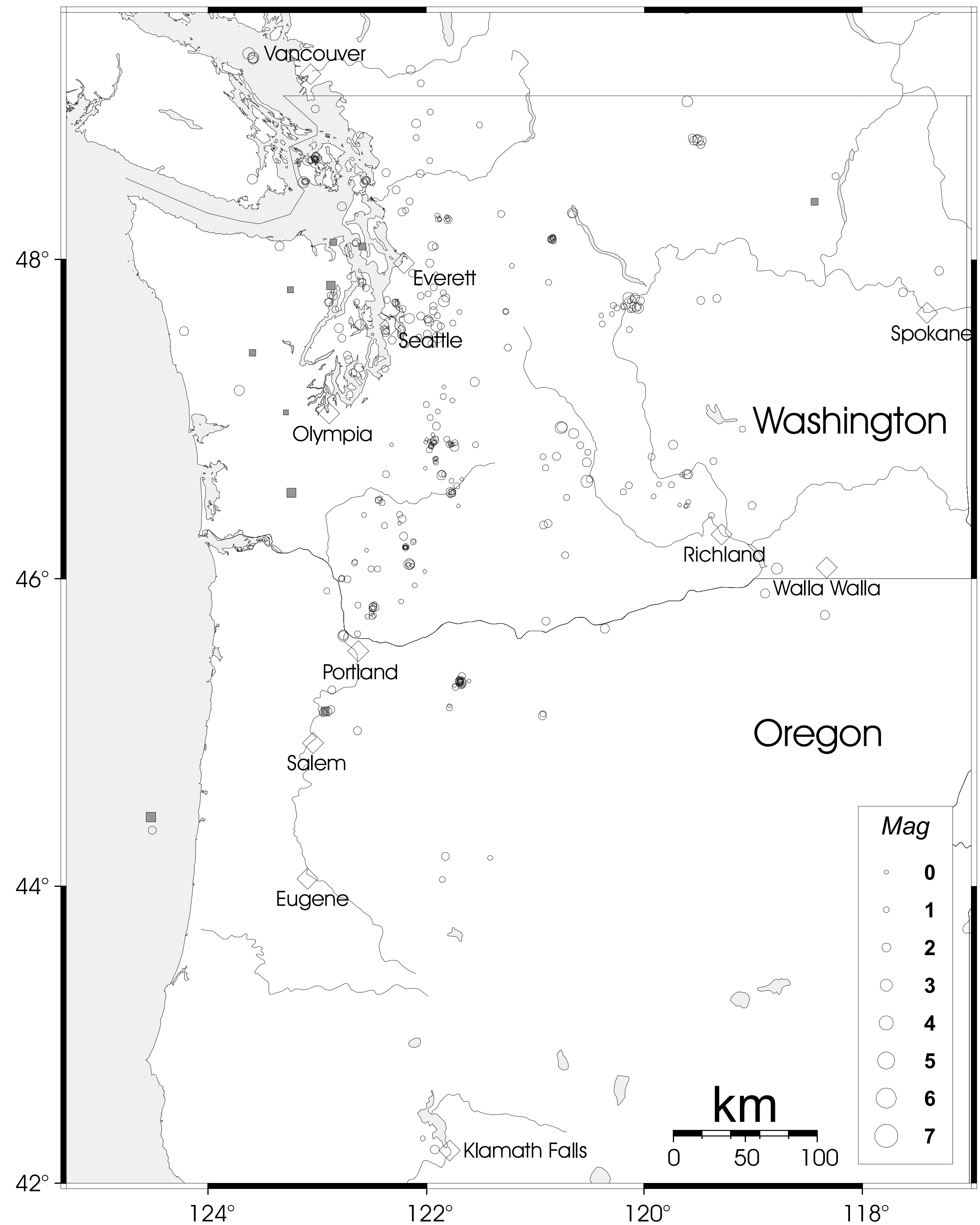

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Figure 2. Earthquakes with magnitude greater than or equal to 0.0 (Mc >=0.)

Unfilled diamonds represent cities.

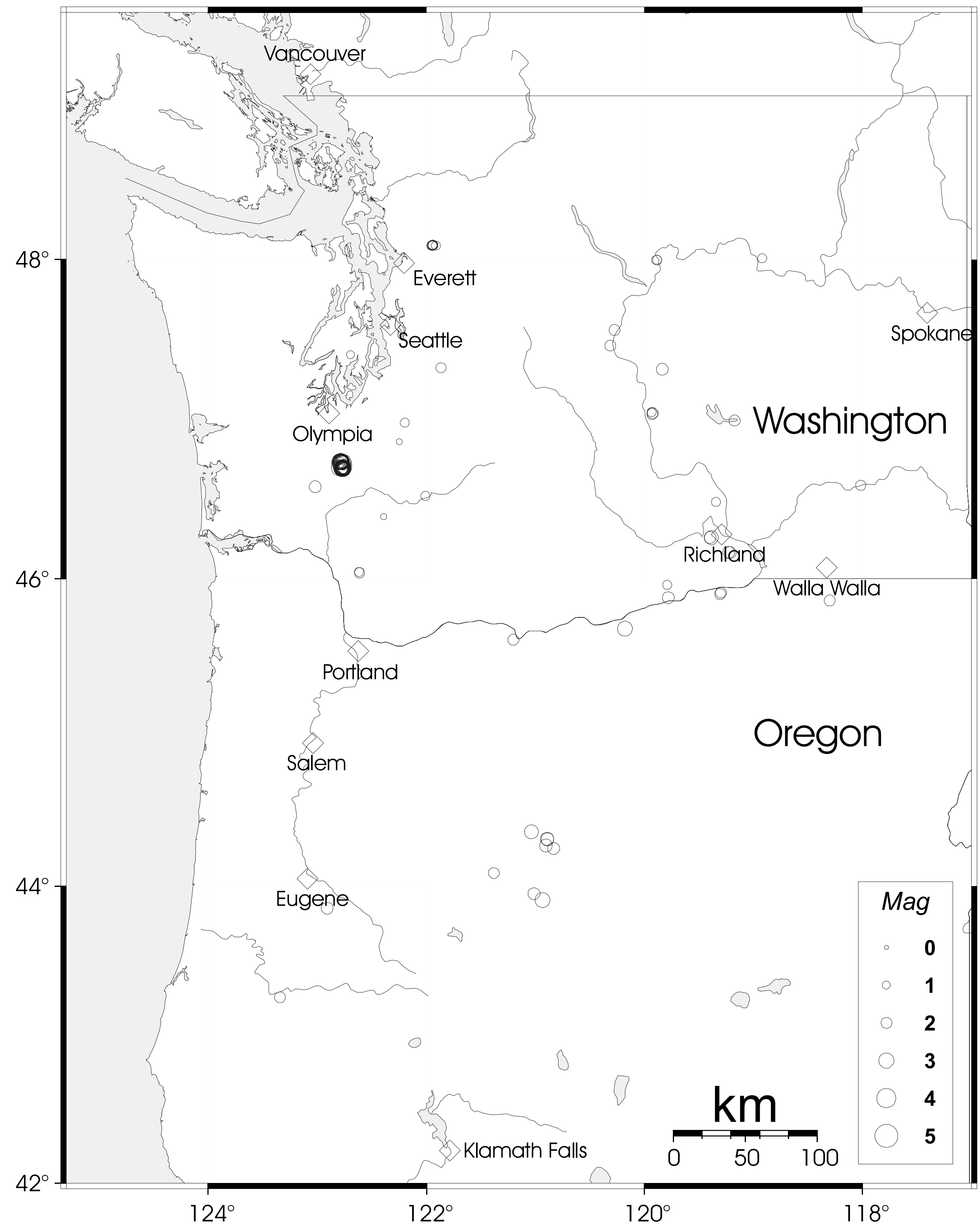
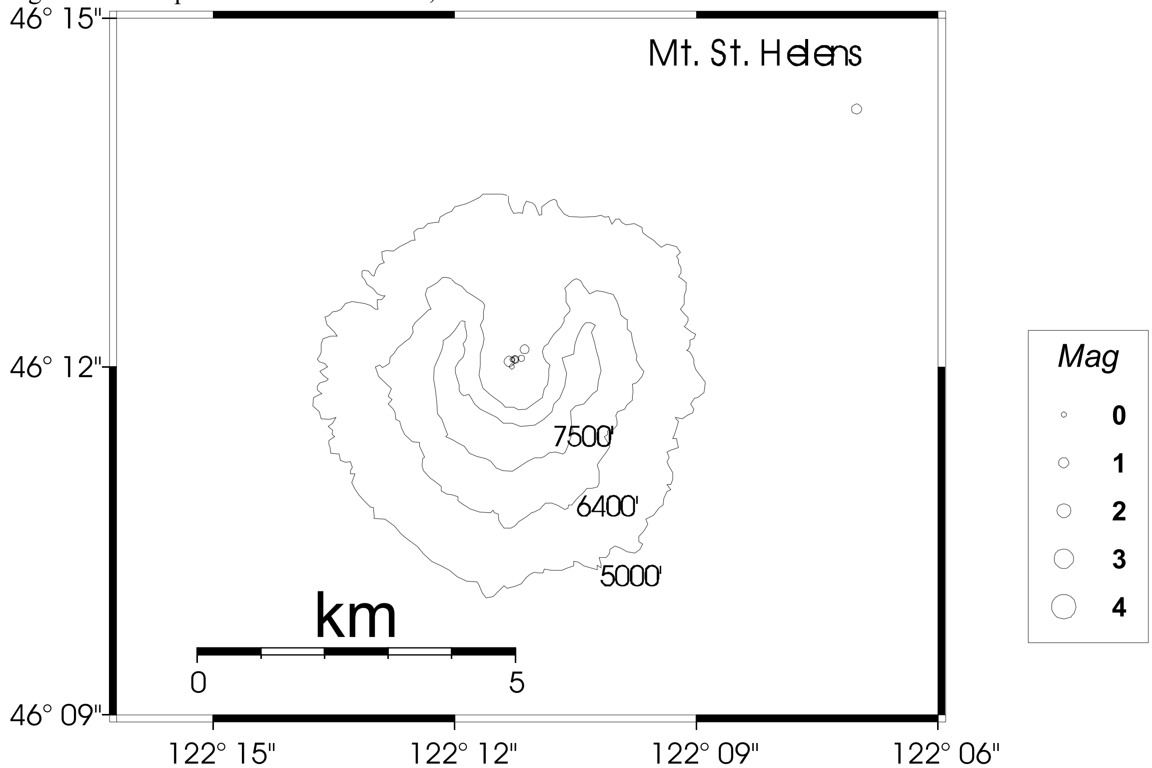


Figure 3. Blasts and probable blasts.

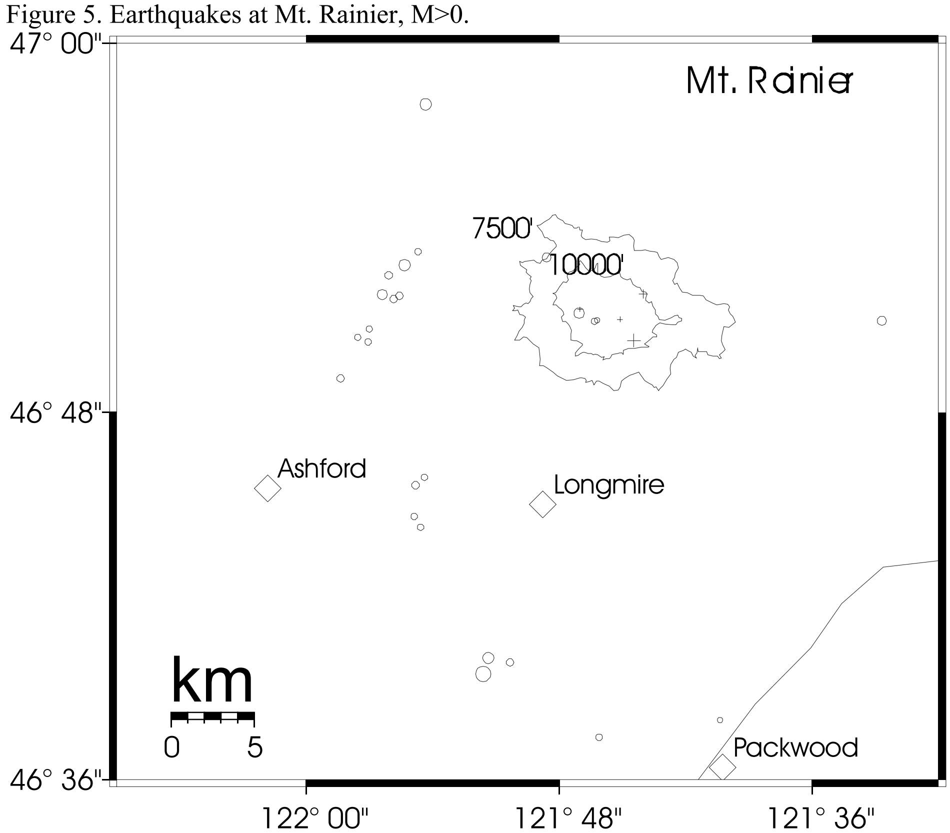
Unfilled diamonds represent cities

Figure 4. Earthquakes at Mt. St. Helens, M>0.



'Plus' symbols indicate depth less than 1 km. Circles indicate depth greater than 1 km. Elevation contours shown in feet

Figure 5. Earthquakes at Mt. Rainier, M>0.



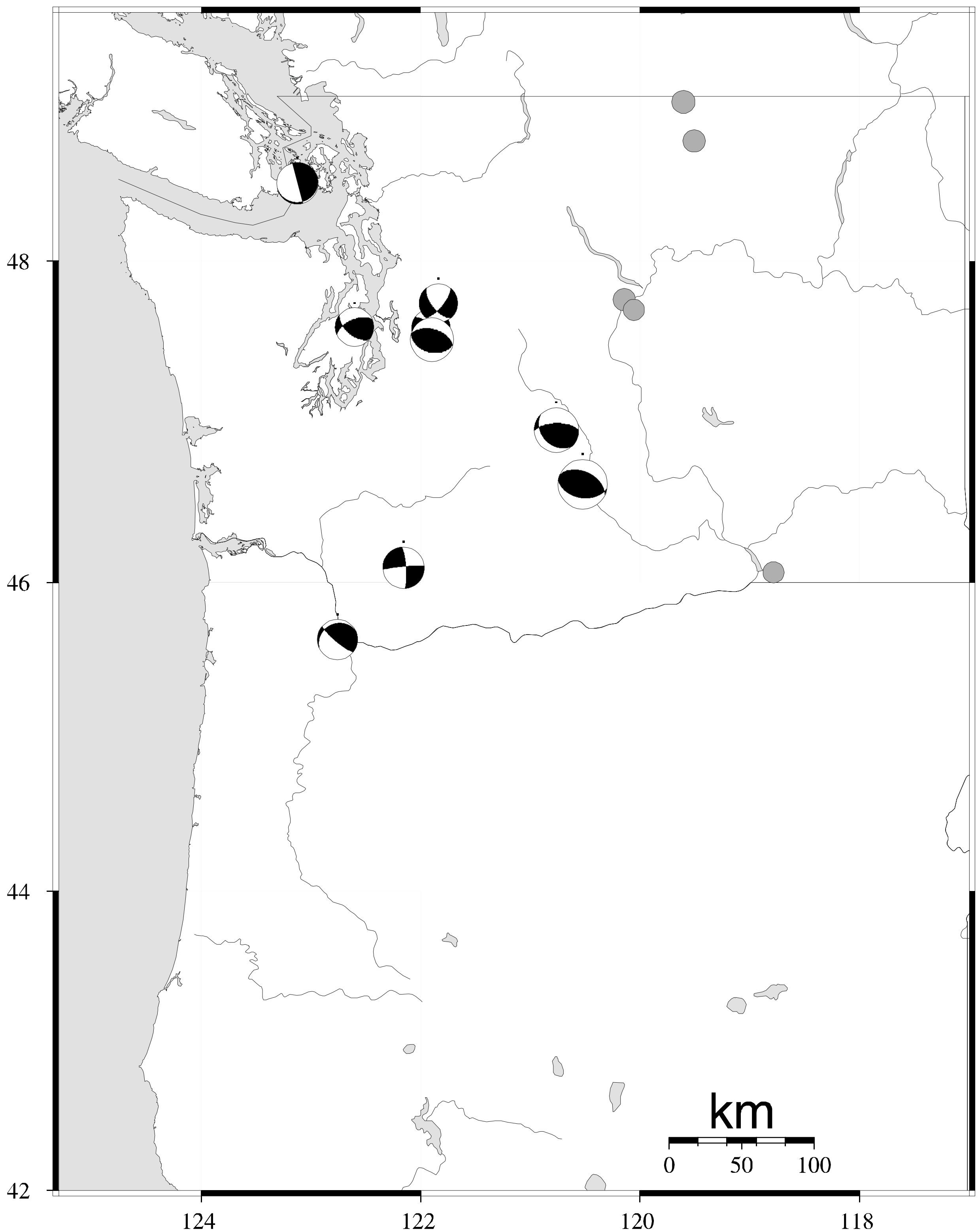


Figure 6. Focal mechanisms for earthquakes magnitude 2.5 or greater.

TABLE 3A - Felt Earthquakes during the 1st Quarter of 2003

DATE-(UTC)-TIME yy/mm/dd hh:mm:ss	LAT(N) deg.	LON(W) deg.	DEP km	MAG Ml	COMMENTS	CIIM	ShakeMap
03/01/09 17:55:11	47.62	121.97	8.8	2.1	5.3 km SW of Carnation, Wa		
03/01/13 09:58:00	47.76	120.14	0.5	2.7	12.9 km NNE of Entiat, WA		
03/01/13 09:58:00	47.77	120.12	4.6	2.6	11.1 km SW of Chelan, WA		
03/01/14 00:06:06	48.47	123.12	20.9	2.7	10.9 km SW of Friday Harbor, WA		
03/01/14 20:52:50	47.59	121.90	2.3	2.5	3.0 km NNW of Fall City, WA	x	x
03/01/15 03:41:58	46.61	120.52	11.0	3.2	2.7 km NNW of Yakima, Wa		
03/01/17 01:18:26	48.62	123.00	13.5	2.4	10.2 km N of Friday Harbor, WA		
03/01/17 01:42:38	48.60	123.08	8.2	2.4	10.2 km NW of Friday Harbor, WA		
03/01/31 22:47:28	47.74	121.83	0.0	2.5	11.0 km E of Duvall, WA		
03/02/07 09:16:50	48.49	123.59	23.0	2.2	19.9 km WNW of Victoria, BC		
03/02/08 18:39:10	47.51	121.89	5.8	2.8	5.3 km S of Fall City, WA	x	
03/02/19 13:54:13	46.54	121.77	1.4	2.4	24.9 km W of Goat Rocks, WA		
03/03/09 03:29:52	47.63	122.15	22.0	2.4	4.3 km NE of Bellevue, WA		
03/03/18 11:42:28	47.59	122.60	27.2	2.5	3.8 km NNE of Bremerton, WA		
03/03/20 16:07:47	48.73	119.51	0.0	2.7	41.0 km N of Okanogan, WA		
03/03/21 11:23:11	49.22	123.59	6.9	2.2	40.2 km WNW of Vancouver,BC		
03/03/24 13:16:49	49.23	123.58	23.6	2.7	39.9 km WNW of Vancouver,BC		
03/03/24 13:43:36	49.25	123.62	15.3	2.9	43.5 km WNW of Vancouver,BC		
03/03/31 21:20:22	45.63	122.75	16.9	2.6	15.5 km NW of Portland, OR		

TABLE 3B - Earthquakes M 2.5 or larger during the 1st Quarter of 2001. Events shown in Fig. 6. Focal mechanisms noted where computed. Some earthquakes have more than one possible mechanism.

DATE-(UTC)-TIME yy/mm/dd hh:mm:ss	LAT(N) deg.	LON(W) deg.	DEP km	MAG	COMMENTS	STRIKE deg.	DIP deg.	RAKE deg.
03/01/13 09:58:00	47.76	120.14	0.5	2.7	12.9 km NNE of Entiat, WA	-	-	-
03/01/14 00:06:06	48.48	123.12	20.9	2.7	10.9 km SW of Friday Harbor, WA	345	90	-80
03/01/14 20:52:50	47.59	121.91	2.3	2.5	3.0 km NNW of Fall City, WA	305	75	150
						150	50	-120
03/01/15 03:41:58	46.62	120.53	11	3.2	2.7 km NNW of Yakima, Wa	100	45	80
03/01/25 12:15:14	46.96	120.76	2.5	2.9	17.5 km WSW of Ellensburg, WA	135	35	130
03/01/31 22:47:28	47.74	121.84	0	2.5	11.0 km E of Duvall, WA	40	70	-30
03/02/08 13:45:00	48.97	119.61	5.4	2.8	59.4 km S of Penticton, BC	-	-	-
03/02/08 18:39:10	47.52	121.9	5.8	2.8	5.3 km S of Fall City, WA	105	40	90
03/02/23 07:54:00	46.06	118.79	8.8	2.6	30.4 km ESE of Kenewick, WA	-	-	-
03/02/27 10:02:10	47.7	120.06	6	2.6	13.3 km ENE of Entiat, WA	-	-	-
03/03/03 19:55:12	46.09	122.16	6.5	2.7	12.1 km SSE of Mt St Helens, WA	265	85	-10
03/03/18 11:42:28	47.6	122.6	27.2	2.5	3.8 km NNE of Bremerton, WA	130	55	140
03/03/20 16:07:47	48.73	119.51	0	2.7	41.0 km N of Okanogan, WA	-	-	-
03/03/31 21:20:22	45.64	122.76	16.9	2.6	15.5 km NW of Portland, OR	130	80	110

OREGON

During the first quarter of 2003, a total of 44 earthquakes were located in Oregon between 42.0 degrees and 45.5 degrees north latitude, and between 117 degrees and 125 degrees west longitude. The largest earthquakes in Oregon this quarter were two magnitude 2.2 events on January 19 UTC, located about 4 km south-south-east of Mt. Hood at a depth of about 5 km.

In the Klamath Falls area, 2 earthquakes, both smaller than magnitude 2.0, were located this quarter. Since 1994, most earthquakes in the Klamath Falls area have occurred in the aftershock zone of a pair of damaging earthquakes in September, 1993. The 1993 earthquakes were followed by a vigorous aftershock sequence that decreased over time.

OREGON CASCADE VOLCANOES

This quarter 27 earthquakes were located in the area around Mount Hood from 45.25 to 45.45 N latitude and 121.6 to 121.8 W longitude. The largest earthquakes near Mt. Hood this quarter were the two magnitude 2.2 events on January 19.

WESTERN WASHINGTON SEISMICITY

During the first quarter of 2003, 336 earthquakes were located between 45.5 degrees and 49.5 degrees north latitude and between 121 degrees and 125.3 degrees west longitude. Fifteen earthquakes, all smaller than magnitude 3.0, were felt this quarter in western Washington. Details are in Table 3A.

The largest felt earthquake in western Washington was a magnitude 2.8 earthquake on Feb. 8, located at about 6 km depth approximately 5 km south of Fall City, WA. The deepest quake in western Washington was a magnitude 1.7 earthquake at about 51 km depth, located about 21 km northwest of Poulsbo, WA on January 22.

In late February and early March, a “silent earthquake” slip event was detected on the Cascadia Subduction Zone. Movement occured deep beneath the Strait of Juan de Fuca and parts of Vancouver Island where the Juan de Fuca tectonic plate is subducted beneath the North American plate. These “silent earthquakes” were first detected several years ago using GPS observations and occur about every 14 months. Although the energy release is equivalent to the magnitude 6.8 Nisqually earthquake, slip is so slow that no shaking is felt. However, careful study by graduate student Wendy McCausland revealed low amplitude seismic signals occurring during the event. The event began on Feb. 26 and continued for several weeks. This was the first time that information on these “silent earthquakes” was available during the event, and the discovery of accompanying seismic signals attracted considerable media attention. Information is available via web pages at:
http://www.washington.edu/newsroom/news/2003archive/03-03archive/k031303.html
http://www.pgc.nrcan.gc.ca/geodyn/docs/slip/slip_info_1.html
http://www.ess.washington.edu/SEIS/PNSN/WEBICORDER/DEEPTREM/

WASHINGTON CASCADE VOLCANOES

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). There was one located event flagged "L" or "S" at Mount Rainier this quarter although 120 "L" or "S" events were recorded, but were too small to locate reliably. Type L and S events are not shown in Fig. 4.

A total of 56 tectonic events (20 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. The largest tectonic earthquake located near Mt. Rainier this quarter was a magnitude 2.1 earthquake on Feb. 27, 06:40 UTC, located about 23 km south-southwest of the summit at about 6 km depth. This quarter, 39 tectonic earthquakes 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). Within 5 km of the summit, there were 11 (4 of them smaller than magnitude 0.0 and thus not shown in Fig. 4) higher-frequency tectonic-style earthquakes, and the remaining events were scattered around the cone of Rainier as seen in Fig. 4.

Mount St. Helens

Figure 5 shows volcano-tectonic earthquakes near Mount St. Helens. Low frequency (L) and avalanche or rockfall events (S) are not shown.

This quarter, 90 earthquakes were located at Mount St. Helens in the area shown in Fig. 5. Of these earthquakes, 13 were magnitude 0.0 or larger and 8 were deeper than 4 km. The largest tectonic earthquake at Mount St. Helens this quarter was a magnitude 1.0 event at about 10 km depth on Feb. 18 UTC. It was located about 5 km southeast of Spirit Lake.

No type "S" or "L" events were located at Mount St. Helens, but 35 "L" or "S" events too small to locate were recorded.

EASTERN WASHINGTON SEISMICITY

During the first quarter of 2003, 85 earthquakes were located in eastern Washington in the area between 45.5-49.5 degrees north latitude and 117-121 degrees west longitude. No earthquakes were recorded near Spokane this quarter. The largest earthquake in Washington this quarter was magnitude 3.2, on January 15. It located at a depth of about 11 km approximately 3 km north-northwest of Yakima. Other activity in eastern Washington included a spatial cluster of 18 crustal events near Entiat, and a cluster of 6 shallow (most less than 2 km depth) events about 40 km north of Okanogan on March 20 UTC.

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@ess.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: Northwest Interpretive Association (NWIA), 909 First Avenue Suite 630, Seattle WA 98104, Telephone 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 4

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.

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

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

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.

Coda-length magnitude, Mc: an estimate of local magnitude ML (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). Magnitudes may be revised as we improve our analysis procedure.

NS: 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.

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

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.

Quality factors: Two 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.

First Quality factor is a measure of the hypocenter quality based on travel-time residuals. For example:

A quality requires an RMS less than 0.15 sec.

D quality has an RMS of 0.5 sec.

Second Quality factor 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. A quality requires a solution with 8 or more phases, GAP <= 90 degrees and DMIN <= 5 km or depth, whichever is greater. If the number of phases, NP, is 5 or fewer or GAP > 180 degrees or DMIN > 50 km the solution is assigned quality D.

Crustal velocity model: Layered velocity models appropriate to different geographic areas are used in location calculations (Ludwin, R.S., et al., 1994, Earthquake hypocenters in Washington and northern Oregon, 1987-1989, and Operation of the Washington Regional Seismograph Network, Information Circular 89, Washington State Dept. of Natural Resources).

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

Flagging: Events flagged in Table 4 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

EARTHQUAKE CATALOG, 2003-A

TABLE 4. Tectonic earthquakes, 1st quarter, 2003, magnitude 2.0 and larger

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

Jan-03

DAY	TIME	LAT	LON	DEPTH	M	NS/NP	GAP	RMS	Q	MOD	TYP
9	55:11.7	47 37.24	121 58.37	8.83	2.1	45/051	40	0.19	BA	P3	F
11	16:08.1	46 32.66	123 13.87	32.21	2.0	6/006	190	0.49	DD	P3	
13	58:01.0	47 46.59	120 07.53	4.59	2.6	27/031	74	0.29	BB	N3	F
14	06:06.4	48 28.52	123 07.34	20.87	2.7	26/028	77	0.26	BA	P3	F
14	52:50.9	47 35.47	121 54.35	2.34*	2.5	51/062	46	0.19	BB	P3	F
15	41:58.4	46 37.06	120 31.51	11.04	3.2	42/044	67	0.18	BA	E3	F
17	18:26.8	48 37.61	123 00.49	13.52	2.4	29/032	92	0.22	BB	P3	F
17	42:38.5	48 36.47	123 05.32	8.17	2.4	32/037	75	0.32	CB	P3	F
19	34:30.5	45 20.41	121 41.19	4.57	2.2	38/039	38	0.29	BA	O0	
19	34:54.0	45 19.87	121 40.59	6.23	2.2	7/007	122	0.06	AB	O0	
19	08:36.0	48 17.37	120 39.45	6.92	2.3	27/036	86	0.65	DC	C3	
19	00:32.6	44 27.26	124 31.39	34.04	2.1	9/009	262	0.09	BD	O0	
25	15:14.8	46 57.39	120 45.69	2.47$	2.9	54/058	42	0.31	CC	C3	
30	23:22.0	46 57.69	120 45.16	0.03*	2.4	31/034	51	0.39	CC	C3	
31	47:28.2	47 44.62	121 50.28	0.03*	2.5	75/077	23	0.38	CB	P3	F

Feb-03

DAY	TIME	LAT	LON	DEPTH	M	NS/NP	GAP	RMS	Q	MOD	TYP
6	54:37.6	45 54.29	118 53.31	18.36	2.1	26/027	141	0.20	BC	E3	
6	44:09.6	47 45.92	120 05.00	4.1	2.1	15/019	65	0.13	AB	N3	
7	16:50.5	48 29.66	123 35.72	23.03	2.2	26/030	126	0.33	CB	P3	F

8	44:59.5	48 57.98	119 36.38	5.42	2.8	13/013	140	0.20	BC	N3	
8	39:10.3	47 31.17	121 53.88	5.75	2.8	66/073	23	0.31	CA	P3	F
10	55:49.1	48 29.01	122 33.07	12.34	2.1	21/024	72	0.20	BA	P3	
14	36:40.9	47 14.56	121 33.34	10.51$	2.0	37/043	52	0.42	CB	C3	
19	54:13.3	46 32.82	121 46.25	1.35$	2.4	53/057	40	0.30	CC	C3	F
23	54:00.1	46 03.73	118 47.16	8.78	2.6	25/027	116	0.34	CB	E3	
23	04:02.3	46 44.36	120 31.71	7.78$	2.0	28/030	71	0.36	CC	E3	
24	09:37.2	45 40.78	120 21.63	0.04*	2.1	10/010	120	0.52	DC	E3	
25	33:09.3	47 11.46	123 42.76	11.06*	2.2	44/050	139	0.51	DC	P3	
27	40:44.9	46 39.45	121 51.58	5.81	2.1	42/043	47	0.11	AB	C3	
27	02:10.1	47 42.17	120 03.45	6.03	2.6	26/027	48	0.20	BB	N3	

Mar-03

DAY	TIME	LAT	LON	DEPTH	M	NS/NP	GAP	RMS	Q	MOD	TYP
3	55:12.3	46 05.54	122 09.40	6.46	2.7	53/055	34	0.23	BA	S3	
9	29:52.8	47 38.23	122 09.44	22.05	2.4	64/066	35	0.20	BA	P3	F
18	18:22.7	46 50.99	119 44.13	3.16	2.0	34/035	37	0.19	BC	E3	
18	10:07.8	49 09.52	122 08.35	6.18*	2.0	14/015	283	0.39	CD	P3	
18	42:28.2	47 35.79	122 36.26	27.19	2.5	83/086	70	0.18	BA	P3	F
18	06:04.9	45 46.07	118 20.51	0.02*	2.1	14/014	232	0.28	BD	E3	
20	54:07.6	48 43.72	119 32.55	0.04*	2.1	15/015	138	0.61	DD	N3	
20	07:47.1	48 43.94	119 30.61	0.03*	2.7	12/012	141	0.05	AD	N3	F
20	29:22.2	48 43.84	119 28.22	0.41#	2.0	17/018	144	0.51	DD	N3	
21	23:11.6	49 13.62	123 35.45	6.87*	2.2	19/020	240	0.21	BD	P3	F
22	52:12.5	46 55.10	120 38.83	10.85	2.4	42/048	44	0.31	CA	E3	
24	16:49.2	49 13.90	123 35.02	23.56*	2.7	22/024	241	0.28	BD	P3	F
24	43:36.9	49 15.27	123 37.50	15.29$	2.9	23/024	244	0.27	BD	P3	F
24	44:19.9	46 39.86	119 36.55	0.24*	2.0	15/016	54	0.25	BB	E3	
27	27:46.2	49 13.10	123 35.34	0.18	2.1	13/014	239	0.26	BD	P3	
29	06:04.8	47 33.66	124 13.13	26.54	2.1	27/030	170	0.29	BC	P3	
31	25:43.0	45 38.18	122 45.68	16.95	2.1	29/032	42	0.11	AA	C3	
31	20:22.0	45 38.13	122 45.46	16.92	2.6	51/052	42	0.18	BA	C3	F

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 geologic hazards. Our outreach includes lectures, classes, lab tours, and workshops. Special attention is played to the information needs of the media we provide with press conferences, contributions to TV and radio news programs and talk shows, provide field trips, and welcome their participation in regional earthquake planning efforts. We provide direct information to the public through information sheets, an audio library, and via the Internet at: http://www.ess.washington.edu/SEIS/PNSN.

Telephone, Mail, and On-line outreach

The PNSN audio library system received about 360 calls this quarter. Our audio library offers recordings on recent seismicity, seismic hazards of Washington and Oregon, and earthquake prediction. We dropped the recording on recent seismicity for a while, but reinstated it this quarter due to popular demand from callers without internet access. Fact sheets on seismic hazards and earthquake prediction are also available, and thousands have been mailed out or distributed. We also encourage others to freely reproduce and further distribute our information.

Callers to the PNSN audio library can choose to be transferred to the Seismology Lab, where additional information is available. This quarter we responded in person to:

- 40 calls from emergency managers and government,
- 55 calls from the media,
- 36 calls from k-12 educators
- 25 calls from the business community
- 65 calls from the general public.

Internet outreach

PNSN staff responded to over 100 e-mail messages from the public seeking information on a variety of topics using our seis_info@ess.washington.edu email address. In addition to routine questions, the appropriate staff person handles complex questions, sometimes requiring in-depth responses. These replies include providing assistance with hazard assessments, consultations with government agencies, and providing strong motion data and related information to the engineering community.

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 Volcanoes, and Quarterly summaries of seismicity are also included. The PNSN recent earthquake list is available through the World-Wide-Web (WWW) at:

http://www.ess.washington.edu/recenteqs/latest.htm

"Webicorder" pages show continuous data from PNSN seismographic stations: http://www.ess.washington.edu/SEIS/PNSN/WEBICORDER/. “ShakeMap” shows maps of instrumentally measured shaking. Table 3A indicates events this quarter with ShakeMaps: http://www.ess.washington.edu/shake/index.html

Web-Site Development

Work has continued to improve navigational ease and enhance the information offered through our web site. Acknowledgement of the contributions made by our numerous partners and contributing organizations can now be found at: http://www.ess.washington.edu/SEIS/PNSN/PARTNERS/welcome.html

In addition to the PNSN web site, the UW Dept. of Earth and Space Sciences and the PNSN host several other earthquake-related web sites:

- **Volcano Systems Center**, http://www.vsc.washington.edu is a cooperative effort of the UW and the USGS that links volcano-related activities of the UW Dept. of Earth and Space Sciences and Oceanography departments with related USGS activities.
- **Seismosurfing**: http://www.ess.washington.edu/seismosurfing.html is a comprehensive listing of sites worldwide that offer substantive seismology data and information. This page is mirrored at two sites in Europe.
- **"Tsunami!"** http://www.ess.washington.edu/tsunami offers many pages, including an excellent discussion on the physics of tsunamis, and short movie clips. Benjamin Cook developed it under the direction of Dr. Catherine Petroff (UW Civil Engineering).
- **The UW Dept. of Earth and Space Sciences Global Positioning System (GPS):** http://www.ess.washington.edu/GPS/gps.html site provides information on geodetic studies of crustal deformation in Washington and Oregon.

K-20 Education Outreach

PNSN and USGS staff provided 25 Seismology Lab tours and presentations for K-20 students and teachers serving about 500 people this quarter. Tours were also provided to visiting scientists, undergraduates, and groups of potential graduate students visiting the PNSN

The PNSN maintains an Education Resources web area: http://www.ess.washington.edu/SEIS/PNSN/EDHOME/index.html.

Amy Lindemuth also maintains an email list of over 50 local K-20 educators interested in earth sciences education and keeps the group informed about interesting records available on the webicorders and other topics when they arise.

PNSN analyst, Amy Wright, writes monthly newsletters for distribution to this list. The first newsletter was distributed in early January 03.

Media Relations

PNSN staff members frequently provide interviews, research support, and referrals to radio, television, film, and print media

Meetings and Presentations

January:

- Bill Steele attended the CREW quarterly directors meeting.
- ESS Professor David Montgomery, NOAA Tsunami scientist Hal Mofjeld, and Bill Steele from the PNSN presented an evening program "The Hydrological Impacts of Earthquakes in the Pacific Northwest" for the Washington Hydrologic Society.
- The PNSN hosted a meeting of the PNW ANSS Advisory Committee to discuss ANSS issues and establish objectives and priorities for new station installations in the 2003 field season.
- Bill Steele attended a meeting of the Seattle Project Impact, Disaster Resistant Business Program.
- Ruth Ludwin made presentations at Simon Fraser University and University of Puget Sound

February:

- Craig Weaver and Ed Harp of the USGS and Bill Steele (PNSN) and Kathy Troost (Seattle Geologic Mapping Project) presented at a half-day workshop for over 100 Seattle City officials. The general theme of the workshop was Hazard Mapping in Seattle.
- Ruth Ludwin gave an invited presentation at the banquet of the annual meeting of the **Earthquake Engineering Research Institute**.

March:

- Steve Malone and Bill Steele attended a meeting hosted by Bill Perkins and Susan Chang of Shannon and Wilson in Seattle. Installation of a down-hole array of strong-motion seismometers and pore-pressure gauges in the Duwamish Valley in South Seattle was planned.
- In late February and early March, low amplitude seismic signals were detected during the Cascadia Subduction Zone "silent earthquake". Because this was the first time information was available while the event was going on, and because of the detection of seismic signals, media interest was high. Tony Qamar, Wendy McCausland, and Steve Malone provided multiple interviews.

The PNSN remains an active participant in a number of organizations whose goals and objectives are complementary to the PNSN mission to reduce loss of life and property due to earthquakes. Tony Qamar is an active member of the **Washington State Seismic Safety Committee,** Bill Steele serves on the Board of Directors of the Cascade Region Earthquake Workgroup (**CREW**), represents the PNSN in The Contingency Planners and Recovery Managers (**CPARM**), serves as an advisor to a number of Project Impact Communities, and is a member of **The Washington State Emergency Management Association**