ANNUAL TECHNICAL REPORT: 2005
USGS Joint Operating Agreement 04HQAG005
PACIFIC NORTHWEST SEISMOGRAPH NETWORK (PNSN) OPERATIONS

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ABSTRACT AND NON-TECHNICAL SUMMARY

This is the annual technical report for USGS Joint Operating Agreement 04HQAG005 *"Pacific Northwest Seismograph Network (PNSN) Operations".* The PNSN operates seismograph stations in Washington and Oregon, and collects and analyzes earthquake data. Between Jan. 1, 2005 and Dec. 31, 2005 the PNSN analyzed 8,621 events. Of these, 6,413 were earthquakes located within the network. The eruptive episode of Mount St. Helens that started on September 23, 2004 continued through 2005. The eruption included hundreds of thousands of earthquakes, of which only a sample were located. The counts given here include only a small percentage of the earthquakes at Mount St. Helens. West of 120.5 degrees west longitude, 6,125 earthquakes were located in Washington and Oregon (including 5,249 volcanic or tectonic events in the general vicinity of Mount St. Helens). East of 120.5 degrees W longitude in Washington and Oregon, 288 earthquakes were located. The remaining 2,208 events include located or unlocated blasts (408), regional earthquakes (396) or teleseisms (614), and small unlocated earthquakes within the network; including 487 low frequency events near the summit of Mt. Rainier (probably icequakes), and 20 surficial events near the summit of Mt. St. Helens (probably rockfalls). .

Between Jan. 1, 2005 and Dec. 31, 2005, 7 earthquakes were reported felt west of the Cascades in Washington or Oregon, ranging in magnitude from 2.6 to 4.0. In addition, two earthquakes larger than magnitude 7.0 that occurred outside the PNSN network area, offshore of California, were felt in southwestern Oregon. Two earthquakes (magnitudes 2.4 and 3.5) were reported felt east of the Cascades in Washington.

SUMMARY

USGS Joint Operating Agreement 04HQAG005 "*Pacific Northwest Seismograph Network (PNSN) Operations*" 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 were maintained by the University of Oregon under Cooperative Agreement 04HQAG006, 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 2005, an overview of our public information program, and a summary of 2005 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.

CURRENT INITIATIVES

Introduction

The PNSN is continuing the long process of upgrading operations. 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.

PNSN Instrumentation

Since 1996, the PNSN has installed digital strong-motion instruments, mostly in the Puget Sound urban area. There are now 61 ANSS instruments in the Pacific Northwest, and a total of 106 strong-motion real-time stations in our network. Data from strong-motion stations are sent continuously to the PNSN via Internet or lease-line modems, but the instruments also have a trigger set to record stronger events on-site. If continuous data transmission fails, most data will still be available via dial-up retrieval or site visit. These are in addition to approximately 30 other strong-motion instruments operated independently by the National Strong Motion Project.

The PNSN operates 18 PNSN CREST (Consolidated Reporting of EarthquakeS and Tsunamis) stations, and receives data from four additional northern California CREST stations.

Emergency Notifications

A PNSN seismologist is always available on-call, and our standard procedure is to respond to pager messages from our automatic earthquake detection process (initiated for any earthquake within our network of magnitude 2.9 or larger), or calls from Washington or Oregon emergency management agencies or the UW police. Information for well-located earthquakes is sent out automatically by the event detection process to selected recipients including the National QDDS system. Emergency managers and other high-priority information users receive very rapid notification through the CISN display via internet, faxes, e-mail, and the national QDDS earthquake message system. Simultaneously, an automatic website is created for the event.

EARTHWORM Progress Report

The *Pigia* computer continues to be the digitizer for analog data. Digital data acquisition is divided among three computers: *verme*, *milli*; and *verli*;which subsequently exchange and share the acquired data. *Scossa* continues to be our main data collection computer, with *tremito*, as a backup and used for manual data analysis. *Tremito* also acts as a fileserver for all the other networked computers in the group. *Grasso*, a 2 CPU Linux box with RAID disc storage, creates near-real-time webicorder images for the PNSN web site and is used for online archival of waveform data. *Gordo* provides additional online archival space to back-up all active file systems.

"Miniworm"systems (computers in the field that run EARTHWORM and digitize data and send it to the UW via Internet, eliminating expensive long-distance leased phone-lines) are running in Oregon at Klamath Falls, Bend, Eugene, and Portland, and in Washington at Forks and Richland.

OPERATIONS

Seismometer Locations and Network Maintenance

Figure 1 shows seismograph stations operated by the PNSN at the end of 2005, when the PNSN EARTHWORM SYSTEM was digitally recording over 600 channels of real-time or near-real-time seismic data. Stations available include a total of 173 short-period stations (8 stations have both high- and low-gain instruments), 60 broad-band, and 106 strong-motion stations. The Pacific Northwest Seismograph Network (PNSN) operates short-period, broad-band, or strong-motion components at 205 sites west of 120 degrees west longitude under this agreement. The supported stations cover much of western Washington and Oregon, including the volcanoes of the central Cascades. Some stations include up to 12 channels of seismic data. PNSN stations in southern and central Oregon are maintained by the University of Oregon under Cooperative Agreement 04HQAG006.

Forty additional permanent stations are operated by the PNSN under other support. The PNSN is also currently receiving data from about 30 EarthScope USArray stations located in our network area. Stations funded by other contracts or telemetered in real or near-real time from adjacent networks are used in event locations. Station Tables 1A-1C list the locations of various types of stations. Quarterly reports provide additional details of station operation. Quarterly reports from January 1, 2005 through December, 2005 are included as Appendix 2. 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, short-period seismometers must be replaced every 4-6 years. More than 30 radio telemetry relay sites are also maintained independently of the seismograph stations.

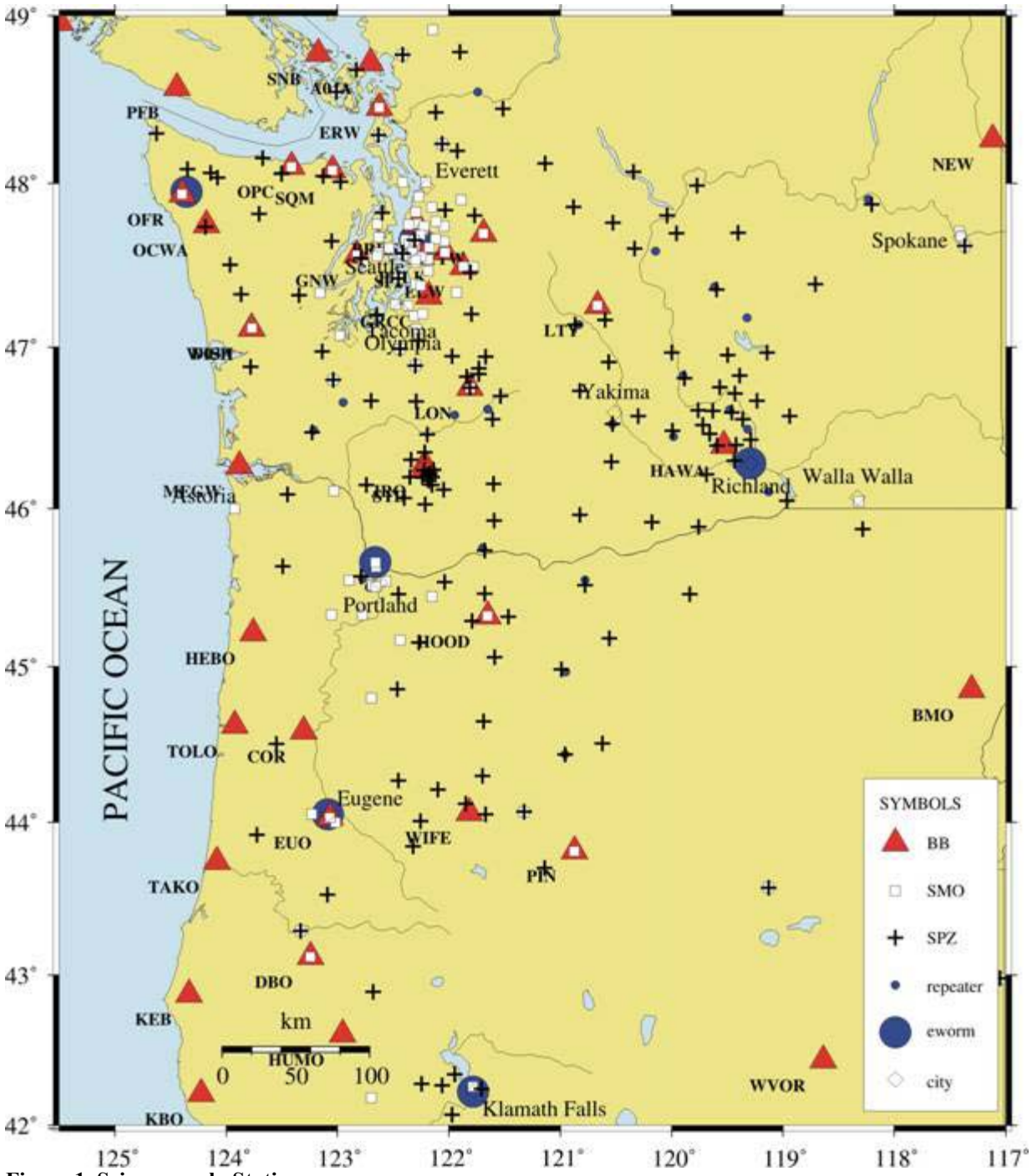

Figure 1. Seismograph Stations.
"BB" indicates broadband stations (Table 1B), "SMO" indicates strong motion stations (Table 1C), and "SPZ" indicates short-period stations (usually vertical component only) (Table 1A). Repeaters are sites with radio receivers and transmitters used in the transmission of seismic data to the UW via FM telemetry. "eworm" represents sites where a "mini-earthworm" system is running on a local computer to collect data for transfer to the UW via the Internet.

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- or 4-character station designator, followed by a symbol designating the funding agency; stations marked by a percent sign (%) were supported by USGS joint operating agreement 04-HQ-AG-005. 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. “E” indicates stations funded by EarthScope. “G” stations are contributed by other organizations, with some assistance from the PNSN. 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 1A – Short period stations

STA	F	LAT	LONG	EL	NAME
ALKI	%	47 34 31.0	122 24 58.9	0.001	Alki Wastewater Plant, ANSS-SMO
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
B001	E	48 02 34.1	123 07 56.2	0.23	Golbeck
B005	E	48 03 34.6	123 30 19.1	0.3	Golbeck Shore 1 NW
B006	E	48 03 31.7	123 30 08.3	0.3	Shore NE
B007	E	48 03 20.2	123 30 19.4	0.29	Shore
BBO	%	42 53 12.6	122 40 46.6	1.671	Butler Butte, OR
BEN	H	46 31 12.0	119 43 18.0	0.335	PNNL station
BEND	%	44 04 00.8	121 19 36.0	1.141	UO Bend Office, DOGAMI SMO
BHW	%	47 50 12.6	122 01 55.8	0.198	Bald Hill
BKC	%	44 17 57.9	121 41 45.6	1.208	Black Crater, OR
BLN	%	48 00 26.5	122 58 18.6	0.585	Blyn Mt.
BLT	H	45 54 54.5	120 10 33.0	0.659	Bickleton
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, OR
BRO	%	44 16 02.5	122 27 07.1	1.341	Big Rock Lookout, OR
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, OR
BURN	G	43 34 23.0	119 07 49.0	1.615	Burns, OR SMO
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
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

Table 1A – Short period stations					
STA	**F**	**LAT**	**LONG**	**EL**	**NAME**
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 06 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, OR
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.
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., OR
HBO	%	43 50 39.5	122 19 11.9	1.615	Huckleberry Mt., OR
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., OR
HSO	%	43 31 33.0	123 05 24.0	1.02	Harness Mountain, OR
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, OR
JCW	%	48 11 43.8	121 55 34.4	0.792	Jim Creek
JORV	G	42 58 40.0	117 03 10.0	1.338	Jorden Valley, OR SMO
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., OR
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, OR
LAM	N	41 36 35.2	122 37 32.1	1.769	CAL-NET
LAS	N	41 35 57.6	121 34 36.0	-	CAL-NET
LBC	N	40 50 12.3	121 20 59.8	-	CAL-NET
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
LHE	N	41 37 42.6	122 13 49.8	-	CAL-NET
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., OR
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
LTI	N	41 10 34.0	121 29 19.6	-	CAL-NET
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 45.1	122 49 52.9	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 06.2	121 40 06.0	2.24	Moon Mt, OR

Table 1A – Short period stations					
STA	**F**	**LAT**	**LONG**	**EL**	**NAME**
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, OR
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, OR
NED	#	46 12 01.5	122 11 03.4	2.06	NE part of old Dome, St. Helens
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., OR
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 53.0	124 37 25.9	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 (replaces OT2 8/26
OTR	%	48 05 00.0	124 20 39.0	0.712	Olympics - Tyee Ridge
P403	E	48 03 43.9	124 08 32.0	0.31	Sandy Floe Quarry
PAT2	+	45 53 01.6	119 45 23.8	0.259	Paterson 2
PCFR	%	46 59 23.3	122 26 27.4	0.137	PC Firing Range ANSS-SMO
PCMD	%	46 53 20.9	122 18 00.9	0.239	PC Mountain Detachment ANSS-SMO
PGO	%	45 27 42.6	122 27 11.5	0.253	Gresham, OR
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
RAFT	#	46 11 45.1	122 11 06.4	2.132	Raft, St Helens crater station
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, OR
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 39.3	121 58 22.7	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 ANSS-SMO
SEA	%	47 39 15.8	122 18 29.3	0.03	UW, Seattle (Wood Anderson BB)
SEND	#	46 11 37.2	122 11 03.2	-	SEND, Mt. St. Helens (Dome station)
SEP	#	46 12 01.4	122 11 21.8	2.116	September lobe, Mt. St. Helens
SFER	%	47 37 10.4	117 21 55.7	0.715	Spokane Schools, Ferris High
SHW	%	46 11 37.1	122 14 06.5	1.425	Mt. St. Helens
SLF	%	47 45 38.6	120 31 41.5	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, OR
STD	%	46 14 16.0	122 13 21.9	1.268	Studebaker Ridge
STDM	%	46 14 16.0	122 13 21.9	1.268	Studebaker Ridge Microphone

Table 1A – Short period stations					
STA	**F**	**LAT**	**LONG**	**EL**	**NAME**
STW	%	48 09 03.1	123 40 11.1	0.308	Striped Peak
SUG	%	46 12 56.6	122 10 30.2	1.859	Sugar Bowl, MSH
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., OR
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
UMPQ	%	43 17 27.8	123 19 50.5	0.162	Umpqua Commun. College, DOGAMI
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, OR
VCR	%	44 58 58.2	120 59 17.4	1.015	Criterion Ridge, OR
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, OR
VG2	%	45 09 20.0	122 16 15.0	0.823	Goat Mt., OR
VGB	+	45 30 56.4	120 46 39.0	0.729	Gordon Butte, OR
VIP	%	44 30 29.4	120 37 07.8	1.731	Ingram Pt., OR
VLL	%	45 27 48.0	121 40 45.0	1.195	Laurance Lk., OR
VLM	%	45 32 18.6	122 02 21.0	1.15	Little Larch, OR
VSP	%	42 20 30.0	121 57 00.0	1.539	Spence Mtn, OR
VT2	+	46 58 02.4	119 59 57.0	0.385	Vantage2
VTH	%	45 10 52.2	120 33 40.8	0.773	The Trough, OR
VVHS	%	47 25 25.1	122 27 13.1	0.095	Vashon HS ANSS-SMO
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
WESG	#	46 11 45.6	122 11 33.2	2.13	St. Helens Crater (west side glacier)
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, OR
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 23.8	120 52 54.4	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

Table 1B lists broad-band stations used in locating seismic events in Washington and Oregon. The format for station locations is the same for all station tables, as described above.

Table 1B - Broadband Stations					
STA	**F**	**LAT**	**LONG**	**EL**	**NAME**
A04A	E	48 43 12.6	122 42 20.5	0.024	Lummi Island, WA
BMO		44 51 09.0	117 18 21.0	1.154	Blue Mountain Ob (USNSN) BB
BRKS	%	47 45 19.1	122 17 17.9	0.02	Brookside ANSS-SMO BB
COR	U	44 35 08.5	123 18 11.5	0.121	Corvallis, OR (USNSN) BB
D03A	E	47 06 58.3	123 46 11.0	0.049	Wishkah, WA
DBO	%	43 07 09.0	123 14 34.0	0.984	Dodson Butte, OR (UO CREST BB)
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
GRCC	%	47 18 42.5	122 10 46.0	0.13	Green River CC BB
HAWA	U	46 23 32.3	119 31 57.2	0.367	Hanford Nike USNSN BB

Table 1B - Broadband Stations					
STA	**F**	**LAT**	**LONG**	**EL**	**NAME**
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
JRO		46 16 31.0	122 12 59.7	1.28	Johnston Ridge Observatory
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 22.6	123 54 28.7	1.265	CAL-NET Red Mtn, OR CREST BB
KSXB	N	41 49 49.4	123 52 36.8	-	CAL-NET Camp Six, OR CREST BB
LON	%	46 45 00.0	121 48 36.0	0.853	Longmire CREST BB LONLZ SMO
LTY	%	47 15 21.2	120 39 53.3	0.97	Liberty BB CREST SMO
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 Center
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 BB
PFB	C	48 34 30.0	124 26 39.8	0.465	P.Renfrew, Canada BB
PIN	%	43 48 40.0	120 52 19.0	1.865	Pine Mt., OR (U0 CREST, BB, SMO)
PNLK	%	47 34 54.5	122 02 01.0	0.128	Pine Lake JH ANSS-SMO BB
PNT	C	49 18 57.6	119 36 57.6	0.55	Canada, 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)
STD	%	46 14 16.0	122 13 21.9	1.268	Studebaker Ridge
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
WIFE		44 03 35.4	121 48 58.7	1.955	Wife at 3-Sisters from CVO
WISH	%	47 07 01.8	123 46 11.6	0.045	Wishkah CREST BB SMO
WVOR	U	42 26 02.0	118 38 13.0	1.344	Wildhorse Valley, OR (USNSN BB)
YBH		41 43 55.3	122 42 37.4	1.06	Yreka, CA from UCB BB

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
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
L4 – Sercel (formerly Mark Products) L-4 short-period vertical sensor

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

Dial-up = intermittently retrieved via dial-up telephone line
Ethernet = continuously telemetered via Internet from a remote EARTHWORM system
Internet = continuously telemetered via Internet
LL = continuously telemetered via dedicated lease-line telephone lines
P = continuously telemetered via dedicated lease-line telephone lines using PPP protocol
Microwave = continuously telemetered via BPA microwave
Spread-spectrum Radio = continuously telemetered via spread-spectrum radio

Table 1C - Strong-motion three-component stations

STA	F	LAT	LONG	EL	NAME	SENSOR	TEL.
ACES	%	47.55953	-122.341	0	Army Corps of Engineers Seattle	CMG5T	Internet
ALCT	%	47.64672	-122.039	0.055	Alcott Elementary	K2	Internet
ALKI	%	47.5751	-122.418	0.001	Alki	K2: L4	LL
ALST	%	46.10881	-123.034	0.198	Alston	A20	Earthworm + Microwave
ALVY	%	43.99796	-123.017	0.155	Alvey	K2	Earthworm + Microwave
ATES	%	48.23617	-122.06	0.062	Trafton Elementary	K2: L4	Internet
BABE	%	47.60565	-122.537	0.083	Blakely Elementary	K2	Internet
BEND	%	44.06673	-121.328	1.141	U of O Bend Field Office	K2: S13	Internet
BEVT	%	47.91982	-122.271	0.17	Boeing Plant Everett	K2	Internet
BRKS	%	47.75512	-122.29	0.02	Brookside Elementary	K2,BBZ	Internet
BSFP	%	47.52	-122.298	0.005	Boeing Fire Protection	CMG5T	Internet
BULL	*	45.44589	-122.156	0.222	Bull Run Dam	A	Internet
BURN	#	43.57293	-119.131	1.615	Burns Butte Radio Building	K2	Internet
COLT	%	45.17015	-122.438	0.213	Colton High School	CMG5T	Internet
CSEN	%	47.80106	-122.22	0.055	Crystal Springs Elementary	K2	Internet
CSO	#	45.51694	-122.69	0.036	Canyon	FBA23	Dial-up
DBO	%	43.11901	-123.244	0.984	Dodson Butte (CREST)	EPI,BB3	LL
EARN	%	47.74072	-122.045	0.159	East Ridge Elementary	K2	Internet
EGRN	%	47.07315	-122.979	0.057	Evergreen State College	K2	Internet
ELW	%	47.4941	-121.873	0.267	Echo Lake	A,BB	Dial-up + Microwave + T1
ERW	%	48.45383	-122.626	0.389	Mount Erie	A,BB	Dial-up + LL + Microwave
EUO	%	44.02921	-123.07	0.16	Eugene Golf Course (CREST)	EPI,BB	Earthworm + LL
EVCC	%	48.00732	-122.206	0.03	Everett Community College	K2	Internet
EVGW	%	47.85422	-122.155	0.122	Gateway Middle School	K2	Internet
EYES	%	45.32942	-123.058	0.061	Ewing Young Elementary	CMG5T	Internet
FINN	%	47.71932	-122.233	0.121	Finn Hill Junior High	K2	Internet
GNW	%	47.56422	-122.827	0.165	Green Mountain (CREST)	EPI,BB3	LL
GRCC	G	47.31162	-122.181	0.13	Green River Community College	EDU-V	Internet
GTWN	%	47.55116	-122.322	0.025	Georgetown Playfield	CMG5T	Intuicom Wireless + Internet
HAO	#	45.50919	-122.657	0.018	Harrison	FBA23	Dial-up

Table 1C - Strong-motion three-component stations							
STA	**F**	**LAT**	**LONG**	**EL**	**NAME**	**SENSOR**	**TEL.**
HART	%	47.58377	-122.35	0.002	Harbor Island	K2	Intuicom Wireless + Internet
HEBO	%	45.2135	-123.755	0.875	Mt. Hebo (CREST)	EPI,BB	Microwave + Earthworm
HICC	%	47.38994	-122.299	0.115	Highline Community College	K2	Internet
HOLY	%	47.56522	-122.385	0.106	Holy Rosary School	K2	Internet
HOOD	%	45.32145	-121.653	1.52	Hood Meadows (CREST)	EPI,BB	LL + Internet
HUBA	%	45.63067	-122.653	0.023	Hudson's Bay High School	CMG5T	Internet
JORV	%	42.97766	-117.054	1.338	Jordan Valley High School	K2	Internet
KCAM	%	47.544	-122.319	0.005	King County Airport Maintenance	CMG5T	Internet
KDK	%	47.59502	-122.333	0.004	King Dome	K2	Internet
KEEL	%	45.55006	-122.896	0.067	Keeler	A20	Dial-up+Earthworm+Microwave
KFAL	%	42.25756	-121.786	1.326	Klamath Falls	CMG5T	Internet
KICC	%	47.577	-122.632	0.017	Kitsap County Central	K2	Internet
KIMB	%	47.57462	-122.304	0.069	Kimball Elementary	K2	Internet
KIMR	%	47.50287	-122.768	0.123	Moderate Risk Waste Collection Fclty.	K2	Internet
KINR	%	47.75148	-122.644	0.008	North Road Shed	K2	Internet
KITP	%	47.67482	-122.631	0.076	Wastewater Treatment Plant	K2	Internet
KNEL	%	47.38052	-122.252	0.014	Kent Elementary School	K2	Internet
KNJH	%	47.38454	-122.23	0.014	Kent Junior High	K2	Internet
LANE	%	44.05165	-123.233	0.12	Lane	K2	Earthworm + Microwave
LAWT	%	47.65632	-122.391	0.05	Lawton Elementary	A20	Internet
LEOT	%	47.76772	-122.117	0.115	Leota Junior High	K2	Internet
LON	%	46.74983	-121.811	0.853	Longmire Springs (CREST)	EPI,BB3	LL
LTY	%	47.25573	-120.666	0.97	Liberty Heights Mine (CREST)	EPI,BB3	LL + Earthworm
LYNC	%	47.82555	-122.294	0.019	Lynnwood City Hall	CMG5T	Internet
MARY	%	47.66252	-122.121	0.011	Marymoor Park	K2	Internet
MBKE	%	48.91707	-122.143	1.01	Kendall Elementary	K2	Internet
MBPA	%	47.89835	-121.89	0.186	Monroe	A20	Dial-up + Microwave + T1
MEAN	%	47.62252	-122.306	0.037	Meany Middle School	K2	Internet
MEGW	%	46.26577	-123.879	0.332	Megler (CREST)	EPI,BB	Microwave + Earthworm
MPL	%	47.46843	-122.186	0.122	Maple Valley	K2	Dial-up + Microwave + T1
MRIN	%	44.80023	-122.699	0.187	Marion	K2	Microwave + Earthworm
MURR	%	47.11982	-122.561	0.082	Camp Murray	K2: L4	none
NIHS	%	47.74126	-122.223	0.137	Inglemoore High School	K2	Internet
NOWS	%	47.68649	-122.257	0.002	NOAA Sand Point	A20	Internet
OFR	%	47.93313	-124.396	0.152	Olympic Natural Resources Cntr. (CRES	EPI,BB	Internet + Earthworm
OHC	%	47.3337	-123.159	0.006	Hood Canal Junior High	K2	Internet
OPC	%	48.10009	-123.413	0.09	Peninsula College (CREST)	EPI,BB	Internet
PAYL	%	47.1926	-122.314	0.009	Aylen Junior High	K2	Internet
PCEP	%	47.11142	-122.291	0.16	Puyallup East Sheriff Precinct	K2	Internet
PCFR	%	46.98962	-122.442	0.137	Roy Training Center	K2: S13	Internet
PCMD	%	46.88896	-122.301	0.239	Mountain Detachment	K2: L4	Internet
PERL	%	45.32818	-122.779	0.068	Pearl	K2	Microwave + Earthworm
PIN	%	43.81096	-120.873	1.865	Pine Mtn. (CREST)	EPI,BB3	Earthworm + LL
PNLK	%	47.58162	-122.035	0.128	Pine Lake Middle School	K2,EDU-V	Internet
PSNS	%	47.55871	-122.644	0.006	Puget Sound Naval Shipyard	CMG5TD	Internet
QAW	%	47.63157	-122.356	0.14	Queen Anne	A20	T1
RAW	%	47.33705	-121.933	0.208	Raver	A20	Microwave + T1
RBEN	%	47.43502	-122.187	0.152	Benson Hill Elementary	K2	Internet
RBO	#	45.54083	-122.564	0.158	Rocky Butte	FBA23	Dial-up
RHAZ	%	47.54002	-122.185	0.108	Hazelwood Elementary	K2	Internet
ROSS	%	45.66178	-122.658	0.061	Ross	A20	Earthworm
RRHS	%	46.79942	-123.042	0.047	Rochester High School	K2: L4	Internet
RWW	%	46.96473	-123.543	0.015	Ranney Well (CREST)	EPI,BB3	LL
SBES	%	48.76814	-122.416	0.119	Silver Beach Elementary School	K2: L4	Internet
SCC	%	47.74965	-122.361	0	Shoreline Community College	CMG5T	Internet
SEA	%	47.65421	-122.309	0.03	University of Washington	A20,PMD2023	LL
SEAS	%	45.99742	-123.926	0.005	Seaside	K2	Internet

Table 1C - Strong-motion three-component stations							
STA	**F**	**LAT**	**LONG**	**EL**	**NAME**	**SENSOR**	**TEL.**
SFER	%	47.61944	-117.367	0.715	Ferris High School	K2	Internet
SGAR	%	47.67705	-117.415	0.579	Garfield Elementary	K2	Internet
SHIP	%	47.65511	-122.322	0.005	WashDOT Lake Union Shop	CMG5T	Intuicom Wireless + Internet
SHLY	$	47.70844	-117.416	0.626	Spokane Temp	K2	None
SMNR	%	47.20442	-122.233	0.022	Sumner High School	K2	Internet
SNIO	$	47.67944	-117.405	0.584	Spokane NIOSH	K2	None
SOPS	$	47.728	-117.313	0.707	Orchard Prairie Elementary	K2	Internet
SOUA	%	42.18375	-122.695	0.634	Southern Oregon University Ashland	K2: L4	Internet
SP2	%	47.55629	-122.249	0.03	Seward Park	A,BB	LL
SQM	%	48.07731	-123.047	0.03	Sequim Battelle Properties (CREST)	EPI,BB	Internet+Spread Spectrum Radio
SSS1	%	47.5818	-122.331	0.005	John Stanford Center 1	K2	Internet
SSS2	%	47.5818	-122.331	0.005	John Stanford Center 2	K2	Internet
SVOH	%	48.2892	-122.633	0.022	Skagit Valley College Oak Harbor	K2: L4	Internet
SVTR	%	47.49576	-121.782	0.146	Two Rivers School	CMG5T	Internet
SWES	%	47.71407	-117.466	0.623	Westview Elementary	K2	Internet
SWID	%	48.00843	-122.413	0.062	South Whidbey Primary School	K2	Internet
TAKO	%	43.74334	-124.082	0.046	Tahkenitch (CREST)	EPI,BB	Earthworm
TBPA	%	47.25788	-122.368	0.002	Tacoma	A20	Microwave + T1 + Dial-up
TKCO	%	47.53668	-122.302	0.005	King County Airport	A20	Internet
TOLO	%	44.62187	-123.923	0.021	Toledo (CREST)	EPI,BB	Microwave + Earthworm
TTW	%	47.69445	-121.69	0.542	Tolt Reservoir (CREST)	EPI,BB3	Internet
UMPQ	%	43.29089	-123.332	0.162	Umpqua Community College	K2: L4	Internet
UPS	%	47.26376	-122.485	0.113	University of Puget Sound	K2	Internet
UWFH	%	48.54593	-123.013	0.01	Friday Harbor Laboratories	K2: L4	Internet
VVHS	%	47.42345	-122.455	0.095	Vashon High School	K2: L4	Internet
WISC	%	47.60872	-122.176	0.056	Wilburton Instructional Services Cntr.	K2	Internet
WISH	%	47.11698	-123.771	0.045	Wishkah School (CREST)	BB	Internet
WWHS	%	46.04527	-118.318	0.01	Walla Walla High School	CMG5T	Internet

Data Processing

The PNSN seismic recording system uses real-time telemetry, and records earthquakes using an 'event trigger'. Analog and strong-motion digital data are recorded at 100 samples per sec., while broad-band digital data are usually digitized at 50 samples per sec. Arrival times, first motion polarities, signal durations, signal amplitudes, locations and focal mechanisms (when possible) are determined in manual post-processing. Digital data are processed for all locatable teleseisms, regional events, and 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. Analog stations, and most digital stations, are continuously telemetered in real time. All of the real-time data are continuously recorded into temporary disk storage areas called "wave tanks" which can accommodate about 24 hours of continuous data for the entire network. Triggering algorithms create individual event files lasting for several minutes depending on the size of the earthquake. In addition, continuous seismic data are permanently archived for about 60 stations, many on volcanoes. We continue to use the UW2 pickfile and data formats, and analysis tools that have been in place for more than a decade.

Unedited network-trigger trace-data are stored on ongoing "network-archive" backup tapes. 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, The Battelle Pacific Northwest National Labs, the Pacific Geoscience Centre, the Montana Bureau of Mines, and NCSN (operated jointly by U.C. Berkeley and the USGS). In addition, we send real-time data to the Alaska Tsunami Warning Center, the Pacific Tsunami Warning Center, the Cascade Volcano Observatory, and the National Earthquake Information Center. The entire PNSN catalog has been contributed to the ANSS composite catalog located at the Northern California Earthquake Data Center. The PNSN section of the ANSS catalog is updated daily.

Since 2003, all PNSN broad-band and short-period traces are sent to the IRIS DMC, which makes complete copies of all our continuous data available through the BUD (Buffer of Uniform Data) system.

Publications

Publications wholly or partly supported under this operating agreement are listed in Appendix 1.

PNSN PERSONNEL CHANGES

PNSN P.I.Tony Qamar (1943-2005) fatally injured

Tony Qamar, co-PI of the PNSN, was tragically killed on October 4th by a logging truck while driving to retrieve GPS instruments on the Olympic Peninsula. His loss has impacted all aspects of PNSN. As a co-Principal Investigator for the Pacific Northwest Seismograph Network, Dr. Qamar was involved with almost every aspect of network operations and research, from field work to detailed studies of both tectonic and volcanic earthquakes. He also served as the Washington State Seismologist providing information and consulting to state government and civil authorities on earthquake hazards.

John Vidale – Incoming Director of the PNSN to replace Steve Malone, retiring

Dr. John Vidale has accepted a position as Director of the PNSN. Dr. Vidale is expected to arrive at the UW in summer of 2006. Dr. Stephen D. Malone is planning to retire as director of the PNSN once Dr. Vidale settles in, but will continue to work with the PNSN part-time, concentrating on volcano seismicity research.

Other Personnel Changes and Plans

Former PNSN co-PI Robert Crosson, who retired several years ago, was seriously ill during the latter half of 2005, but is now recovering.

Research Scientist George Thomas and technicians Allen Strelow and Robert Leslie resigned. Karl Hagel was hired as a technician, and programmer Bill Gustafson joined us part-time to implement new code and help improve the robustness of our computer operations. Jon Connolly and Eric Flood, both former student helpers who had graduated recently, were hired temporarily to assist with field operations. Lynn Simmons, a USGS contract employee assumed additional duties, and Tom Yelin of the USGS is taking a more active role in the PNSN, including assuming occasional responsibility for emergency response duties. The PNSN has initiated a job search for a Network Manager to oversee day-to-day network operations, including field work, data-acquisition hardware and software, data analysis, and response to significant events.

SEISMICITY, EMERGENCY NOTIFICATION, AND OUTREACH

Seismicity

Figure 2 shows earthquakes of magnitude 2.0 or larger located in Washington and Oregon during this repnorting period.

Table 2 lists earthquakes reported to have been felt during 2005. Events with ShakeMaps or Community Internet Intensity Maps (CIIM) are indicated. “CIIM” maps (**http://pasadena.wr.usgs.gov/shake/pnw/**), which convert "felt" reports sent by the general public (via Internet) into numeric intensity values. CIIM maps show the average intensity by zip code. ShakeMaps (**http://www.pnsn.org/shake/**) show ground acceleration, combining measured values obtained from seismometers and modeled values interpolated from measured values and adjusted for soil properties.

Table 3 gives information on seismic activity recorded at the PNSN annually since 1980. Between Jan. 1, 2005 and Dec. 31, 2005, 7 earthquakes were reported felt in Washington or Oregon west of the Cascades, ranging in magnitude from 2.3 to 4.0. . In addition, two earthquakes larger than magnitude 7.0 that occurred outside the PNSN network area, offshore of California, were felt in southwestern Oregon. Two earthquakes (magnitudes 2.4 and 3.5) were reported felt east of the Cascades in Washington and Oregon.

TABLE 2 - Felt Earthquakes during 2005

DATE-(UTC)-TIME	LAT(N)	LON(W)	DEP	MAG	COMMENTS	CIIM	Shake Map
yy/mm/dd hh:mm:ss	deg.	deg.	km				
05/02/03 14:08:04	48.08	122.57	32.2	3.1	30.4 km WNW of Everett, WA	✔	✔
05/03/06 13:20:06	48.02	121.83	13.6	3.5	12.2 km SE of Granite Falls, WA	✔	✔
05/03/13 03:37:47	47.25	122.82	24.1	3.3	23.8 km NNE of Olympia, WA	✔	✔
05/05/18 14:46:23	48.14	122.60	27.2	2.6	35.4 km WNW of Everett, WA	✔	
05/06/15 02:50:57	41.32	126.03	10.0	7.2 (USGS)	160.6 km WSW of Crescent City, CA	✔	
05/06/17 06:21:34	40.18	127.54	10.0	6.4 (USGS)	295.0 km WSW of Eureka, CA	✔	
05/06/25 13:49:11	45.52	122.63	14.9	2.7	2.0 km SW of Portland, OR	✔	✔
05/06/29 14:37:14	46.65	120.61	10.0	3.5	10.1 km NW of Yakima, WA		
05/11/23 20:53:15	48.85	122.13	0.0	4.0	6.6 km ENE of Deming, WA	✔	✔
05/12/15 10:26:02	47.72	117.76	0.1	2.4	27.0 km WNW of Spokane, WA (Mission & N Division)		
05/12/27 05:46:07	47.76	121.82	12.4	2.3	12.4 km ENE of Duvall, WA	✔	

TABLE 3 Annual counts of events recorded by the PNSN, 1980-2005

Year	Total #	Out of Net	Inside Net			
			Unlocated	Located		
				Total	EQs(felt)	Blasts
1980	4576	253	1075	3246	2874(18)	372
1981	5155	291	1474	3385	2672(29)	713
1982	4452	329	1824	2297	1948(20)	349
1983	4489	405	2338	1745	1356(15)	389
1984	3144	267	1095	1780	1409(16)	371
1985	3560	266	1168	2122	1890(16)	232
1986	2554	318	452	1776	1594(21)	182
1987	1981	537	127	1304	966(22)	338
1988	2249	507	114	1624	1263(19)	361
1989	2781	501	137	2136	1835(38)	301
1990	3433	717	204	2505	2096(26)	409
1991	3083	675	315	2085	1687(26)	398
1992	3522	891	235	2381	1993(22)	388
1993	5594	731	626	4224	3877(35)	347
1994	6243	900	1518	3816	3424(28)	392
1995	5354	959	1462	2915	2539(16)	376
1996	4741	911	1192	2628	2214(39)	414
1997	3881	728	904	2239	1992(35)	247
1998	7463	831	2174	4430	4176(11)	254
1999	4505	803	1483	2187	1965(30)	222

TABLE 3 Annual counts of events recorded by the PNSN, 1980-2005

Year	Total #	Out of Net	Inside Net			
			Unlocated	Located		
				Total	EQs(felt)	Blasts
2000	5625	1121	1686	2818	2482(18)	341
2001	5945	1090	2106	2730	2258(95)	472
2002	5495	951	1751	2752	2299(39)	453
2003	4863	887	1537	2407	1973(47)	434
2004	7287	914	*	4992	4555(46)	437
2005	8621	1010	836	6758	6401(9)	357

* The eruption of Mount St. Helens that started in 2004 produced over 500,000 earthquakes. Only a small fraction of these were located.

The Indian Ocean tsunami of December 26, 2004 caused considerable public interest well into 2005. The tectonic situation and length of the Cascadia Subduction Zone are virtually identical to the Sumatra rupture area of 2004, and the graphic visuals from the Indian Ocean event were a wake-up call for many Cascadia residents.

The most notable earthquake occurrences in Washington and Oregon in 2005 (see quarterly reports for details) were:

- Two sizable earthquakes in June 2005 occurred offshore of northern California, outside the area of PNSN authoritative coverage. The larger of these, events (M 7.2), triggered a tsunami warning (although no sizable tsunami actually occurred) in the early evening hours of June 17 (PDT) that revealed several shortcomings in preparedness. The USGS reported: "Crescent City sounded its warning sirens …. and thousands of residents and visitors were evacuated. In many other areas, communication problems prevented the tsunami warning from reaching the public until after the warning had been canceled.…Tuesday's warning…revealed some gaps in communication and planning that local agencies and communities now have an opportunity to fix." **http://soundwaves.usgs.gov/2005/07/research.html**
- Mount St. Helens' eruption: The eruption that began in 2004 continued through 2005. Seismicity remained vigorous, although at a lower level than in the early weeks of the eruption. Dome-building and dome-breakup continued through the year. Counts by calendar quarter at station HSR are provided below. The general pattern was ongoing seismicity located at the juncture of the new and old domes, with ongoing dome extrusion and intermittent large rockfalls as the extruded material cooled and crumbled. Flashes of light were observed on the Johnston Ridge webcam when nighttime rockfalls exposed glowing magma in the extruded magma.

Mount St. Helens 2004-2006 Quarterly earthquake counts at HSR; provided by CVO.

Year	Quarter	HSR event count
2004	4th	292,352
2005	1st	123,502
	2nd	49,811
	3rd	12,085
	4th	30,315

- "Episodic Tremor and Slip" (ETS) associated with geodetic changes occurred north of Puget Sound from about September 5-30. Additional information is available at: http://www.pnsn.org/WEBICORDER/DEEPTREM/summer2005.html

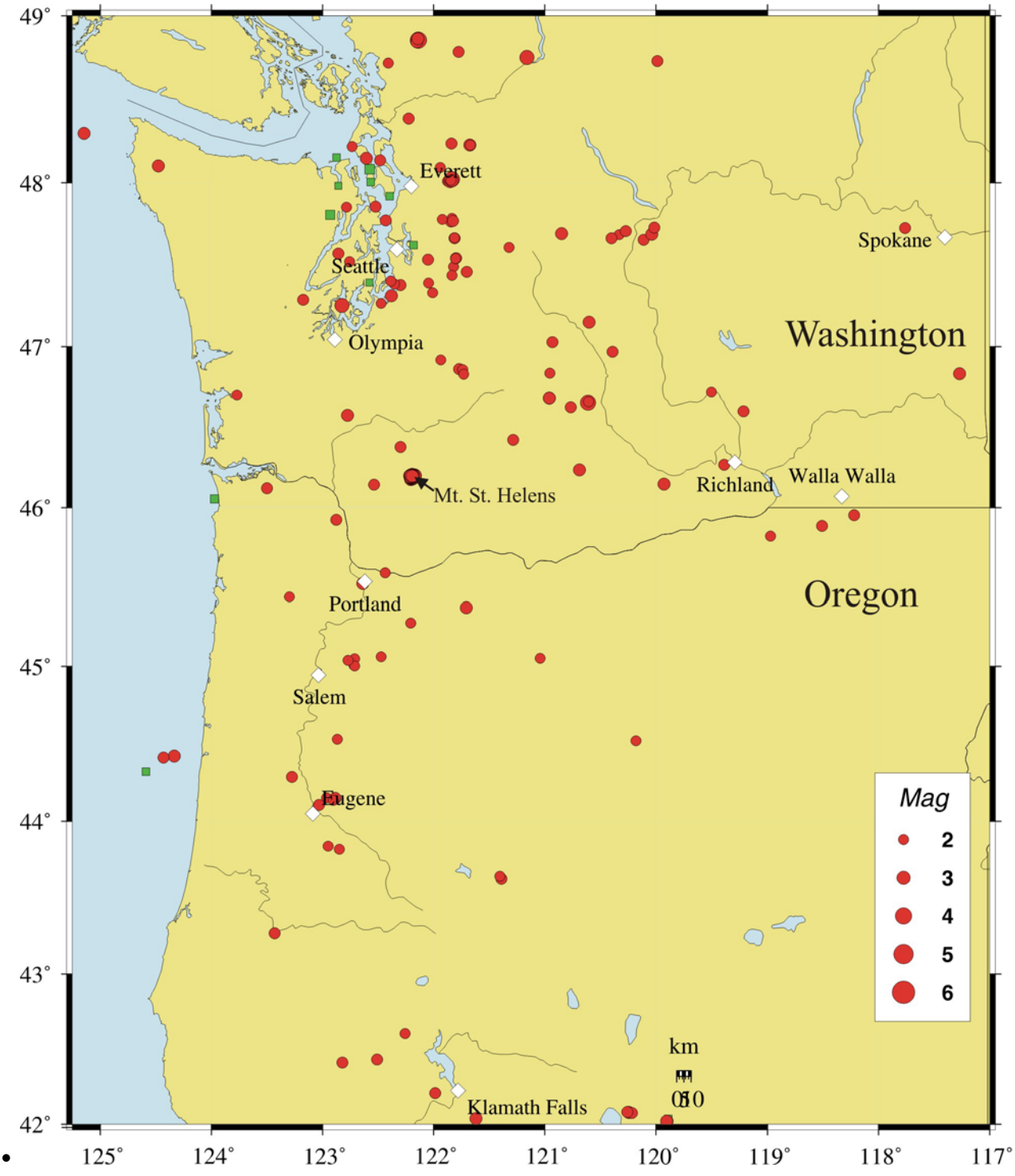

Figure 2. Seismicity 2005

Located earthquakes, magnitude >= 2.0. Green squares indicate earthquakes with depth greater than 30km. Red circles indicate earthquakes with depth <= 30km. White diamonds indicate cities. Area covered is 117W-125.25W, 42N-49N

Public Information and Outreach

Summary lists for all earthquakes located by the PNSN since 1969 are available via anonymous ftp on **ftp.ess.washington.edu/pub/seis_net**. This information is also available through the PNSN website **http://www.pnsn.org** and selected events are included in the USGS ANSS catalog search: **http://quake.geo.berkeley.edu/anss/catalog-search.html**. The PNSN website offers information about recent earthquake activity, network operations, and earthquake hazards in the Pacific Northwest as well as links to other sources of earthquake information.

The PNSN has an educational outreach program to better inform the public, policy makers, and emergency managers. Outreach includes information sheets, lab tours, lectures, workshops, and media interviews, and an audio library with several tapes. Services for the press and other media include interviews, consultations, referrals and research to provide accurate information to reporters. PNSN staff hosted or organized several meetings and made numerous presentations on topics related to earthquake or volcanic hazards, preparedness, and related information. Outreach talks were presented to a wide variety of groups, including state and county officials, representatives of utility and private companies, and engineering and emergency management groups and many general public groups. Seismology Lab tours and lectures were provided for visiting class groups, serving ~1,200 students; primarily from grades 3-12.

The devastating Indian Ocean tsunami of Dec. 26 2004 heightened both public and scientific understanding of the anticipated effects of a similar occurrence on the Cascadia Subduction Zone and created a demand for information about Cascadia megathrust hazards. A scenario for a M 9.0. Cascadia megathrust earthquake was released in summer of 2005. A M 7.2 earthquake offshore California sparked a tsunami warning and evacuations, though no significant tsunami occurred. Two articles detailing Cascadia Native American earthquake/tsunami/landslide-related traditions also attracted wide media attention, in part because of the recent Indian Ocean tsunami, which produced effects similar to those described in Cascadia Native traditions. Indigenous groups survived the Indian Ocean tsunami using traditional knowledge, while groups that had migrated to the area in the last few centuries were devastated.

The continuing eruption of Mount St. Helens continued to create a demand for information, though at a much lower level than in the last quarter of 2004.

A scenario for a M 6.7 shallow crustal earthquake on the Seattle fault was also released in summer of 2005. Links to both the Cascadia and Seattle fault scenarios are available:
http://www.pnsn.org/NEWS/PRESS_RELEASES/SCENARIOS.html

Episodic Tremor and Slip (ETS) occurred in northern Washington in September of 2005, continuing the 14-month periodic pattern previously noted. The ETS attracted press attention, as did the fatal accident in early October that took the lives of PNSN co-PI Tony Qamar and Dan Johnson of the University of Puget Sound. Tony and Dan were on their way to collect instrumentation used to record the ETS event.

ACKNOWLEDGMENTS

Seismic stations, telemetry links, and data acquisition equipment were maintained by Karl Hagel at the UW, Patrick McChesney (UW engineer 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 was involved in governmental relations, and provided information to the public with assistance from Jon Connolly and student helper Karl Popejoy. Amy Wright handled routine data analysis and archiving of digital trace data in UW2 format. Lynn Simmons, Eric Flood, and George Thomas worked on strong motion instrumentation and software. Ruth Ludwin wrote reports and maintained the PNSN web-pages. The University of Oregon (UO) installed and maintained stations and telemetry links in central Oregon, and operated an earthworm node to transmit data to the University of Washington.

APPENDIX 1 - Publications wholly or partially funded under this agreement.

Publications

Quarterly bulletins from the PNSN (http://www.pnsn.org/REPTS/quarterly.html) provide operational details and descriptions of seismic activity in Washington and Oregon. These are available from 1984 through the first quarter of 2006. Final published catalogs are available from 1970, when the network began operation, though 1989.

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APPENDIX 2 - PNSN Quarterly Reports: 05-A, 05-B, 05-C, and 05-D

QUARTERLY NETWORK REPORT 2005-A

on

Seismicity of Washington and Oregon

January 1 through March 31, 2005

Pacific Northwest Seismograph Network

Dept. of Earth and Space Sciences

Box 351310

University of Washington

Seattle, Washington 98195-1310

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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U.S. Geological Survey
Joint Operating Agreement O4HQAG005
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 2005 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 earthquake catalog is available on-line, both through our web-site and through the ANSS earthquake 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.

Prior to 2004, each quarterly included station tables and maps. Beginning in 2004, station tables and maps will be included only in the 4th quarter report. Lists of currently operating stations are available on-line through web page http://www.pnsn.org/OPS/stations.html.

NETWORK OPERATIONS

Lists of currently operating stations are available on-line through web page http://www.pnsn.org/OPS/stations.html. 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.

TABLE 1 - Station outages and installations

Station	Outage Dates	Comment
AHAB	02/08/05	Installed on growing dome – Mt. St. Helens
AHAB	02/16/05	Removed; replaced by MIDE
ALVY	01/23/05-03/08/05	Dead
ATES	02/25/05-03/01/05	No communications
BHW	03/14/04-End	Very noisy
BLIS	02/12/05	Dead; power failure
BRKS	12/23/04-01/03/05	No communications
BULL	03/28/05-End	Dead
BURN	11/23/04-02/20/05	Dead
ERW	12/13/04-01/08/05	No communications
FL2	11/28/04-End	Dead
GHW	12/23/04-02/02/05	Noisy
GL2	10/21/04-End	Dead
GLK	11/26/04-End	Noisy
GNW	01/01/05-End	Noisy
GPW	03/16/04-End	Dead
HART	02/09/05	Installed
HART	02/09/05-02/21/05	No communications
HDW	12/28/04-End	Dead
JBO	10/15/04-End	Noisy
KEEL	08/18/04-12/01/04	No communications
LYNC	02/08/05	Installed
MBKE	11/18/04-01/05/05	K2 removed for repair
MBW	12/07/04-End	Dead; shut down relay site due to radio interference
MCW	12/07/04-End	Dead. bad seismometer
MIDE	02/16/05	Installed – Mt. St. Helens
MIDE	03/08/05	Destroyed by Mt. St. Helens eruption
MIDE	04/14/05	Re-installed – Mt. St. Helens

TABLE 1 - Station outages and installations

Station	Outage Dates	Comment
NED	03/08/05	Destroyed by Mt. St. Helens eruption
NED	04/06/05	Re-installed – Mt. St. Helens
NLO	08/20/04-09/11/04	Dead; aircells died
OBH	01/31/02-End	Temp. removed for logging
ON2	03/01/05-End	Noisy
OOW	01/13/05-02/14/05	Dead
OSD	01/13/05-02/14/05	Dead because it transmits through OOW
OSR	01/22/05-02/09/05	Dead
OSR	03/01/05-End	Dead
PAYL	12/13/04-01/12/05	Intermittent communications
PCMD	01/18/05-03/10/05	Dead; water in vault
PERL	01/29/05-End	No communications
PGW	10/08/03-End	Dead
RCS	12/25/04-01/27/05	Noisy
RER	10/20/04-End	Noisy
RMW	12/07/04-End	Dead
RVC	12/05/03-End	Noisy
RVW	02/23/05-End	Dead
SAW	01/08/05-02/01/05	Noisy
SEA.HH?	12/05/03-End	Disconnected for renovation
SEP	03/08/05	Destroyed by Mt. St. Helens eruption
SEP	03/15/05	Re-installed – Mt. St. Helens
SFER	09/01/04-End	Short period dead; needs removal
SHIP	11/05/04-End	Removed due to building demolition
SLF	01/06/05-01/22/05	Dead
SMW	06/20/03-End	Intermittent
SOPS	08/27/02-End	K2 flash problem
SSS1	9/23/04-01/01/05	Communication intermittent
SSS1	03/05/05-End	Dead
SSS2	10/25/04-01/01/05	Communication intermittent
SSO	08/28/04-End	Intermittent
SUG	03/09/05	Installed – Mt. St. Helens
SVOH	12/30/04-01/10/05	No communications
TDL	11/28/04-End	Dead
TOLO	10/15/04-End	No communications
TRW	01/09/05-01/22/05	Dead
TTW	01/01/05-End	Noisy
VBE	02/17/05-End	Intermittent; usually very noisy
VGB	09/23/04-End	Intermittent; usually very noisy
WA2	01/05/05-02/02/05	Dead
WA2	02/08/05-02/17/05	Dead
WPW	05/02/04-01/06/05	Intermittent
WWHS	02/22/05-03/03/05	No communications
YA2	01/17/05-02/18/05	Dead

Mt. St. Helens eruption, 2004-2005

Beginning on September 23, 2004 a series of small earthquakes at Mount St. Helens signaled the beginning of the first dome-building eruption at the volcano since 1986. The small earthquakes soon escalated into the most vigorous seismic activity at Mount St. Helens since the catastrophic eruption of 1980. Continuous seismic data from short-period stations near Mt. St. Helens are archived at the PNSN and streamed to the IRIS BUD archive. New procedures were implemented to rapidly handle the large volume of data so the PNSN and Cascade Volcanoes Observatory could assess the significance of the rapidly changing seismicity.

Equipment; gain changes, destruction, replacement, and new installations

Station BLIS died from a power failure on February 12; it was most likely buried by the portion of the dome known as the "whaleback", a mound of new magma that increased in size over the quarter. Station AHAB was installed (EHZ and ELZ components) on the whaleback February 8. Because of its location on the unstable magma dome AHAB wasn't expected to survive long, so with new radios and batteries, it was moved on February 16 and became station MIDE. Station MIDE was installed near the site of old station BLIS.

Stations SEP, MIDE, and NED were destroyed during the ash and steam eruption of March 8. SEP was replaced on March 15. Station NED was reinstalled on April 6 and station MIDE was reinstalled on April 14. New station SUG (EHZ component) was installed on March 9 near the crater at Sugar Bowl.

Gain changes were made at station YEL (turned down 6 db on March 16). The gain change was made to improve the usefulness of this station. The volcano signals were nearly continuous and energetic enough to saturate the station at its previous gain.

24 Hour Volcano Watch and pager alert changes

Throughout the quarter, scientists at the PNSN and CVO shared 24-hour volcano watch duties. During the night, scientists would check seismic monitors, webcams and debris flow monitors every 2 hours for unusual activity.

Daytime (7 AM – 11 PM) pager triggering for Mt. St. Helens earthquakes had to be desensitized. Normal procedure for daytime pages has been to page for events larger than magnitude 1.5. In late September, daytime pages from Mt. St. Helens began to occur continuously. Therefore, the daytime paging script was modified in early October to page only on Mt. St. Helens events having preliminary magnitudes of 2.0 or greater and having 8 or more stations in a triggered state. The daytime paging threshold has been adjusted over the course of the sequence to page on events of higher-than-average magnitude. Alert event pages, normally for earthquakes larger than 2.8, were adjusted to exclude St. Helens events from early Oct. to early November.

Rapid automatic analysis of earthquake data

Our traditional method of analyzing earthquake data in the Pacific Northwest, i.e. using a triggering algorithm to detect earthquakes and manually processing every earthquake, quickly became unmanageable. To get rapid information on the ongoing sequence, we implemented automatic analysis of selected channels of continuously recorded seismic data. Near-real-time results of these analyses are being updated every 30 minutes at http://www.pnsn.org/WEBICORDER/RMS/

One of the most useful parameters we compute is a Real Time Seismic Amplitude Monitor (RSAM). RSAM is the root mean square (RMS) amplitude of ground motion at a station averaged over a time period. We have found averaging times of 10 minutes and 1 minute to be useful. It is necessary to monitor the RSAM at several stations because the data at close stations may be clipped. The RSAM provides an important parameter to consider in determining the hazard alert level at the volcano.

In addition to the RSAM we implemented an event detection algorithm to automatically determine earthquake times from the continuous seismic data. For each earthquake detected we determine the (trigger) time, duration of the signal, maximum amplitude, maximum RMS amplitude, and the frequency of the maximum spectral amplitude. Using this automated procedure on the continuous data from station YEL, we detected about 500,000earthquakes of magnitude 0.1 or greater from the beginning of the seismic activity (September 23, 2004) through the first quarter of 2005; with about 70,000 earthquakes occurring in the first quarter of 2005.

Standard analysis of earthquake data

On November 20, 2004 we desensitized the triggering at Mount St. Helens stations so that only the largest earthquakes are recorded automatically. All non-Mount St. Helens events still produced triggers. To capture significant events at Mount St. Helens, we reviewed continuous data from stations near the mountain, and retrieved data in selected time windows containing especially interesting events and a sample of the seismicity (usually only a few events/hr.), particularly events with large amplitude, impulsive arrivals, or unusual depth, frequency, location , or signal characteristics. These events are processed in the traditional way, i.e. determine a hypocenter, magnitude, and fault plane solution if possible. Less than 1 percent of the detected events were processed in this way and we tended to favor processing of the larger events.

Disk Space

This sequence required emergency acquisition of additional disk space. See last quarter's report for details.

Strong Motion Instrumentation Update

The final Duwamish Valley array station was installed on March 2 of this quarter. Station HART is co-located with USGS Seattle Urban Hazards Array station HAR on Harbor Island. The station location had been identified for over a year but

finding a suitable means of telemetry required additional time. Data from HART are sent via wireless radio to the roof of Harborview Medical Center, and from there are sent via the Internet using TCP/IP. Harborview is part of University of Washington, so the IP permitting was straightforward. The wireless telemetry for HART and GTWN continue to operate in a satisfactory manner despite radio interference.

An additional ANSS station was installed in south Snohomish County. Station LYNC was installed in the Lynnwood City Hall on February 9. This is a reference site installation with TCP/IP telemetry. This location fills in a gap in coverage for the area between Seattle and Everett.

Computer Hardware Update

Scossa continues to be our main data collection computer, and *tremito* provides additional computational power for manual processing of earthquake data and acts as a fileserver for all the other networked computers in the group.

Automatically generated Web-pages: Webicorder Update

Currently 100 PNSN stations are available on webicorders through six index pages. Webicorders indexes are grouped by type (short-period, broad-band, and strong motion), plus a special index for stations located on volcanoes.

Use of PNSN Data

The IRIS Data Management Center reports 185 requests for PNSN trace-data this quarter. Nearly 3,500,000 traces were requested. This represents at least an order of magnitude increase in the number of traces requested compared to a "typical" quarter.

EARTHQUAKE DATA – 2005-A

Between January 1 and March 31, 2005, 3,027 events were digitally recorded and processed at the University of Washington. Thousands of additional unlocated events occurred at Mount St. Helens associated with the dome-building eruption which began in late September 2004. Locations in Washington, Oregon, or southernmost British Columbia were determined for 2,529 of these events; 2,442 were classified as earthquakes and 87 as known or suspected blasts. The remaining processed events include teleseisms (159 events), regional events outside the PNSN (70), and unlocated events within the PNSN, mostly at Mt. St. Helens. Due to the overwhelmingly large number of events, event triggering was used only for quakes larger than about 2.0. Additional individual event files were created manually for a representative sampling of Mount St. Helens seismicity to be located and cataloged. Continuous data from Mt. St. Helens stations are available from the IRIS DMC. Other unlocated events within the PNSN normally include surficial events on Mt. St. Helens and Mt. Rainier quakes, and blasts. Frequent mining blasts occur near Centralia, Washington and we routinely locate them.

Table 2 lists earthquakes reported to have been felt during this quarter. Events with ShakeMaps or Community Internet Intensity Maps (CIIM) are indicated. This quarter, all three felt events generated both ShakeMaps and "CIIM" maps (**http://pasadena.wr.usgs.gov/shake/pnw/**), which convert "felt" reports sent by the general public (via Internet) into numeric intensity values. CIIM maps show the average intensity by zip code.

Table 3 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 1. Earthquakes with magnitude greater than or equal to 0.0 (M_c >=0).

Figure 2. Blasts and probable blasts (M_c >=0).

Figure 3. Earthquakes located near Mt. St. Helens (M_c >=0).

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

TABLE 2 - Felt Earthquakes during the 1st Quarter of 2005

DATE-(UTC)-TIME	LAT(N)	LON(W)	DEP	MAG	COMMENTS	CIIM	ShakeMap
yy/mm/dd hh:mm:ss	deg.	deg.	km	Ml			
05/02/03 14:08:04	48.08	122.57	32.2	3.1	30.4 km WNW of Everett, WA	✔	✔
05/03/06 13:20:06	48.02	121.83	13.6	3.5	12.2 km SE of Granite Falls, WA	✔	✔
05/03/13 03:37:47	47.25	122.82	24.1	3.3	23.8 km NNE of Olympia, WA	✔	✔

OREGON

During the first quarter of 2005, 65 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 most notable earthquake in Oregon this quarter was a very shallow M 2.6 event on Jan. 26 near Lakeview, Oregon, near the California border, where swarm activity occurred last year. The PNSN located only 3 quakes in the Lakeview area this quarter.

WESTERN WASHINGTON SEISMICITY

During the first quarter of 2005, 2,317 earthquakes were located between 45.5 degrees and 49.5 degrees north latitude and between 121.0 degrees and 125.3 degrees west longitude. Most western Washington seismicity this quarter was in the Mount St. Helens area, see discussion below. Three earthquakes were felt this quarter in western Washington.

Excluding Mt. St. Helens, the largest earthquake in western Washington this quarter was a magnitude 3.5 event on March 6 (UTC), located about 12 km south-east of Granite Falls at a depth of about 14 km. The deepest earthquake in western Washington this quarter was a magnitude 1.1 event at about 60 km depth located about 9 km west-southwest of Everett, WA on March 5 (UTC).

WASHINGTON CASCADE VOLCANOES

Mount St. Helens

Mount St. Helens seismicity and dome building eruption continued through this quarter. The eruptive episode began with a vigorous sequence of seismic activity starting on September 23, 2004. Activity accelerated into early October. The most energetic seismicity occurred on Oct. 1-5 when several phreatic explosions and half-hour to hour-long periods of harmonic tremor interrupted and temporarily calmed extremely high rates of magnitude 3+ seismicity. Seismicity fell following after Oct. 5, though frequent, but smaller earthquakes have continued through this quarter. Because of the high rates of seismicity, only a representative sample of Mount St. Helens events was located using conventional manual processing. Figure 3 shows located volcano-tectonic earthquakes near Mount St. Helens. Low frequency (L) and avalanche or rockfall events (S) are not shown. Seismograph stations operating during the fourth quarter are shown in the Appendix. See the operations section for details on destruction, replacement and new instrument installation during the first quarter.

An estimate of Mount St. Helens seismicity using automated counting procedures and data from station YEL suggests that about 70,000 earthquakes magnitude 0.1 or larger occurred at Mount St. Helens during the 1st quarter of 2005. Although in seismically quiet times our catalog of events at Mount St. Helens is complete to about magnitude 0.0, only a small subset of this quarter's activity was processed using our normal procedure. This quarter, 2,099 earthquakes were located in the area shown in Fig. 3 using conventional manual processing procedures (including 1,914 earthquakes between magnitude 1.0 and 2.9, and 7 slightly larger events with magnitudes between 3.0 and 3.2). All locatable earthquakes in the 2004/2005 sequence are relatively shallow. No events occurred at depths exceeding 2 km. The vigorous seismicity last quarter, and the tectonic events this quarter tended to be located on the boundary between the old and new domes near the vent that first appeared in early October, 2004. This quarter we recorded some large rockfalls off the new dome. Rockfalls that occurred during clear weather exposed glowing hot rocks in the core of the whaleback, and flashes of light were recorded simultaneously with rockfall signals at 04:38 UTC Jan. 14, 7:00 UTC Jan 15, and 9:11 UTC Feb. 7. An eruption at 01:25 UTC on March 9 (afternoon of March 8, local time) sent an ash plume to 36,000 feet elevation. Darryl Luscombe has been compiling and digitally enhancing nighttime volcano-cam images (http://www.luscombe-carter.com/mount_st_helens/index.html) that show variations in the amount of light shining forth from the new dome. At times a steady glow is visible, while sudden brief bursts of light (likely rockfalls) are seen at other times. Volcano-Tectonic earthquakes continue to occur with a somewhat regular inter-occurrence time which has varied slowly over days and weeks.

The USGS has issued an information sheet summarizing the 2004-2005 eruption through March 31, 2005.
http://vulcan.wr.usgs.gov/Volcanoes/MSH/Publications/FS2005-3036/FS2005-3036.html

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). Three events flagged "L" or "S" were located at Mount Rainier this quarter and 172 "L" or "S" events were recorded, but were too small or too emergent to locate reliably. Type L and S events are not shown in Fig. 4.

A total of 56 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. The largest tectonic earthquake located near Mt. Rainier this quarter was a magnitude 2.1

event on Jan. 20 (UTC), located about 15 km west-northwest of the mountain at about 9 km depth. This quarter, 33 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 46.6-47.0 degrees north latitude and 121.83-122 west longitude). Within 5 km of the summit, there were 11 (3 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 shown in Fig. 4.

EASTERN WASHINGTON SEISMICITY

During the first quarter of 2005, 69 earthquakes were located in eastern Washington in the area between 45.5 - 49.5 degrees north latitude and 117 - 121 degrees west longitude. The largest earthquake recorded in eastern Washington this quarter was a magnitude 2.6 event on Feb. 25 (UTC). It occurred at about 2 km depth, and was located about 36 km west-northwest-of Yakima.

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.

Other regional agencies provide earthquake information. These include the Geological Survey of Canada (Pacific Geoscience Centre), Sidney, B.C. **http://www.pgc.nrcan.gc.ca/seismo/table.htm** ; and other regional networks in the United States **http://earthquake.usgs.gov/regional/** The US Geological Survey coordinates earthquake information nationally; **http://earthquake.usgs.gov**.

Complete catalog listings are available on-line through **http://www.pnsn.org/CATDAT/catalog.html** Key to earthquake catalog can be found in the last quarterly report of each year, or at:
http://www.pnsn.org/INFO_GENERAL/PNSN_QUARTERLY_EQ_CATALOG_KEY.htm

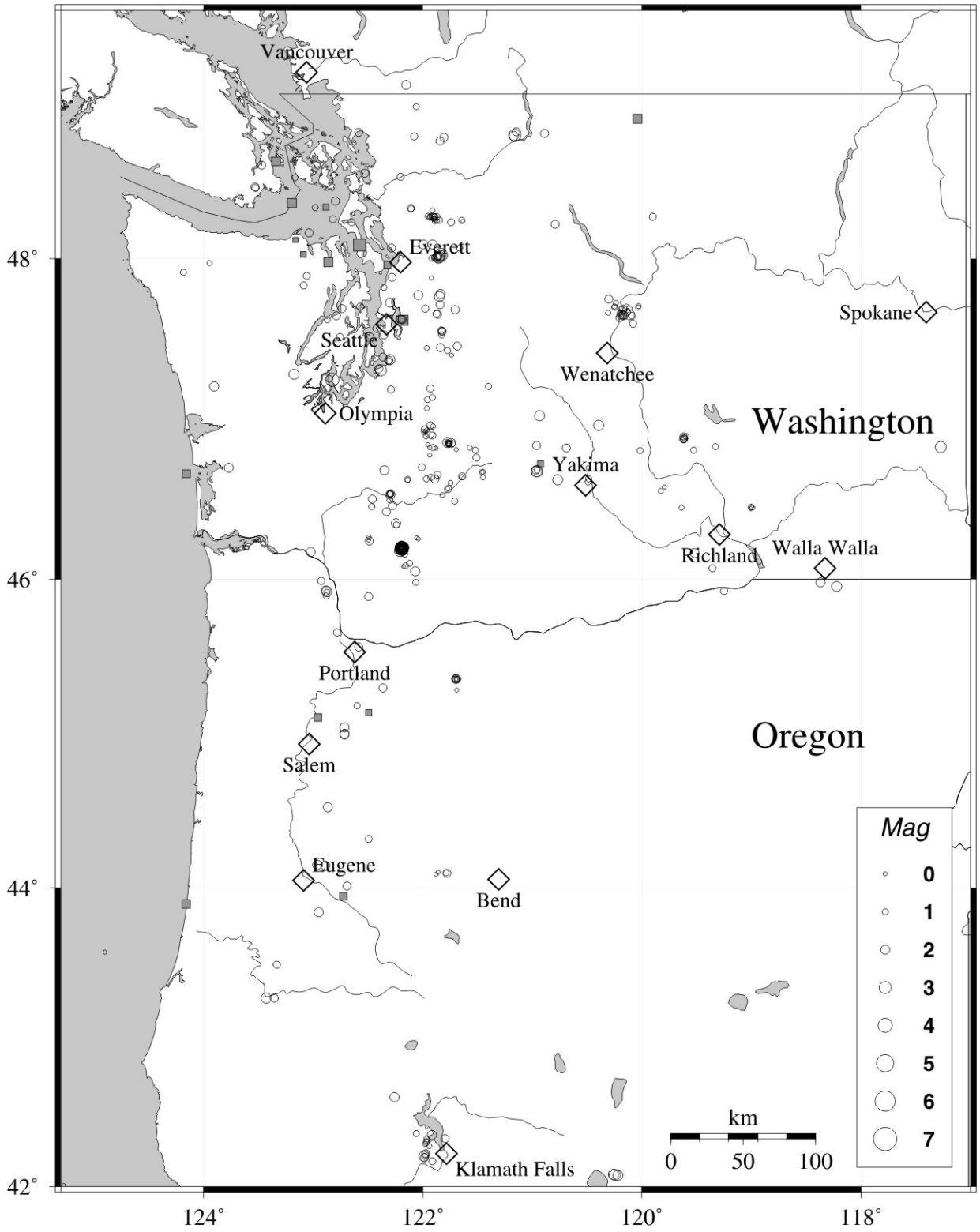

Figure 1 Earthquakes with magnitude greater than or equal to 0.0 (Mc>=0.0). Unfilled diamonds represent cities. Quakes shallower than 30 km are indicated by circles, and deeper quakes by filled squares.

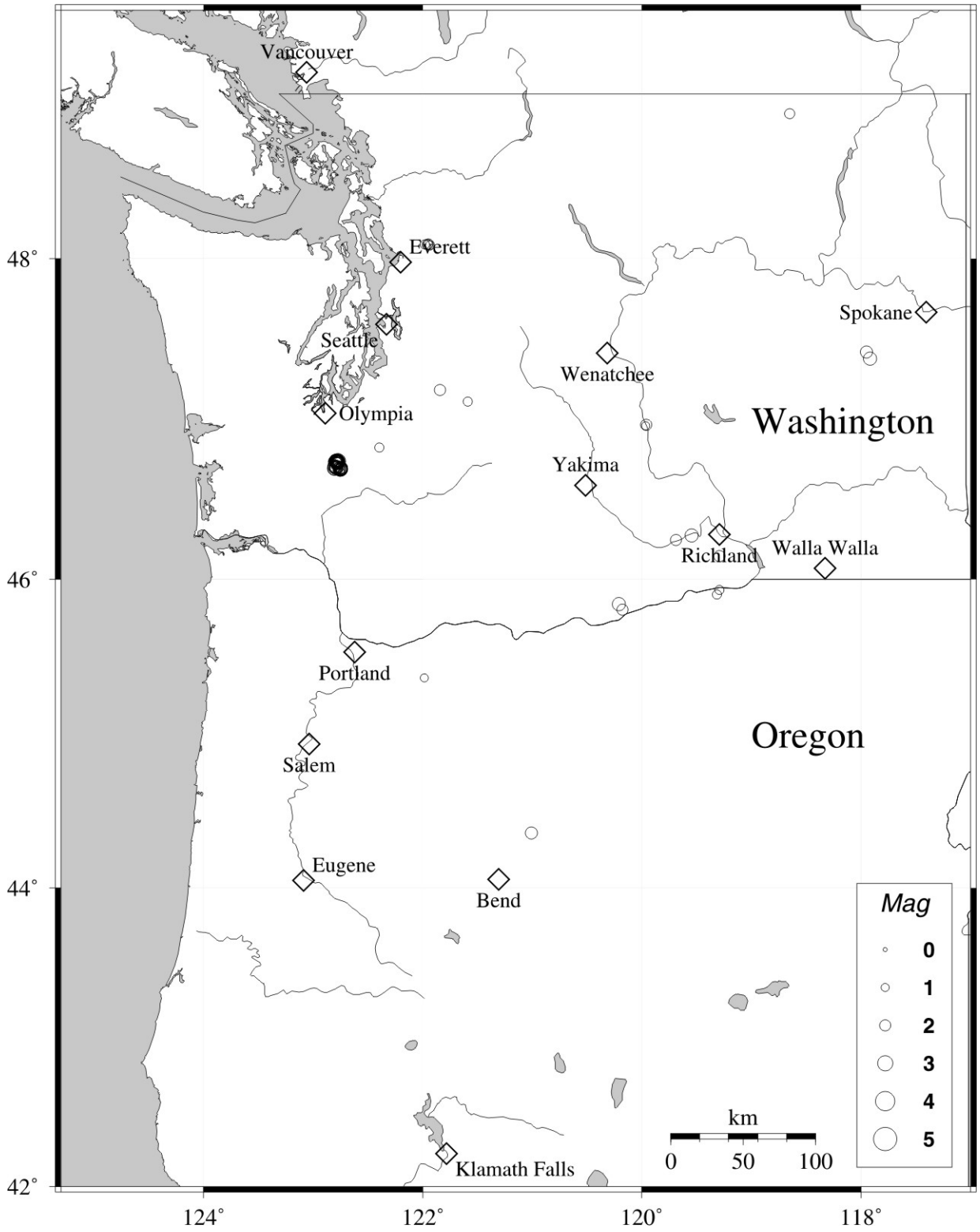

Figure 2. Blasts and probable blasts. Unfilled diamonds represent cities.

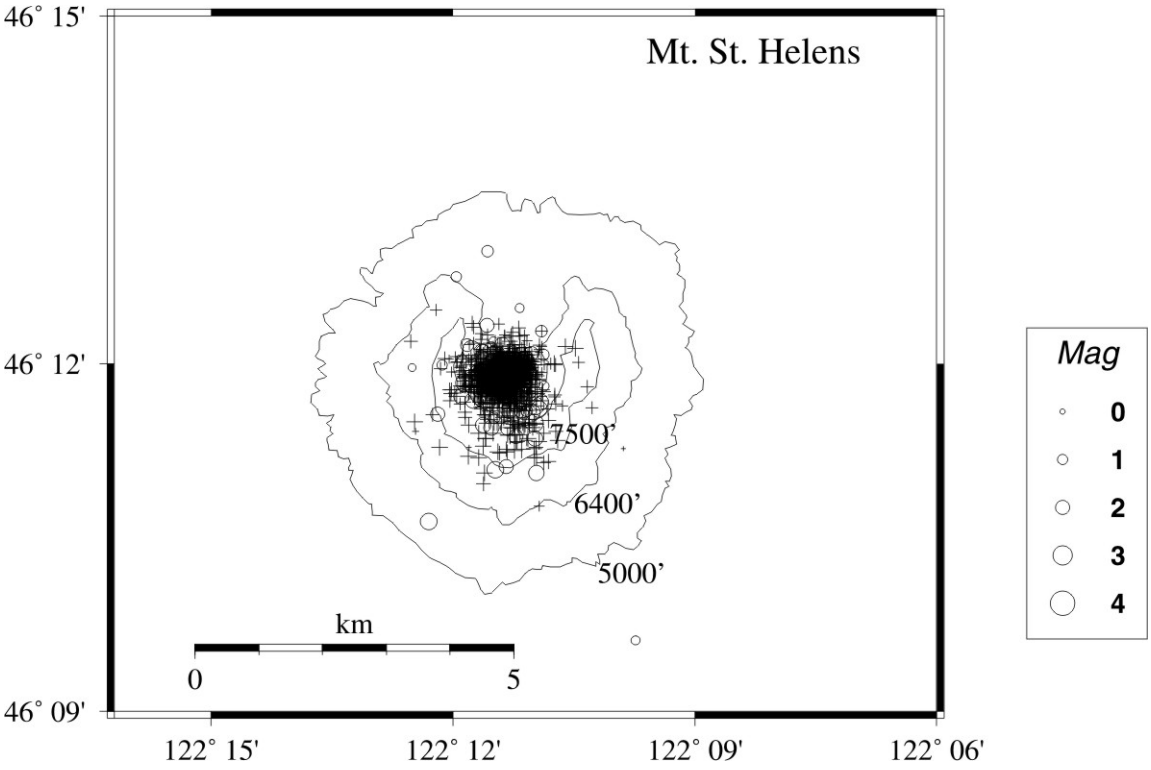

Figure 3. Earthquakes at St Helens, M>0.0.

Events elected by the analyst for location are small fraction of the number of events recorded during the quarter.
Plus symbols indicate depth less than 1 km. Circles indicate depth greater than 1 km. Elevation contours shown in feet.

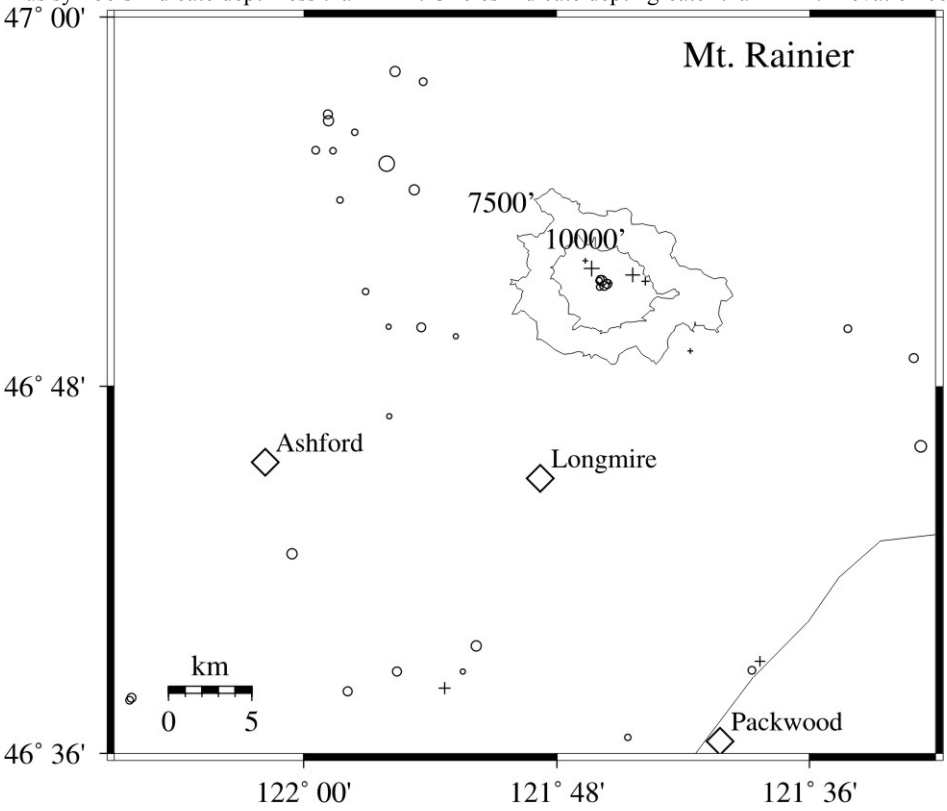

Figure 4. Earthquakes at Mt. Rainier, M>0.0.

EARTHQUAKE CATALOG, 2005-A

This quarter's catalog lists earthquakes of magnitude 2.0 or larger, except at Mt. St. Helens, where only events of magnitude 3.0 or larger are shown. Complete catalog listings are available on-line through **http://www.pnsn.org/CATDAT/catalog.html**
Key to earthquake catalog can be found in the last quarterly report of each year, or at:
http://www.pnsn.org/INFO_GENERAL/PNSN_QUARTERLY_EQ_CATALOG_KEY.htm

Jan 2005

DAY	TIME	LAT	LON	DEPTH	M	NS/NP	GAP	RMS	Q	MOD	TYP
13	05:15:27.44	44 08.67	122 53.28	3.90	2.1	21/024	57	0.34	CC	O0	
15	00:44:35.48	42 36.38	122 15.42	22.06*	2.1	4/004	243	0.01	AD	K3	
19	01:27:27.99	47 46.04	121 50.65	0.40	2.4	41/042	36	0.38	CB	P3	
20	05:23:30.17	46 55.23	121 56.06	8.59	2.1	36/037	33	0.28	BC	C3	
24	13:20:20.55	42 04.80	120 14.83	0.02*	2.6	10/010	148	0.19	BD	K3	

Feb 2005

DAY	TIME	LAT	LON	DEPTH	M	NS/NP	GAP	RMS	Q	MOD	TYP
2	22:31:52.77	47 37.35	122 10.70	30.13	2.3	53/054	34	0.33	CA	P3	
2	23:10:40.28	43 16.21	123 25.80	6.17$	2.4	8/008	257	0.18	CD	O0	
3	00:19:10.94	45 00.36	122 42.78	13.44	2.1	8/008	152	0.05	AC	O0	
3	09:06:02.58	48 00.52	121 51.09	17.11	2.3	39/040	59	0.53	DB	P3	
3	14:08:04.23	48 05.02	122 34.56	32.16	3.1	76/089	55	0.36	CA	P3	F
4	19:30:05.83	47 18.76	122 22.90	27.54	2.5	60/061	67	0.24	BA	P3	
6	03:14:51.02	47 39.36	120 06.81	0.70	2.3	24/025	80	0.32	CC	N3	
6	04:01:19.66	46 42.20	123 46.13	20.04*	2.0	22/022	167	0.18	BC	P3	
6	04:33:45.49	42 04.50	120 12.98	5.34	2.3	10/010	127	0.36	CC	K3	
6	08:53:53.48	48 45.14	121 09.64	0.02*	3.2	26/029	127	0.25	BC	C3	
8	00:15:28.89	44 31.85	122 51.88	0.05*	2.0	13/013	174	0.22	BC	O0	
9	09:58:44.14	45 55.36	122 52.42	17.94#	2.3	36/036	56	0.17	BB	C3	
9	22:16:48.85	46 58.14	120 23.51	0.47*	2.4	15/015	42	0.26	BC	E3	
11	00:12:13.23	46 50.05	117 16.28	15.16$	2.5	14/014	231	0.71	DD	E3	
12	13:17:13.13	46 12.07	122 11.30	0.03*	2.4	16/016	58	0.19	BA	R0	
19	03:50:10.40	47 47.14	121 50.25	8.65	2.1	18/018	77	0.2	BA	P3	
19	13:01:52.72	45 02.88	122 42.72	7.56	2.0	4/004	179	0.45	DD	O0	
20	03:39:33.70	46 40.97	120 57.51	1.46$	2.5	41/043	76	0.34	CC	C3	
21	12:01:08.51	48 00.69	121 52.52	10.37	2.1	18/020	93	0.27	BC	P3	
23	21:45:29.43	47 22.64	122 17.86	22.31	2.2	55/056	39	0.34	CA	P3	
24	05:55:54.08	46 11.52	122 11.54	0.19	2.8	11/011	165	0.07	AC	SD	
25	23:21:12.68	46 40.99	120 57.55	1.59$	2.6	51/052	28	0.32	CC	C3	
26	03:35:39.92	48 51.02	120 02.23	32.22	2.0	6/006	318	0.3	DD	N3	
26	20:56:45.03	44 09.13	122 57.69	0.26	2.1	7/007	220	0.14	BD	O0	
27	08:47:54.16	47 17.27	123 10.42	18.62	2.3	32/033	50	0.18	BA	P3	

Mar 2005

DAY	TIME	LAT	LON	DEPTH	M	NS/NP	GAP	RMS	Q	MOD	TYP
1	20:26:15.34	46 37.60	120 46.12	0.03*	2.2	12/013	185	0.28	BD	C3	
2	22:18:12.38	48 01.11	121 50.02	13.15	2.2	30/031	60	0.49	CB	P3	
4	13:51:14.49	42 12.39	121 59.26	3.74	2.4	15/016	77	0.25	BB	K3	
5	11:42:46.65	46 11.77	122 11.40	0.59	3.0	18/018	50	0.09	AA	S4	
6	11:36:02.24	48 00.46	121 51.31	13.06#	2.7	22/023	59	0.38	CB	P3	
6	13:20:06.43	48 01.30	121 50.00	13.57	3.5	93/093	60	0.5	DB	P3	F
9	17:28:21.72	47 58.90	122 51.48	54.13	2.0	24/024	63	0.16	BA	P3	

9	22:27:48.26	45 57.13	118 13.21	0.02*	2.2	13/013	192	0.46	CD	E3	
11	01:22:15.29	42 04.92	120 15.54	0.02*	2.2	9/009	139	0.26	BD	K3	
13	03:37:47.71	47 15.26	122 49.49	24.11*	3.3	83/083	40	0.31	CA	P3	F
18	20:01:51.64	43 50.38	122 56.90	17.99	2.0	6/006	245	0.24	CD	O0	
18	21:12:14.67	45 00.18	122 42.74	11.67	2.0	5/005	157	0.05	AD	O0	
26	14:15:20.39	46 11.58	122 11.25	0.63	3.1	29/029	45	0.34	CA	S4	
27	01:28:54.24	46 11.71	122 11.39	0.35	3.2	29/029	43	0.19	BA	S4	
27	04:31:14.36	46 11.65	122 11.38	0.05*	3.0	33/033	43	0.44	CA	S4	
27	11:46:03.38	46 11.68	122 11.43	0.66	3.0	32/032	43	0.37	CA	S4	
27	17:26:13.85	46 11.39	122 11.28	0.97	3.0	23/024	46	0.15	BA	S4	
30	12:33:41.15	47 01.82	120 55.95	3.51	2.4	47/049	51	0.21	BC	C3	
31	01:46:34.75	46 11.68	122 11.12	0.04*	3.1	24/024	43	0.25	BA	S4	

OUTREACH ACTIVITIES

The PNSN staff and faculty participate in an educational outreach program designed to better inform the public, educators, businesses, policy makers, government agencies, engineers, and the emergency management community about earthquake, volcano and related hazards. Our program offers lectures, classes, lab tours, workshops, consultations, and electronic and printed information products. Special attention is paid to the information needs of the media. We provide information directly to the public through information sheets, an audio library, email, and via the Internet at http://www.pnsn.org.

Audio Library, Phone

The Seismology Lab responded to over 100 calls from the general public, Emergency Managers and government agencies, and another 100 calls from the Media. In addition, the PNSN audio library system received 375 calls this quarter. The audio library provides several recordings. We have a regularly updated message concerning current seismic activity, and there are also recordings describing seismic hazards in Washington and Oregon and earthquake prediction. Callers to the audio library have the option of being transferred to the Seismology Lab for additional information.

Internet outreach: www.pnsn.org

The URL www.pnsn.org was moved to a University server in Sept. 2004 when the Dept. of Earth and Space Sciences (ESS) server was overwhelmed with traffic due to the eruption of Mt. St. Helen. The University server handled extremely high volumes of traffic during the fourth quarter of 2004, providing about 12 million pages to clients. However, the ESS server also provides another popular web site, **Tsunami!**, and internet traffic following the Dec. 26th Sumatra & Andaman Islands earthquake and tsunami again overwhelmed the ESS departmental server. Millions of "Tsunami!" pages were served in January '05, though many hours of intervention were required to keep the server up and running.

Tsunami!, hosted by ESS since 1995, was the #1 tsunami link on Google and other popular search engines, but was somewhat out of date. PNSN staff joined a committee to renovate the **Tsunami!** web site led by Dr. Catherine Petroff of UW's Civil Engineering and Professor Jody Bourgeois of ESS. Mike Brown, the chair of the Dept. of Earth and Space Sciences, declared PNSN, **Tsunami**!, and the departmental web sites essential departmental services, and ESS developed and signed a memorandum of understanding with the University's Computer & Communications (C&C) unit. C&C will provide dual separated web servers located in different UW Gigabit backbone locations and will implement a round-robin-type dynamic network service (DNS) to these machines with "fail-over" redundancy to maximize availability and reliability. The total cost of these services and necessary hardware is about $3,000 a year, which is being paid by the Dept. of Earth and Space Sciences, a significant new contribution to PNSN operations. PNSN server upgrades are also in the works and full transition to the new system is expected in the summer of 2005.

E-mail Communications

PNSN staff replied to about 360 e-mail messages from the public seeking information on a variety of topics via the ***seis_info@ess.washington.edu*** email address. Ruth Ludwin managed our e-mails this quarter, typically responding to routine questions within a day. Complex or sensitive questions are routed to the appropriate person (PNSN or otherwise) for a more in-depth response. Requests may include complex scientific inquiries, assistance with hazard assessments and legal issues, consultations with government agencies, and support for engineering issues related to strong motion data.

Information Products

CIIM (Community Internet Intensity Maps) and ShakeMaps were generated for several events this quarter. See the "Earthquake Data" section for details.

CISN Display , a product that will first supplement and later replace the CUBE based RACE (Rapid Alert for Cascadia Earthquakes) system, was released in December (Version 1) and distributed to 24 select users including lifeline operators, emergency managers, and large businesses. CISN servers receiving and displaying PNSN recent earthquake data are being tested, and now provide links to the PNSN ShakeMaps, which are automatically generated following significant earthquakes.

The Seattle ShakeMap Working Group, led by Ivan Wong, convened at UW and finalized details for a proposal to FEMA to build high-resolution ShakeMaps in the greater Seattle area, and to push data to FEMA, WSEMD, Seattle EM to aid in response and to improve loss estimation.

K-20 Education Outreach: http://www.pnsn.org/EDHOME/index.html

PNSN and USGS staff gave 25 Seismology Lab tours and presentations for K-12 students and teachers, serving about 625 students this quarter.. This included a series of tours for participants in "Math Day" at the UW, a function attended by hundreds of math-aware high school students from all over Washington State. The PNSN maintains an email list-service of over 50 local K-20 educators and subscribers interested in earth-sciences education, and occasionally send out messages on events of special interest.

The PNSN provided 5 tours for college students, including groups from Western Washington University, The Seattle Arts Institute, and prospective graduate students of the UW Dept. of Earth and Space Sciences.

Media Relations:

The PNSN staff frequently provides interviews, research support, and referrals to radio, television, film, and print media. The PNSN organizes press conferences, contributes to TV and radio news programs and talk shows, and provides field opportunities linking reporters with working scientists. Staff members also assist news organizations, authors, television producers, and independent documentary makers to design accurate and informative stories and programs related to earthquake and volcano hazards. PNSN staff work to link reporters and producers developing stories with the appropriate research institutions, agencies, and scientists working in the areas to be covered by the piece. The PNSN coordinates the release of information and media relations with the USGS Western Region, the Cascades Volcano Observatory, and the Oregon Department of Geology and Mineral Industries (DOGAMI).

The current eruption of Mount St. Helens (MSH) continued to stimulate media inquiries but at a much reduced level from the last quarter. PNSN staff was called upon to help plan a variety of news stories, documentaries and films related to the December 26th 2004 Banda Aceh Earthquake and Tsunami. Our own Cascadia Subduction Zone was the focus of many of these productions and reports. Films produced by the Discovery Channel, National Geographic, and the BBC were aired on regional television.

Throughout the quarter, PNSN scientists participated in morning science conferences with CVO three times a week to share data and interpretations, and develop "talking points" for use in interviews.

Meetings, Presentations and Visitors:

- The PNSN helped publicize a series of public lectures at the UW on the impacts of the Dec. 26th Earthquake and Tsunami.
- Bill Steele gave talks on "Understanding Mount St. Helens" and "The Faults Beneath our Feet, Uncovering Earthquake hazards in the Puget Sound Region" at a national, 2 day, Disaster Resistant University Symposium at UW in January, sponsored by the US Department of Homeland Security. He also provided a Seismology Lab Tour for participants at the close of the symposium.
- In February, Bill Steele taught a Puget Sound earthquake hazards class at the Whidbey Island Beach Watchers Association annual Sound Waters Conference, and also gave a lunch-time keynote speech to several hundred Whidbey Island residents.
- Chris Newhall and Bill Steele provided separate public talks at the Pacific Science Center IMAX Theater as part of a "Disaster 101" lecture series accompanying the IMAX movie "Natures Fury".
- Tony Qamar gave a talk on Puget Sound Earthquake Hazards to the Public Affairs Forum in Gig Harbor, WA
- In anticipation of the EERI Seattle Fault Scenario and the CREW Cascadia Subduction Zone Scenario, a presentation was made to the Bellevue City Emergency Management Committee on paleoseismological work in the Puget Sound Region.
- PNSN staff and faculty attended the day-long rollout of the EERI Seattle Fault Scenario in Bellevue (on February 28th, the 4th anniversary of the Nisqually Earthquake), and Bill Steele assisted CREW (The Cascadia Region Earthquake Workgroup) with meeting organization and media relations.
- Tony Qamar, Bill Steele, and Craig Weaver attended a meeting of the PNW ANSS Advisory Committee, Structures Sub Committee working to identify regional candidate buildings for structural instrumentation.

QUARTERLY NETWORK REPORT 2005-B

on

Seismicity of Washington and Oregon

April 1 through June 30, 2005

Pacific Northwest Seismograph Network

Dept. of Earth and Space Sciences

Box 351310

University of Washington

Seattle, Washington 98195-1310

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 O4HQAG005
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 second quarterly report of 2005 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 earthquake catalog is available on-line, both through our web-site and through the ANSS earthquake 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.

Prior to 2004, each quarterly included station tables and maps. Beginning in 2004, station tables and maps will be included only in the 4th quarter report. Lists of currently operating stations are available on-line through web page http://www.pnsn.org/OPS/stations.html.

NETWORK OPERATIONS

Lists of currently operating stations are available on-line through web page http://www.pnsn.org/OPS/stations.html. 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.

TABLE 1 - Station outages and installations

Station	Outage Dates	Comment
ALVY	05/02/05-05/26/05	No communications
BEVT	05/02/05-05/20/05	Dead
BEVT	05/20/05-End	Removed for repair
BHW	03/14/04-04/19/05	Very noisy; transmitter problems
BULL	03/28/05-End	Dead
BURN	04/11/05-05/20/05	Dead
COLT	04/11/05-06/02/05	No communications
COLT	06/02/05-End	Removed for repair
FL2	11/28/04-06/16/05	Dead; seismometer problem
GL2	10/21/04-End	Dead
GLK	11/26/04-05/13/05	Noisy
GNW	01/01/05-05/12/05	Bad E component
GPW	03/16/04-End	Dead
GRCC	06/06/05-End	No communications
GTWN	06/01/05-End	Dead; telemetry being moved for bldg. renovation
HDW	12/28/04-04/21/05	Dead battery
HSO	05/08/05-05/21/05	Noisy
JBO	10/15/04-End	Noisy
KEEL	05/30/05-End	Dead
KFAL	06/13/05-End	Dead; possible firewall problem
KICC	03/04/05-End	Bad timing
LCW	05/08/05-06/02/05	Noisy
LNO	06/07/05-End	Dead; subcarrier problem
LTY	04/13/05-05/13/05	No communications
MBKE	06/07/05-End	Dead; possible K2 problem
MBW	12/07/04-04/14/05	Dead; shut down relay site due to radio interference
MCW	12/07/04-04/14/05	Dead. bad seismometer
MIDE	04/14/05	Installed – St. Helens
NCO	05/08/05-06/07/05	Noisy

TABLE 1 - Station outages and installations

Station	Outage Dates	Comment
NED	04/06/05	Installed – St. Helens
OBH	01/31/02-End	Temp. removed for logging
ON2	03/01/05-04/27/05	Noisy
OSR	03/01/05-04/27/05	Dead
PERL	01/29/05-04/26/05	No communications
PGW	10/08/03-End	Dead
RCS	06/11/05-End	Noisy
RER	10/20/04-01/31/05	Noisy
RHAZ	06/26/05-End	Dead
RMW	12/07/04-06/07/05	Dead
RVC	12/05/03-05/21/05	Noisy
RVW	02/23/05-06/21/05	Dead
SEA.HH?	12/05/03-End	Disconnected for renovation
SBES	05/18/05-End	Short period noisy
SFER	09/01/04-End	Short period dead; needs removal
SMNR	06/23/05-End	Temp. removed for work on the bldg.
SMW	06/20/03-05/27/05	Intermittent; equalization problem
SOPS	08/27/02-End	K2 flash-memory problem
SP2	11/14/04-06/23/05	Bad timing
SSS1	03/05/05-End	Dead
STW	04/28/05-05/08/05	Noisy
TDL	11/28/04-05/25/05	Dead; animal ate through seismometer cable
TOLO	10/15/04-05/14/05	No communications
TTW	01/01/05-06/13/05	Bad E component
VBE	02/17/05-03/20/05	Intermittent; usually very noisy
VBE	04/12/05-05/04/05	Noisy
VGB	09/23/04-End	Intermittent; usually very noisy
VVHS	04/11/05-04/29/05	No communications
VVHS	05/27/05-06/14/05	No communications
WAT	04/16/05-05/04/05	Dead; discriminator needed to be adjusted

Mt. St. Helens eruption, 2004-2005

Beginning on September 23, 2004 a series of small earthquakes at Mount St. Helens signaled the beginning of the first dome-building eruption at the volcano since 1986. The small earthquakes soon escalated into the most vigorous seismic activity at Mount St. Helens since the catastrophic eruption of 1980. Continuous seismic data from short-period stations near Mt. St. Helens are archived at the PNSN and streamed to the IRIS BUD archive. New procedures were implemented to rapidly handle the large volume of data so the PNSN and Cascade Volcanoes Observatory could assess the significance of the rapidly changing seismicity. For details, see the 2004-D and 2005-A quarterly reports.

- ***MSH Equipment; destruction and replacement -*** Stations SEP, MIDE, and NED were destroyed during the ash and steam eruption of March 8. SEP was replaced on March 15. Station NED was reinstalled on April 6 and station MIDE was reinstalled on April 14. All done by the staff of CVO.

PNSN Personnel changes

Two new staff members joined the PNSN this quarter. Karl Hagel is an electronics technician who will maintain our analog radio-telemetered stations and other equipment in the lab and field.. Bill Gustafson is a programmer who is implementing new code and helping to improve the robustness of our computer operations.

Strong Motion Instrumentation Update

Two ANSS stations, funded through the Oregon Department of Geology and Mineral Industries (DOGAMI), were installed in southern Oregon this quarter. USGS Staff completed the installations in early May. Station SOUA is located on the Southern Oregon University campus in Ashland in a free field enclosure installed by University staff, students, and volunteers.

Station UMPQ is installed at the Umpqua Community College campus in Roseburg. College staff installed the free field enclosure. Both stations have K2 seismographs with internal episensors. Telemetry for both stations is TCP/IP.

Computer Hardware Update

Scossa continues to be our main data collection computer, and *tremito* provides additional computational power for manual processing of earthquake data and acts as a fileserver for all the other networked computers in the group.

Use of PNSN Data

The IRIS Data Management Center reports 2,181 requests for PNSN trace-data this quarter. Nearly 52,500,000 traces were requested. The number of traces requested remains at an elevated level compared to a "typical" quarter.

EARTHQUAKE DATA – 2005-B

Between April 1 and June 30, 2005, 2,742 events were digitally recorded and processed at the University of Washington. Thousands of additional unlocated events occurred at Mount St. Helens associated with the dome-building eruption which began in late September 2004. Locations in Washington, Oregon, or southernmost British Columbia were determined for 2,134 of these events; 2,062 were classified as earthquakes and 72 as known or suspected blasts. The remaining processed events include teleseisms (167 events), regional events outside the PNSN (178), and unlocated events within the PNSN, mostly at Mt. St. Helens. Due to the extremely large number of events, only a representative sample of Mount St. Helens seismicity was located. Other unlocated events within the PNSN normally 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 2 lists earthquakes reported to have been felt during this quarter. Events with ShakeMaps or Community Internet Intensity Maps (CIIM) are indicated. This quarter, one event generated a ShakeMap. Four events produced "CIIM" maps (**http://pasadena.wr.usgs.gov/shake/pnw/**), which convert "felt" reports sent by the general public (via Internet) into numeric intensity values. CIIM maps show the average intensity by zip code.

Table 3 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 1. Earthquakes with magnitude greater than or equal to 0.0 (M_c >=0).

Figure 2. Blasts and probable blasts (M_c >=0).

Figure 3. Earthquakes located near Mt. St. Helens (M_c >=0).

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

TABLE 2 - Felt Earthquakes during the 2nd Quarter of 2005

DATE-(UTC)-TIME	LAT(N)	LON(W)	DEP	MAG	COMMENTS		Shake
yy/mm/dd hh:mm:ss	deg.	deg.	km	Ml		CIIM	Map
05/05/18 14:46:23	48.14	122.60	27.2	2.6	35.4 km WNW of Everett, WA	✓	
05/06/15 02:50:57	41.32	126.03	10.0	7.2 (USGS)	160.6 km WSW of Crescent City, CA	✓	
05/06/17 06:21:34	40.18	127.54	10.0	6.4 (USGS)	295.0 km WSW of Eureka, CA	✓	
05/06/25 13:49:11	45.52	122.63	14.9	2.7	2.0 km SW of Portland, OR	✓	✓
05/06/29 14:37:14	46.65	120.61	10.0	3.5	10.1 km NW of Yakima, WA		

OREGON

During the second quarter of 2005, 39 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 most notable earthquakes in Oregon this quarter were a M 2.7 quake at about 15 km depth located near Portland, OR on June 25 (UTC), and a M 2.8 event at about 1 km depth located near Mount Hood, Oregon on April 6 (UTC). Three quakes, M 1.4 – 2.5, were located 30-50 km southwest of Newport, OR near the location of a magnitude 4.9 earthquake on July 12, 2004 (see the 2004C quarterly for details). Like the events offshore of Newport in 2004, this quarter's quakes were at depths greater than 25 km.

South of Oregon, two sizable earthquakes occurred offshore northern California on June 15 UTC (USGS magnitude 7.2) and June 17 UTC (USGS magnitude 6.4). These earthquakes lie outside the PNSN network, and they were located by the NEIC. PNSN personnel learned of the events through the news media. The June 15 UTC earthquake triggered a tsunami alert for the coasts of California, Oregon, and Washington. Although no significant tsunami resulted and the alert was called off within an hour or so, the event exposed a number of glitches in notification systems and evacuation plans. A NOAA weather

radio problem prevented the alert from being broadcast along the northwest coast of Washington, and another problem apparently delayed delivery of the alert message to responders in California.

WESTERN WASHINGTON SEISMICITY

During the first quarter of 2005, 1,946 earthquakes were located between 45.5 degrees and 49.5 degrees north latitude and between 121.0 degrees and 125.3 degrees west longitude. Most western Washington seismicity this quarter was in the Mount St. Helens area, see discussion below. Two earthquakes were felt this quarter in western Washington.

Excluding Mt. St. Helens, the largest earthquake in western Washington this quarter was a magnitude 2.6 event on May 18 (UTC), located about 35 km west-north-west of Everett at a depth of about 27 km and reported felt in the area. The deepest earthquake in western Washington this quarter was a magnitude 2.1 event at about 62 km depth located about 28 km west of Everett, WA on April 4 (UTC).

WASHINGTON CASCADE VOLCANOES

Mount St. Helens

Mount St. Helens seismicity and dome building eruption continued through this quarter. The eruptive episode began with a vigorous sequence of seismic activity starting on September 23, 2004. Activity accelerated into early October. The most energetic seismicity occurred on Oct. 1-5 when several phreatic explosions and half-hour to hour-long periods of harmonic tremor interrupted and temporarily calmed extremely high rates of magnitude 3+ seismicity. Seismicity fell following after Oct. 5, though frequent, but smaller earthquakes have continued through this quarter. Because of the high rates of seismicity, only a representative sample of Mount St. Helens events were located using conventional manual processing. Figure 3 shows located volcano-tectonic earthquakes near Mount St. Helens. Low frequency (L) and avalanche or rockfall events (S) are not shown. See the operations section for details on destruction, replacement and new instrument installation during the first quarter.

This quarter, 1,655 earthquakes were located in the area shown in Fig. 3 using conventional manual processing procedures (including 1,597 earthquakes between magnitude 1.0 and 2.9, and 5 slightly larger events with magnitudes between 3.0 and 3.4. Most of the larger events are associated with rockfalls off the new dome. Rockfalls expose glowing hot rocks in the core of the whaleback, and flashes of light continue to be recorded simultaneously with rockfall signals. Digitally enhanced nighttime volcano-cam images (http://www.luscombe-carter.com/mount_st_helens/index.html) show variations in the intensity of glow from the new dome. At times a steady glow is visible, while sudden brief bursts of light (likely rockfalls) are seen at other times. Volcano-Tectonic earthquakes continue to occur with a somewhat regular inter-occurrence time which has varied slowly over days and weeks.

All locatable earthquakes in the 2004/2005 sequence are relatively shallow. No events occurred at depths exceeding 2 km. The vigorous seismicity last quarter and the tectonic events this quarter tended to be located on the boundary between the old and new domes near the vent that appeared in early October, 2004.

Estimating counts of Mount St. Helens seismicity using automated counting procedures and data from station YEL suggests that about 70,000 earthquakes magnitude 0.1 or larger (about 31 events/hour) occurred at Mount St. Helens during the 2nd quarter of 2005. Although in seismically quiet times our catalog of events at Mount St. Helens is complete to about magnitude 0.0, only a small subset of this quarter's activity was processed using our normal procedure.

Correction of 2005A Mount St. Helens Event Count While checking the event count at Mt. St. Helens for this quarterly report, an error in the previous quarterly was noted. Automated counting procedures and data from station YEL suggest that about 240,000 earthquakes magnitude 0.1 or larger (about 91 events/hour) occurred at Mount St. Helens during the 1st quarter of 2005 (Last quarter's report erroneously estimated the number of 1st quarter events at 70,000.).

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). Two events flagged "L" or "S" were located at Mount Rainier this quarter and 163 "L" or "S" events were recorded, but were too small or too emergent to locate reliably. Type L and S events are not shown in Fig. 4.

A total of 74 tectonic events (37 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 1.9 event on May 28 (UTC), located about 13 km northeast of Morton, WA at about 16 km depth. This quarter, 40 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 46.6-47.0

degrees north latitude and 121.83-122 west longitude). Within 5 km of the summit, there were 21 (15 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 shown in Fig. 4.

EASTERN WASHINGTON SEISMICITY

During the second quarter of 2005, 75 earthquakes were located in eastern Washington in the area between 45.5 - 49.5 degrees north latitude and 117 - 121 degrees west longitude. The largest earthquake recorded in eastern Washington this quarter was a magnitude 3.5 event on June 29. It occurred at about 10 km depth, was located about 10 km northwest-of Yakima, and was reported to have been felt locally.

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.

Other regional agencies provide earthquake information. These include the Geological Survey of Canada (Pacific Geoscience Centre), Sidney, B.C. **http://www.pgc.nrcan.gc.ca/seismo/table.htm** ; and other regional networks in the United States **http://earthquake.usgs.gov/regional/** The US Geological Survey coordinates earthquake information nationally; **http://earthquake.usgs.gov**.

Complete catalog listings are available on-line through **http://www.pnsn.org/CATDAT/catalog.html** Key to earthquake catalog can be found in the last quarterly report of each year, or at:
http://www.pnsn.org/INFO_GENERAL/PNSN_QUARTERLY_EQ_CATALOG_KEY.htm

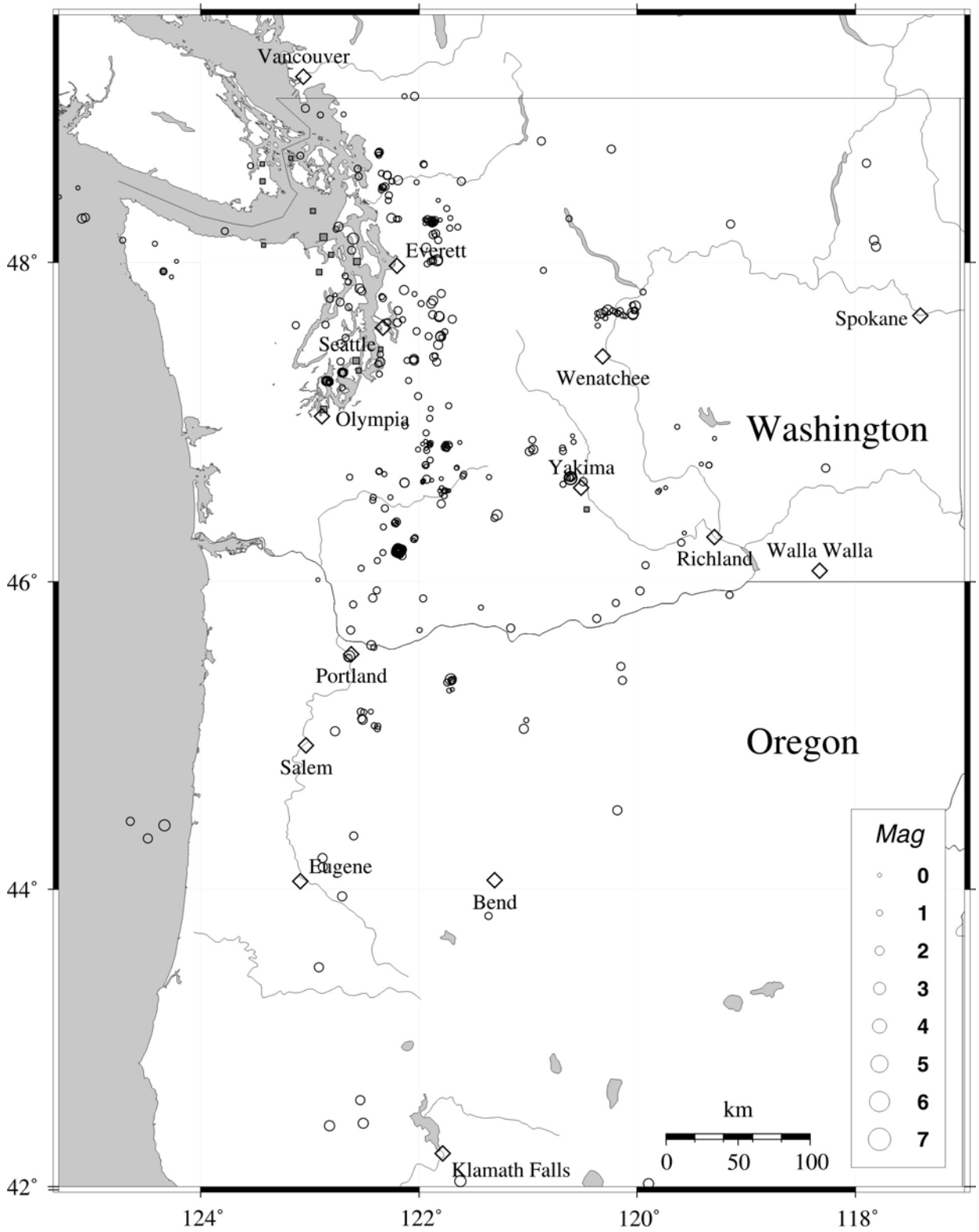

Figure 1 Earthquakes with magnitude greater than or equal to 0.0 (Mc>=0.0). Unfilled diamonds represent cities. Quakes shallower than 30 km are indicated by circles, and deeper quakes by filled squares.

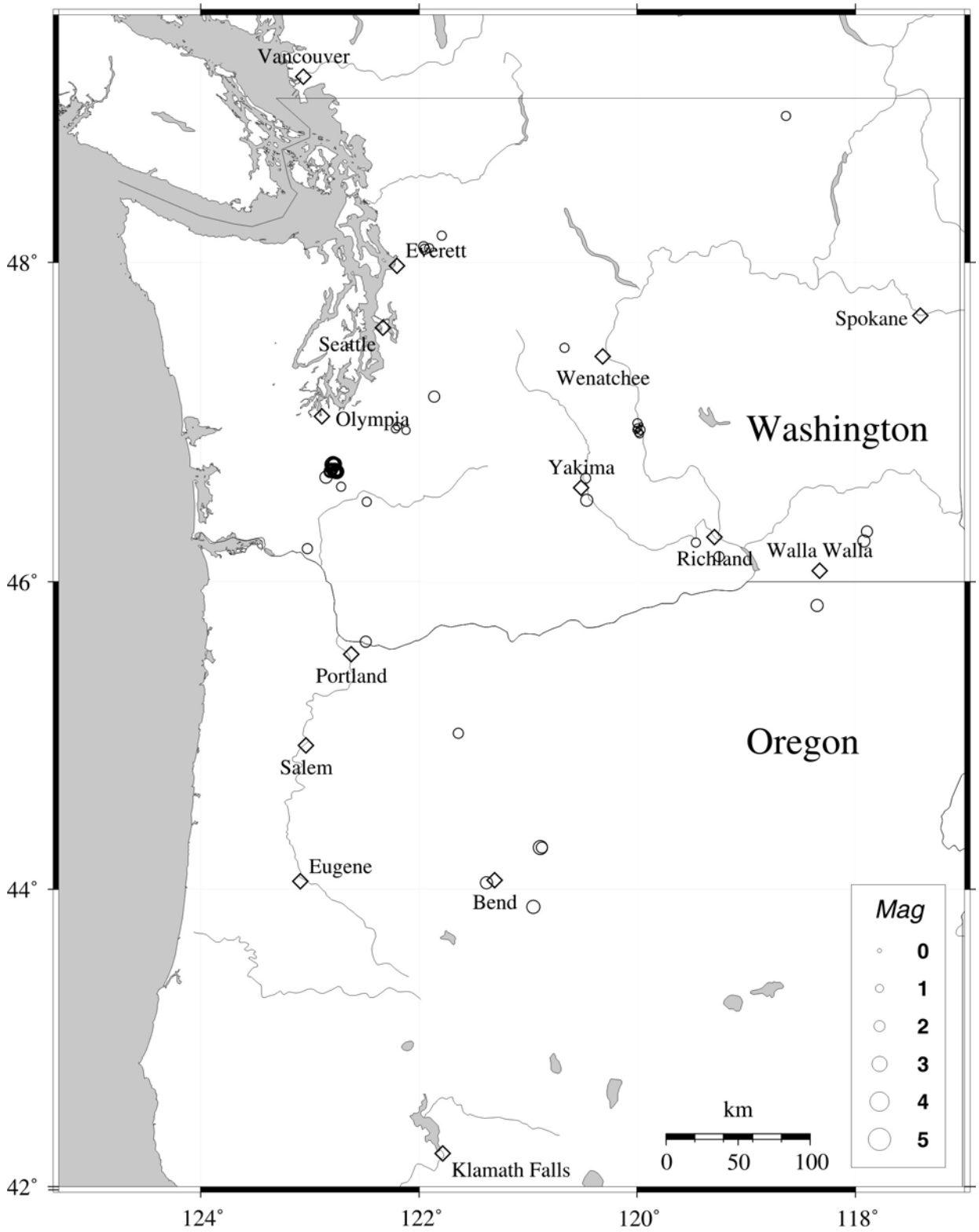

Figure 2. Blasts and probable blasts. Unfilled diamonds represent cities.

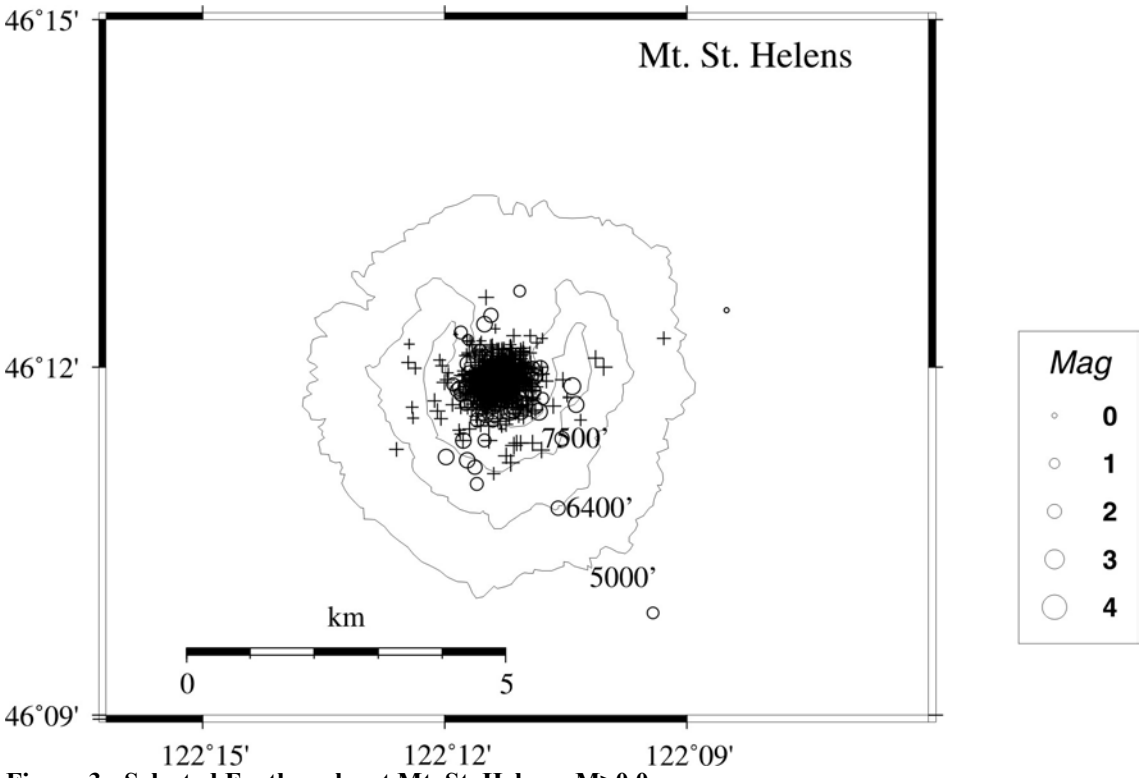

Figure 3 - Selected Earthquake at Mt. St. Helens; M>0.0
Events elected by the analyst for location are small fraction of the number of events recorded during the quarter.
Plus symbols indicate depth less than 1 km. Circles indicate depth greater than 1 km. Elevation contours shown in feet.

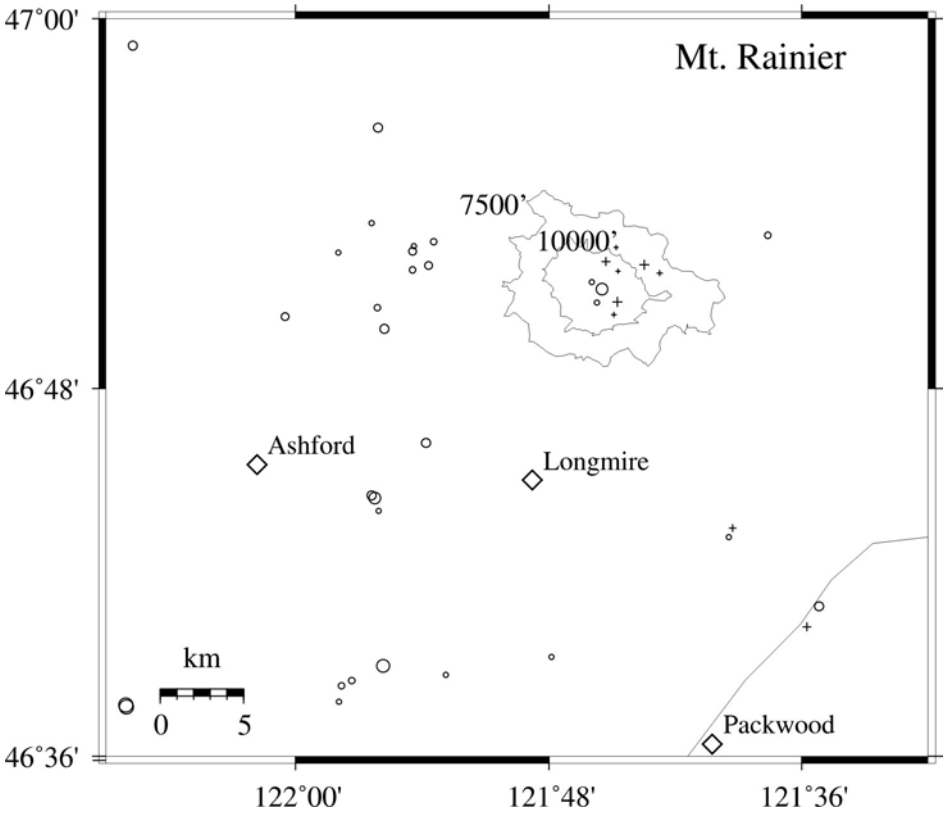

Figure 4. Earthquakes at Mt. Rainier; M>0.0

EARTHQUAKE CATALOG, 2005-B

This quarter's catalog lists earthquakes of magnitude 2.0 or larger, except at Mt. St. Helens, where only events of magnitude 3.0 or larger are shown. Complete catalog listings are available on-line through **http://www.pnsn.org/CATDAT/catalog.html**
Key to earthquake catalog can be found in the last quarterly report of each year, or at:
http://www.pnsn.org/INFO_GENERAL/PNSN_QUARTERLY_EQ_CATALOG_KEY.htm

Apr-05											
DAY	**TIME**	**LAT**	**LON**	**DEPTH**	**M**	**NS/NP**	**GAP**	**RMS**	**Q**	**MOD**	**TYP**
3	16:41:13	46 11.69	122 11.47	1.19	3.0	22/022	49	0.14	AA	S4	
4	4:41:02	48 00.30	122 33.97	62.30	2.1	48/048	54	0.20	BA	P3	
4	5:43:41	46 11.75	122 11.34	0.94	3.4	32/032	45	0.18	BA	S4	
4	10:56:35	46 11.81	122 11.46	0.62	3.2	29/029	47	0.22	BA	S4	
5	4:16:15	46 11.64	122 11.19	1.03	3.3	38/038	35	0.31	CA	S4	
5	13:56:31	47 29.40	121 49.30	21.70	2.0	40/043	60	0.35	CA	P3	
6	17:36:42	48 13.16	122 44.06	18.87*	2.0	22/024	66	0.19	BA	P3	
6	22:57:41	45 22.37	121 42.38	1.31	2.8	37/037	53	0.34	CB	O0	
9	8:01:19	46 11.65	122 11.15	1.03	3.0	27/027	43	0.32	CA	S4	
12	6:07:27	44 08.77	122 52.73	3.87$	2.0	18/021	57	0.26	BC	O0	
13	4:51:06	44 25.32	124 20.00	28.90	2.5	13/013	247	0.41	CD	O0	
19	12:30:44	47 39.90	121 48.70	17.69	2.3	36/038	56	0.20	BA	P3	
21	11:55:12	47 40.13	121 48.73	17.79	2.1	38/040	61	0.23	BA	P3	
29	8:06:55	47 23.58	122 02.68	7.06*	2.1	40/042	42	0.23	BB	P3	
29	22:45:57	45 02.23	122 46.12	7.57	2.1	7/007	265	0.28	DD	O0	
May-05											
DAY	**TIME**	**LAT**	**LON**	**DEPTH**	**M**	**NS/NP**	**GAP**	**RMS**	**Q**	**MOD**	**TYP**
1	4:56:04	48 09.29	122 52.46	52.32	2.3	30/031	80	0.17	BA	P3	
1	22:07:30	47 41.36	120 02.35	4.87	2.8	29/030	50	0.38	CC	N3	
3	19:06:22	45 35.47	122 26.26	8.75	2.0	17/018	89	0.18	BB	C3	
13	16:20:44	48 00.86	121 50.02	17.00	2.6	41/043	60	0.57	DA	P3	
16	20:38:42	44 31.27	120 10.82	11.80	2.0	11/011	234	0.27	CD	O0	
18	14:46:24	48 08.84	122 36.24	27.22	2.6	59/059	36	0.29	BA	P3	F
19	21:44:03	47 41.10	120 19.87	3.32	2.0	14/014	87	0.10	AB	N3	
20	6:20:59	47 42.39	120 16.23	3.78	2.4	31/033	57	0.31	CC	N3	
24	1:34:14	47 43.85	120 00.81	5.81	2.2	24/027	50	0.29	BA	N3	
31	5:57:04	46 50.31	120 57.19	1.62$	2.1	29/030	60	0.37	CC	C3	
Jun-05											
DAY	**TIME**	**LAT**	**LON**	**DEPTH**	**M**	**NS/NP**	**GAP**	**RMS**	**Q**	**MOD**	**TYP**
10	1:05:41	47 32.63	121 47.99	18.16	2.4	40/043	84	0.20	BA	P3	
10	2:19:49	47 32.50	121 48.20	18.42	2.0	29/032	83	0.19	BA	P3	
12	0:26:43	42 01.30	119 53.75	12.90	2.3	7/008	303	0.29	CD	K3	
12	0:44:39	46 25.49	121 17.03	9.49	2.2	36/037	39	0.39	CC	C3	
14	1:32:51	45 03.11	121 02.48	19.45	2.1	18/019	81	0.12	AA	O0	
14	22:42:02	42 24.84	122 49.14	8.76	2.2	4/004	202	0.16	BD	K3	
15	2:50:57	41 19.50	126 02.24	10.00*	7.2	45/045	280	0.74	DD	J1	R
17	6:21:34	40 10.94	127 32.74	10.00*	6.4	30/030	314	0.30	BD	J1	R
20	8:45:55	47 23.06	122 21.17	18.29	2.0	24/026	66	0.17	BA	P3	
21	12:30:08	46 39.39	120 36.76	10.43*	2.9	38/038	50	0.16	BB	E3	
23	17:01:31	42 25.87	122 30.62	5.78	2.2	6/006	122	0.07	AC	K3	

24	12:03:55	47 23.65	122 34.74	50.50	2.0	37/039	36	0.23	BA	P3	
25	13:49:11	45 31.27	122 38.24	14.87	2.7	43/043	58	0.21	BA	C3	F
29	14:37:14	46 39.38	120 36.62	9.96	3.5	39/039	50	0.20	BB	E3	F
29	23:18:14	42 02.33	121 37.21	0.02*	2.7	8/008	187	0.10	AD	K3	

OUTREACH ACTIVITIES

The PNSN staff and faculty participate in an educational outreach program designed to better inform the public, educators, businesses, policy makers, government agencies, engineers, and the emergency management community about earthquake, volcano and related hazards. Our program offers lectures, classes, lab tours, workshops, consultations, and electronic and printed information products. Special attention is paid to the information needs of the media. We provide information directly to the public through information sheets, an audio library, email, and via the Internet at http://www.pnsn.org.

Audio Library, Phone

The Seismology Lab responded to over 100 calls from the general public, Emergency Managers and government agencies, and another 60 calls from the Media. In addition, the PNSN audio library system received 360 calls this quarter. The audio library provides several recordings. We have a regularly updated message concerning current seismic activity, and there are also recordings describing seismic hazards in Washington and Oregon and earthquake prediction. Callers to the audio library have the option of being transferred to the Seismology Lab for additional information.

Internet outreach

In 2004 URL www.pnsn.org was moved to a University server when www.ess.washington.edu, the Dept. of Earth and Space Sciences (ESS) server, was overwhelmed with internet traffic due to the eruption of Mt. St. Helens in Sept. 2004. The Dec. 26th Sumatra & Andaman Islands earthquake and tsunami again caused overload of the ESS server.

This quarter, the entire ESS site was augmented by additional high-traffic, high-security servers operated by the University's Computer & Communications (C&C) unit, which provided dual separated web servers located in different UW locations to provide "fail-over" redundancy, each with Gigabit backbone access. The C&C machines use a round-robin-type dynamic network service (DNS) to balance load. The startup hardware cost for this system was $6000, and annual operations will cost about $3,000 a year which is being paid by the Dept. of Earth and Space Sciences, a welcome and useful contribution to PNSN operations. The authoritative "master" web server was upgraded in June. This ESS departmental computer supplies updates every 5 minutes to the C&C high capacity servers.

PNSN staff replied to about 250 e-mail messages from the public seeking information on a variety of topics via the ***seis_info@ess.washington.edu*** email address. Ruth Ludwin managed this service this quarter, typically responding to routine questions within a day. Complex or sensitive questions are routed to the appropriate staff person for a more in-depth response. Requests may include complex scientific inquiries, assistance with hazard assessments and legal issues, consultations with government agencies, and support for engineering issues related to strong motion data.

Information Products

Four CIIM Maps and one ShakeMap were generated for this quarter. See the "Earthquake Data" section for details.

CISN display servers are receiving and displaying PNSN recent earthquake data and now provide links to the PNSN ShakeMaps, which are automatically generated following significant earthquakes. The CISN Display version 1 was released in December 2004 and distributed to 24 select users including lifeline operators, emergency managers, and large businesses. This product will first supplement and later replace the CUBE based RACE (Rapid Alert for Cascadia Earthquakes) systems currently deployed.

The Seattle ShakeMap Working Group, led by Ivan Wong, has submitted a proposal to FEMA to build high resolution ShakeMaps in the greater Seattle area and to push data to FEMA, WSEMD, and Seattle EM to aid in response and to improve loss estimation. Steve Palmer and colleagues at the Washington State Department of Natural Resources Division of Geology offered to help lay the groundwork for the Seattle ShakeMap Project by testing various ways to compile higher resolution NEHRP soils map grids for the State of Washington using the best available data. A number of meetings and conversations were held and the new grided maps will be available in August 2005.

K-20 Education Outreach

PNSN and USGS staff gave 11 Seismology Lab tours and presentations for K-12 students and teachers, serving about 240 students this quarter. Bill Steele also gave two assemblies at Briarcrest Elementary School to about 300 students on "How Mt. St. Helens Works". The PNSN maintains an email list-service of over 50 local K-20 educators and subscribers interested in earth-sciences education, and occasionally send out messages on events of special interest.

Media Relations

The PNSN staff frequently provides interviews, research support, and referrals to radio, television, film, and print media. The PNSN organizes press conferences, contributes to TV and radio news programs and talk shows, and provides field opportunities linking reporters with working scientists. Staff members also assist news organizations, authors, television producers, and independent documentary makers to design accurate and informative stories and programs related to earthquake and volcano hazards. PNSN staff work to link reporters and producers developing stories with the appropriate research institutions, agencies, and scientists working in the areas to be covered by the piece. The PNSN coordinates the release of information and media relations with the USGS Western Region, the Cascades Volcano Observatory, and the Oregon Department of Geology and Mineral Industries (DOGAMI).

The ongoing eruption of Mount St. Helens (MSH) continued to stimulate media inquiries but at a much reduced level from the last quarter. PNSN staff were called upon to help plan a variety of news stories, documentaries and films related to the December 26th, 2004 Banda Aceh Earthquake and Tsunami. Our own Cascadia Subduction Zone was the focus of many of these productions and reports. Films produced by the Discovery Channel, National Geographic and the BBC were aired on regional television.

In addition to the ongoing eruption updates, PNSN staff and, in particular, Director Steve Malone, provided a large number of interviews and assisted in the development of radio and television programs commemorating the 25th Anniversary of the 1980 Mt. St. Helens Eruption.

PNSN staff were very involved in the release and coverage of the EERI Seattle Fault Scenario and the CREW Cascadia Earthquake Scenario. Both scenarios attracted significant media coverage.

A June 15 UTC M 7.2 earthquake off the coast of California triggered a brief tsunami warning for the coasts of California, Oregon, and Washington. The warning was issued by the Alaska Tsunami Warning Center (ATWC), and did not involve the PNSN directly, although the local media response was considerable, and the seismology lab remained open until 11 PM to accommodated interview requests.

Throughout the quarter, PNSN scientists participated in morning science conferences with CVO three times a week to share data and interpretations, and develop "talking points" for use in interviews.

Meetings, Presentations and Visitors

- A Northwest Science Writers Association meeting was hosted by the PNSN and Cynthia Gardner, Steve Malone, and Bill Steele spoke to the group about the eruption of Mt. St. Helens, and scientist-media relations.
- PNSN and UW management continued to work with State of Washington representatives to obtain State funding to meet State agency information needs.
- Bill Steele assisted the Cascadia Region Earthquake Workgroup with the development and roll out of the CREW Cascadia Earthquake Scenario at the State Partners in Preparedness Conference and with the submission of an Op-Ed article published by the Seattle Post Intelligencer.
- The PNSN participated in University-sponsored events including an Alumni Open House, the Arts and Sciences Celebration of Distinction program and poster session, and provided a lab tour while meeting with Regent and past Governor Dan Evans.
- Steve Malone provided the Presidential speech at the Seismological Society of America (SSA) Conference in Reno, NV.
- 2005 SSA presentations by PNSN faculty, staff and graduate students:

  - **High-resolution 3D Travel-time Tomography Using Controlled Sources and Earthquakes: Application to the Seattle Basin and Vicinity** CROSSON, R. S.,
  - **The Origins of the Advanced National Seismic System** FILSON, J. R., ARABASZ, W. J., BENZ, H. M. and BULAND, R., GEE, L. S., MALONE, S. D., and OPPENHEIMER, D.
  - **Broadband Seismic Monitoring of Recent Activity at Mount Saint Helens, Washington** HORTON, S. P., BRACKMAN, T., WATSON, C., WITHERS, M., PATTERSON, G., and BODIN, P.,NORRIS, R.; MORAN, S., and QAMAR, T.
  - **The 2004-2005 Eruption of Mount Saint Helens: Possible Links between Seismicity and Physical Changes in the New Lava Dome** MORAN, S. C. and VALLANCE, J. W., QAMAR, A. I. and MALONE, S. D.

- **Rapid Analysis of Earthquake Data during the 2004-2005 Dome-building Eruption of Mount Saint Helens** QAMAR, A. and MALONE, S. D., and MORAN, S.
- **Azimuthal Patterns in High-frequency Energy Observed at Mount Saint Helens, Washington: Implications for Near-surface Structure** THELEN, W. A. and MALONE, S. D
- **Pacific Northwest Seismograph Network (PNSN) as Part of ANSS** THOMAS, G., QAMAR, A., BARBEROPOULOU, A., LINDQUIST, P. C., and MALONE, S. D.
- **Source Parameters of Microearthquakes at Mount St. Helens (USA)** TUSA, G. and GRESTA, S.; and MALONE, S. D.

- UWTV recorded a May 1, 2005 public lecture on Mt. St. Helens given by PNSN Director Stephen D. Malone. The lecture is scheduled for a half-dozen re-broadcasts on UWTV in the near future. Dr. Malone was also videotaped presenting a lecture on predicting earthquake and volcanic eruptions to the UW Program on the Environment and the UW Alumni Club . This lecture has been broadcast on a public-access channel.
- Steve Malone provided lectures on Mt. St. Helens during a visit to Italy at the INGV (National Institute of Geophysics and Vplcanology) and the University of Pisa.
- The PNSN hosted many meeting this quarter including The Contingency Planners and Recovery Managers (CPARM), Seattle ShakeMap Workgroup, and the University of Washington Emergency Planning Group.
- Ruth Ludwin presented a poster and participated in a panel discussion at the NSF Tsunami Deposits Workshop hosted June 12-15 by the Dept. of Earth and Space Sciences. http://earthweb.ess.washington.edu/tsunami2/deposits/.
- Staff scientist Ruth Ludwin was first author on a paper titled **Dating the 1700 Cascadia Earthquake - Great Coastal Earthquakes in Native Stories**, 2005, R. S. Ludwin, R. Dennis, D. Carver, A. D. McMillan, R. Losey, J. Clague, C. Jonientz-Trisler, J. Bowechop, J. Wray, and K. James, Seismological Research Letters, V. 76, No. 2
- Bill Steele gave a number of invited talks including the Oregon Telecommunications Associations Annual Conference in Bend Oregon. A talk for the Thoracic Oncology Conference, and the University Rotary Club.

QUARTERLY NETWORK REPORT 2005-C

on

Seismicity of Washington and Oregon

July 1 through September 30, 2005

Pacific Northwest Seismograph Network

Dept. of Earth and Space Sciences

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Seattle, Washington 98195-1310

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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INTRODUCTION

This is the third quarterly report of 2005 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 earthquake catalog is available on-line, both through our web-site and through the ANSS earthquake 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.

Prior to 2004, each quarterly included station tables and maps. Beginning in 2004, station tables and maps appear in the quarterly report only once a year. The 2005C Quarterly Report includes these tables and maps in Appendix. \

NETWORK OPERATIONS

Lists of currently operating stations are available on-line through web page http://www.pnsn.org/OPS/stations.html. 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.

TABLE 1 - Station outages and installations

Station	Outage Dates	Comment
ACES	08/03/05-End	Bad timing
ALCT	08/16/05-End	Removed for repair
ALVY	07/20/05-End	No communications
BEVT	05/20/05-End	Removed for repair
BULL	03/28/05-07/29/05	Dead
COLT	06/02/05-End	Removed for repair
EARN	08/29/05-09/09/05	No communications
ERW	07/25/05-09/19/05	No communications
GL2	10/21/04-End	Dead
GPW	03/16/04-End	Dead
GRCC	06/06/05-08/12/05	No communications
GRCC	08/12/05-End	Removed for repair
GTWN	06/01/05-End	No communications; telemetry being moved for bldg. renovation
HOLY	07/13/05-09/09/05	No communications; firewall changed
HTW	08/30/05-09/07/05	Dead air cells
HUO	08/21/05-09/20/05	Dead
JBO	10/15/04-End	Noisy
KDK	07/06/05-07/26/05	No communications
KEEL	05/30/05-End	Dead
KFAL	06/15/05	Replaced sensor
KICC	03/04/05-End	Bad timing
LANE	07/20/05-End	No communications
LEOT	08/24/05-09/01/05	No communications
LNO	06/07/05-08/06/05	Dead; subcarrier problem
LTY	09/07/05-End	Intermittent
MBKE	06/07/05-End	Dead; possible K2 problem
MIDE	07/18/05	Destroyed by St. Helens rockfall
OBH	01/31/02-End	Temp. removed for logging
PGW	10/08/03-End	Dead
PNLK	08/26/05-09/02/05	No communications

TABLE 1 - Station outages and installations

Station	Outage Dates	Comment
RAFT	07/28/05	Installed—Mount St. Helens
RCS	06/11/05-07/07/05	Dead; replaced seismometer and cable
RHAZ	06/26/05-08/08/05	Dead
RHAZ	08/08/05-08/11/05	Removed for repair
SBES	05/18/05-End	Short period noisy
SCC	08/03/05-End	Bad timing
SEA.HH?	12/05/03-End	Disconnected for renovation
SEND	07/01/05	Installed—Mount St. Helens
SFER	09/01/04-End	Short period dead; needs removal
SMNR	06/23/05-08/18/05	Temp. removed for work on the bldg.
SMW	06/20/03-05/27/05	Intermittent; equalization problem
SOPS	08/27/02-End	K2 flash-memory problem
SOS	09/14/05	Replaced seismometer
SSS1	03/05/05-End	One of 3 downhole 3-D sensors removed for repair
UWFH	05/01/05-End	Short period problems; needs removal
VGB	09/23/04-End	Intermittent; usually very noisy
VVHS	06/30/05-End	No communications
WWHS	08/03/05-End	Bad timing

Mt. St. Helens eruption, 2004-2005

Beginning on September 23, 2004 a series of small earthquakes at Mount St. Helens signaled the beginning of the first dome-building eruption at the volcano since 1986. The small earthquakes soon escalated into the most vigorous seismic activity at Mount St. Helens since the catastrophic eruption of 1980. Continuous seismic data from short-period stations near Mt. St. Helens are archived at the PNSN and streamed to the IRIS BUD archive. New procedures were implemented to rapidly handle the large volume of data so the PNSN and Cascade Volcanoes Observatory could assess the significance of the rapidly changing seismicity. For details, see the 2004-D, 2005-A and 2005-B quarterly reports.

- ***MSH Equipment; destruction and replacement*** **-** Station MIDE was destroyed during a large rockfall and magnitude 3.2 earthquake on July 18. New stations SEND and RAFT were installed on July 1 and July 28, respectively. All were done by the staff of CVO. Major service of many Mt. St. Helens stations was done during this quarter because of good weather and helicopter support provided by CVO. Under separate funding, 40 portable "Texan" high-frequency seismometers were installed for 3 days in August at 100m spacing along a line going from the dome 4 kilometers north. Around the same time, five other three-component stations were installed high on the flanks of the mountain for a three-week period.

PNSN Personnel changes

George Thomas left the PNSN at the end of September to begin a new job as a research scientist with the Land Surface Hydrology Research Group in the Civil and Environmental Engineering department at the University of Washington. We will miss him and all his expertise but wish him luck and happiness in his new job.

Our co-Principal Investigator, Tony Qamar, was fatally injured in a logging truck accident on October 4, 2005 while driving with Dan Johnson, of the University of Puget Sound, to the Olympic Peninsula to retrieve a GPS instrument. This is a terrible loss personally and professionally for everyone associated with the PNSN. A section devoted to Tony will be included in the report for the 4th quarter of 2005.

As the cycle of life goes on, congratulations to Karl Hagel, our electronics technician, who welcomed a baby boy, Giancarlo Martin Hagel, into the world on September 30, 2005.

Strong Motion Instrumentation Update

There were no new strong motion installations this quarter. However, the implementation of a maintenance program for the ANSS strong motion instruments was started with 2001 and 2002 instruments this year. This program includes changing batteries, upgrading flash cards and firmware.

At station SSS1, the deepest of three downhole seismometer package located at the John Stanford Center in Seattle and installed in Oct. 2004, ceased operation in March of 2005. The logistics of retrieving and replacing a downhole instrument are considerable. The USGS and the UW are currently preparing to remove the failed instrument. Repairs and a subsequent lengthy tests of the repaired unit will likely delay reinstallation of the unit until sometime in early to mid 2006.

Computer Hardware Update

Scossa continues to be our main data collection computer, and *tremito* provides additional computational power for manual processing of earthquake data and acts as a fileserver for all the other networked computers in the group. A second Windows computer was configured to act as a backup to our main digitizing computer. Tests continue into the 4th quarter.

Use of PNSN Data

The IRIS Data Management Center reports 1,103 requests for PNSN trace-data this quarter. Nearly 9,800,000 traces were requested. The number of traces requested remains at an elevated level compared to a "typical" quarter prior to the current eruption of Mount St. Helens.

EARTHQUAKE DATA – 2005-C

Between July 1 and September 30, 2005, 1,754 events were digitally recorded and processed at the University of Washington. Tens of thousands of additional unlocated events occurred at Mount St. Helens associated with the dome-building eruption which began in late September 2004. Of the processed events, locations in Washington, Oregon, or southernmost British Columbia were determined for 1,277 of these events; 1,171 were classified as earthquakes and 106 as known or suspected blasts. The remaining processed events include teleseisms (163 events), regional events outside the PNSN (102), and unlocated events within the PNSN, mostly at Mt. St. Helens. Due to the extremely large number of events, only a representative sample of Mount St. Helens seismicity was located. Other unlocated events within the PNSN normally 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 2 lists earthquakes reported to have been felt during this quarter. Events with ShakeMaps or Community Internet Intensity Maps (CIIM) are indicated. This quarter, one event generated a ShakeMap. Four events produced "CIIM" maps (**http://pasadena.wr.usgs.gov/shake/pnw/**), which convert "felt" reports sent by the general public (via Internet) into numeric intensity values. CIIM maps show the average intensity by zip code.

Table 3 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 1. Earthquakes with magnitude greater than or equal to 0.0 (M_c >=0).

Figure 2. Blasts and probable blasts (M_c >=0).

Figure 3. Earthquakes located near Mt. St. Helens (M_c >=0).

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

TABLE 2 - Felt Earthquakes during the 3rd Quarter of 2005

DATE-(UTC)-TIME	LAT(N)	LON(W)	DEP	MAG	COMMENTS		Shake
yy/mm/dd hh:mm:ss	deg.	deg.	km	Ml		CIIM	Map
					No felt earthquakes this quarter		

OREGON

During the third quarter of 2005, 40 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 most notable earthquake in Oregon this quarter was a M 2.7 quake at about 13 km depth located near Adel, OR on August 16 (UTC).

WESTERN WASHINGTON SEISMICITY

During the first quarter of 2005, 1,088 earthquakes were located between 45.5 degrees and 49.5 degrees north latitude and between 121.0 degrees and 125.3 degrees west longitude. Most western Washington seismicity this quarter was in the Mount St. Helens area, see discussion below. No earthquakes were felt this quarter in western Washington.

Excluding Mt. St. Helens, the largest earthquake in western Washington this quarter was a magnitude 2.9 event on Sept. 13 (UTC), located about 23 km west-north-west of Poulsbo at a depth of about 49 km. The deepest earthquake in western Washington this quarter was a magnitude 0.7 event at about 97 km depth located about 13 km SSW of Skykomish, WA on September 28 (UTC).

Episodic Tremor and Slip event (ETS)

ETS was expected to occur sometime between August and October, 2005. It began on September 6, 2005 and ended by September 30, 2005. The tremor began in the Puget Sound area and moved north, terminating to the west of Port Alberni, B.C. Additional details are available at http://www.pnsn.org/NEWS/PRESS_RELEASES/TREMOR_05.html

WASHINGTON CASCADE VOLCANOES

Mount St. Helens

Mount St. Helens seismicity and dome building eruption continued through this quarter. The current eruptive episode began on September 23, 2004 with a vigorous sequence of seismic activity. The initial phase of the activity culminated Oct. 1-5, 2004 when several phreatic explosions and half-hour to hour-long periods of harmonic tremor interrupted and temporarily calmed extremely high rates of magnitude 3+ seismicity. Seismicity declined following Oct. 5, 2004 though frequent, but smaller earthquakes have continued through this quarter. Because of the high rates of seismicity, only a representative sample of Mount St. Helens events was located using conventional manual processing. Figure 3 shows located volcano-tectonic earthquakes near Mount St. Helens. Low frequency (L) and avalanche or rockfall events (S) are not shown. See the operations section for details on destruction, replacement and new instrument installation.

This quarter, 839 earthquakes were located in the area shown in Fig. 3 using conventional manual processing procedures (including 716 earthquakes between magnitude 1.0 and 2.9, and 31 slightly larger events with magnitudes between 3.0 and 3.4. Most of the larger events are associated with rockfalls off the new dome. Rockfalls expose glowing hot rocks in the core of the whaleback, and flashes of light continue to be recorded simultaneously with rockfall signals. Digitally enhanced nighttime volcano-cam images (http://www.luscombe-carter.com/mount_st_helens/index.html) show variations in the intensity of glow from the new dome. Earthquakes continue to occur with a somewhat regular inter-occurrence time which has varied slowly over days and weeks. This activity, called “drum-beat earthquakes” declined, and the count of events went down by a factor of 4 this quarter compared to last quarter.

All locatable earthquakes in the 2004/2005 sequence are relatively shallow. Only a few events have been located deeper that 2 km. Seismicity this quarter continued to be located on the boundary between the old and new domes near the vent that appeared in early October, 2004.

Seth Moran of CVO has provided improved counts of seismic events during the current eruptive sequence. These numbers represent automated counts at HSR, which is intermediate in distance between YEL and JUN (the stations used for count estimates given in previous quarters) . Helena Buurman, a summer intern at CVO reveiwed the data to assure uniformity and quality.

Earthquake counts at Mount St. Helens, quarterly break-down, provided by CVO.

4th quarter 2004 - 292,352 events

1st quarter 2005 - 123,502 events

2nd quarter 2005 - 49,811 events

3rd quarter 2005 - 12,085 events

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). One event flagged "L" or "S" was located at Mount Rainier this quarter and 100 "L" or "S" events were recorded, but were too small or too emergent to locate reliably. Type L and S events are not shown in Fig. 4.

A total of 46 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. The largest tectonic earthquake located near Mt. Rainier this quarter was a magnitude 1.8 event on July 2 (UTC), located about 15 km west of the summit of Mt. Rainier at about 6 km depth. This quarter, 21 tectonic earthquakes (13 of them smaller than magnitude 0.0 and thus not shown in Fig. 4)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 46.6-47.0 degrees north latitude and 121.83-122 west longitude). Within 5 km of the summit, there were 11 (5 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 shown in Fig. 4.

EASTERN WASHINGTON SEISMICITY

During the third quarter of 2005, 41 earthquakes were located in eastern Washington in the area between 45.5 - 49.5 degrees north latitude and 117 - 121 degrees west longitude. The largest earthquakes recorded in eastern Washington this quarter was were two magnitude 2.6 events. The first occurred on July 22 (UTC), and was located about 18 km north-northwest of Ellensburg at less than 1 km depth. The second was on Sept. 27 (UTC), and was located about 39 km east of Skykomish, WA at a depth of about 6 km.

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.

Other regional agencies provide earthquake information. These include the Geological Survey of Canada (Pacific Geoscience Centre), Sidney, B.C. **http://www.pgc.nrcan.gc.ca/seismo/table.htm** and other regional networks in the United States **http://earthquake.usgs.gov/regional/** The US Geological Survey coordinates earthquake information nationally; **http://earthquake.usgs.gov**.

Complete catalog listings are available on-line through **http://www.pnsn.org/CATDAT/catalog.html** Key to earthquake catalog can be found in the last quarterly report of each year, or at:
http://www.pnsn.org/INFO_GENERAL/PNSN_QUARTERLY_EQ_CATALOG_KEY.htm

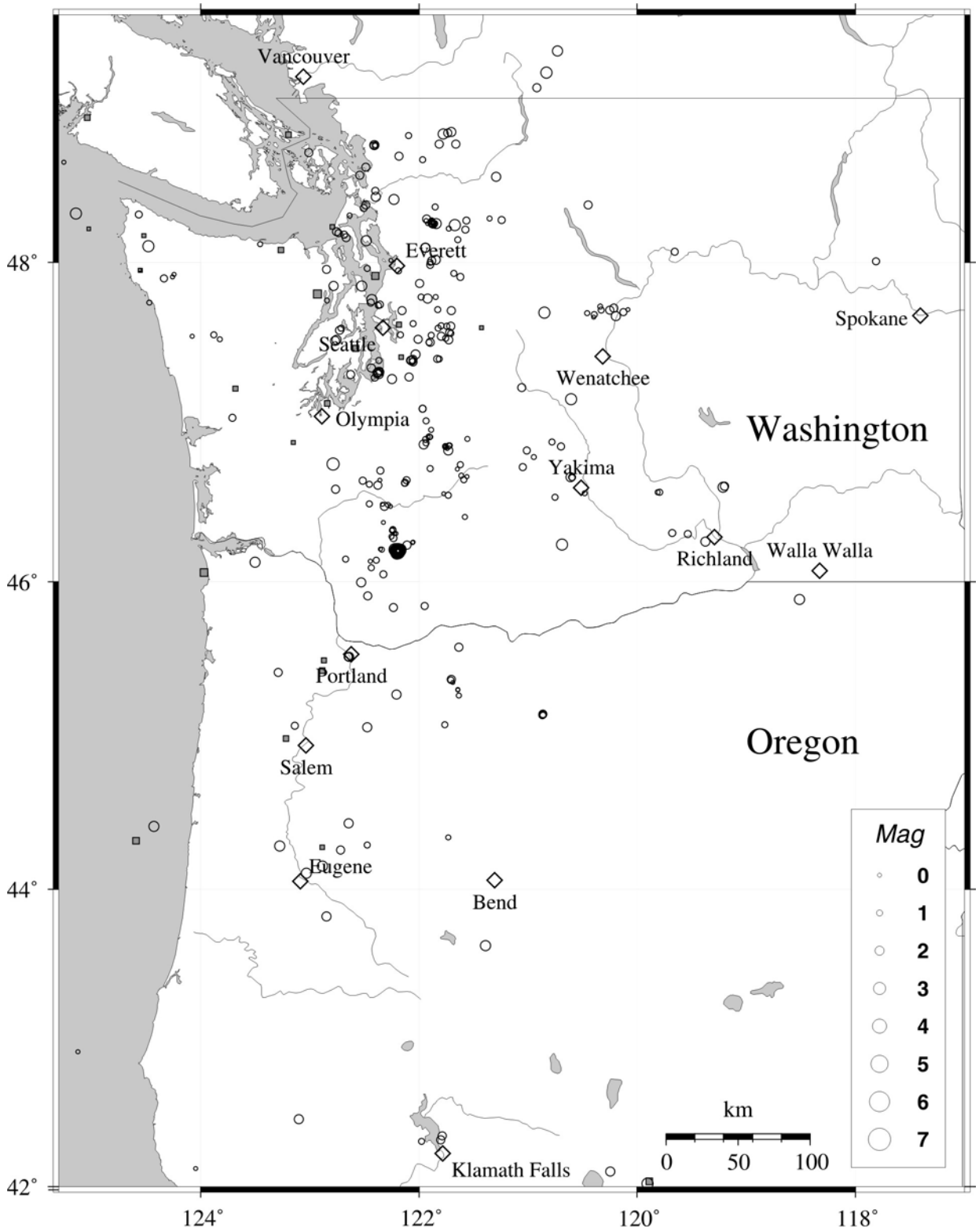

Figure 1 Earthquakes with magnitude greater than or equal to 0.0 (Mc>=0.0).

Unfilled diamonds represent cities. Quakes shallower than 30 km are indicated by circles, and deeper quakes by filled squares.

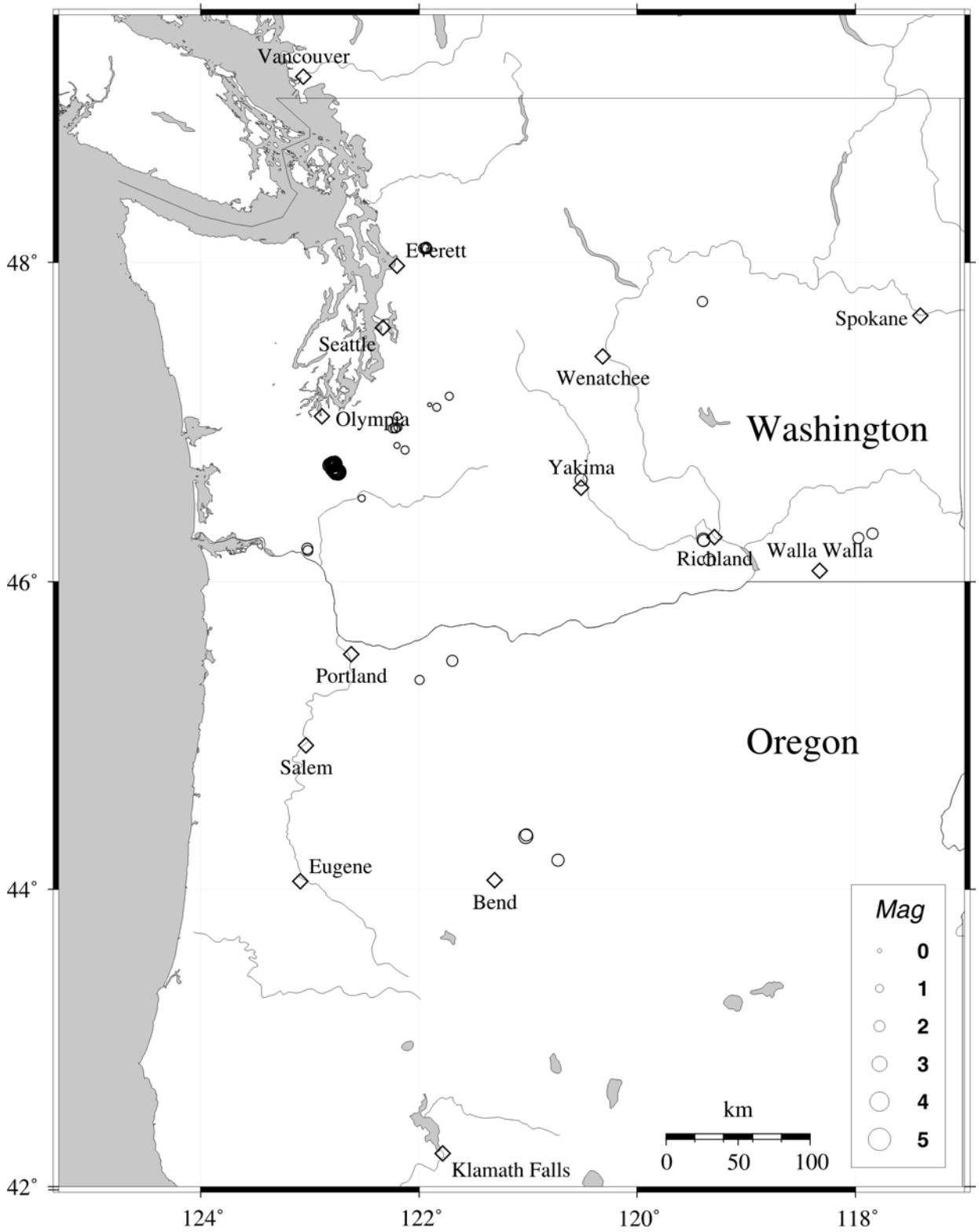

Figure 2. Blasts and probable blasts. Unfilled diamonds represent cities.

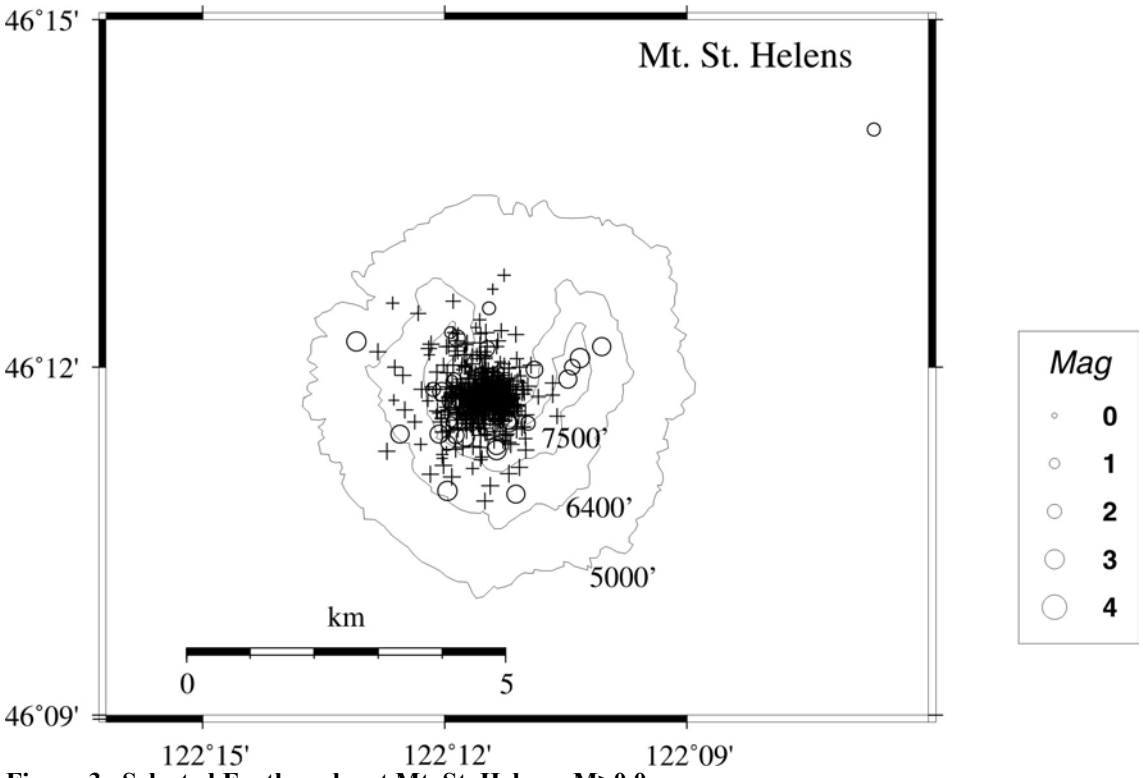

Figure 3. Selected Earthquake at Mt. St. Helens; M>0.0
Events elected by the analyst for location are small fraction of the number of events recorded during the quarter. Plus symbols indicate depth less than 1 km. Circles indicate depth greater than 1 km. Elevation contours shown in feet.

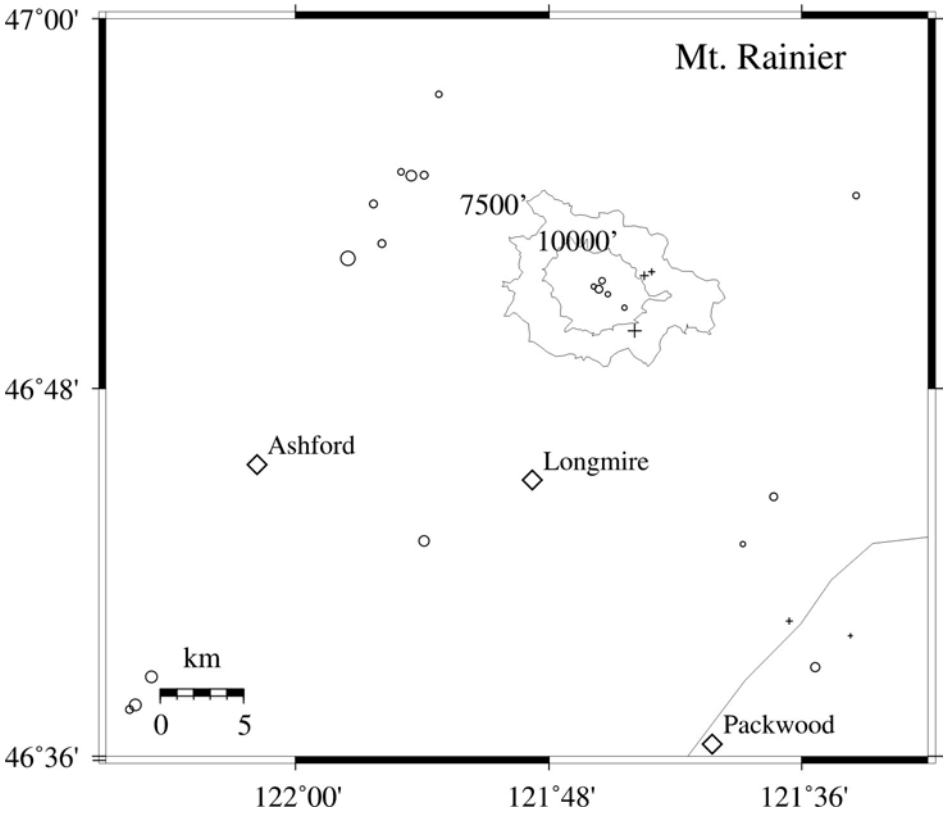

Figure 4. Earthquakes at Mt. Rainier; M>0.0

EARTHQUAKE CATALOG, 2005-C

This quarter's catalog lists earthquakes of magnitude 2.0 or larger, except at Mt. St. Helens, where only events of magnitude 3.0 or larger are shown. Complete catalog listings are available on-line through **http://www.pnsn.org/CATDAT/catalog.html**
Key to earthquake catalog can be found in the last quarterly report of each year, or at:
http://www.pnsn.org/INFO_GENERAL/PNSN_QUARTERLY_EQ_CATALOG_KEY.htm

TABLE 3 - EARTHQUAKE CATALOG, 2005-C

Jul-05

DAY	TIME	LAT	LON	DEPTH	M	NS/NP	GAP	RMS	Q	MOD	TYP
2	13:29:54	46 12.07	122 11.56	0.02*	3.1	12/012	104	0.17	BB	S4	
2	22:39:31	48 08.13	122 28.92	16.87	2.2	23/024	53	0.22	BA	P3	
3	0:53:31	47 51.35	122 31.32	26.43	2.4	29/032	56	0.19	BA	P3	
3	8:16:57	47 46.31	122 25.83	26.02	2.3	37/043	40	0.26	BA	P3	
9	11:16:19	47 55.09	122 23.90	32.96	2.2	46/052	44	0.23	BA	P3	
10	16:13:42	48 14.32	121 50.45	9.33	2.2	27/029	53	0.39	CA	P3	
13	1:31:39	46 35.99	119 12.75	19.98	2.4	34/037	73	0.21	BA	E3	
13	19:50:01	46 39.74	120 36.51	8.25*	2.1	25/025	88	0.17	BB	E3	
14	16:22:15	43 49.14	122 50.91	0.30	2.0	6/007	181	0.17	BD	O0	
15	12:22:01	46 11.77	122 11.35	0.37	3.1	32/032	43	0.18	BA	S4	
16	20:08:39	46 11.81	122 11.51	0.45	3.2	36/036	43	0.13	AA	S4	
19	3:54:53	46 11.77	122 11.46	0.02*	3.2	33/033	46	0.16	BA	S4	
20	5:19:57	46 11.78	122 11.52	0.02*	3.3	44/044	38	0.20	BA	S4	
21	10:00:04	46 11.75	122 11.49	0.22	3.1	34/034	43	0.16	BA	S4	
22	3:53:52	47 09.12	120 36.22	0.02*	2.6	22/022	71	0.28	BA	N3	
22	17:47:49	46 11.71	122 11.49	0.19	3.1	26/026	43	0.16	BA	S4	
23	9:38:19	46 11.78	122 11.51	0.23	3.2	28/028	46	0.17	BA	S4	
24	10:35:49	46 11.71	122 11.55	0.05*	3.3	35/036	43	0.27	BA	S4	
26	5:12:14	46 14.17	120 41.41	1.36	2.5	20/020	170	0.24	BC	C3	
27	10:15:22	49 17.07	120 43.93	0.02*	2.3	10/010	274	0.70	DD	C3	
27	20:41:57	48 23.18	122 13.60	14.10	2.3	23/024	72	0.34	CA	P3	
29	1:12:04	44 09.22	122 53.06	2.46$	2.3	23/024	57	0.91	DC	O0	
29	17:04:26	46 11.77	122 11.47	0.52	3.2	30/030	43	0.22	BA	S4	
30	1:29:19	46 11.65	122 11.23	0.05*	3.0	15/015	101	0.18	BB	S4	
30	12:31:36	46 11.54	122 11.28	0.02*	3.0	19/019	107	0.24	BB	S4	
31	6:09:58	46 11.46	122 11.10	0.02*	3.0	18/018	61	0.30	CA	S4	
31	9:34:39	46 11.80	122 11.39	0.69	3.3	29/029	43	0.11	AA	S4	

Aug-05

DAY	TIME	LAT	LON	DEPTH	M	NS/NP	GAP	RMS	Q	MOD	TYP
1	1:41:44	46 11.75	122 11.46	0.55	3.0	23/023	66	0.11	AA	S4	
1	5:36:57	47 31.39	122 45.34	21.34	2.0	27/029	98	0.13	AB	P3	
1	7:15:07	46 11.38	122 11.39	0.02*	3.0	16/016	115	0.27	BB	S4	
1	17:50:17	46 11.71	122 11.51	0.03*	3.0	23/023	68	0.13	AA	S4	
2	19:24:13	43 37.52	121 23.49	5.71	2.2	9/009	138	0.29	BC	O0	
8	16:22:13	48 17.99	125 08.67	19.06	2.6	18/019	284	0.44	CD	P3	
9	21:39:45	48 47.07	121 46.58	18.73	2.3	10/010	194	0.30	CD	C3	
10	18:34:59	46 11.67	122 11.33	0.03*	3.0	15/015	64	0.24	BA	S4	
11	1:06:19	44 06.44	123 01.79	0.03*	2.3	9/009	112	0.38	CB	O0	
12	0:10:58	46 11.68	122 11.54	0.05*	3.0	19/019	109	0.26	BB	S4	
13	1:10:07	46 11.62	122 11.34	0.03*	3.2	28/028	43	0.35	CA	S4	
13	17:41:13	44 24.80	124 25.72	28.06	2.2	10/011	254	0.19	BD	O0	
13	19:32:31	48 06.09	124 28.63	0.02*	2.5	17/018	171	0.51	DC	P3	
16	12:10:51	46 49.86	121 43.91	0.48*	2.0	5/005	193	0.24	BD	C3	L

16	13:31:22	42 02.14	119 53.41	42.88#	2.1	7/007	313	0.61	DD	K3	
Aug-05, cont.											
DAY	**TIME**	**LAT**	**LON**	**DEPTH**	**M**	**NS/NP**	**GAP**	**RMS**	**Q**	**MOD**	**TYP**
16	15:52:07	46 11.80	122 11.03	0.02#	3.4	28/028	47	0.54	DA	S4	
18	2:25:26	48 43.07	122 24.51	15.86*	2.1	21/025	83	0.34	CA	P3	
19	5:49:59	46 11.74	122 11.92	0.04*	3.1	23/023	44	0.17	BA	S4	
19	8:52:38	45 16.37	122 12.30	16.30	2.0	35/036	60	0.26	BA	O0	
22	3:55:41	46 11.65	122 11.36	0.04#	3.0	14/014	105	0.42	CB	S4	
22	13:34:30	48 01.07	121 50.79	12.81*	2.1	13/016	76	0.19	BB	P3	
22	19:10:18	45 53.09	118 30.61	1.74$	2.4	13/013	207	0.31	DD	E3	
23	10:07:29	46 12.07	122 10.31	1.31	3.0	14/014	118	0.31	CB	S4	
24	2:12:46	46 11.67	122 11.26	0.04*	3.1	16/016	62	0.24	BA	S4	
24	6:16:54	46 11.56	122 11.36	0.04*	3.0	16/016	109	0.23	BB	S4	
24	23:00:20	46 07.41	123 30.03	2.29	2.3	8/008	208	0.17	BD	P3	
25	0:44:18	46 03.43	123 58.33	36.47	2.5	29/030	197	0.28	BD	P3	
26	8:42:42	47 46.69	121 55.24	20.81	2.1	38/040	53	0.32	CA	P3	
26	22:34:39	48 13.75	121 40.37	9.25	2.5	25/026	74	0.30	BC	C3	
29	8:31:36	47 51.25	122 47.03	22.40	2.1	27/027	71	0.21	BA	P3	
29	18:35:13	48 05.50	121 56.36	0.02*	2.0	12/013	100	0.26	BC	P3	
Sep-05											
DAY	**TIME**	**LAT**	**LON**	**DEPTH**	**M**	**NS/NP**	**GAP**	**RMS**	**Q**	**MOD**	**TYP**
4	18:57:05	42 01.18	119 54.39	12.72	2.7	9/009	156	0.26	BC	K3	
7	2:14:31	46 11.81	122 12.10	0.02*	3.2	18/018	79	0.49	CA	S4	
7	20:48:56	49 09.36	120 49.90	0.04*	2.8	17/017	177	0.50	DD	C3	
13	5:14:24	47 48.40	122 55.83	49.03	2.9	80/082	45	0.26	BA	P3	
14	7:45:17	46 11.81	122 11.29	0.37	3.0	13/013	85	0.11	AA	S4	
15	2:43:13	44 17.21	123 16.56	1.58$	2.2	6/007	230	0.15	AD	O0	
17	20:39:30	46 11.71	122 11.36	0.10*	3.0	16/016	103	0.32	CB	S4	
20	10:16:09	45 03.64	122 28.41	18.31	2.0	33/034	74	0.33	CB	O0	
23	8:22:09	46 11.67	122 11.65	0.02*	3.0	13/013	73	0.44	CA	S4	
26	18:11:05	44 19.32	124 35.44	33.26	2.1	7/008	304	0.23	CD	O0	
27	15:36:17	46 11.98	122 11.51	0.03*	3.0	14/014	64	0.15	BA	S4	
27	22:46:17	47 41.55	120 50.92	5.76	2.6	25/025	50	0.29	BC	C3	

OUTREACH ACTIVITIES

The PNSN staff and faculty participate in an educational outreach program designed to better inform the public, educators, businesses, policy makers, government agencies, engineers, and the emergency management community about earthquake, volcano and related hazards. Our program offers lectures, classes, lab tours, workshops, consultations, and electronic and printed information products. Special attention is paid to the information needs of the media. We provide information directly to the public through information sheets, an audio library, email, and via the Internet at http://www.pnsn.org.

Tony Qamar, co-PI of the PNSN, and Dan Johnson were tragically killed on October 4th by a logging truck while driving to retrieve GPS instruments on the Olympic Peninsula. His loss has impacted all aspects of PNSN Operations and all who contribute to it. An anonymous tribute on Tony's office door reads:

"Seldom have the qualities of friendship, gentleness, and courage been so arraigned in one person. Your passing leaves a large void in our lives. You will live on in our memories and in our hearts. We will never forget you."

The following is a partial overview of the quarter's outreach activities, and does not include Tony's activities.

Audio Library, Phone

The Seismology Lab responded to over 200 calls from the general public, Emergency Managers and government agencies, and another 60 calls from the Media. In addition, the PNSN audio library system received 250 calls this quarter. The audio library provides several recordings. We have a regularly updated message concerning current seismic activity, and there

are also recordings describing seismic hazards in Washington and Oregon and earthquake prediction. Callers to the audio library have the option of being transferred to the Seismology Lab for additional information.

Internet outreach

In 2004 URL www.pnsn.org was moved to a University server when www.ess.washington.edu, the Dept. of Earth and Space Sciences (ESS) server, was overwhelmed with internet traffic due to the eruption of Mt. St. Helens in Sept. 2004. The Dec. 26th Sumatra & Andaman Islands earthquake and tsunami again caused overload of the ESS server. This year, the entire ESS site was improved by additional high-traffic, high-security servers operated by the University's Computer & Communications (C&C) unit, which provided dual separated web servers located in different UW locations to provide "fail-over" redundancy, each with Gigabit backbone access. The C&C machines use a round-robin-type dynamic network service (DNS) to balance load. The startup hardware cost for this system was $6000, and annual operations will cost about $3,000 a year which is being paid by the Dept. of Earth and Space Sciences, a welcome and useful contribution to PNSN operations. The authoritative "master" web server was upgraded in June. This ESS departmental computer supplies updates every 5 minutes to the C&C high capacity servers.

PNSN staff replied to over 300 e-mail messages from the public seeking information on a variety of topics via the ***seis_info@ess.washington.edu*** email address. Ruth Ludwin managed this service this quarter, typically responding to routine questions within a day. Complex or sensitive questions are routed to the appropriate staff person for a more in-depth response. Requests may include complex scientific inquiries, assistance with hazard assessments and legal issues, consultations with government agencies, and support for engineering issues related to strong motion data. Bill Steele and other staff members also respond to numerous requests for information via their own email accounts.

Information Products

California Integrated Seismic Network (CISN) display servers are receiving and displaying PNSN recent earthquake data and now provide links to the PNSN ShakeMaps, which are automatically generated following significant earthquakes. The CISN Display version 1 was released in December 2004 and distributed to 25 select users including lifeline operators, emergency managers, and large businesses. This product has replaced the CUBE based RACE (Rapid Alert for Cascadia Earthquakes) systems which have largely been removed. After initial registration and configuration, the administrative duties for maintaining these accounts have been light.

K-20 Education Outreach

PNSN and USGS staff gave 10 Seismology Lab tours and presentations for K-12 students and teachers, serving about 240 students this quarter, and one college level tour for 25. The PNSN maintains an email list-service of over 50 local K-20 educators and subscribers interested in earth-sciences education, and occasionally sends out messages on events of special interest.

Media Relations

The PNSN staff frequently provides interviews, research support, and referrals to radio, television, film, and print media. The PNSN organizes press conferences, contributes to TV and radio news programs and talk shows, and provides field opportunities linking reporters with working scientists. Staff members also assist news organizations, authors, television producers, and independent documentary makers to design accurate and informative stories and programs related to earthquake and volcano hazards. PNSN staff work to link reporters and producers developing stories with the appropriate research institutions, agencies, and scientists working in the areas to be covered by the piece. The PNSN coordinates the release of information and media relations with the USGS Western Region, the Cascades Volcano Observatory, and the Oregon Department of Geology and Mineral Industries (DOGAMI).

The Seattle Fault Scenario, first introduced on Feb. 28th 2005, was published in July resulting in renewed media interest in this product. PNSN staff participated in reports about the evolution of earthquake hazards assessments for Western Washington.

The episodic tremor and slip event began on 9/06/05 and ended 9/30/05 under northern Vancouver Island attracted a great deal of local and National attention when reports originating with the Canadian Geologic Survey suggested an increased probability during the slip of a Cascadia Subduction Zone earthquake. PNSN staff participated in dozens of interviews with TV, print, and radio media.

The ongoing eruption of Mount St. Helens (MSH) continued to stimulate media inquiries particularly when rock falls produced visible plumes. Throughout the quarter, PNSN scientists participated in morning science conferences with CVO three times a week to share data and interpretations, and develop "talking points" for use in interviews.

Meetings, Presentations and Visitors

Congratulations to Ruth Ludwin, who was appointed Affiliate Faculty in the University of Washington's Henry M. Jackson School of International Studies Canadian Studies Center for her investigations into Native American and First Nations traditions related to earthquakes, tsunamis, and landslides. This quarter, Ruth taught an NSF Chautauqua field course in late July titled "**Pacific Northwest Earthquakes: Evidence in Native Myth and Tradition**", and was first author on two recent articles on this subject that appeared in Seismological Research Letters: " **Pacific Northwest Earthquakes: Evidence in Native Myth and Tradition** ", by R. S. Ludwin, C. P. Thrush, K. James, D. Buerge, C. Jonientz-Trisler, J. Rasmussen, K. Troost, and A. de los Angeles, SRL, V. 76, No. 4, pp. 426-431. and "**Dating the 1700 Cascadia Earthquake - Great Coastal Earthquakes in Native Stories**", by R. S. Ludwin, R. Dennis, D. Carver, A. D. McMillan, R. Losey, J. Clague, C. Jonientz-Trisler, J. Bowechop, J. Wray, and K. James, SRL, V. 76, No. 2.

Ruth Ludwin provided presentations on "Earthquake hazards in Washington and Oregon" at Home Street Bank in Seattle, and to several groups of students and teachers from Northwest Indian College in Bellingham. Ruth also provided background and information on First Nations and Native American knowledge of geologic hazards to a Canadian filmmaker working on a production about the effects of a large earthquake on Vancouver, B.C., to a journalist working on an article about Geomythology for Science Magazine, and to staff members of the American Museum of Natural History for a display on tsunamis.

Bill Steele was re-elected to the Board of Trustees of CREW, the Cascadia Region Earthquake Workgroup, and gave an invited talk to the Justices of the Ninth Circuit Court at their annual meeting in Seattle August 31st. Mark Pierepiekarz, Senior Project Manager EQE International, and Bill Steele teamed up to offer a three-hour class on regional earthquake hazards and the potential impact of a Seattle Fault earthquake to the Seattle Chapter of the American Architectural Institute. Bill Steele also co-led a NSF Chautauqua class "**Volcano Monitoring at Mt. St. Helens**".

The University of Washington was chosen by the Federal Emergency Management Agency (FEMA) as the first university to participate in an upcoming Integrated Emergency Management Course (IEMC). The five-day disaster planning and response training event took place **August 8-12, 2005** at FEMA's National Emergency Training Center in Emmitsburg, Maryland. Bill Steele represented the PNSN at the training and assisted in the exercise development.

Steve Malone, PNSN Director gave a summary presentation of the state of the PNSN to the Scientific Earthquake Studies Advisory Committee (SESAC) at their annual meeting, held this year on September 27th in Seattle. Bill Steele organized an ESS-funded reception for SESAC participants following their meeting, and Steve Malone provided a tour of our facilities.

From Sep 18 until Oct 8, 2005, the PNSN hosted Roberto Scandone and Lisetta Giacomelle, two Italian volcanologists who are interested in the current activity at Mount St. Helens.

Due to a printing error last quarters report omitted the final page of this section. The missing portion of last quarter's Outreach Activities section is reprinted below.

From PNSN Quarterly Report 2005-B: Outreach Activities; Meetings, Presentations and Visitors

- A Northwest Science Writers Association meeting was hosted by the PNSN. Cynthia Gardner, Steve Malone, and Bill Steele spoke to the group about the eruption of Mt. St. Helens, and scientist-media relations.
- PNSN and UW management continued to work with State of Washington representatives to obtain State funding to meet State agency information needs.
- Bill Steele assisted the Cascadia Region Earthquake Workgroup with the development and roll out of the CREW Cascadia Earthquake Scenario at the State Partners in Preparedness Conference and with the submission of an Op-Ed article published by the Seattle Post Intelligencer.
- The PNSN participated in University-sponsored events including an Alumni Open House, the Arts and Sciences Celebration of Distinction program and poster session, and provided a lab tour while meeting with Regent and past Governor Dan Evans.
- Steve Malone provided the Presidential speech at the Seismological Society of America (SSA) Conference in Reno, NV.

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- **2005 –B: SSA presentations by PNSN faculty, staff and graduate students:**

  - **High-resolution 3D Travel-time Tomography Using Controlled Sources and Earthquakes: Application to the Seattle Basin and Vicinity** CROSSON, R. S.,
  - **The Origins of the Advanced National Seismic System** FILSON, J. R., ARABASZ, W. J., BENZ, H. M. and BULAND, R., GEE, L. S., MALONE, S. D., and OPPENHEIMER, D.
  - **Broadband Seismic Monitoring of Recent Activity at Mount Saint Helens, Washington** HORTON, S. P., BRACKMAN, T., WATSON, C., WITHERS, M., PATTERSON, G., and BODIN, P.,NORRIS, R.; MORAN, S., and QAMAR, T.
  - **The 2004-2005 Eruption of Mount Saint Helens: Possible Links between Seismicity and Physical Changes in the New Lava Dome** MORAN, S. C. and VALLANCE, J. W., QAMAR, A. I. and MALONE, S. D.
  - **Rapid Analysis of Earthquake Data during the 2004-2005 Dome-building Eruption of Mount Saint Helens** QAMAR, A. and MALONE, S. D., and MORAN, S.
  - **Azimuthal Patterns in High-frequency Energy Observed at Mount Saint Helens, Washington: Implications for Near-surface Structure** THELEN, W. A. and MALONE, S. D
  - **Pacific Northwest Seismograph Network (PNSN) as Part of ANSS** THOMAS, G., QAMAR, A., BARBEROPOULOU, A., LINDQUIST, P. C., and MALONE, S. D.
  - **Source Parameters of Microearthquakes at Mount St. Helens (USA)** TUSA, G. and GRESTA, S.; and MALONE, S. D.

- UWTV recorded a May 1, 2005 public lecture on Mt. St. Helens given by PNSN Director Stephen D. Malone. The lecture is scheduled for a half-dozen re-broadcasts on UWTV in the near future. Dr. Malone was also videotaped presenting a lecture on predicting earthquake and volcanic eruptions to the UW Program on the Environment and the UW Alumni Club . This lecture has been broadcast on a public-access channel.
- Steve Malone provided lectures on Mt. St. Helens during a visit to Italy at the INGV (National Institute of Geophysics and Volcanology) and the University of Pisa.
- The PNSN hosted many meeting this quarter including The Contingency Planners and Recovery Managers (CPARM), Seattle ShakeMap Workgroup, and the University of Washington Emergency Planning Group.
- Ruth Ludwin presented a poster and participated in a panel discussion at the NSF Tsunami Deposits Workshop hosted June 12-15 by the Dept. of Earth and Space Sciences. http://earthweb.ess.washington.edu/tsunami2/deposits/.
- Bill Steele gave a number of invited talks including the Oregon Telecommunications Associations Annual Conference in Bend Oregon. A talk for the Thoracic Oncology Conference, and the University Rotary Club.

APPENDIX 1, PNSN Quarterly Report 2005-C – Station Maps and Locations

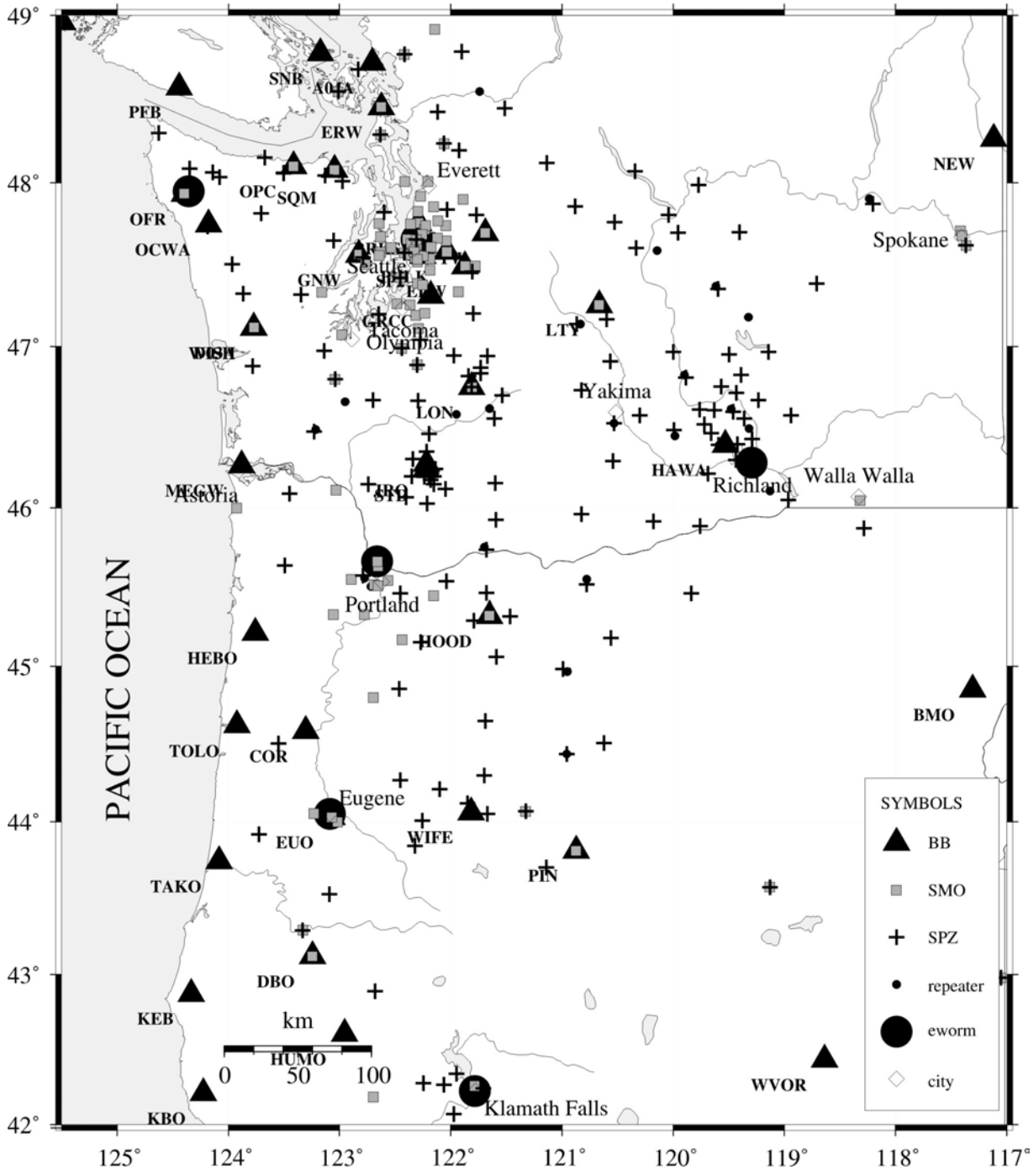

Figure 1 A. Seismograph Stations.

"BB" indicates broadband stations (Table 1B) "SMO" indicates strong motion stations (Table 1C), and "SPZ" indicates short-period stations (usually vertical component only) (Table 1A). "Repeater" designates a site with radio receivers and transmitter used in the transmission of seismic data to the UW via FM telemetry. "eworm" represents sites where a "mini-earthworm" system is running on a local computer to collect data for transfer to the UW via the internet.

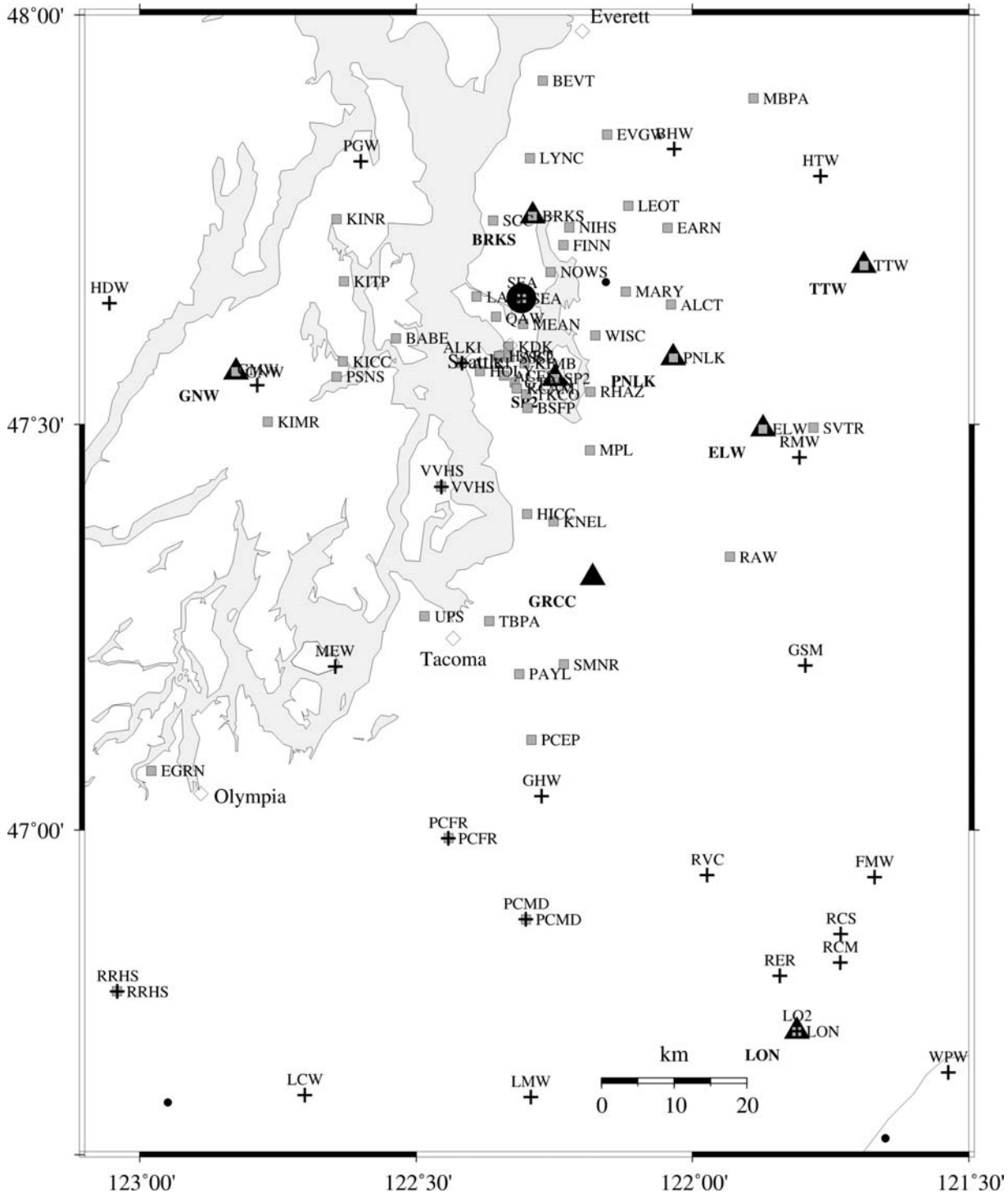

Figure 1 B. Puget Sound seismograph stations, detail of Fig. 1 A

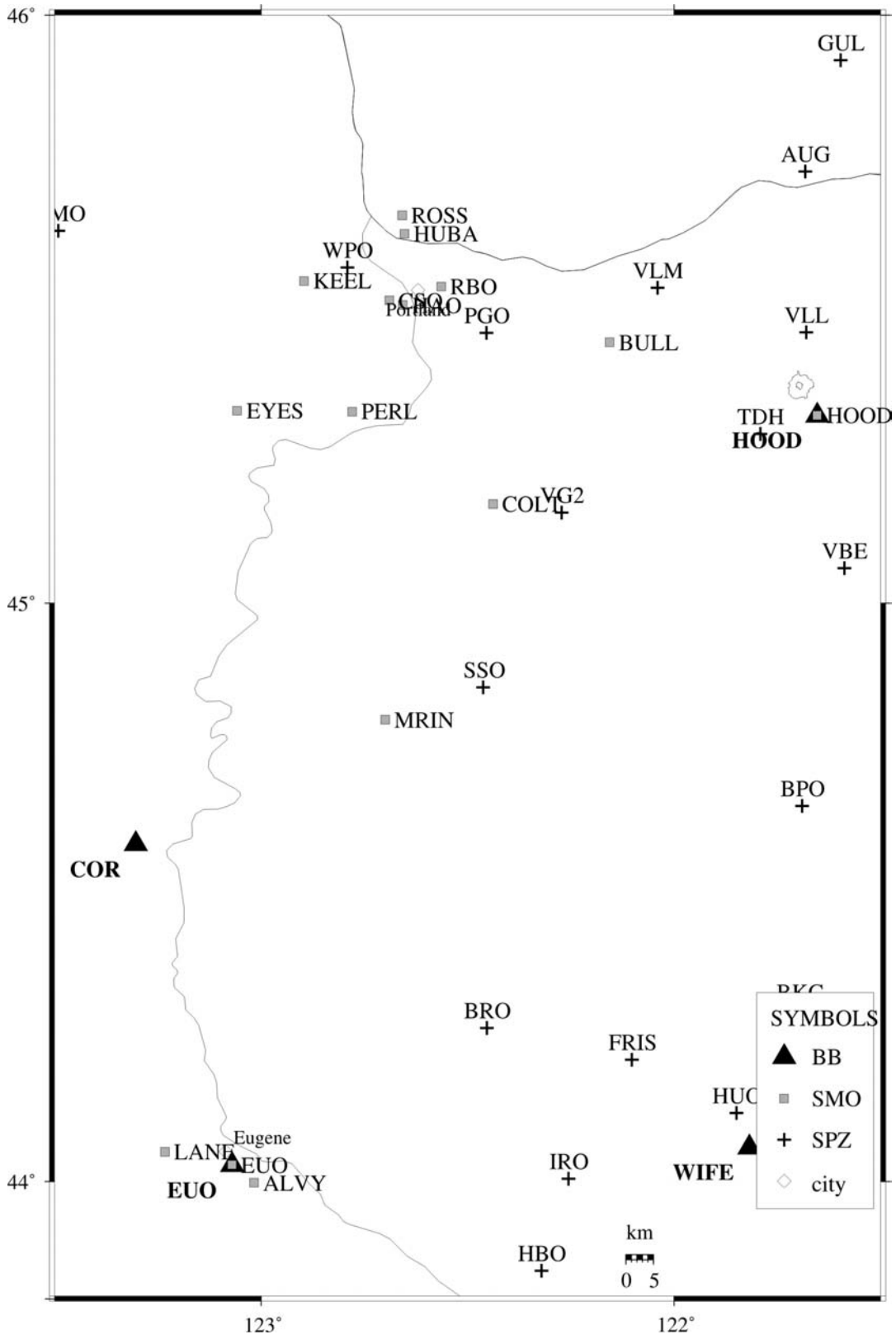

Figure 1 C. Willamette Valley seismograph stations, detail of Fig. 1 A

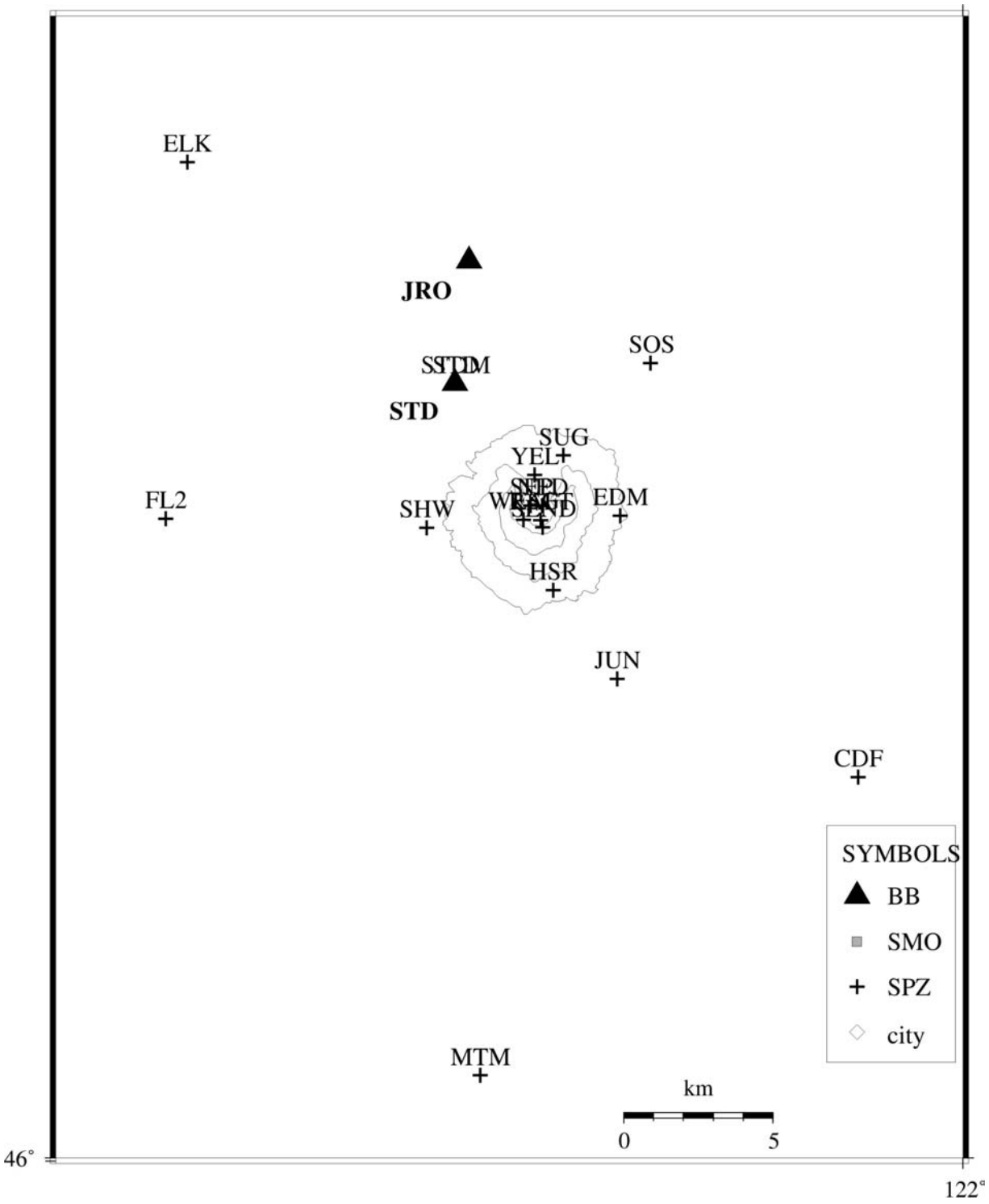

Figure 1 D. Mount St. Helens seismograph stations, detail of Fig. 1 A

Station Tables

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 04-HQ-AG-005. 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. "G" stations are contributed by other organizations, with some assistance from the PNSN. 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 1A – Short period stations

STA	F	LAT	LONG	EL	NAME
ALKI	%	47 34 31.0	122 24 58.9	0.001	Alki Wastewater Plant, ANSS-SMO
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
B001	E	48 02 34.1	123 07 56.2	0.23	Golbeck
B005	E	48 03 34.6	123 30 19.1	0.3	Golbeck Shore 1 NW
B006	E	48 03 31.7	123 30 08.3	0.3	Shore NE
B007	E	48 03 20.2	123 30 19.4	0.29	Shore
BBO	%	42 53 12.6	122 40 46.6	1.671	Butler Butte, OR
BEN	H	46 31 12.0	119 43 18.0	0.335	PNNL station
BEND	%	44 04 00.8	121 19 36.0	1.141	UO Bend Office, DOGAMI SMO
BHW	%	47 50 12.6	122 01 55.8	0.198	Bald Hill
BKC	%	44 17 57.9	121 41 45.6	1.208	Black Crater, OR
BLN	%	48 00 26.5	122 58 18.6	0.585	Blyn Mt.
BLT		45 54 54.5	120 10 33.0	0.659	Bickleton
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, OR
BRO	%	44 16 02.5	122 27 07.1	1.341	Big Rock Lookout, OR
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, OR
BURN		43 34 23.0	119 07 49.0	1.615	Burns, OR SMO
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
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)

Table 1A – Short period stations					
STA	**F**	**LAT**	**LONG**	**EL**	**NAME**
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 06 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, OR
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.
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., OR
HBO	%	43 50 39.5	122 19 11.9	1.615	Huckleberry Mt., OR
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., OR
HSO	%	43 31 33.0	123 05 24.0	1.02	Harness Mountain, OR
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, OR
JCW	%	48 11 43.8	121 55 34.4	0.792	Jim Creek
JORV	%	42 58 40.0	117 03 10.0	1.338	Jorden Valley, OR SMO
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., OR
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, OR
LAM	N	41 36 35.2	122 37 32.1	1.769	CAL-NET
LAS	N	41 35 57.6	121 34 36.0	-	CAL-NET
LBC	N	40 50 12.3	121 20 59.8	-	CAL-NET
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
LHE	N	41 37 42.6	122 13 49.8	-	CAL-NET
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., OR
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
LTI	N	41 10 34.0	121 29 19.6	-	CAL-NET
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 45.1	122 49 52.9	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

Table 1A – Short period stations					
STA	**F**	**LAT**	**LONG**	**EL**	**NAME**
MOON	%	44 03 06.2	121 40 06.0	2.24	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, OR
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, OR
NED	#	46 12 01.5	122 11 03.4	2.06	NE part of old Dome, St. Helens
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., OR
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 53.0	124 37 25.9	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 (replaces OT2 8/26
OTR	%	48 05 00.0	124 20 39.0	0.712	Olympics - Tyee Ridge
P403	E	48 03 43.9	124 08 32.0	0.31	Sandy Floe Quarry
PAT2	+	45 53 01.6	119 45 23.8	0.259	Paterson 2
PCFR	%	46 59 23.3	122 26 27.4	0.137	PC Firing Range ANSS-SMO
PCMD	%	46 53 20.9	122 18 00.9	0.239	PC Mountain Detachment ANSS-SMO
PGO	%	45 27 42.6	122 27 11.5	0.253	Gresham, OR
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
RAFT		46 11 45.1	122 11 06.4	2.132	Raft, St Helens crater station
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, OR
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 39.3	121 58 22.7	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 ANSS-SMO
SEA	%	47 39 15.8	122 18 29.3	0.03	UW, Seattle (Wood Anderson BB)
SEND		46 11 37.2	122 11 03.2	-	SEND, Mt. St. Helens (Dome station)
SEP	#	46 12 01.4	122 11 21.8	2.116	September lobe, Mt. St. Helens
SFER	%	47 37 10.4	117 21 55.7	0.715	Spokane Schools, Ferris High
SHW	%	46 11 37.1	122 14 06.5	1.425	Mt. St. Helens
SLF	%	47 45 38.6	120 31 41.5	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, OR
STD	%	46 14 16.0	122 13 21.9	1.268	Studebaker Ridge

Table 1A – Short period stations					
STA	**F**	**LAT**	**LONG**	**EL**	**NAME**
STDM	%	46 14 16.0	122 13 21.9	1.268	Studebaker Ridge Microphone
STW	%	48 09 03.1	123 40 11.1	0.308	Striped Peak
SUG	%	46 12 56.6	122 10 30.2	1.859	Sugar Bowl, MSH
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., OR
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
UMPQ	%	43 17 27.8	123 19 50.5	0.162	Umpqua Commun. College, DOGAMI
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, OR
VCR	%	44 58 58.2	120 59 17.4	1.015	Criterion Ridge, OR
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, OR
VG2	%	45 09 20.0	122 16 15.0	0.823	Goat Mt., OR
VGB	+	45 30 56.4	120 46 39.0	0.729	Gordon Butte, OR
VIP	%	44 30 29.4	120 37 07.8	1.731	Ingram Pt., OR
VLL	%	45 27 48.0	121 40 45.0	1.195	Laurance Lk., OR
VLM	%	45 32 18.6	122 02 21.0	1.15	Little Larch, OR
VSP	%	42 20 30.0	121 57 00.0	1.539	Spence Mtn, OR
VT2	+	46 58 02.4	119 59 57.0	0.385	Vantage2
VTH	%	45 10 52.2	120 33 40.8	0.773	The Trough, OR
VVHS	%	47 25 25.1	122 27 13.1	0.095	Vashon HS ANSS-SMO
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
WESG		46 11 45.6	122 11 33.2	2.13	St. Helens Crater (west side glacier)
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, OR
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 23.8	120 52 54.4	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

Table 1B lists broad-band stations used in locating seismic events in Washington and Oregon, and Table 1C lists strong-motion stations. The format for station locations is the same for all station tables, as described above.

Table 1B - Broadband Stations					
STA	**F**	**LAT**	**LONG**	**EL**	**NAME**
A04A	E	48 43 12.6	122 42 20.5	0.024	Lummi Island, WA
BMO		44 51 09.0	117 18 21.0	1.154	Blue Mountain Ob (USNSN) BB
BRKS	%	47 45 19.1	122 17 17.9	0.02	Brookside ANSS-SMO BB
COR	U	44 35 08.5	123 18 11.5	0.121	Corvallis, OR (USNSN) BB
D03A	E	47 06 58.3	123 46 11.0	0.049	Wishkah, WA
DBO	%	43 07 09.0	123 14 34.0	0.984	Dodson Butte, OR (UO CREST BB)
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
GRCC	%	47 18 42.5	122 10 46.0	0.13	Green River CC BB
HAWA	U	46 23 32.3	119 31 57.2	0.367	Hanford Nike USNSN BB

Table 1B - Broadband Stations					
STA	**F**	**LAT**	**LONG**	**EL**	**NAME**
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
JRO		46 16 31.0	122 12 59.7	1.28	Johnston Ridge Observatory
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 22.6	123 54 28.7	1.265	CAL-NET Red Mtn, OR CREST BB
KSXB	N	41 49 49.4	123 52 36.8	-	CAL-NET Camp Six, OR CREST BB
LON	%	46 45 00.0	121 48 36.0	0.853	Longmire CREST BB LONLZ SMO
LTY	%	47 15 21.2	120 39 53.3	0.97	Liberty BB CREST SMO
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 Center
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 BB
PFB	C	48 34 30.0	124 26 39.8	0.465	P.Renfrew, Canada BB
PIN	%	43 48 40.0	120 52 19.0	1.865	Pine Mt., OR (U0 CREST, BB, SMO)
PNLK	%	47 34 54.5	122 02 01.0	0.128	Pine Lake JH ANSS-SMO BB
PNT	C	49 18 57.6	119 36 57.6	0.55	Canada, 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)
STD	%	46 14 16.0	122 13 21.9	1.268	Studebaker Ridge
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
WIFE		44 03 35.4	121 48 58.7	1.955	Wife at 3-Sisters from CVO
WISH	%	47 07 01.8	123 46 11.6	0.045	Wishkah CREST BB SMO
WVOR	U	42 26 02.0	118 38 13.0	1.344	Wildhorse Valley, OR (USNSN BB)
YBH		41 43 55.3	122 42 37.4	1.06	Yreka, CA from UCB BB

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
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 1C - Strong-motion three-component stations

STA	F	LAT	LONG	EL	NAME	SENSOR	TEL.
ACES	%	47.55953	-122.341	0	Army Corps of Engineers Seattle	CMG5T	Internet
ALCT	%	47.64672	-122.039	0.055	Alcott Elementary	K2	Internet
ALKI	%	47.5751	-122.418	0.001	Alki	K2: L4	LL
ALST	%	46.10881	-123.034	0.198	Alston	A20	Earthworm + Microwave
ALVY	%	43.99796	-123.017	0.155	Alvey	K2	Earthworm + Microwave
ATES	%	48.23617	-122.06	0.062	Trafton Elementary	K2: L4	Internet
BABE	%	47.60565	-122.537	0.083	Blakely Elementary	K2	Internet
BEND	%	44.06673	-121.328	1.141	U of O Bend Field Office	K2: S13	Internet
BEVT	%	47.91982	-122.271	0.17	Boeing Plant Everett	K2	Internet
BRKS	%	47.75512	-122.29	0.02	Brookside Elementary	K2,BBZ	Internet
BSFP	%	47.52	-122.298	0.005	Boeing Fire Protection	CMG5T	Internet
BULL	*	45.44589	-122.156	0.222	Bull Run Dam	A	Internet
BURN	#	43.57293	-119.131	1.615	Burns Butte Radio Building	K2	Internet
COLT	%	45.17015	-122.438	0.213	Colton High School	CMG5T	Internet
CSEN	%	47.80106	-122.22	0.055	Crystal Springs Elementary	K2	Internet
CSO	#	45.51694	-122.69	0.036	Canyon	FBA23	Dial-up
DBO	%	43.11901	-123.244	0.984	Dodson Butte (CREST)	EPI,BB3	LL
EARN	%	47.74072	-122.045	0.159	East Ridge Elementary	K2	Internet
EGRN	%	47.07315	-122.979	0.057	Evergreen State College	K2	Internet
ELW	%	47.4941	-121.873	0.267	Echo Lake	A,BB	Dial-up + Microwave + T1
ERW	%	48.45383	-122.626	0.389	Mount Erie	A,BB	Dial-up + LL + Microwave
EUO	%	44.02921	-123.07	0.16	Eugene Golf Course (CREST)	EPI,BB	Earthworm + LL
EVCC	%	48.00732	-122.206	0.03	Everett Community College	K2	Internet
EVGW	%	47.85422	-122.155	0.122	Gateway Middle School	K2	Internet
EYES	%	45.32942	-123.058	0.061	Ewing Young Elementary	CMG5T	Internet
FINN	%	47.71932	-122.233	0.121	Finn Hill Junior High	K2	Internet
GNW	%	47.56422	-122.827	0.165	Green Mountain (CREST)	EPI,BB3	LL
GRCC	G	47.31162	-122.181	0.13	Green River Community College	EDU-V	Internet
GTWN	%	47.55116	-122.322	0.025	Georgetown Playfield	CMG5T	Intuicom Wireless + Internet
HAO	#	45.50919	-122.657	0.018	Harrison	FBA23	Dial-up
HART	%	47.58377	-122.35	0.002	Harbor Island	K2	Intuicom Wireless + Internet
HEBO	%	45.2135	-123.755	0.875	Mt. Hebo (CREST)	EPI,BB	Microwave + Earthworm
HICC	%	47.38994	-122.299	0.115	Highline Community College	K2	Internet
HOLY	%	47.56522	-122.385	0.106	Holy Rosary School	K2	Internet

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Table 1C - Strong-motion three-component stations							
STA	**F**	**LAT**	**LONG**	**EL**	**NAME**	**SENSOR**	**TEL.**
HOOD	%	45.32145	-121.653	1.52	Hood Meadows (CREST)	EPI,BB	LL + Internet
HUBA	%	45.63067	-122.653	0.023	Hudson's Bay High School	CMG5T	Internet
JORV	%	42.97766	-117.054	1.338	Jordan Valley High School	K2	Internet
KCAM	%	47.544	-122.319	0.005	King County Airport Maintenance	CMG5T	Internet
KDK	%	47.59502	-122.333	0.004	King Dome	K2	Internet
KEEL	%	45.55006	-122.896	0.067	Keeler	A20	Dial-up+Earthworm+Microwave
KFAL	%	42.25756	-121.786	1.326	Klamath Falls	CMG5T	Internet
KICC	%	47.577	-122.632	0.017	Kitsap County Central Commun.s	K2	Internet
KIMB	%	47.57462	-122.304	0.069	Kimball Elementary	K2	Internet
KIMR	%	47.50287	-122.768	0.123	Moderate Risk Waste Collection Fclty.	K2	Internet
KINR	%	47.75148	-122.644	0.008	North Road Shed	K2	Internet
KITP	%	47.67482	-122.631	0.076	Wastewater Treatment Plant	K2	Internet
KNEL	%	47.38052	-122.252	0.014	Kent Elementary School	K2	Internet
KNJH	%	47.38454	-122.23	0.014	Kent Junior High	K2	Internet
LANE	%	44.05165	-123.233	0.12	Lane	K2	Earthworm + Microwave
LAWT	%	47.65632	-122.391	0.05	Lawton Elementary	SLN-320	Internet
LEOT	%	47.76772	-122.117	0.115	Leota Junior High	K2	Internet
LON	%	46.74983	-121.811	0.853	Longmire Springs (CREST)	EPI,BB3	LL
LTY	%	47.25573	-120.666	0.97	Liberty Heights Mine (CREST)	EPI,BB3	LL + Earthworm
LYNC	%	47.82555	-122.294	0.019	Lynnwood City Hall	CMG5T	Internet
MARY	%	47.66252	-122.121	0.011	Marymoor Park	K2	Internet
MBKE	%	48.91707	-122.143	1.01	Kendall Elementary	K2	Internet
MBPA	%	47.89835	-121.89	0.186	Monroe	A20	Dial-up + Microwave + T1
MEAN	%	47.62252	-122.306	0.037	Meany Middle School	K2	Internet
MEGW	%	46.26577	-123.879	0.332	Megler (CREST)	EPI,BB	Microwave + Earthworm
MPL	%	47.46843	-122.186	0.122	Maple Valley	K2	Dial-up + Microwave + T1
MRIN	%	44.80023	-122.699	0.187	Marion	K2	Microwave + Earthworm
MURR	%	47.11982	-122.561	0.082	Camp Murray	K2: L4	none
NIHS	%	47.74126	-122.223	0.137	Inglemoore High School	K2	Internet
NOWS	%	47.68649	-122.257	0.002	NOAA Sand Point	A20	Internet
OFR	%	47.93313	-124.396	0.152	Olympic Natural Resources Cntr. (CRES	EPI,BB	Internet + Earthworm
OHC	%	47.3337	-123.159	0.006	Hood Canal Junior High	K2	Internet
OPC	%	48.10009	-123.413	0.09	Peninsula College (CREST)	EPI,BB	Internet
PAYL	%	47.1926	-122.314	0.009	Aylen Junior High	K2	Internet
PCEP	%	47.11142	-122.291	0.16	Puyallup East Sheriff Precinct	K2	Internet
PCFR	%	46.98962	-122.442	0.137	Roy Training Center	K2: S13	Internet
PCMD	%	46.88896	-122.301	0.239	Mountain Detachment	K2: L4	Internet
PERL	%	45.32818	-122.779	0.068	Pearl	K2	Microwave + Earthworm
PIN	%	43.81096	-120.873	1.865	Pine Mtn. (CREST)	EPI,BB3	Earthworm + LL
PNLK	%	47.58162	-122.035	0.128	Pine Lake Middle School	K2,EDU-V	Internet
PSNS	%	47.55871	-122.644	0.006	Puget Sound Naval Shipyard	CMG5TD	Internet
QAW	%	47.63157	-122.356	0.14	Queen Anne	A20	T1
RAW	%	47.33705	-121.933	0.208	Raver	A20	Microwave + T1
RBEN	%	47.43502	-122.187	0.152	Benson Hill Elementary	K2	Internet
RBO	#	45.54083	-122.564	0.158	Rocky Butte	FBA23	Dial-up
RHAZ	%	47.54002	-122.185	0.108	Hazelwood Elementary	K2	Internet
ROSS	%	45.66178	-122.658	0.061	Ross	A20	Earthworm
RRHS	%	46.79942	-123.042	0.047	Rochester High School	K2: L4	Internet
RWW	%	46.96473	-123.543	0.015	Ranney Well (CREST)	EPI,BB3	LL
SBES	%	48.76814	-122.416	0.119	Silver Beach Elementary School	K2: L4	Internet
SCC	%	47.74965	-122.361	0	Shoreline Community College	CMG5T	Internet
SEA	%	47.65421	-122.309	0.03	University of Washington	A20,PMD2023	LL
SEAS	%	45.99742	-123.926	0.005	Seaside	K2	Internet
SFER	%	47.61944	-117.367	0.715	Ferris High School	K2	Internet
SGAR	%	47.67705	-117.415	0.579	Garfield Elementary	K2	Internet
SHIP	%	47.65511	-122.322	0.005	WashDOT Lake Union Shop	CMG5T	Intuicom Wireless + Internet
SHLY	$	47.70844	-117.416	0.626	Spokane Temp	K2	None

Table 1C - Strong-motion three-component stations							
STA	**F**	**LAT**	**LONG**	**EL**	**NAME**	**SENSOR**	**TEL.**
SMNR	%	47.20442	-122.233	0.022	Sumner High School	K2	Internet
SNIO	$	47.67944	-117.405	0.584	Spokane NIOSH	K2	None
SOPS	$	47.728	-117.313	0.707	Orchard Prairie Elementary	K2	Internet
SOUA	%	42.18375	-122.695	0.634	Southern Oregon University Ashland	K2: L4	Internet
SP2	%	47.55629	-122.249	0.03	Seward Park	A,BB	LL
SQM	%	48.07731	-123.047	0.03	Sequim Battelle Properties (CREST)	EPI,BB	Internet+Spread Spectrum Radio
SSS1	%	47.5818	-122.331	0.005	John Stanford Center 1	K2	Internet
SSS2	%	47.5818	-122.331	0.005	John Stanford Center 2	K2	Internet
SVOH	%	48.2892	-122.633	0.022	Skagit Valley College Oak Harbor	K2: L4	Internet
SVTR	%	47.49576	-121.782	0.146	Two Rivers School	CMG5T	Internet
SWES	%	47.71407	-117.466	0.623	Westview Elementary	K2	Internet
SWID	%	48.00843	-122.413	0.062	South Whidbey Primary School	K2	Internet
TAKO	%	43.74334	-124.082	0.046	Tahkenitch (CREST)	EPI,BB	Earthworm
TBPA	%	47.25788	-122.368	0.002	Tacoma	A20	Microwave + T1 + Dial-up
TKCO	%	47.53668	-122.302	0.005	King County Airport	A20	Internet
TOLO	%	44.62187	-123.923	0.021	Toledo (CREST)	EPI,BB	Microwave + Earthworm
TTW	%	47.69445	-121.69	0.542	Tolt Reservoir (CREST)	EPI,BB3	Internet
UMPQ	%	43.29089	-123.332	0.162	Umpqua Community College	K2: L4	Internet
UPS	%	47.26376	-122.485	0.113	University of Puget Sound	K2	Internet
UWFH	%	48.54593	-123.013	0.01	Friday Harbor Laboratories	K2: L4	Internet
VVHS	%	47.42345	-122.455	0.095	Vashon High School	K2: L4	Internet
WISC	%	47.60872	-122.176	0.056	Wilburton Instructional Services Cntr.	K2	Internet
WISH	%	47.11698	-123.771	0.045	Wishkah School (CREST)	BB	Internet
WWHS	%	46.04527	-118.318	0.01	Walla Walla High School	CMG5T	Internet

QUARTERLY NETWORK REPORT 2005-D

on

Seismicity of Washington and Oregon

October 1 through December 31, 2005

Pacific Northwest Seismograph Network

Dept. of Earth and Space Sciences

Box 351310

University of Washington

Seattle, Washington 98195-1310

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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INTRODUCTION

This is the fourth quarterly report of 2005 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. In these reports we provide information about network operations, our educational and outreach activities, and seismicity of the region including special coverage (figures, counts, listings, etc.) of earthquake swarms, aftershock sequences, or unusual events or findings.

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.

Prior to 2004, each quarterly included station tables and maps. Beginning in 2004, station tables and maps appear in the quarterly report only once a year. These tables were included in Appendix 1 of the 2005C Quarterly Report. 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 earthquake catalog is available on-line, both through our web-site and through the ANSS earthquake catalog.

NETWORK OPERATIONS

Lists of currently operating stations are available on-line through web page http://www.pnsn.org/OPS/stations.html. We currently receive data from 289 stations in our network area. There are 215 stations in Washington and 64 in Oregon. These stations provide short-period data from 174 stations, strong motion data from 110 stations, and broadband data from 45 stations. The PNSN also receives data from 40 stations operated by other seismic networks.

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.

TABLE 1 - Station outages and installations

Station	Outage Dates	Comment
ACES	08/03/05-End	Bad timing
ALCT	08/16/05-End	Removed for repair
ALKI	11/07/05-11/14/05	No communications
ALVY	07/20/05-10/06/05	No communications
BEVT	05/20/05-End	Removed for repair
BHW	10/04/05-12/14/05	Dead; installed new seismometer & seismometer cable
BKC	11/19/05-End	Dead
BLT	10/21/05	Installed
CDF	11/03/05-11/22/05	Dead
COLT	06/23/05-End	Removed for repair
CSO	12/15/05	Removed
ELK	12/26/05-End	Dead
ERW	07/25/05-End	Intermittent communications
GHW	05/04/05-12/09/05	Int. due to low solar exposure; converted site to air cell/solar site
GL2	10/21/04-End	Dead
GLK	09/29/05-End	Intermittent
GPW	03/16/04-09/28/05	Dead
GRCC	08/12/05-10/10/05	Removed for repair
GTWN	06/01/05-End	No communications; telemetry being moved for bldg. renovation
HAO	11/10/05	Removed
HOLY	10/01/05-10/26/05	No communications
JBO	10/15/04-End	Noisy
JRO	11/04/05-12/13/05	No communications (Coldwater VSAT down)
KDK	11/04/05-11/16/05	No communications
KEEL	05/30/05-End	Dead
KFAL	06/15/05-End	Dead
KICC	03/04/05-End	Bad timing

TABLE 1 - Station outages and installations

Station	Outage Dates	Comment
KICC	12/14/05-End	No communications
KIMB	12/14/05-12/23/05	No communications
KMO	12/29/05-End	Dead
KNEL	10/26/05-12/30/05	No communications
KOS	11/24/05-End	Dead
LANE	07/20/05-10/06/05	No communications
LTY	09/07/05-End	Intermittent communications
LYNC	12/17/05-12/29/05	No communications
MBKE	06/07/05-End	Dead, communications?
MIBL	11/17/05	Installed (St. Helens)
MOON	11/27/05-End	Intermittent
MRIN	10/18/05-End	Dead
MTM	12/12/05-End	Dead
NED	11/04/05-End	Dead
OBC	10/27/05-End	Dead
OBH	01/31/02-End	Temp. removed for logging
OOW	12/15/05-End	Dead
OSD	12/15/05-End	Dead because of OOW
PAT2	10/21/05	Installed
PERL	10/04/05-End	Dead
PGW	10/08/03-09/21/05	Dead; removed, site abandoned
RBO	11/09/05	Removed
RCM	12/26/05-End	Dead
RCS	12/29/05-End	Dead
RER	12/19/05-End	Noisy
SBES	05/18/05-End	Short period noisy
SCC	08/03/05-End	Bad timing
SEA.HH?	12/05/03-End	Disconnected for renovation
SEND	11/04/05-12/1305	No communications (Coldwater VSAT down)
SEP	11/04/05-12/13/05	No communications (Coldwater VSAT down)
SFER	09/01/04-End	Short period dead; needs removal
SOPS	08/27/02-End	K2 flash-memory problem
SOS	12/15/05-End	Dead
SP2	09/28/05-10/26/05	No communications
SSS1	03/05/05-End	One of 3 downhole 3-D sensors dead
STD (BB)	11/04/05-12/13/05	No communications (Coldwater VSAT down)
STD (SP)	12/15/05-End	Dead
SUG	10/02/05-10/18/05	Dead aircells
TAKO	12/25/05-End	No communications
TKCO	09/22/05-11/16/05	No communications
TOLO	12/24/05-End	No communications
TTW	12/01/05-End	Removed; strong motion sensor moved to USArray site for 2 years
UWFH	05/01/05-End	Short period problems; needs removal
VGB	09/23/04-End	Intermittent; usually very noisy
VVHS	06/30/05-12/27/05	No communications
WWHS	08/03/05-End	Bad timing

Mt. St. Helens eruption, 2004-2005

The dome-building eruption of Mount St. Helens that began on September 23, 2004 continues. This quarter, a slight change was made in the procedure for selecting events at Mt. St. Helens to be located. Previously, triggering was desensitized so that only the largest events at Mt. St. Helens caused data files to be automatically generated. Continuous trace data from Mt. St. Helens stations were manually reviewed and trace-data files cut from the continuous data for selected events. Beginning in December, the triggering threshold for automatically recording Mt. St. Helens earthquakes was lowered slightly, webicorders

were reviewed to identify events to be manually retrieved from the continuous data stream, and the continuous data were fully reviewed only for one hour of every six.

- **MSH Equipment; destruction and replacement**

Aircells died at station SUG causing no data to be collected from October 2-18, 2005. Station NED died for good on November 4, 2005. That same day, the feed from the Coldwater VSAT was lost. That was the source for signals from stations NED, SEND, SEP, STD (broadband), and JRO. The VSAT was down until December 13, 2005. On November 17, 2005, station SEND was moved to the old station BLIS location and was named MIBL.

Strong Motion Instrumentation Update

There were no new strong motion installations this quarter.

Station SSS1, the deepest of three downhole seismometer packages installed in Oct. 2004 at the John Stanford Center in Seattle, ceased operation in March of 2005. This quarter, a 5' X 5' square was cut in the parking apron to access the borehole wellhead. On their first visit, Eric Flood and Tom Yelin did some spade work to excavate the wellhead after the concrete slab was removed. On a second visit, they attempted to pull a cable through the conduit to the wellhead. The cable was binding somewhere in the conduit and they were unable to free it. Arrangements were made to bring in a driller in January 2006 to attempt to clear out the bentonite-cement grout that had been used to backfill the borehole after the sensor was installed. Replacement of the faulty sensor will delay reinstallation of the unit until sometime in mid 2006.

CREST Instrumentation Update

The EarthScope USArray transportable seismic station C05A was installed at the South Fork Tolt Reservoir on December 1, 2005. This Pacific Northwest USArray station includes a Streckeisen STS-2 broadband seismometer, Kinemetrics Quanterra Q330 seismic data acquisition system, and Kinemetrics Baler recording instrument. On December 1, 2005, the strong motion CREST station, TTW, was removed and the Kinemetric EpiSensor ES-T from this station was installed in the C05A vault. The USArray equipment will be removed after the completion of the 18-24 month deployment, at which point the rest of the original CREST TTW station will be installed permanently in the new C05A vault. The USArray installation was headed by Robert Busby of IRIS and assisted by Lynn Simmons of the PNSN. Seattle Public Utilities provided a great deal of support, in particular, staff members Bill Steenberg, Ted Victa, Teresa Hallauer, and Steve Monsey.

Computer Hardware Update

Scossa continues to be our main data collection computer, and *tremito* provides additional computational power for manual processing of earthquake data and acts as a fileserver for all the other networked computers in the group. A second Windows computer was configured to act as a backup to our main digitizing computer.

Use of PNSN Data

The IRIS Data Management Center reports 1,162 requests for PNSN trace-data this quarter. More than 16,200,000 traces were requested. The number of traces requested remains at an elevated level compared to a “typical” quarter prior to the current eruption of Mount St. Helens.

PNSN PERSONNEL CHANGES

PNSN P.I.Tony Qamar (1943-2005) fatally injured

Tony Qamar, co-PI of the PNSN, was tragically killed on October 4th by a logging truck while driving to retrieve GPS instruments on the Olympic Peninsula. His loss has impacted all aspects of PNSN operations and all who contribute to it. As a co-Principal Investigator for the Pacific Northwest Seismograph Network, Dr. Qamar was involved with almost every aspect of network operations and research, from field work to detailed studies of both tectonic and volcanic earthquakes. He also served as the Washington State Seismologist providing information and consulting to state government and civil authorities on earthquake hazards. His seismic investigations included studies of seismicity of the region, and earthquake hazards. He helped to develop an early version of a web based survey technique for felt earthquakes. He studied the seismicity of Cascade volcanoes and also the seismic signals related to glacier motion. He was instrumental in developing seismic processing and mapping software and managed the calibration and instrument response database for the network.

Dr. Qamar was an early leader in doing geodetic measurements in Washington using GPS technology. In cooperation with the Pacific Geoscience Centre in Canada he installed one of the early GPS "tracking" instruments at Neah Bay that detected the slow eastward movement of the west coast due to subduction of the oceanic plate under Washington. Additional

collaboration with scientists at Central Washington University and others resulted in the establishment of the "Pacific Northwest Geodetic Array" (PANGA).

Recently, Dr. Qamar was a major contributor to the seismic study of renewed activity at Mount St. Helens. His interest in volcanoes began in the spring of 1980, prior to the major eruption on May 18, 1980, when he and several colleagues camped on the slopes of Mount St. Helens and operated portable seismic stations and to make simultaneous visual and thermal observations of surface activity. More recently, he closely tracked the recent Mount St. Helens activity; contributing significant new data processing procedures and visual display techniques. His contributions included thoughtful insight both into the details of seismograms and the big picture of how volcanoes work. He was a regular participant in group discussions within the PNSN lab and in frequent conference calls and meetings with the staff of the Cascade Volcano Observatory (CVO).

The Department of Earth and Space Sciences sponsored a memorial for Tony Qamar at 7 PM Oct. 11 at the University of Washington. Over three hundred and fifty friends and family from the local area and across the country gathered to celebrate Tony's life and provide each other with support in the face of this devastating loss. Dr. Daniel Johnson of the University of Puget Sound was killed in the same accident, and hundreds attended his memorial service, held at the University of Puget Sound at noon on October 10th. Web pages with biographical information, photographs, and friends' remembrances may be found at:

http://www.pnsn.org/NEWS/PRESS_RELEASES/TONY_QAMAR.html
and
http://www.pnsn.org/NEWS/PRESS_RELEASES/DAN_JOHNSON.html

Tony's passing is mourned by the PNSN and the Dept. of Earth and Space Sciences, by the broader seismological community, and by colleagues and friends at the many other organizations he was involved with professionally and personally. His scientific curiosity and love of nature and the outdoors were combined in a particularly pleasant way with his friendliness, sense of humor and enjoyment of cooking. Tony's presence, knowledge, and sociability are missed.

John Vidale – Incoming Director of the PNSN to replace Steve Malone, retiring

Dr. John Vidale has accepted a position as Director of the PNSN. Dr. Vidale is expected to arrive at the UW in summer of 2006. Dr. Stephen D. Malone is planning to retire from the PNSN once Dr. Vidale settles in, but will continue to work with the PNSN part-time, concentrating on volcano seismicity problems.

Other Personnel Changes

Technician Robert Leslie resigned. Jon Connolly and Eric Flood, both former student helpers who had graduated recently, were hired temporarily to assist with field operations. Tom Yelin of the USGS is taking a more active role in the PNSN, including assuming occasional responsibility for emergency response duties. The PNSN has initiated a job search for a Network Manager to oversee day-to-day network operations, including field work, data-acquisition hardware and software, data analysis, and response to significant events.

EARTHQUAKE DATA – 2005-D

Between October 1 and December 31, 2005, 1,098 events were digitally recorded and processed at the University of Washington. Tens of thousands of additional unlocated events occurred at Mount St. Helens associated with the dome-building eruption that began in late September 2004. Of the processed events, locations in Washington, Oregon, or southernmost British Columbia were determined for 832 of these events; 741 were classified as earthquakes and 91 as known or suspected blasts. The remaining processed events include teleseisms (125 events), regional events outside the PNSN (53), and unlocated events within the PNSN, mostly at Mt. St. Helens. Due to the extremely large number of events, only a representative sample of Mount St. Helens seismicity was located. Other unlocated events within the PNSN normally 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 2 lists earthquakes reported to have been felt during this quarter. Events with ShakeMaps or Community Internet Intensity Maps (CIIM) are indicated. This quarter, one event generated a ShakeMap. Four events produced "CIIM" maps (**http://pasadena.wr.usgs.gov/shake/pnw/**), which convert "felt" reports sent by the general public (via Internet) into numeric intensity values. CIIM maps show the average intensity by zip code.

Table 3 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 1. Earthquakes with magnitude greater than or equal to 0.0 (M_c >=0).

Figure 2. Blasts and probable blasts (M_c >=0).
Figure 3. Earthquakes located near Mt. St. Helens (M_c >=0).
Figure 4. Earthquakes located near Mt. Rainier (M_c >=0).

TABLE 2 - Felt Earthquakes during the 4th Quarter of 2005

DATE-(UTC)-TIME	LAT(N)	LON(W)	DEP	MAG	COMMENTS		Shake
yy/mm/dd hh:mm:ss	deg.	deg.	km	Ml		CIIM	Map
05/11/23 20:53:15	48.85	122.13	0.0	4.0	6.6 km ENE of Deming, WA	✓	✓
05/12/15 10:26:02	47.72	117.76	0.1	2.4	27.0 km WNW of Spokane, WA (Mission & N Division)		
05/12/27 05:46:07	47.76	121.82	12.4	2.3	12.4 km ENE of Duvall, WA	✓	

OREGON

During the fourth quarter of 2005, 26 (none larger than magnitude 2.2) earthquakes were located in Oregon between 42.0 degrees and 45.5 degrees north latitude, and between 117 degrees and 125 degrees west longitude.

WESTERN WASHINGTON SEISMICITY

During the fourth quarter of 2005, 624 earthquakes were located between 45.5 degrees and 49.5 degrees north latitude and between 121.0 degrees and 125.3 degrees west longitude. Most western Washington seismicity this quarter was in the Mount St. Helens area, see discussion below. Two earthquakes were felt this quarter in western Washington.

The largest earthquake in western Washington this quarter was a magnitude 4.0 event on November 23 (UTC), located about 6 km east-north-east of Deming at a depth of less than 1 km. The deepest earthquake in western Washington this quarter was a magnitude 0.8 event at about 74 km depth located about 8 km SW of Bend, WA on November 14 (UTC).

WASHINGTON CASCADE VOLCANOES

Mount St. Helens

At Mount St. Helens, seismicity associated with the dome building eruption continue. During the 4th quarter of 2005, seismicity increased; event counts at HSR more than doubled compared to the 3rd quarter. However, due to the smaller magnitudes of 4th quarter events, the emergent nature of the seismic signals, and loss of a key crater station (NED), the number of located earthquakes declined from last quarter. Some changes in the procedure for selecting Mount St. Helens quakes to be located were also made during the 4th quarter (see this report's section on Network Operations). Located events at Mount St. Helens are only a representative sample of the seismicity.

Figure 3 shows located volcano-tectonic earthquakes near Mount St. Helens. Low frequency (L) and avalanche or rockfall events (S) are not shown. See the operations section for details on destruction, replacement and new instrument installation.

This quarter, 404 earthquakes were located in the area shown in Fig. 3 using conventional manual processing procedures (including 342 earthquakes between magnitude 1.0 and 2.9, and 3 slightly larger events with magnitudes between 3.0 and 3.4).

All locatable earthquakes in the 2004/2005 sequence are relatively shallow. Only a few events have been located deeper that 2 km. Seismicity this quarter continued to be located on the boundary between the old and new domes near the vent that appeared in early October, 2004.

Seth Moran of CVO has provided improved counts of seismic events during the current eruptive sequence. These numbers represent automated counts at HSR, which is intermediate in distance between YEL and JUN (the stations used for count estimates given in previous quarters). Helena Buurman, a summer intern at CVO in 2005, reviewed the data to assure uniformity and quality.

Earthquake counts at Mount St. Helens, quarterly break-down, provided by CVO.
4th quarter 2004 - 292,352 events
1st quarter 2005 - 123,502 events
2nd quarter 2005 - 49,811 events
3rd quarter 2005 - 12,085 events
4th quarter 2005 - 30,315 events

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). No events flagged "L" or "S" were located at Mount Rainier this quarter, though 32 "L" or "S" events were recorded, but were too small or too emergent to locate reliably. Type L and S events are not shown in Fig. 4.

A total of 37 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. The largest tectonic earthquake located near Mt. Rainier this quarter was a magnitude 1.2 event on October 18 (UTC), located about 3 km north-northeast of the summit of Mt. Rainier at less than 1 km depth. This quarter, 18 tectonic earthquakes (12 of them smaller than magnitude 0.0 and thus not shown in Fig. 4) 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 46.6-47.0 degrees north latitude and 121.83-122 west longitude). Within 5 km of the summit, there were 15 (11 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 shown in Fig. 4.

EASTERN WASHINGTON SEISMICITY

During the fourth quarter of 2005, 88 earthquakes were located in eastern Washington in the area between 45.5 - 49.5 degrees north latitude and 117 - 121 degrees west longitude. The largest earthquake recorded in eastern Washington this quarter was a magnitude 2.5 event on November 10 (UTC), located about 14 km west-southwest of Prosser at about 11km depth. This quarter's seismicity included a swarm of about 20 small (none larger than magnitude 2.0) shallow earthquakes (none deeper than 2 km) located near Wahluke, about 28 km west-southwest of Othello, during the month of December.

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.

Other regional agencies provide earthquake information. These include the Geological Survey of Canada (Pacific Geoscience Centre), Sidney, B.C. **http://www.pgc.nrcan.gc.ca/seismo/table.htm** and other regional networks in the United States **http://earthquake.usgs.gov/regional/** The US Geological Survey coordinates earthquake information nationally; **http://earthquake.usgs.gov**.

Complete catalog listings are available on-line through **http://www.pnsn.org/CATDAT/catalog.html** Key to earthquake catalog can be found in the last quarterly report of each year, or at:
http://www.pnsn.org/INFO_GENERAL/PNSN_QUARTERLY_EQ_CATALOG_KEY.htm

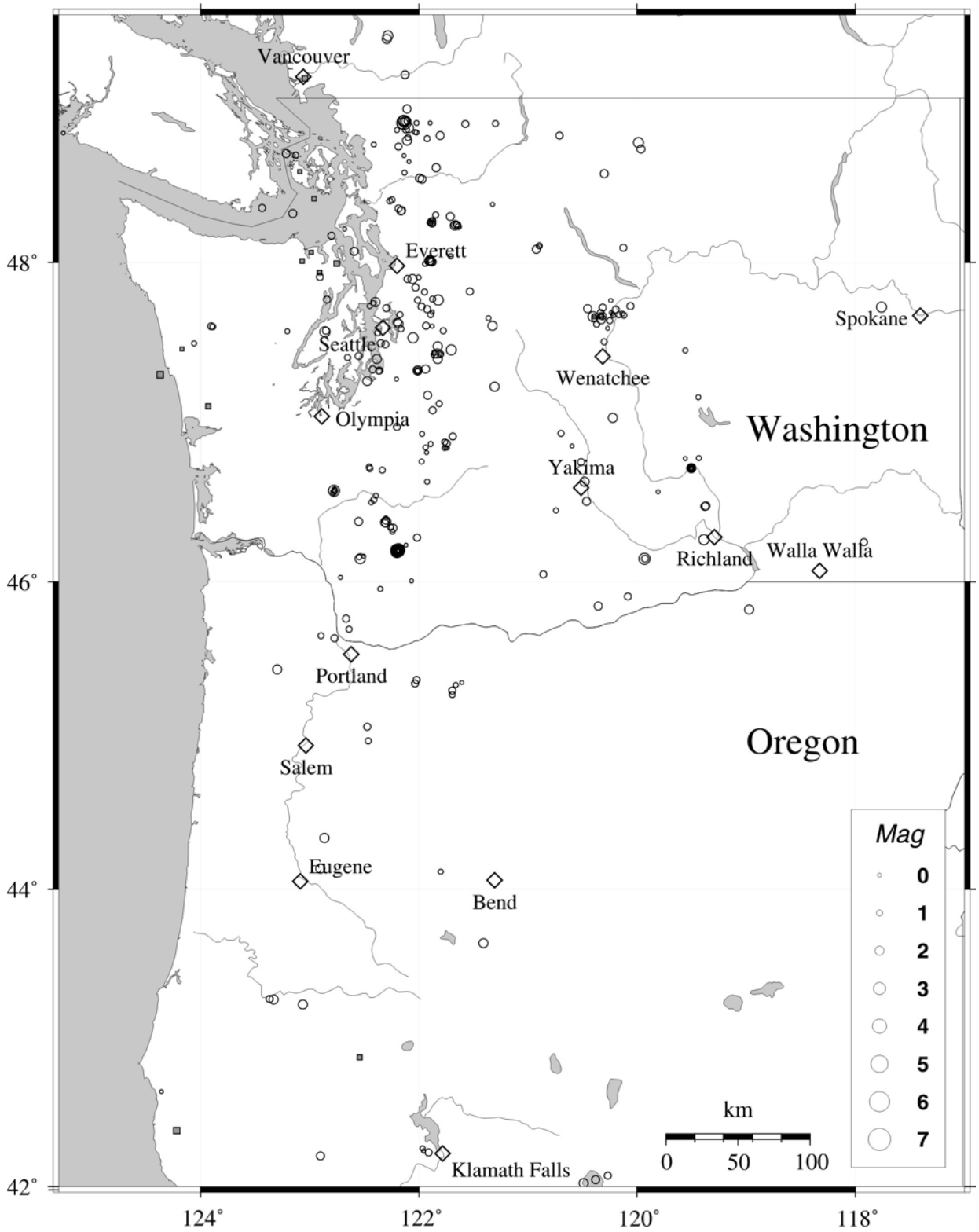

Figure 1 Earthquakes with magnitude greater than or equal to 0.0 (Mc>=0.0).

Unfilled diamonds represent cities. Quakes shallower than 30 km are indicated by circles, and deeper quakes by filled squares.

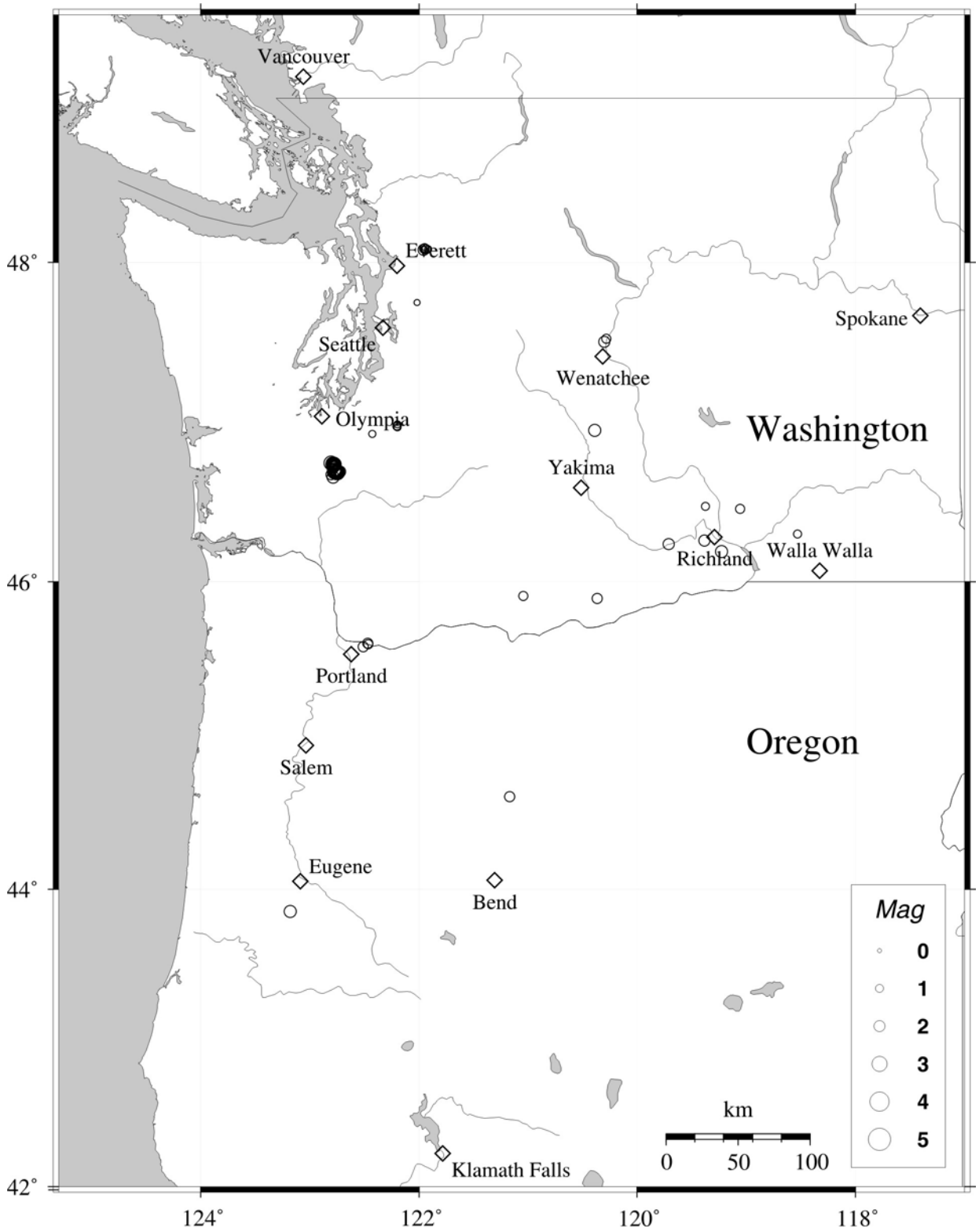

Figure 2. Blasts and probable blasts. Unfilled diamonds represent cities.

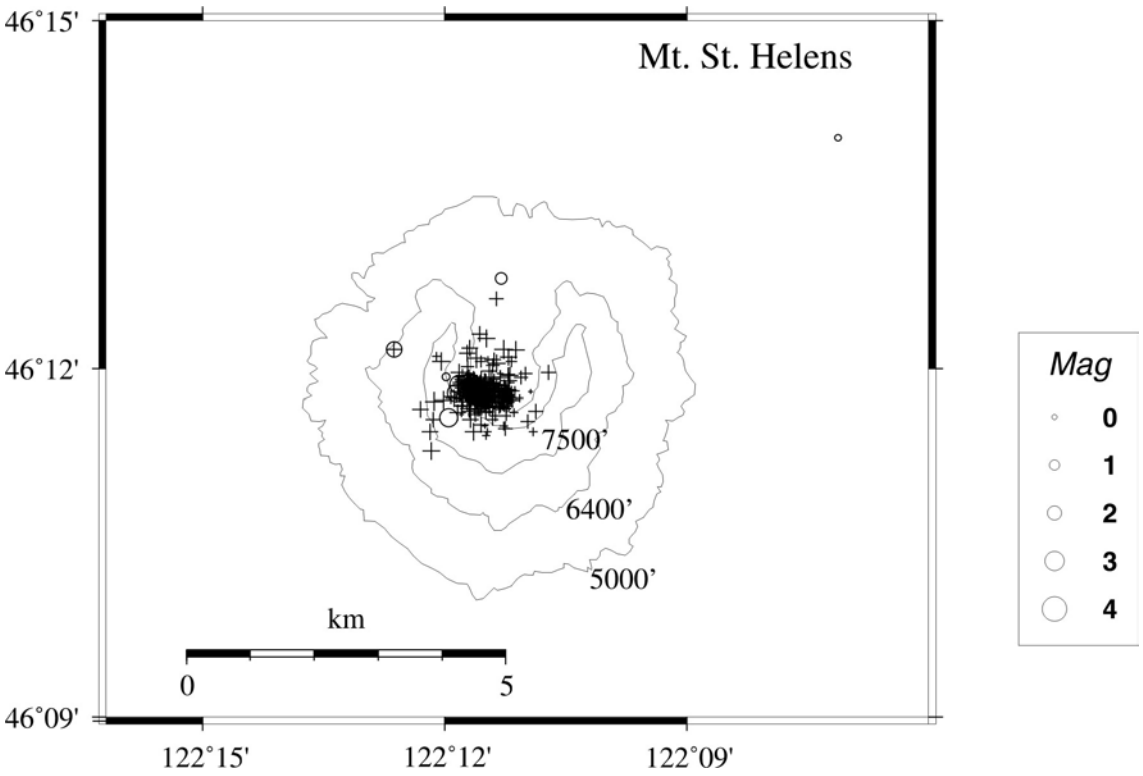

Figure 3. Selected Earthquake at Mt. St. Helens; (Mc>=0.0)
Events elected by the analyst for location are small fraction of the number of events recorded during the quarter.
Plus symbols indicate depth less than 1 km. Circles indicate depth greater than 1 km. Elevation contours shown in feet.

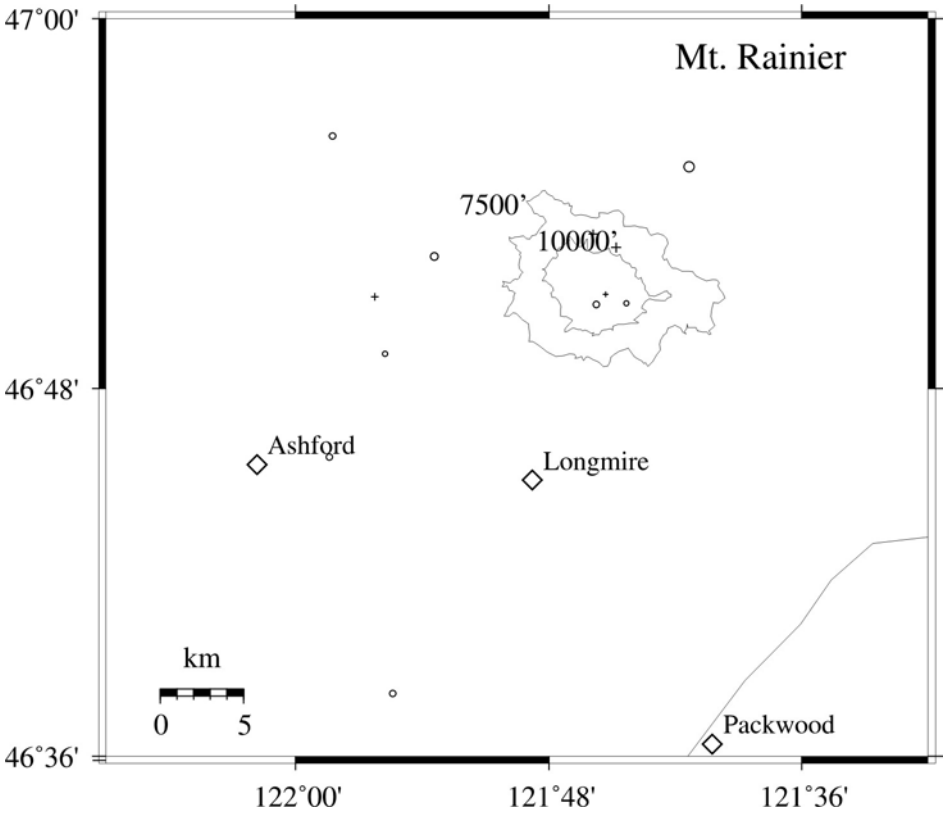

Figure 4. Earthquakes at Mt. Rainier; (Mc>=0.0)

EARTHQUAKE CATALOG, 2005-D

This quarter's catalog lists earthquakes of magnitude 2.0 or larger, except at Mt. St. Helens, where only events of magnitude 3.0 or larger are shown. Complete catalog listings are available on-line through **http://www.pnsn.org/CATDAT/catalog.html**
Key to earthquake catalog can be found in the last quarterly report of each year, or at:
http://www.pnsn.org/INFO_GENERAL/PNSN_QUARTERLY_EQ_CATALOG_KEY.htm

TABLE 3 - EARTHQUAKE CATALOG, 2005-D

Oct-05

DAY	TIME	LAT	LON	DEPTH	M	NS/NP	GAP	RMS	Q	MOD	TYP
1	7:52	46 11.84	122 11.49	0.91	2.5	15/015	66	0.06	AA	S4	
1	11:54	46 11.67	122 11.40	0.05*	2.7	16/016	66	0.19	BA	S4	
2	1:14	46 11.84	122 11.84	0.58	2.8	14/014	108	0.12	AB	S4	
2	7:01	46 11.68	122 11.43	0.73	2.2	21/025	67	0.11	AA	S4	
2	17:40	46 11.97	122 11.45	0.92	2.1	11/012	90	0.22	BA	S4	
2	20:02	46 11.58	122 11.94	1.22	2.6	11/011	82	0.13	AA	S4	
3	1:06	46 11.77	122 11.43	0.03*	2.5	13/013	102	0.22	BB	S4	
3	12:55	46 11.46	122 11.64	0.89	2.7	15/015	121	0.18	BB	S4	
3	13:30	46 11.71	122 11.43	0.93	2.2	10/010	119	0.15	BB	S4	
3	22:41	46 11.87	122 11.67	0.02*	2.5	14/014	103	0.29	BB	S4	
4	3:08	46 11.87	122 11.64	0.68	2.7	13/013	102	0.07	AB	S4	
4	4:31	46 11.91	122 11.30	0.29	2.1	12/012	93	0.08	AB	S4	
4	6:48	46 12.17	122 11.27	0.35	3.0	16/016	62	0.20	BA	S4	
4	12:47	46 11.77	122 11.28	0.02*	2.0	15/015	98	0.11	AB	S4	
4	22:18	46 11.81	122 11.36	0.72	2.9	27/027	43	0.11	AA	S4	
5	13:06	46 11.49	122 11.25	0.79*	2.1	7/007	145	0.21	BC	S4	
5	15:33	46 11.74	122 11.52	0.63	2.4	13/013	106	0.05	AB	S4	
5	20:37	46 11.90	122 11.20	0.03*	2.5	13/013	87	0.13	AA	S4	
6	3:49	46 11.81	122 11.20	0.03*	2.1	7/007	97	0.11	AB	S4	
6	8:00	46 11.81	122 11.39	0.13	2.7	12/012	99	0.08	AB	S4	
6	14:05	46 11.75	122 11.69	0.02*	2.9	15/015	72	0.15	BA	S4	
6	17:20	46 11.81	122 11.36	0.02*	2.2	12/012	99	0.14	AB	S4	
6	23:45	46 11.69	122 11.54	0.03*	2.1	12/012	108	0.13	AB	S4	
7	9:28	46 12.17	122 11.68	0.03*	2.5	10/010	99	0.27	BB	S4	
7	14:31	46 11.97	122 11.81	0.63	2.6	13/013	101	0.11	AB	S4	
7	16:42	46 11.78	122 11.28	0.04*	2.5	10/010	98	0.26	BB	S4	
7	22:02	46 11.55	122 10.96	0.04*	2.1	9/009	279	0.13	AD	S4	
8	1:41	46 11.56	122 11.67	0.91	2.5	13/013	76	0.15	BA	S4	
8	2:23	46 11.96	122 11.00	0.79	2.0	9/009	139	0.19	BC	S4	
8	9:11	46 11.56	122 12.13	0.5	2.2	5/005	128	0.05	AD	S4	
8	10:49	46 11.94	122 11.19	0.05*	2.6	14/014	83	0.16	BA	S4	
8	11:32	46 12.10	122 11.21	0.64	2.6	15/015	61	0.14	AA	S4	
8	16:00	46 11.94	122 11.21	0.02*	2.0	7/007	138	0.07	AC	S4	
8	19:24	46 11.84	122 11.54	0.31	2.0	13/013	102	0.13	AB	S4	
9	5:07	46 11.78	122 11.86	1.07	2.5	13/013	111	0.09	AB	S4	
9	14:09	46 11.77	122 11.34	0.04*	2.5	15/015	100	0.15	AB	S4	
9	21:56	46 11.72	122 12.00	0.67	2.8	14/014	79	0.07	AA	S4	
10	5:34	46 11.80	122 11.23	0.09	2.1	13/013	96	0.10	AB	S4	
10	6:22	46 11.84	122 11.67	0.4	2.1	10/010	112	0.19	BB	S4	
10	7:24	46 11.64	122 10.87	0.02*	2.2	7/007	128	0.21	BB	S4	
10	11:38	46 11.72	122 11.51	0.55	2.2	12/012	106	0.13	AB	S4	
11	1:29	46 11.84	122 11.60	0.42	2.0	15/015	103	0.10	AB	S4	
11	7:41	46 11.84	122 11.58	0.61	2.0	16/016	102	0.09	AB	S4	
11	8:56	46 11.74	122 11.77	0.62	2.8	14/014	111	0.10	AB	S4	

TABLE 3 - EARTHQUAKE CATALOG, 2005-D											
11	11:27	46 11.82	122 11.64	0.51	2.0	17/017	104	0.09	AB	S4	
11	12:30	46 11.84	122 11.34	0.48	2.0	14/014	97	0.08	AB	S4	
11	14:45	46 11.65	122 12.30	0.17	2.5	14/014	128	0.30	BB	S4	
11	19:52	47 27.59	121 42.17	17.5	2.3	40/041	56	0.14	AA	P3	
11	23:32	46 11.90	122 11.68	1.07	2.2	12/012	69	0.04	AA	S4	
12	2:12	46 11.81	122 11.54	0.62	2.1	17/017	67	0.11	AA	S4	
12	4:11	46 11.75	122 11.48	0.68	2.0	16/016	104	0.08	AB	S4	
12	8:15	46 11.85	122 11.81	1.11	2.6	15/015	73	0.09	AA	S4	
12	8:29	46 11.88	122 11.48	0.67	2.2	15/015	98	0.08	AB	S4	
12	12:23	46 11.84	122 11.67	0.34	2.0	12/012	105	0.09	AB	S4	
12	13:41	46 11.91	122 11.62	0.7	2.1	12/012	100	0.07	AB	S4	
12	15:45	46 11.78	122 11.52	0.48	2.2	15/015	103	0.08	AB	S4	
13	3:48	46 12.26	122 11.47	0.02*	2.8	8/008	86	0.24	BA	S4	
13	10:47	46 11.77	122 11.66	0.04*	2.4	14/014	108	0.12	AB	S4	
14	18:56	46 11.69	122 11.52	0.14	2.6	12/012	69	0.13	AA	S4	
15	16:16	46 11.71	122 11.59	0.7	2.5	14/014	108	0.10	AB	S4	
15	19:21	46 11.81	122 11.32	0.04*	2.0	14/014	98	0.13	AB	S4	
15	22:20	46 34.60	122 46.60	24.38	2.5	53/053	41	0.24	BA	P3	
18	4:47	46 12.06	122 12.04	0.26	2.9	16/016	73	0.05	AA	S4	
18	19:32	49 22.47	122 16.94	5.30$	2.3	14/016	270	0.34	CD	P3	
19	22:06	46 11.78	122 11.54	0.49	2.5	16/016	104	0.13	AB	S4	
22	6:52	46 11.80	122 11.60	0.03*	2.6	13/013	105	0.11	AB	S4	
25	5:51	46 11.80	122 11.81	0.58	2.3	14/014	109	0.08	AB	S4	
25	5:51	48 51.67	122 07.67	1.27*	2.3	21/021	111	0.48	CC	P3	
26	3:05	46 11.84	122 11.46	0.15*	2.6	18/018	77	0.13	AA	S4	
27	1:34	46 12.04	122 11.34	0.02*	2.7	10/010	96	0.16	BB	S4	
28	0:15	46 11.62	122 11.84	0.48	2.4	14/014	119	0.08	AB	S4	
28	12:49	46 11.68	122 11.40	0.31	2.1	14/014	105	0.11	AB	S4	
29	16:13	46 11.71	122 11.72	0.34	2.7	17/017	73	0.08	AA	S4	
30	13:35	46 11.80	122 11.54	0.32	2.3	14/014	103	0.10	AB	S4	
31	13:17	47 34.31	122 51.54	21.72	2.4	62/062	60	0.22	BA	P3	
31	13:56	46 11.68	122 11.79	0.21	2.3	15/015	114	0.13	AB	S4	
Nov-05											
DAY	**TIME**	**LAT**	**LON**	**DEPTH**	**M**	**NS/NP**	**GAP**	**RMS**	**Q**	**MOD**	**TYP**
2	13:50	46 12.09	122 11.60	0.04*	3.1	15/015	65	0.15	BA	S4	
6	17:24	46 11.77	122 11.66	0.69	2.9	14/014	71	0.09	AA	S4	
7	12:50	47 15.95	122 28.40	12.05	2.1	46/047	38	0.19	BA	P3	
9	4:43	49 21.41	122 17.70	6.73$	2.1	17/018	285	0.36	CD	P3	
10	12:45	46 08.77	119 55.85	10.53*	2.5	22/022	114	0.10	AB	E3	
11	18:26	46 11.75	122 11.40	0.69	2.8	16/016	55	0.11	AA	S4	
14	7:26	46 11.77	122 11.41	0.13	2.6	15/015	65	0.11	AA	S4	
14	21:05	45 26.26	123 17.88	20.13	2.1	29/030	90	0.25	BB	O0	
15	6:55	46 11.77	122 11.34	0.72	2.7	15/015	63	0.10	AA	S4	
16	16:12	46 11.82	122 11.62	0.35	2.5	10/010	104	0.10	AB	S4	
18	17:41	46 11.52	122 11.54	0.04*	2.3	9/009	117	0.08	AB	S4	
20	7:41	46 12.13	122 11.72	0.05*	2.5	4/004	153	0.10	AD	S4	
22	6:06	46 11.78	122 11.33	0.03*	2.5	15/015	99	0.14	AB	S4	
23	13:07	46 11.84	122 11.42	0.03*	2.3	14/014	98	0.15	AB	S4	
23	20:53	48 51.22	122 08.28	0.03*	4.0	30/031	106	0.42	CC	P3	F
24	9:11	46 11.77	122 11.54	0.05*	2.4	14/014	105	0.13	AB	S4	
25	11:08	46 11.91	122 11.41	0.03*	2.3	12/012	96	0.12	AB	S4	
25	15:57	47 39.90	120 24.12	0.64	2.4	22/022	54	0.17	BB	N3	
26	9:11	46 11.75	122 11.45	0.12	3.0	13/013	66	0.11	AA	S4	

TABLE 3 - EARTHQUAKE CATALOG, 2005-D											
27	2:37	46 11.72	122 11.15	0.04*	2.1	7/008	100	0.17	BB	S4	
28	1:57	46 11.81	122 11.47	0.11	2.6	11/011	83	0.09	AA	S4	
28	16:52	47 26.23	121 50.01	20.75	2.0	23/024	67	0.20	BA	P3	
Dec-05											
DAY	**TIME**	**LAT**	**LON**	**DEPTH**	**M**	**NS/NP**	**GAP**	**RMS**	**Q**	**MOD**	**TYP**
1	6:33	46 11.68	122 11.45	0.11*	2.1	11/011	106	0.17	BB	S4	
1	20:46	46 11.78	122 11.61	0.28	2.1	10/010	106	0.13	AB	S4	
3	7:19	46 08.74	122 32.22	16.58	2.3	38/038	35	0.13	AA	C3	
4	2:57	46 11.65	122 11.69	0.7	2.7	16/016	114	0.15	AB	S4	
4	5:01	46 43.21	119 30.28	0.04*	2.0	20/020	67	0.12	AB	E3	
4	22:51	48 52.02	122 08.61	0.73	2.3	16/017	229	0.44	CD	P3	
5	12:41	46 11.71	122 11.68	0.10*	2.4	12/012	111	0.13	AB	S4	
5	21:05	44 08.12	122 54.08	8.52	2.0	13/014	100	0.11	BC	O0	
5	21:13	46 16.05	119 23.25	0.03*	2.3	15/015	209	0.21	BD	E3	
5	21:58	48 13.69	121 40.35	8.76	2.1	18/019	74	0.25	BC	C3	
6	3:43	46 12.59	122 11.35	0.36	2.1	6/007	212	0.13	BD	S4	
6	16:22	46 11.75	122 11.87	0.59	2.6	13/013	114	0.12	AB	S4	
8	6:40	46 11.29	122 12.16	0.05*	2.8	13/013	134	0.62	DB	S4	
8	11:38	46 22.74	122 18.02	16.76	2.3	46/047	45	0.18	BA	S4	
9	14:12	48 50.83	122 09.08	1.94*	2.6	17/017	106	0.18	BC	P3	
9	16:46	46 11.80	122 11.34	0.04*	2.8	13/013	98	0.12	AB	S4	
11	12:19	46 11.64	122 11.67	0.67	2.4	12/012	115	0.12	AB	S4	
12	20:20	46 11.46	122 12.18	0.05*	2.5	9/009	131	0.29	BB	S4	
14	2:19	46 12.03	122 11.40	0.02*	2.0	7/007	129	0.05	AB	S4	
14	14:02	47 32.04	122 03.11	17.80*	2.3	47/050	37	0.21	BA	P3	
15	1:26	46 11.71	122 12.12	0.02*	2.9	11/011	120	0.12	AB	S4	
15	10:26	47 43.56	117 45.73	0.05*	2.4	9/009	292	0.41	CD	N3	F
15	13:05	48 43.90	119 59.25	0.03*	2.4	16/016	146	0.30	CD	N3	
16	2:20	45 49.21	118 58.30	14.27*	2.0	18/018	155	0.23	BC	E3	
18	0:35	46 11.61	122 11.61	0.02*	2.1	11/011	114	0.13	AB	S4	
18	5:09	47 24.16	122 23.00	20.81	2.0	23/024	43	0.13	AA	P3	
19	11:46	46 11.72	122 11.46	0.03*	2.8	13/013	108	0.13	AB	S4	
19	20:04	47 36.54	121 19.37	4.81#	2.1	30/032	40	0.39	CC	C3	
22	13:57	46 12.16	122 11.12	0.21	2.7	14/015	105	0.23	BB	S4	
24	1:46	46 11.64	122 11.48	0.04#	2.4	7/007	141	0.48	CC	S4	
24	14:04	46 11.77	122 11.28	0.02#	2.1	13/013	98	0.12	AB	S4	
26	3:47	46 11.77	122 11.28	0.05*	2.8	13/013	98	0.20	BB	S4	
26	14:55	46 11.80	122 11.59	1.24	2.0	10/010	104	0.06	AB	S4	
27	5:46	47 46.14	121 49.47	12.42	2.3	43/044	30	0.23	BA	P3	F
27	18:55	46 12.30	122 11.56	0.02*	2.3	10/010	88	0.15	AA	S4	
28	7:25	46 11.97	122 10.70	0.02#	2.2	11/011	91	0.42	CB	S4	
29	8:42	48 51.79	122 08.45	1.27	2.5	22/022	107	0.50	CC	P3	
30	12:14	46 12.17	122 12.63	1	2.3	9/009	98	0.30	BB	S4	
30	23:23	46 11.85	122 11.61	0.1	2.8	15/015	103	0.12	AB	S4	
31	7:34	47 19.86	122 00.63	18.75	2.0	30/030	33	0.21	BA	P3	

OUTREACH ACTIVITIES

PNSN staff and faculty participate in an educational outreach program designed to better inform the public, educators, businesses, policy makers, government agencies, engineers, and the emergency management community about earthquake, volcano and related hazards. Our program offers lectures, classes, lab tours, workshops, consultations, and electronic and printed information products. Special attention is paid to the information needs of the media. We provide information directly to the public through information sheets, an audio library, email, and via the Internet at **http://www.pnsn.org**. The following is a partial list of activities this quarter.

Audio Library, Phone

The Seismology Lab responded to over 100 calls from the general public, Emergency Managers and government agencies, and another 50 calls from the media. In addition, the PNSN audio library system received 240 calls this quarter. The audio library provides several recordings. We have a regularly updated message concerning current seismic activity, and there are also recordings describing seismic hazards in Washington and Oregon and earthquake prediction. Callers to the audio library have the option of being transferred to the Seismology Lab for additional information.

Internet outreach

PNSN staff replied to over 150 e-mail messages from the public seeking information on a variety of topics via the ***seis_info@ess.washington.edu*** email address. Ruth Ludwin managed this service this quarter, typically responding to routine questions within a day. Complex or sensitive questions are routed to the appropriate staff person for a more in-depth response. Requests may include complex scientific inquiries, assistance with hazard assessments and legal issues, consultations with government agencies, and support for engineering issues related to strong motion data. Bill Steele and other staff members also respond to numerous requests for information via their own email accounts.

Washington State Support

The University Board of Regents submitted a supplemental budget request for ~$400,000 for support of information product development and infrastructure hardening of the PNSN. Governor Christine Gregoire included this request in her budget submission to the Legislature. Steve Malone and have testified before legislative committees and we are hopeful budget will be approved.

Information Products

CISN display servers are receiving and displaying PNSN recent earthquake data and now provide links to the PNSN ShakeMaps, which are automatically generated following significant earthquakes. The CISN display version 1 was released in December 2004 and distributed to 25 select users including lifeline operators, emergency managers, and large businesses. This product has replaced the CUBE based RACE (Rapid Alert for Cascadia Earthquakes) systems which have largely been removed. After initial registration and configuration, the administrative duties for maintaining these accounts have been light.

Two CIIM maps were generated for felt events this quarter. The widest felt event was a very shallow, magnitude 4 earthquake on 11/23/05 located 17 miles ENE of Bellingham, Washington. Over 100 people filed felt reports. A ShakeMap was also generated for this event.

K-20 Education Outreach

PNSN and USGS staff gave 6 Seismology Lab tours and presentations for K-12 students and teachers, serving about 115 students this quarter, and one college level tour for 15. A lecture at Northwest Indian College, presented by Ruth Ludwin, was broadcast to distance-learning classes at several other Puget Sound locations.

Media Relations

The PNSN staff frequently provides interviews, research support, and referrals to radio, television, film, and print media. The PNSN organizes press conferences, contributes to TV and radio news programs and talk shows, and provides field opportunities linking reporters with working scientists. Staff members also assist news organizations, authors, television producers, and independent documentary makers to design accurate and informative stories and programs related to earthquake and volcano hazards. PNSN staff work to link reporters and producers developing stories with the appropriate research institutions, agencies, and scientists working in the areas to be covered by the piece. The PNSN coordinates the release of

information and media relations with the USGS Western Region, the Cascades Volcano Observatory, and the Oregon Department of Geology and Mineral Industries (DOGAMI).

Bill Steele provided a briefing about regional earthquake hazards for the management of Belo Corporation that owns King 5 TV and Cable Network News and radio stations. Belo is reviewing its business continuity plans and mitigation activities with the goal of remaining on air following a large earthquake near Seattle.

The ongoing eruption of Mount St. Helens (MSH) continued to stimulate media inquiries particularly when rock falls produced visible plumes. Throughout the quarter, PNSN scientists participated in morning science conferences with CVO once or twice a week to share data and interpretations, plan field activities and develop "talking points" for use in interviews when needed.

Meetings, Presentations and Visitors

- Bill Steele spoke at a CREW held a seminar October 19, 2005 called: How will we Respond and Recover from a "Katrina/Rita" Scale event? Video of the presentations is now available from this link: http://depts.washington.edu/mspci/directory_fall05.html
- Bill Steele represented Steve Malone and the PNSN at a CUSVO (Consortium of U.S. Volcano Observatories) meeting on November 8th in Salt Lake City.
- PNSN incoming Director John Vidale and Bill Steele attended an Oregon Seismic Monitoring Workshop sponsored by DOGAMI and the ANSS NW (PNSN).
- Bill Steele gave a workshop on Pacific Northwest Earthquake Hazards for the Pacific Policy Foundation.
- Ruth Ludwin gave presentations to the Pacific Northwest Historian's Guild and to a regional MENSA gathering; both in Seattle.
- Steve Malone presented a paper on Mount St. Helens at a special session at the annual meeting of the Geological Society of America in Salt Lake City, Utah
- Steve Malone participated in the yearly meeting of the Regional Coordinators of the ANSS in Memphis, TN.
- Steve Malone, Bill Steele and Robert Winglee (chair of the UW's Dept. of Earth and Space Sciences) attended a hearing of the Washington State Legislature on emergency preparedness. Malone gave a presentation on the role of the PNSN in emergency response and hazard mitigation.
- Steve Malone gave a presentation on the operations of the PNSN to the ANSS Steering Committee for the USGS in Denver, CO
- Steve Malone attended the annual meeting of the AGU in San Francisco, CA