SeaSHIPS

Earthquake recordings from the 2002 Seattle Seismic Hazard Investigation of Puget Sound (SHIPS), Washington State

Thomas L. Pratt[1], Karen L. Meagher[2], Thomas M. Brocher[3], Thomas Yelin[2], Robert Norris[2], Lynn Hultgrien[2], Elizabeth Barnett[2], Craig S. Weaver[2]

[1] U.S. Geological Survey, School of Oceanography, Box 357940
Univ. of Washington, Seattle, WA 98195

[2]U.S. Geological Survey, Earth and Space Sciences, Box 351650
Univ. of Washington, Seattle, WA 98195

[3]U.S. Geological Survey, 345 Middlefield Road, M/S 977, Menlo Park, CA 94025

USGS Open-File Report 03-361

Assembled Data Set 03-008

DATA
MANAGEMENT
SYSTEM

Distributed by:
Incorporated Research Institutions for Seismology
Data Management Center
1408 NE 45th Street, Suite 201
Seattle, Washington 98105 USA
www.iris.edu

Earthquake recordings from the 2002 Seattle Seismic Hazard Investigation of Puget Sound (SHIPS), Washington State

Thomas L. Pratt[1], Karen L. Meagher[2], Thomas M. Brocher[3], Thomas Yelin[2], Robert Norris[2], Lynn Hultgrien[2], Elizabeth Barnett[2], Craig S. Weaver[2]

Open-File Report 03-361

2003

U.S. Department of the Interior
U.S. Geological Survey

[1]U.S. Geological Survey, School of Oceanography, Box 357940, Univ. of Washington, Seattle, WA 98195
[2]U.S. Geological Survey, Earth and Space Sciences, Box 351650, Univ. of Washington, Seattle, WA 98195
[3]U.S. Geological Survey, 345 Middlefield Road, M/S 977, Menlo Park, CA 94025

TABLE OF CONTENTS

ABSTRACT

This report describes seismic data obtained during the fourth Seismic Hazard Investigation of Puget Sound (SHIPS) experiment, termed Seattle SHIPS . The experiment was designed to study the influence of the Seattle sedimentary basin on ground shaking during earthquakes. To accomplish this, we deployed seismometers over the basin to record local earthquakes, quarry blasts, and teleseisms during the period of January 26 to May 27, 2002. We plan to analyze the recordings to compute spectral amplitudes at each site, to determine the variability of ground motions over the basin.

During the Seattle SHIPS experiment, seismometers were deployed at 87 sites in a 110-km-long east-west line, three north-south lines, and a grid throughout the Seattle urban area (Figure 1). At each of these sites, an L-22, 2-Hz velocity transducer was installed and connected to a REF TEK Digital Acquisition System (DAS), both provided by the Program for Array Seismic Studies of the Continental Lithosphere (PASSCAL) of the Incorporated Research Institutes for Seismology (IRIS). The instruments were installed on January 26 and 27, and were retrieved gradually between April 18 and May 27. All instruments continuously sampled all three components of motion (velocity) at a sample rate of 50 samples/sec. To ensure accurate computations of amplitude, we calibrated the geophones *in situ* to obtain the instrument responses.

In this report, we discuss the acquisition of these data, we describe the processing and merging of these data into 1-hour long traces and into windowed events, we discuss the geophone calibration process and its results, and we display some of the earthquake recordings.

INTRODUCTION

The Seismic Hazard Investigations of Puget Sound (SHIPS) experiments are designed to better understand the earthquake hazard in the Puget Lowland region of Washington State (Pratt et al., 2002). During the 1998 wet SHIPS project, airgun shots behind the University of Washington s research vessel *Thomas G. Thompson* were recorded by a marine multichannel system and by 250 land-based seismic recorders (Fisher et al., 1999; Brocher et al., 1999). The 1999 dry SHIPS study was a refraction experiment in which 1008 land seismometers were placed along an east-west profile across the Seattle basin to record 38 underground detonations (Brocher et al., 2000a; Brocher et al., 2000b; Brocher et al., 2001b). The 2000 Kingdome SHIPS experiment used 207 land-based seismographs to record the destruction of the Kingdome sports stadium (equivalent to a M2.3 earthquake) and 4 underground explosions (Brocher et al., 2002; Brocher et al., 2000a).

The 2002 Seattle SHIPS experiment is predicated on the recordings of earthquakes during the first two SHIPS experiments. During the 1998 experiment, we analyzed recordings from 3 local earthquakes of magnitude 2.1 to 2.5 to look at ground shaking across the Puget Lowland, and the results demonstrated attenuation of high-frequency (8 to 20 Hz) seismic waves by the Seattle basin (Pratt et al., 2003). Following the 1999 experiment, analyses of ground shaking during two local events, five blasts, and the M7.6 Chi-Chi, Taiwan, earthquake confirmed the high-frequency attenuation over the basin but demonstrated amplifications of 12 to 16 over the Seattle basin at low frequencies (0.1-1 Hz; Pratt et al., 2003; Brocher et al., 2000b).

The results from these earlier SHIPS experiments, in which the analyses of ground motions were an afterthought, led to the planning of an experiment specifically to study the influence of the Seattle basin on ground shaking. The Seattle SHIPS experiment was designed to record ground motions during local events and teleseisms over a 3-month time period at a large number of sites distributed over and around the basin. The cancellation of an unrelated experiment allowed us to keep some of the instruments an extra month, until late May. This report describes the collection, processing and archiving of the data recorded during the 2002 Seattle SHIPS experiment.

EXPERIMENT DESIGN

The Seattle SHIPS experiment was designed to deploy and maintain a 3-dimensional array of 87 similar seismographs distributed over the Seattle basin (Figures 1 and 2; Johnson et al., 1994; Pratt et al., 1997; Brocher et al., 2001a; VanWagoner et al., 2002). One set of 26 seismographs was deployed along an east-west line across the center of the basin and onto bedrock at both ends, approximately coincident with the 1999 SHIPS refraction profile (Brocher et al., 2000b; Snelson, 2001; Pratt et al., 2003). A north-south line of 24 instruments extended from Mukilteo (north of Seattle) to Federal Way (north of Tacoma), crossing the center of the Seattle basin and the areas of shallow bedrock (structural uplifts) that form the north and south edges of the basin. Two shorter north-south profiles, of seven stations each, crossed the basin east of Lake Washington and west of Puget Sound. Finally, a grid of receivers within the city of Seattle provided denser coverage over the urban area on the center of the basin.

We sited all but three of the instruments at private residences and businesses willing to let us draw power from their outdoor outlets. Volunteer property owners were first solicited by emailing our extensive database of people who had volunteered their houses during previous SHIPS experiments or who had volunteered to help in previous USGS projects, which resulted in about 180 potential sites. After plotting the volunteered sites on a map, we divided them into three categories: 1) primary sites that we wanted to use, 2) alternative sites near the primary sites, or 3) sites that were not in appropriate locations for our seismometers. We also identified additional locations where we wanted instruments but did not have any volunteered sites.

Once our potential seismometer locations were identified, USGS staff visited each site to confirm that the volunteered site (or a nearby alternative site) was suitable, or to knock on doors to find a homeowner or business owner willing to let us deploy a seismometer on their property. Requirements for each site were:

1) a relatively quiet location away from traffic, industrial operations, or other continuous sources of noise;

2) the ability to conceal the seismometer behind buildings or landscaping;

3) a convenient source of electrical power;

4) adequate sky view for the global positioning system (GPS) to work; and

5) accessibility for deploying and visiting the site 4 to 8 times over the 4-month period.

Three sites at the east end of the array were located on remote timberlands without electric power, so these instruments were powered by two 130 amp-hour, deep-cycle batteries.

Table 1 lists the final site locations by address, with latitude, longitude, UTM zone 10 Easting and Northing, elevation, instrument number and geophone number. The positions are determined from the average of the GPS locations recorded by the instruments, with elevations read from topographic maps. For each site, a sheet was prepared with driving directions, the owner s contact information, a site description, a listing of maintenance visits, and any special instructions. These sheets are included in this report as a Microsoft Excel spreadsheet on a CD written from a Microsoft Windows computer.

SEISMOGRAPH DEPLOYMENT AND MAINTENANCE

The seismographs were deployed on January 26 and 27 under adverse conditions — a snowstorm started on the afternoon of January 26 and continued through the next day. The 87 sites were grouped into 10 deployment routes of 7 to 11 instruments each, with teams of two people deploying each group of instruments. Teams with a large driving distance between sites were given fewer instruments to deploy. The same groupings of instruments used for deployment were also used to group instruments for maintenance.

At each site we deployed the following equipment (Figure 3):

1) a Mark products L-22, 2-Hz velocity transducer (geophone) buried 0.1 to 0.4 m deep, oriented with axes pointed to ***magnetic*** north and east;

2) a Refraction Technology (REF TEK) Digital Acquisition System (DAS);

3) a GPS clock with an external antenna (or an external clock) that could be extended to reach areas of clear sky;

4) a 70 amp-hour car battery to provide power to the DAS; and

5) a 0.5-amp battery charger to maintain the charge on the battery.

All of the equipment except the seismometer and GPS antenna was placed inside a plastic case (Action Packer storage container) to keep it dry (Figure 3). At sites where the instrument had an open view of the sky, the GPS antenna also was placed inside the plastic case on top of the DAS. At most sites, the GPS antenna was mounted nearby where it had a good view of the sky.

Most (71) of the L-22 sensors were identical units provided by IRIS. The remaining 16 sensors were L-22s owned by the USGS. The USGS sensors had a variety of resistors in them to equalize the sensitivity, resulting in a uniformly lower sensitivity than the IRIS seismometers. The geophone characteristics (natural period, sensitivity), determined from *in situ* or lab calibration tests are described later. Geophones were buried to a depth of 0.1 to 0.4 m depending upon site conditions. Geophone axes were leveled with a bubble level and oriented with their axes pointed to ***magnetic*** north and east. In the Seattle area, magnetic north lies about 20… east of true north.

Counting spares, we used 105 Digital Acquisition Systems (DASes) in the experiment, most (92) of which were REF TEK 07s with 0.5, 1.0, 2.0, or 4.0 gigabyte hard drives. These disk sizes allowed the stations to run continuously for 2 weeks (0.5 gigabyte drives on an 06 DAS) to 8 weeks (4 gigabyte drives on an 07 DAS). However, we visited the sites at least once every 4 weeks to check on the instruments and download data. Because we did not have enough 07 REF TEKs, thirteen of the instruments were REF TEK 06s. The 06 instruments have slightly smaller dynamic range because of smaller A/D size (24 versus 16 bits), and they had smaller disk sizes. The 06 instruments were used at noisier and more accessible sites within the city of Seattle, under the assumption that the dynamic range was less important because only the largest events would be recorded at these noisier sites. PASSCAL (1991) and Brocher et al. (1999) describe the REF TEK instruments. All instruments were programmed to record three channels continuously at 50 samples/sec during the duration of the experiment.

For maintenance, the array was divided into the same 10 routes used in the deployment, with five USGS staff each responsible for maintaining two of these routes. Appendix A lists the sites by numerical order within each of these deployment routes. Sites were visited every 2 to 4 weeks, depending upon the size of the disks. During each maintenance visit, the status of the instrument was checked and the data were downloaded to a laptop. The disk drive was then cleared and the DAS was restarted and its status checked. The data were later transferred from the laptop to a workstation in the office.

When DASes were found to be non-functional, we attempted to fix the problem in the field. We generally carried a spare DAS in the maintenance vehicle to immediately replace malfunctioning DASes in the field, but during the latter part of the experiment we no longer had spare instruments available. If we could not resolve the problem in the field, we brought the DAS back to the office for inspection, reprogramming or minor repairs. If fixed, we put the DAS back at the site or used it as a spare to replace the next broken DAS. The number of functioning instruments decreased throughout the duration of the experiment, and some sites have time gaps in which a DAS was not present. Appendix A contains a chart that lists the stations, the days each station was functioning, the days the data were downloaded, and the size of the data file that was downloaded in the field.

We removed 50 instruments in late April and early May to move to the San Juan Islands, Washington State, and southwest Canada for another experiment (Brocher et al., 2003). These instruments were taken from throughout the array so that we could maintain the same aerial coverage with fewer instruments. All remaining instruments were removed by May 27th to ship back to IRIS on June 1st.

DATA RECOVERY

The chart in Appendix A summarizes our instrument history and data recovery at each site. Figure 4 shows a summary of the number of stations that recorded each event.

We recovered about 83% of the data that potentially could have been collected by the instruments. The data recovery percentage is relatively low because it was often two or three weeks between instrument failure and our next visit. The most common problem was power loss because of homeowners accidentally turning off the power to the outdoor outlets, or because of broken power ports on the DASes. In the latter case the instrument would appear in the field to be functioning properly but the bad power port prevented the battery from charging, resulting in battery drain 4 to 5 days later.

Of the data recovered, about 9% had little or no GPS information from which to do accurate timing corrections, and about 2% had obvious sensor problems (Appendix A). The GPS clocks gave us numerous problems because of malfunctions or few locks due to limited sky coverage. During our initial site inspection we used a small GPS unit to check for satellite visibility, but this hand-held unit apparently had far better satellite tracking capabilities than the GPS units within the DASes. Sensor problems were primarily due to bad channels (broken wires, flooding), although one site (site #71) was set on a concrete floor for several weeks before being buried outside of the building (in drier conditions).

About 70 to 75 instruments recorded each event (Figure 4), until we began removing instruments in mid April. The percentage of sites with working instruments gradually declined through the experiment as equipment irrecoverably failed, and the number of instruments decreases rapidly beginning in mid April when we began removing them to send to the other experiment.

GEOPHONE CALIBRATION

During the experiment, every geophone was calibrated *in situ* to determine its instrument response (fundamental frequency, % of critical damping, sensitivity). The calibration process is described in Rogers et al. (1995). The seismometer mass was pulled to the side of the instrument by sending a current into the coil; the mass was held there for several seconds and then released. This was repeated for each direction of each axis (6 measurements total). The resulting response curves were recorded and modeled to obtain an estimate of the resonant frequency, damping and sensitivity for each component. These results are listed in Table 2. In some cases, the calibration pulse was larger than the dynamic range of the recorder, resulting in a clipped calibration pulse (listed in Table 2). This clipping was not recognized in the field because the calibration software mislabeled the calibration pulse and the best-fit model pulse, leading us to the mistaken assumption that the calibration pulse was good but the software had problems with the model. The geophones had been removed before we discovered this problem, so the clipped calibration values have an unknown error. Sixty of the 87 geophones had successful calibrations of the horizontal channels, which were the channels we were interested in for this site response study. The USGS geophones, because they had resistors that were incompatible with the calibration software, were calibrated in the USGS seismology lab in Menlo Park, CA, about 3 weeks after the experiment ended. These values are included for the USGS geophones in Table 2.

DATA PROCESSING

Data were transferred from the field laptops to a Sun Microsystems workstation, and traces were extracted using the standard PASSCAL software routine ref2segy . This produced 1-hour SEGY traces plus a log file. Data were quality checked by looking at the log file and plotting the traces on the workstation screen.

Timing corrections were applied using the refrate and clockcor programs. The refrate program produced the PASSCAL Correction Format (PCF) file, which was inspected with the clockview program to see whether there were timing errors. The timing quality varied from the GPS regularly locking every hour for the duration of the experiment to having few to no locks during each 2-week period. Timing corrections were calculated from the log files using the refrate program, but the data suffered from numerous 1-s bugs in which the clock jumps 1 sec and then resets itself at some later time. Timing corrections to remove most of these 1-s bugs were automatically calculated in the refrate program, but there were numerous instances where the refrate program did not properly handle the errors. If these timing errors occurred during an event that we were saving (Tables 3-5), we hand-edited the timing correction file (PCF file) to attempt to fix the timing errors. When 1-s bugs were improperly handled by the refrate program (i.e. timing errors) but did not coincide with an earthquake, we left the errors in the timing correction files (PCF files) because we did not have time to individually correct all of these errors. Thus, a small percentage (we estimate about 2%) of our data that does not coincide with one of our events may have timing errors of up to 1 sec that we did not attempt to fix.

After fixing the timing corrections up to a certain date, we concatenated all of the PCF files for each instrument into a composite PCF file named by the date (i.e., MAR_8.PCF). This composite file was copied into the daily data directories, and we used the clockcor program to apply the timing corrections. The output from the clockcor program was directed to the file clockcor.out, which lists the timing correction applied to each data trace.

All local events and local quarry blasts above coda magnitude 1.5, as well as some smaller events that were prominent on the Pacific Northwest Seismic Network, (PNSN) were saved as 5-minute (300 sec) traces. A total of 68 local earthquakes were archived (Fig. 5, Table 3), as well as 48 local quarry blasts (Table 4). The traces were started 60 to 90 sec before the origin time of the event.

For teleseisms, records from all events larger than magnitude 5.5 that occurred anywhere on Earth were cut and saved. A total of 143 teleseisms were archived (Fig. 6, Table 5). In addition, smaller teleseisms that were nearby or had prominent arrivals on the PNSN stations were saved.

For all teleseisms less than M7.0, a 1-hour record was saved beginning at the origin time of the event. For earthquakes with magnitudes greater than 7.0, two hours of data beginning at the origin time were cut and saved in two, one-hour records.

DATA QUALITY

Local events of magnitude 1.9 and above were well recorded if they occurred within the array or on its perimeter (Figs. 7-14), and magnitude 2.3 and larger events within about 50 km of the array were well recorded (e.g., Figs. 8a, 8b, 9a, 13a). Figures 7-14 show the local events with a 0.5-1-8-16 Hz trapezoidal bandpass filter. The quarry blasts, most of which were from the Centralia mine ~100 km southwest of the array, were rarely visible on the array.

For teleseisms, M6.6 and greater events often had a good P-wave signal-to-noise ratio from periods of about 10 sec to 1 sec. The S-wave arrivals were near or below noise levels for teleseismic events below M7.0. The largest teleseisms are shown in figures 15 to 20 with a 0.05-0.1-0.8-1.6 Hz trapezoidal bandpass filter. Although events less than M6.5 were not obvious on the records, we cut and archived events down to M5.5 under the assumption that stacking could be used to view these data.

DATA FORMAT AND ARCHIVE

Data are archived in two forms: as 1-hour traces for each instrument for the duration of the experiment, and as cut records of the individual earthquakes and blasts. The former are standard PASSCAL SEGY seismic traces tarred in a directory format, with each day being a separate directory. Within each day s directory are 72 traces for each instrument (24 hours times 3 components), for a total of about 5400 traces per day (~75 instruments times 72 traces). The archived data have had timing corrections applied, and the timing correction file (PCF) is included with each daily directory. Each archive tape contains 3 days of data (about 18 gbytes) except the last two, which contain a greater number of days because there were fewer instruments near the end of the experiment. Also on every archive tape is a main directory with all of the LOG files and all of the PCF files for the individual instruments.

The event records are archived as event directories containing 5-min (local) or 1-hour (teleseism) traces, three per instrument (3 components). These data are in PASSCAL SEGY format with timing corrections applied.

The trace header values are described in Table 6, and include several non-standard entries. Specifically, the receiver latitude and longitude header entries are in the form of decimal degrees multiplied by 3600 to make them integers (divide by 3600 to return latitude and longitude values. We also put the UTM Easting and Northing of the receiver into the datumElevRec and datumElevSource header locations as 4-byte integers. There are no source locations in the headers.

Traces from the larger events (Figs. 5-18) also were combined into common-source gathers stored as industry-standard SEGY data suitable for reading with seismic reflection or refraction data processing software. The trace lengths in these gathers are limited to 32,767 samples by the 16-bit SEGY header, so we resampled the teleseism data to 10 samples/sec and made the gathers a slightly shortened version of the teleseisms (3276 sec; 54.6 min). Because the sample rate in the trace headers is limited to a 2-byte integer (32,767 microsec; 3276 millisec), the 100,000 microsecond sample rate was set to 10,000 microsec (10 millisec rather than the true 100 millisec sample rate). Thus, the time scales on these SEGY gathers are a factor of 10 smaller than the true time scale.

DATA AVAILABILITY

Tape copies of the SEGY data may be ordered via the World Wide Web from the IRIS Data Management System (DMS) in Seattle, Washington. The current web site address of the IRIS Consortium is www.iris.edu. The current email address for the IRIS DMS is webmaster@iris.washington.edu.

In addition to the archival data tapes, the data set contains a CD ROM with Microsoft Excel databases describing:

1) station locations with a calendar showing visits and data recovered [Appendix A];

2) a detailed, 1-page description of each site (contact information, description of seismometer location, instrument numbers, records of site visits), and

3) the data quality control (QC) spreadsheet used during the experiment, which lists the start and end times for each station download, and a list of any problems found during the QC process [data_archive.xls].

Also on the CD are postscript images of the calibration test results (~522 pages).

ACKNOWLEDGMENTS

Mary Templeton, Steve Azevedo, Marcos Alvarez and Noel Barstow of IRIS PASSCAL provided field support, technical assistance, and logistical support. In addition to the USGS staff, the following volunteers helped deploy the seismometers: Eric Baer, Peter Burkholder, Shane Detweiler, Richard Galster, Greg Geehan, David Hay, Tom Hay, Mike Hickey, Daniel Huang, Lara Linde, Dave McCormack, Mark Molinari, Roger Nye, Charles Oppelt, Ana Pierson, Anne Udaloy, David B. Williams.

The deployment staging area was provided by North Seattle Community College, as was the storage space for equipment cases during the 4 months of the experiment. We thank Dr. Ron LaFayette, President of North Seattle Community College (NSCC), and Mr. Allan Ward, Vice President of Administrative Services, for allowing us to use these facilities. Mr. Larry Raaen, Construction Coordinator, and Mr. Wally Fosmore, Manager of Facilities Operations at NSCC prepared the facilities and provided ongoing logistical support during the duration of the experiment.

Bob Frost and Ana Pierson, both volunteers, spent many days carrying out the geophone calibration process. Mike Flanagan and Shannon Casseia, student volunteers from NSCC, devoted many days to maintaining the instruments and helping with the database. Russell Sell, USGS, Menlo Park, provided the USGS geophones and relevant calibration information. We thank the many landowners whose properties were used during the experiment or who volunteered the use of properties that we chose not to use. Amy Wright of the PNSN provided lists of events that were visible on the permanent network. Bill Steele of the Pacific Northwest Seismology Laboratory handled media coverage and provided logistical support. We thank Mary Templeton for reviewing this manuscript.

REFERENCES

Brocher, T.M., T. Parsons, K.C. Creager, R.S. Crosson, N.P. Symons, G.D. Spence, B.C. Zelt, P.T.C. Hammer, R.D. Hyndman, D.C. Mosher, A.M. Trehu, K.C. Miller, M.A. Fisher, T.L. Pratt, M.G. Alvarez, B.C. Beaudoin, K.E. Louden, and C.S. Weaver, 1999, Wide-angle seismic recordings from the 1998 seismic hazards investigation of Puget Sound (SHIPS), western Washington and British Columbia, *U. S. Geological Survey Open-File Report* **99-314**, 110 p.

Brocher, T.M., T. L. Pratt, K. C. Miller, A. M. Tr hu, C. M. Snelson, C. S. Weaver, K. S. Creager, R. S. Crosson, U. S. ten Brink, M. G. Alvarez, S. H. Harder and I. Asudeh, 2000a, Report for explosion and earthquake data acquired in the 1999 Seismic Hazard Investigation of Puget Sound (SHIPS), Washington, *U. S. Geol. Surv. Open-File Report* **00-318**, 85 p.

Brocher, T. M., T. L. Pratt, K. C. Creager, R. S. Crosson, W. P. Steele, C. S. Weaver, A. D. Frankel, A. M. Tr hu, C. M. Snelson, K. C. Miller, S. H. Harder and U. S. ten Brink, 2000b, Urban seismic experiments investigate Seattle fault and basin, *EOS Trans. Am. Geophys. Union*, **81**, 545-552.

Brocher, T. M., T. Parsons, R. J. Blakely, N. I. Christensen, M. A. Fisher, R. E. Wells, and SHIPS working group 2001a, Upper crustal structure in Puget Lowland, Washington: Results from the 1998 Seismic Hazards Investigation in Puget Sound, *J. Geophys. Res.* **106**, 13541-13564.

Brocher, T. M., T.L. Pratt, and Dry SHIPS Working Group 2001b, Dry SHIPS recordings of the Chi-Chi earthquake, Seattle, Washington, *Bull. Seismol. Soc. Am.* **96**, 1395.

Brocher, T.M., T.L. Pratt, G.D. Spence, M. Reidel, and R.D. Hyndman R.D., 2003, Wide-angle seismic recordings from the 2002 Georgia Basin geohazards initiative, northwestern Washington and British Columbia, U. S. Geological Survey Open-File Report, **03-160**, 35 p.

Fisher, M.A., T.M. Brocher, R.D. Hyndman, A.M. Trehu, C.S. Weaver, K.C. Creager, R.S. Crosson, T. Parsons, A.K. Cooper, D. Mosher, G. Spence, B.C. Zelt, P.T. Hammer, U.S. ten Brink, T.L. Pratt, K.C. Miller, J.R. Childs, G.R. Cochrane, S. Chopra and R. Walia, 1999, Seismic survey probes urban earthquake hazards in Pacific Northwest, *EOS Trans. American Geophys. Union*, **80**, no. 2, 13-17.

Johnson, S.Y., C.J. Potter and J.M. Armentrout, 1994, Origin and evolution of the Seattle fault and Seattle basin, Washington, *Geology*, **22**, 71-74.

PASSCAL, 1991, Users Guide, A guide to planning experiments using PASSCAL instruments: IRIS, 28 p.

Pratt, T. L., S. Johnson, C. Potter, W. Stephenson and C. Finn, 1997, Seismic reflection images beneath Puget Sound, western Washington State: the Puget lowland thrust sheet hypothesis, *J. Geophys. Res.* **102**, 27469-27489.

Pratt, T.L., C.S. Weaver, T.M. Brocher, T. Parsons, M.A. Fisher, K.C. Creager, R.S. Crosson, R.D. Hyndman, G. Spence, A.M. Trehu, K.C. Miller and U.S. ten Brink, 2002, Understanding the seismotectonics of the Cascadia subduction zone: Overview and recent seismic work, in Fujinawa, Y., and Toshida, A., editors, *Seismotectonics in Convergent Plate Boundary*, Terra Scientific Publishing, Tokyo, p. 25-36.

Pratt, T.L., T.M. Brocher, C.S. Weaver, K.C. Miller, A.M. Trehu, K.C. Creager and R.S. Crosson, 2003, Amplification of seismic waves by the Seattle basin, Washington State, *Bulletin of the Seismological Society of America,* **93**, p. 533-545.

Rogers, P.W., A.J. Martin, M.C. Robertson, M.M. Hsu and D.B. Harris, 1995, Signal-coil calibration of electromagnetic seismometers, Bulletin of the Seismological Society of America, **85**, p. 845-850.

Snelson, C.M., 2001, Investigating crustal structure in western Washington and in the Rocky Mountains: Implications for seismic hazards and crustal growth, Ph.D. Dissertation, The University of Texas at El Paso, El Paso, Texas, 234 pp.

VanWagoner, T.M., R.S. Crosson, K.C. Creager, G. Medema, L. Preston, N.P. Symons and T.M. Brocher, 2002, Crustal structure and relocated earthquakes in the Puget Lowland, Washington, from high-resolution seismic tomography, Journal of Geophysical Research, **107**, no. 12, p. 22-1 — 22-23.

TABLE 1: SEISMOMETER SITES

Site no.	Latitude (degrees west)	Longitude (degrees north)	UTM Easting (m)	UTM Northing (m)	Elev (m)	DAS number	L-22 no.	CITY	Zip
1	-122.3157	47.9178	551132	5307174	25	7616	1489-L/765-L	Mukilteo	98275
2	-122.3247	47.8444	550243	5299028	95	7348	484-L	Edmonds	98026
3	-122.3502	47.7925	548669	5293228	138	7285	963-L	Edmonds	98026
4	-122.3690	47.7809	547270	5291921	124	7284	1514-L	Edmonds	98020
5	-122.3325	47.7322	550053	5286532	138	7432	736-L	Seattle	98133
6	-122.3737	47.7069	546982	5283696	92	7335	977-L	Seattle	98177
7	-122.3587	47.7303	548088	5286303	149	7626	459-L	Seattle	98177
9	-122.3347	47.6930	549926	5282176	84	7629	454-L	Seattle	98103
10	-122.2925	47.6878	553099	5281630	101	7281	512-L	Seattle	98115
11	-122.2793	47.7008	554074	5283078	18	7343	748-L	Seattle	98115
12	-122.3953	47.6749	545394	5280124	47	7457	533-L	Seattle	98107
13	-122.3560	47.6813	548335	5280856	103	7433	527-L	Seattle	98103
14	-122.2736	47.6828	554523	5281077	105	7443	971-L	Seattle	98115
15	-122.3156	47.6691	551377	5279532	61	7354	1503-L	Seattle	98105
16	-122.2562	47.6713	555841	5279815	29	7439	471-L	Seattle	98105
18	-122.3684	47.6447	547436	5276786	94	6088	542-L	Seattle	98119
19	-122.3181	47.6416	551219	5276471	61	6096	522-L	Seattle	98102
20	-122.3455	47.6313	549174	5275316	58	6042	541-L	Seattle	98109
21	-122.2830	47.6351	553866	5275777	19	7462	994-L	Seattle	98112
22	-122.3173	47.6228	551298	5274382	111	7365	728-L	Seattle	98102
23	-122.2868	47.6102	553606	5273005	79	7429	524-L	Seattle	98122
25	-122.2913	47.5815	553293	5269809	53	7594	526-L	Seattle	98144
27	-122.3164	47.5696	551418	5268469	90	7090/7451	956-L	Seattle	98108
28	-122.2728	47.5657	554698	5268064	26	6021/6084	531-L	Seattle	98118
29	-122.3755	47.5531	546985	5266605	115	7048	746-L	Seattle	98126
30	-122.2989	47.5567	552750	5267050	104	7317	538-L	Seattle	98108
31	-122.2628	47.5544	555469	5266823	23	7449	535-L	Seattle	98118

32	-122.3855	47.5331	546255	5264377	128	7079	724-L	Seattle	98136
33	-122.3452	47.5282	549294	5263851	129	7081	448-L	Seattle	98106
34	-122.3835	47.5119	546420	5262016	125	7065	967-L	Seattle	98146
35	-122.3580	47.4710	548379	5257488	113	7279	953-L	Burien	98166
36	-122.3150	47.4150	551674	5251292	79	7450	458-L	Des Moines	98198
37	-122.3710	47.2960	547557	5238032	130	7445	462-L	Federal Way	98093
38	-122.2850	47.3390	554015	5242867	142	7467/6111/7608	507-L	Auburn	98001
39	-122.7356	47.6852	519840	5281131	65	7331	742-L	Silverdale	98383
40	-122.5770	47.4910	531864	5259598	87	7596/7303	491-L	Port Orchard	98367
41	-122.6142	47.6610	528971	5278476	18	7597	747-L	Poulsbo	98370
42	-122.5447	47.6654	534183	5278993	75	7333	643-L	Bainbridge Island	98110
43	-122.1942	47.6539	560510	5277933	97	7316	463-L	Kirkland	98033
44	-122.1614	47.6633	562961	5278997	142	7437	1486-L	Kirkland	98033
45	-122.1106	47.6430	566806	5276790	48	7601	640-L	Redmond	98052
46	-121.9117	47.6449	581740	5277185	26	7620	949-L	Carnation	98014
50	-122.3000	47.8877	552333	5303839	155	7460	1508-L	Mukilteo	98275
51	-122.3126	47.4889	551785	5259502	116	7458	537-L	Seattle	98168
52	-122.3490	47.4560	549072	5255827	118	7466	957-L	Burien	98166
53	-122.2940	47.3000	553375	5238526	122	7610	968-L	Auburn	98001
54	-122.3083	47.6047	551993	5272382	99	7098	523-L	Seattle	98122
56	-122.2589	47.5125	555802	5262163	76	7326/6126	536-L	Seattle	98118
57	-122.3208	47.5280	551127	5263841	5	7103	951-L	Seattle	98108
58	-122.3267	47.5539	550659	5266717	5	7091	493-L	Seattle	98134
59	-122.3711	47.6703	547214	5279634	26	6019	528-L	Seattle	98107
60	-122.2854	47.7208	553592	5285299	79	7280	733-L	Seattle	98125
61	-122.2839	47.6601	553772	5278555	17	7344	950-L	Seattle	98105
62	-122.3090	47.3720	552170	5246518	84	7448	743-L	Des Moines	98198
63	-122.4051	47.6375	544686	5275965	69	6039/6085	539-L	Seattle	98199
64	-122.9731	47.7195	502020	5284909	51	7319	465-L	Brinnon	98320
65	-122.9310	47.7078	505173	5283602	37	7294	722-L	Brinnon	98320
66	-122.9035	47.6883	507246	5281444	10	7618	861-L	Brinnon	98320
67	-122.7984	47.7092	515121	5283779	128	7591	727-L	Quilcene	98376

68	-122.7945	47.6948	515419	5282177	86	7595	975-L	Quilcene	98376
71	-122.5785	47.6656	531648	5278997	40	7441	1506-L	Bainbridge Island	98110
74	-122.0930	47.6644	568097	5279184	53	7602	1490-L	Redmond	98052
75	-122.0418	47.6626	571946	5279022	111	7328	498-L	Redmond	98053
76	-121.9927	47.6760	575610	5280564	179	7302	495-L	Redmond	98053
77	-121.9532	47.6547	578608	5278235	111	7617/6119	497-L	Carnation	98014
79	-121.8295	47.6589	587894	5278832	226	7605	451-L	Carnation	98014
80	-121.7614	47.6535	593014	5278317	335	7295	1499-L	Carnation	98014
81	-121.7119	47.6536	596733	5278386	417	7608/7327	958-L	Carnation	98014
82	-122.1428	47.7462	564256	5288228	67	7619	473-L	Woodinville	98072
83	-122.1683	47.7899	562291	5293066	118	7444	496-L	Bothell	98021
84	-122.1459	47.5935	564216	5271258	111	7453	718-L	Bellevue	98007
85	-122.1447	47.5573	564351	5267229	298	7352	464-L	Bellevue	98006
96	-122.3989	47.6902	545107	5281827	86	7336/7596	450-L	Seattle	98117
98	-122.3396	47.6635	549582	5278894	66	6132	529-L	Seattle	98103
111	-122.4033	47.5780	544877	5269348	30	7107	959-L	Seattle	98116
113	-122.3900	47.5644	545889	5267852	94	7064	962-L	Seattle	98116
118	-122.6592	47.6780	525578	5280347	68	7446	504-L	Poulsbo	98370
143	-122.5630	47.7060	532783	5283502	33	7325	1502-L	Bainbridge Island	98110
144	-122.5079	47.6886	536929	5281589	20	7630	966-L	Bainbridge Island	98110
148	-122.1615	47.7213	562889	5285451	106	7442	485-L	Kirkland	98034
169	-122.1386	47.6681	564667	5279555	82	7283	461-L	Redmond	98052
181	-122.5682	47.8094	532332	5294982	59	7609	1496-L	Kingston	98346
182	-122.5844	47.8555	531091	5300106	15	7299/7296	457-L	Poulsbo	98370
183	-122.1503	47.5311	563961	5264318	221	7288	479-L	Newcastle	98059
186	-122.5479	47.6370	533960	5275833	63	7599	483-L	Bainbridge Island	98110
188	-122.5480	47.5750	533994	5268944	7	7431	644-L	Port Orchard	98366
189	-122.3709	47.8162	547098	5295848	25	7355	1487-L	Edmonds	98020

TABLE 2: GEOPHONE CALIBRATION RESULTS

(bold = bad calibrations due to clipped pulses)

calib.	statn	geoph	sensor	sensor	comp.	polarity						average of P+N			horizontal average		
date		owner	type	no.	L=N-S	P=pos		period	damp	Snstvty	0=no		damp	Snstvty	period	damp	Snstvty
ymmdd		Passcal			T=E-W	N=neg	Freq	(sec)	(%crit)	V/m/s	1=some	Freq	(%crit)	V/m/s	Freq	(%crit)	V/m/s
		USGS									2=lots						
20314	1	PSCL	L22	L765	V	P	1.969	0.508	0.761	92.9	2	1.966	0.762	92.7	1.966	0.762	92.7
20314	1	PSCL	L22	L765	V	N	1.963	0.509	0.763	92.6	2						
20314	1	PSCL	L22	L765	L	P	2.186	0.457	0.695	89.1	0	2.172	0.691	89.3	2.003	0.762	91.0
20314	1	PSCL	L22	L765	L	N	2.157	0.464	0.687	89.5	0						
20314	1	PSCL	L22	L765	T	P	1.817	0.550	0.837	92.6	2	1.835	0.832	92.7			
20314	1	PSCL	L22	L765	T	N	1.853	0.540	0.827	92.7	2						
20418	2	PSCL	L22	L484	V	P	2.104	0.475	0.773	93.6	0	2.073	0.751	92.0	2.073	0.751	92.0
20418	2	PSCL	L22	L484	V	N	2.041	0.490	0.729	90.4	0						
20418	2	PSCL	L22	L484	L	P	2.184	0.458	0.685	87.9	0	2.100	0.670	86.5	2.101	0.673	86.0
20418	2	PSCL	L22	L484	L	N	2.016	0.496	0.655	85.0	0						
20418	2	PSCL	L22	L484	T	P	2.178	0.459	0.693	87.3	0	2.102	0.676	85.6			
20418	2	PSCL	L22	L484	T	N	2.027	0.493	0.660	83.8	0						
20314	3	PSCL	L22	L963	V	P	2.016	0.496	0.756	92.3	0	2.077	0.788	95.3	2.077	0.788	95.3
20314	3	PSCL	L22	L963	V	N	2.138	0.468	0.820	98.4	1						
20314	3	PSCL	L22	L963	L	P	1.845	0.542	0.825	90.7	0	1.847	0.824	90.4	2.012	0.746	88.8
20314	3	PSCL	L22	L963	L	N	1.849	0.541	0.823	90.1	0						
20314	3	PSCL	L22	L963	T	P	2.245	0.445	0.689	88.5	0	2.176	0.668	87.1			
20314	3	PSCL	L22	L963	T	N	2.107	0.475	0.647	85.7	0						
20314	4	PSCL	L22	L1514	V	P	1.813	0.552	0.758	89.2	2	1.833	0.763	89.9	1.833	0.763	89.9
20314	4	PSCL	L22	L1514	V	N	1.853	0.540	0.768	90.6	2						
20314	4	PSCL	L22	L1514	L	P	2.071	0.483	0.668	91.4	2	2.170	0.682	93.6	2.058	0.728	93.4
20314	4	PSCL	L22	L1514	L	N	2.270	0.441	0.696	95.8	0						
20314	4	PSCL	L22	L1514	T	P	1.935	0.517	0.766	92.7	2	1.946	0.774	93.3			
20314	4	PSCL	L22	L1514	T	N	1.957	0.511	0.782	93.9	2						
20314	5	PSCL	L22	L736	V	P	1.982	0.505	0.707	89.8	0	1.963	0.703	89.4	1.963	0.703	89.4
20314	5	PSCL	L22	L736	V	N	1.944	0.514	0.699	89.0	1						

20314	5PSCL	L22	L736	L	P	2.145	0.466	0.859	99.0	0	2.080	0.834	96.9	1.899	0.859	93.4
20314	5PSCL	L22	L736	L	N	2.016	0.496	0.808	94.8	1						
20314	5PSCL	L22	L736	T	P	1.742	0.574	0.880	90.0	1	1.718	0.885	89.9			
20314	5PSCL	L22	L736	T	N	1.693	0.591	0.890	89.8	1						
20222	6PSCL	L22	L977	V	P	2.139	0.468	0.767	93.6	0	2.112	0.765	92.5	2.112	0.765	92.5
20222	6PSCL	L22	L977	V	N	2.085	0.480	0.762	91.4	0						
20222	6PSCL	L22	L977	L	P	2.136	0.468	0.776	93.2	0	2.094	0.778	92.9	2.063	0.748	90.4
20222	6PSCL	L22	L977	L	N	2.052	0.487	0.781	92.7	0						
20222	6PSCL	L22	L977	T	P	2.036	0.491	0.692	86.0	0	2.033	0.718	88.0			
20222	6PSCL	L22	L977	T	N	2.030	0.493	0.743	89.9	0						
20314	7PSCL	L22	L459	V	P	2.102	0.476	0.814	97.1	0	2.098	0.816	96.8	2.098	0.816	96.8
20314	7PSCL	L22	L459	V	N	2.093	0.478	0.819	96.6	0						
20314	7PSCL	L22	L459	L	P	1.847	0.541	0.802	90.1	0	1.905	0.789	89.6	1.948	0.760	89.0
20314	7PSCL	L22	L459	L	N	1.962	0.510	0.776	89.1	0						
20314	7PSCL	L22	L459	T	P	1.960	0.510	0.719	87.4	0	1.991	0.731	88.5			
20314	7PSCL	L22	L459	T	N	2.021	0.495	0.743	89.5	0						
20222	9PSCL	L22	L454	V	P	2.206	0.453	0.603	91.0	0	2.210	0.617	92.3	2.210	0.617	92.3
20222	9PSCL	L22	L454	V	N	2.214	0.452	0.631	93.7	2						
20222	9PSCL	L22	L454	L	P	1.689	0.592	0.805	88.4	2	1.600	0.788	85.5	1.823	0.728	88.1
20222	9PSCL	L22	L454	L	N	1.510	0.662	0.772	82.7	2						
20222	9PSCL	L22	L454	T	P	2.120	0.472	0.671	91.6	0	2.046	0.668	90.6			
20222	9PSCL	L22	L454	T	N	1.973	0.507	0.665	89.7	2						
20427	10PSCL	L22	L512	V	P	2.193	0.456	0.764	95.3	0	2.176	0.758	94.5	2.176	0.758	94.5
20427	10PSCL	L22	L512	V	N	2.160	0.463	0.752	93.8	0						
20427	10PSCL	L22	L512	L	P	1.546	0.647	0.810	83.5	2	1.632	0.809	84.8	1.853	0.776	88.0
20427	10PSCL	L22	L512	L	N	1.718	0.582	0.808	86.1	0						
20427	10PSCL	L22	L512	T	P	62.500	0.016	0.166	245.0	bad	2.075	0.743	91.3			
20427	10PSCL	L22	L512	T	N	2.075	0.482	0.743	91.3	0						
20427	10PSCL	L22	L512	V	P	2.211	0.452	0.764	95.3	0	2.213	0.763	95.5	2.213	0.763	95.5
20427	10PSCL	L22	L512	V	N	2.214	0.452	0.762	95.7	0						
20427	10PSCL	L22	L512	L	P	1.576	0.635	0.810	84.4	1	1.653	0.812	85.4	1.881	0.774	88.2
20427	10PSCL	L22	L512	L	N	1.731	0.578	0.813	86.4	0						

20427	10	PSCL	L22	L512	T	P	2.145	0.466	0.751	91.8	0	2.108	0.737	91.1			
20427	10	PSCL	L22	L512	T	N	2.072	0.483	0.723	90.3	0						
20314	11	PSCL	L22	L748	V	P	1.950	0.513	0.770	93.6	2	1.917	0.761	92.3	1.917	0.761	92.3
20314	11	PSCL	L22	L748	V	N	1.884	0.531	0.751	91.1	2						
20314	11	PSCL	L22	L748	L	P	2.117	0.472	0.706	93.6	1	2.205	0.713	94.4	2.037	0.730	92.3
20314	11	PSCL	L22	L748	L	N	2.293	0.436	0.720	95.2	0						
20314	11	PSCL	L22	L748	T	P	1.885	0.531	0.755	90.9	2	1.870	0.748	90.2			
20314	11	PSCL	L22	L748	T	N	1.855	0.539	0.740	89.5	2						
20222	12	USGS	L22	L533	V	P	2.100	0.476	0.819	54.4	0	2.083	0.819	54.2	2.083	0.819	54.2
20222	12	USGS	L22	L533	V	N	2.067	0.484	0.819	54.1	0						
20222	12	USGS	L22	L533	L	P	2.133	0.469	0.792	49.3	0	2.133	0.788	49.3	2.061	0.824	49.7
20222	12	USGS	L22	L533	L	N	2.133	0.469	0.785	49.3	0						
20222	12	USGS	L22	L533	T	P	2.025	0.494	0.842	49.7	0	1.990	0.860	50.2			
20222	12	USGS	L22	L533	T	N	1.955	0.512	0.879	50.7	0						
20222	13	USGS	L22	L527	V	P	2.232	0.448	0.891	56.2	0	2.203	0.867	55.1	2.203	0.867	55.1
20222	13	USGS	L22	L527	V	N	2.173	0.460	0.844	53.9	0						
20222	13	USGS	L22	L527	L	P	2.112	0.474	0.921	54.5	0	2.098	0.927	54.7	2.023	0.907	54.6
20222	13	USGS	L22	L527	L	N	2.084	0.480	0.933	54.8	0						
20222	13	USGS	L22	L527	T	P	1.943	0.515	0.892	54.6	0	1.948	0.886	54.4			
20222	13	USGS	L22	L527	T	N	1.952	0.512	0.880	54.3	0						
20314	14	PSCL	L22	L971	V	P	2.048	0.488	0.722	89.8	0	2.089	0.752	92.3	2.089	0.752	92.3
20314	14	PSCL	L22	L971	V	N	2.131	0.469	0.782	94.9	0						
20314	14	PSCL	L22	L971	L	P	1.961	0.510	0.791	89.6	0	1.913	0.777	88.7	1.830	0.797	87.7
20314	14	PSCL	L22	L971	L	N	1.866	0.536	0.764	87.8	0						
20314	14	PSCL	L22	L971	T	P	1.761	0.568	0.815	86.9	0	1.747	0.816	86.7			
20314	14	PSCL	L22	L971	T	N	1.734	0.577	0.818	86.4	0						
20222	15	PSCL	L22	L1503	V	P	1.946	0.514	0.811	94.3	2	1.940	0.793	93.4	1.940	0.793	93.4
20222	15	PSCL	L22	L1503	V	N	1.935	0.517	0.776	92.4	2						
20222	15	PSCL	L22	L1503	L	P	1.869	0.535	0.779	88.0	0	1.885	0.782	88.1	2.111	0.765	93.8
20222	15	PSCL	L22	L1503	L	N	1.901	0.526	0.785	88.2	0						
20222	15	PSCL	L22	L1503	T	P	2.404	0.416	0.734	99.1	0	2.338	0.748	99.6			
20222	15	PSCL	L22	L1503	T	N	2.272	0.440	0.763	100.1	1						

20314	16PSCL	L22	L471	V	P	2.149	0.465	0.685	89.3	0	2.152	0.694	90.3	2.152	0.694	90.3
20314	16PSCL	L22	L471	V	N	2.155	0.464	0.702	91.4	0						
20314	16PSCL	L22	L471	L	P	46.948	0.021	0.016	53.9	dead	45.404	0.071	64.0	2.439	0.563	84.0
20314	16PSCL	L22	L471	L	N	43.860	0.023	0.125	74.1	dead						
20314	16PSCL	L22	L471	T	P	2.473	0.404	0.562	83.5	0	2.439	0.563	84.0			
20314	16PSCL	L22	L471	T	N	2.404	0.416	0.564	84.5	0						
20314	16PSCL	L22	L471	V	P	2.208	0.453	0.696	90.9	0	2.177	0.694	90.6	2.177	0.694	90.6
20314	16PSCL	L22	L471	V	N	2.146	0.466	0.691	90.3	0						
20314	16PSCL	L22	L471	L	P	46.948	0.021	0.017	53.8	dead	46.201	0.061	64.2	2.440	0.553	83.0
20314	16PSCL	L22	L471	L	N	45.455	0.022	0.104	74.5	dead						
20314	16PSCL	L22	L471	T	P	2.481	0.403	0.553	82.8	0	2.440	0.553	83.0			
20314	16PSCL	L22	L471	T	N	2.398	0.417	0.552	83.1	0						
20222	18USGS	L22	L542	V	P	2.058	0.486	0.762	48.3	0	2.045	0.761	48.1	2.045	0.761	48.1
20222	18USGS	L22	L542	V	N	2.033	0.492	0.760	47.9	0						
20222	18USGS	L22	L542	L	P	2.027	0.493	0.809	51.4	0	2.001	0.821	51.6	1.983	0.811	51.1
20222	18USGS	L22	L542	L	N	1.976	0.506	0.832	51.8	0						
20222	18USGS	L22	L542	T	P	2.017	0.496	0.806	51.1	0	1.964	0.801	50.5			
20222	18USGS	L22	L542	T	N	1.912	0.523	0.795	49.9	0						
20418	19USGS	L22	L522(552)	V	P	1.999	0.500	0.818	51.0	0	2.004	0.818	52.4	2.004	0.818	52.4
20418	19USGS	L22	L522	V	N	2.010	0.498	0.818	53.8	0						
20418	19USGS	L22	L522	L	P	1.996	0.501	0.763	51.9	0	1.993	0.768	52.5	2.112	0.758	52.1
20418	19USGS	L22	L522	L	N	1.990	0.503	0.774	53.2	0						
20418	19USGS	L22	L522	T	P	2.247	0.445	0.751	52.0	0	2.230	0.748	51.7			
20418	19USGS	L22	L522	T	N	2.213	0.452	0.744	51.3	0						
20222	20USGS	L22	L541	V	P	2.261	0.442	0.844	55.6	0	2.259	0.856	56.0	2.259	0.856	56.0
20222	20USGS	L22	L541	V	N	2.257	0.443	0.869	56.4	0						
20222	20USGS	L22	L541	L	P	1.982	0.505	0.815	53.5	0	1.989	0.817	53.5	1.974	0.807	53.1
20222	20USGS	L22	L541	L	N	1.996	0.501	0.820	53.6	0						
20222	20USGS	L22	L541	T	P	1.962	0.510	0.802	52.8	0	1.959	0.796	52.6			
20222	20USGS	L22	L541	T	N	1.956	0.511	0.790	52.3	0						
20418	21PSCL	L22	L974	V	P	2.091	0.478	0.750	90.8	0	2.063	0.736	89.8	2.063	0.736	89.8

FIGURES

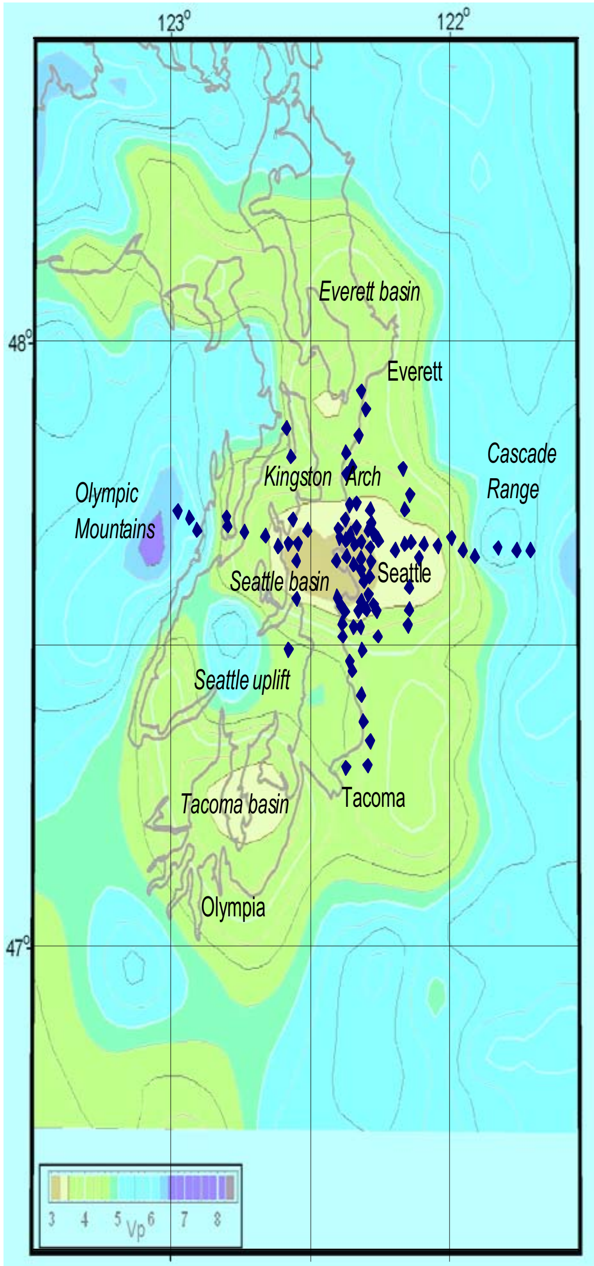

Figure 1: Stations locations superimposed on a tomography map. The colored background shows the speed of sound at 2.5 km depth derived from a regional tomographic study (VanWagoner et al., 2002). The blue dots are the locations of the Seattle SHIPS seismometer sites. The sites span the basin in both the north-south and east-west directions, and provide some 3-dimensional control over the basin.

20418	21	PSCL	L22	L974	V	N	2.035	0.492	0.722	88.7	0						
20418	21	PSCL	L22	L974	L	P	2.521	0.397	0.569	85.0	0	2.513	0.575	86.1	2.287	0.677	89.2
20418	21	PSCL	L22	L974	L	N	2.506	0.399	0.582	87.2	0						
20418	21	PSCL	L22	L974	T	P	2.107	0.475	0.779	92.4	0	2.062	0.778	92.3			
20418	21	PSCL	L22	L974	T	N	2.016	0.496	0.777	92.1	0						
20418	22	PSCL	L22	L728	V	P	1.957	0.511	0.717	89.4	0	1.926	0.705	88.3	1.926	0.705	88.3
20418	22	PSCL	L22	L728	V	N	1.896	0.527	0.693	87.1	0						
20418	22	PSCL	L22	L728	L	P	2.287	0.437	0.700	89.0	0	2.216	0.694	88.2	2.231	0.639	84.8
20418	22	PSCL	L22	L728	L	N	2.145	0.466	0.688	87.5	0						
20418	22	PSCL	L22	L728	T	P	2.285	0.438	0.579	80.4	0	2.245	0.583	81.4			
20418	22	PSCL	L22	L728	T	N	2.205	0.454	0.588	82.3	0						
20427	23	USGS	L22	L524	V	P	1.925	0.520	0.802	49.0	0	1.926	0.798	50.5	1.926	0.798	50.5
20427	23	USGS	L22	L524	V	N	1.928	0.519	0.794	52.0	0						
20427	23	USGS	L22	L524	L	P	-60.241	-0.017	0.000	55.9	bad	-0.180	0.000	56.4	2.107	0.736	50.6
20427	23	USGS	L22	L524	L	N	59.880	0.017	0.000	56.9	bad						
20427	23	USGS	L22	L524	T	P	1.981	0.505	0.781	50.8	0	2.107	0.736	50.6			
20427	23	USGS	L22	L524	T	N	2.234	0.448	0.691	50.3	0						
20528	25	USGS	L22	L526	V	P	1.963	0.510	0.786	49.5	0	1.938	0.787	49.1	1.938	0.787	49.1
20528	25	USGS	L22	L526	V	N	1.913	0.523	0.788	48.7	0						
20528	25	USGS	L22	L526	L	P	2.050	0.488	0.758	48.4	0	2.081	0.767	49.0	2.176	0.774	48.1
20528	25	USGS	L22	L526	L	N	2.111	0.474	0.776	49.5	0						
20528	25	USGS	L22	L526	T	P	2.325	0.430	0.788	47.8	0	2.270	0.781	47.2			
20528	25	USGS	L22	L526	T	N	2.216	0.451	0.775	46.7	0						
20314	27	PSCL	L22	L956	V	P	2.021	0.495	0.717	88.3	0	2.023	0.732	88.6	2.023	0.732	88.6
20314	27	PSCL	L22	L956	V	N	2.026	0.494	0.747	89.0	0						
20314	27	PSCL	L22	L956	L	P	47.619	0.021	0.062	73.8	dead	47.848	0.042	63.4	3.096	0.446	74.6
20314	27	PSCL	L22	L956	L	N	48.077	0.021	0.022	53.0	dead						
20314	27	PSCL	L22	L956	T	P	3.074	0.325	0.446	66.6	0	3.096	0.446	74.6			
20314	27	PSCL	L22	L956	T	N	3.117	0.321	0.447	82.7	0						
20528	28	USGS	L22	L531	V	P	1.997	0.501	0.739	44.9	0	1.985	0.727	44.2	1.985	0.727	44.2
20528	28	USGS	L22	L531	V	N	1.973	0.507	0.715	43.5	0						
20528	28	USGS	L22	L531	L	P	1.895	0.528	0.789	50.7	0	1.911	0.792	50.8	1.965	0.790	50.6

20528	28USGS	L22	L531	L	N	1.928	0.519	0.794	51.0		0						
20528	28USGS	L22	L531	T	P	1.981	0.505	0.781	49.8		0	2.018	0.789	50.4			
20528	28USGS	L22	L531	T	N	2.056	0.487	0.797	51.1		0						
20314	29PSCL	L22	L746	V	P	1.974	0.507	0.716	91.3		2	1.976	0.715	91.0	1.976	0.715	91.0
20314	29PSCL	L22	L746	V	N	1.977	0.506	0.714	90.7		1						
20314	29PSCL	L22	L746	L	P	2.914	0.343	0.512	88.6		0	2.944	0.521	90.5	2.944	0.521	90.5
20314	29PSCL	L22	L746	L	N	2.974	0.336	0.530	92.4		0						
20314	29PSCL	L22	L746	T	P	60.241	0.017	0.109	97.9	dead		50.120	0.067	79.2			
20314	29PSCL	L22	L746	T	N	40.000	0.025	0.025	60.6	dead							
20528	30USGS	L22	L538	V	P	2.238	0.447	0.786	50.7		0	2.232	0.789	50.6	2.232	0.789	50.6
20528	30USGS	L22	L538	V	N	2.226	0.449	0.793	50.5		0						
20528	30USGS	L22	L538	L	P	2.591	0.386	0.703	51.4		0	2.561	0.701	51.3	2.283	0.716	46.0
20528	30USGS	L22	L538	L	N	2.531	0.395	0.699	51.2		0						
20528	30USGS	L22	L538	T	P	2.005	0.499	0.730	40.8		0	2.005	0.730	40.8			
20528	30USGS	L22	L538	T	N	47.393	0.021	1.171	230.2	bad							
20528	31USGS	L22	L535	V	P	1.920	0.521	0.825	50.0		0	1.938	0.823	50.2	1.938	0.823	50.2
20528	31USGS	L22	L535	V	N	1.957	0.511	0.821	50.5		0						
20528	31USGS	L22	L535	L	P	2.024	0.494	0.778	50.5		0	1.994	0.782	50.6	2.004	0.788	50.3
20528	31USGS	L22	L535	L	N	1.964	0.509	0.786	50.7		0						
20528	31USGS	L22	L535	T	P	2.025	0.494	0.794	49.8		0	2.014	0.795	50.1			
20528	31USGS	L22	L535	T	N	2.003	0.499	0.795	50.3		0						
20314	32PSCL	L22	L724	V	P	1.860	0.538	0.715	88.2		2	1.874	0.727	89.0	1.874	0.727	89.0
20314	32PSCL	L22	L724	V	N	1.889	0.530	0.740	89.8		1						
20314	32PSCL	L22	L724	L	P	2.424	0.413	0.634	90.8	noisy		13.005	0.762	218.9			
20314	32PSCL	L22	L724	L	N	23.585	0.042	0.889	347.1	dead							
20314	32PSCL	L22	L724	T	P	23.585	0.042	0.699	295.6	dead		13.120	0.610	192.1			
20314	32PSCL	L22	L724	T	N	2.655	0.377	0.522	88.6	noisy							
20314	33PSCL	L22	L448	V	P	2.077	0.482	0.658	86.1		0	2.066	0.660	86.5	2.066	0.660	86.5
20314	33PSCL	L22	L448	V	N	2.055	0.487	0.663	86.9		0						
20314	33PSCL	L22	L448	L	P	2.455	0.407	0.578	83.7		0	2.439	0.581	84.3	2.518	0.557	83.9
20314	33PSCL	L22	L448	L	N	2.422	0.413	0.583	84.9		0						
20314	33PSCL	L22	L448	T	P	2.591	0.386	0.527	81.9		0	2.596	0.534	83.4			

20314	33	PSCL	L22	L448	T	N	2.601	0.384	0.542	84.9	0						
20314	34	PSCL	L22	L967	V	P	2.097	0.477	0.768	95.1	0	2.104	0.778	95.3	2.104	0.778	95.3
20314	34	PSCL	L22	L967	V	N	2.110	0.474	0.788	95.6	0						
20314	34	PSCL	L22	L967	L	P	2.438	0.410	0.678	91.9	0	2.424	0.668	92.3	2.399	0.663	90.9
20314	34	PSCL	L22	L967	L	N	2.409	0.415	0.657	92.7	0						
20314	34	PSCL	L22	L967	T	P	2.402	0.416	0.668	89.7	0	2.374	0.657	89.6			
20314	34	PSCL	L22	L967	T	N	2.347	0.426	0.646	89.4	0						
20314	35	PSCL	L22	L953	V	P	2.023	0.494	0.736	90.7	0	2.053	0.760	92.9	2.053	0.760	92.9
20314	35	PSCL	L22	L953	V	N	2.082	0.480	0.784	95.1	0						
20314	35	PSCL	L22	L953	L	P	1.816	0.551	0.785	87.9	0	1.830	0.786	88.1	1.881	0.770	88.2
20314	35	PSCL	L22	L953	L	N	1.844	0.542	0.787	88.2	0						
20314	35	PSCL	L22	L953	T	P	1.895	0.528	0.761	88.7	0	1.932	0.755	88.4			
20314	35	PSCL	L22	L953	T	N	1.970	0.508	0.749	88.1	0						
20314	36	PSCL	L22	L458	V	P	2.178	0.459	0.621	84.6	0	2.147	0.619	84.5	2.147	0.619	84.5
20314	36	PSCL	L22	L458	V	N	2.116	0.473	0.617	84.5	0						
20314	36	PSCL	L22	L458	L	P	2.030	0.493	0.748	90.3	0	1.996	0.753	90.8	2.204	0.672	88.6
20314	36	PSCL	L22	L458	L	N	1.962	0.510	0.757	91.3	0						
20314	36	PSCL	L22	L458	T	P	2.422	0.413	0.585	85.7	0	2.412	0.590	86.4			
20314	36	PSCL	L22	L458	T	N	2.402	0.416	0.596	87.1	0						
20528	37	PSCL	L22	L462	V	P	2.046	0.489	0.732	93.6	2	2.019	0.733	93.4	2.019	0.733	93.4
20528	37	PSCL	L22	L462	V	N	1.992	0.502	0.734	93.2	2						
20528	37	PSCL	L22	L462	L	P	2.192	0.456	0.746	94.1	0	2.124	0.756	94.2	2.055	0.755	93.4
20528	37	PSCL	L22	L462	L	N	2.056	0.486	0.765	94.3	1						
20528	37	PSCL	L22	L462	T	P	2.008	0.498	0.752	92.6	0	1.986	0.754	92.6			
20528	37	PSCL	L22	L462	T	N	1.965	0.509	0.755	92.6	1						
20314	38	PSCL	L22	L507	V	P	2.251	0.444	0.749	93.4	0	2.212	0.739	92.7	2.212	0.739	92.7
20314	38	PSCL	L22	L507	V	N	2.173	0.460	0.729	92.0	0						
20314	38	PSCL	L22	L507	L	P	2.007	0.498	0.855	95.1	0	1.861	0.834	91.6	2.089	0.727	89.2
20314	38	PSCL	L22	L507	L	N	1.715	0.583	0.812	88.2	1						
20314	38	PSCL	L22	L507	T	P	2.329	0.429	0.610	85.2	0	2.316	0.620	86.7			
20314	38	PSCL	L22	L507	T	N	2.303	0.434	0.631	88.2	0						

20402	39PSCL	L22	L742	V	P	1.925	0.520	0.739	90.8	1	1.926	0.743	91.3	1.926	0.743	91.3
20402	39PSCL	L22	L742	V	N	1.926	0.519	0.747	91.7	1						
20402	39PSCL	L22	L742	L	P	2.217	0.451	0.608	85.3	0	2.148	0.609	85.7	2.000	0.672	87.5
20402	39PSCL	L22	L742	L	N	2.079	0.481	0.611	86.1	0						
20402	39PSCL	L22	L742	T	P	1.891	0.529	0.746	90.3	2	1.853	0.735	89.3			
20402	39PSCL	L22	L742	T	N	1.816	0.551	0.725	88.2	2						
20418	40PSCL	L22	L491	V	P	2.041	0.490	0.771	93.3	0	2.037	0.768	92.8	2.037	0.768	92.8
20418	40PSCL	L22	L491	V	N	2.033	0.492	0.766	92.3	0						
20418	40PSCL	L22	L491	L	P	2.015	0.496	0.762	87.2	0	1.937	0.760	86.0	2.053	0.729	88.2
20418	40PSCL	L22	L491	L	N	1.860	0.538	0.757	84.9	0						
20418	40PSCL	L22	L491	T	P	2.288	0.437	0.716	92.5	0	2.169	0.698	90.3			
20418	40PSCL	L22	L491	T	N	2.050	0.488	0.679	88.1	0						
20402	41PSCL	L22	L747	V	P	1.934	0.517	0.635	50.3	1	2.015	0.709	73.0	2.015	0.709	73.0
20402	41PSCL	L22	L747	V	N	2.096	0.477	0.782	95.7	1						
20402	41PSCL	L22	L747	L	P	2.151	0.465	0.832	99.8	1	2.015	0.820	96.2	1.917	0.812	93.2
20402	41PSCL	L22	L747	L	N	1.880	0.532	0.808	92.5	2						
20402	41PSCL	L22	L747	T	P	1.748	0.572	0.824	91.2	0	1.819	0.804	90.2			
20402	41PSCL	L22	L747	T	N	1.890	0.529	0.784	89.2	0						
20402	41PSCL	L22	L747	V	P	2.101	0.476	0.781	95.9	1	2.121	0.794	97.2	2.121	0.794	97.2
20402	41PSCL	L22	L747	V	N	2.141	0.467	0.806	98.5	1						
20402	41PSCL	L22	L747	L	P	1.859	0.538	0.795	91.3	1	1.787	0.801	90.4	1.843	0.792	89.7
20402	41PSCL	L22	L747	L	N	1.715	0.583	0.806	89.4	2						
20402	41PSCL	L22	L747	T	P	1.887	0.530	0.795	89.5	0	1.899	0.784	89.1			
20402	41PSCL	L22	L747	T	N	1.912	0.523	0.772	88.6	0						
20402	42PSCL	L22	L643	V	P	2.160	0.463	0.768	96.6	1	2.130	0.770	96.4	2.130	0.770	96.4
20402	42PSCL	L22	L643	V	N	2.101	0.476	0.771	96.2	1						
20402	42PSCL	L22	L643	L	P	2.564	0.390	0.657	96.0	0	2.496	0.659	95.8	2.148	0.725	90.9
20402	42PSCL	L22	L643	L	N	2.427	0.412	0.660	95.5	0						
20402	42PSCL	L22	L643	T	P	1.618	0.618	0.806	84.6	0	1.801	0.792	86.1			
20402	42PSCL	L22	L643	T	N	1.984	0.504	0.777	87.6	0						
20402	42PSCL	L22	L643	V	P	2.151	0.465	0.748	95.4	0	2.108	0.748	94.8	2.108	0.748	94.8
20402	42PSCL	L22	L643	V	N	2.066	0.484	0.747	94.2	1						

20402	42	PSCL	L22	L643	L	P	2.500	0.400	0.642	93.7	0	2.485	0.666	95.7	2.160	0.737	91.7
20402	42	PSCL	L22	L643	L	N	2.469	0.405	0.690	97.6	0						
20402	42	PSCL	L22	L643	T	P	1.656	0.604	0.826	86.3	1	1.836	0.809	87.7			
20402	42	PSCL	L22	L643	T	N	2.016	0.496	0.791	89.1	0						
20402	43	PSCL	L22	L463	V	P	1.913	0.523	0.799	93.5	2	1.908	0.795	93.1	1.908	0.795	93.1
20402	43	PSCL	L22	L463	V	N	1.904	0.525	0.791	92.7	2						
20402	43	PSCL	L22	L463	L	P	2.258	0.443	0.626	84.2	0	2.196	0.630	84.9	2.058	0.724	88.9
20402	43	PSCL	L22	L463	L	N	2.133	0.469	0.635	85.6	0						
20402	43	PSCL	L22	L463	T	P	1.924	0.520	0.804	92.3	1	1.920	0.818	92.9			
20402	43	PSCL	L22	L463	T	N	1.916	0.522	0.832	93.6	1						
20402	44	PSCL	L22	L1486	V	P	2.013	0.497	0.739	92.5	1	1.993	0.739	92.3	1.993	0.739	92.3
20402	44	PSCL	L22	L1486	V	N	1.974	0.507	0.739	92.1	2						
20402	44	PSCL	L22	L1486	L	P	1.955	0.512	0.756	91.8	1	1.932	0.768	91.9	1.796	0.773	89.0
20402	44	PSCL	L22	L1486	L	N	1.910	0.524	0.780	92.0	1						
20402	44	PSCL	L22	L1486	T	P	1.595	0.627	0.776	84.7	2	1.661	0.778	86.1			
20402	44	PSCL	L22	L1486	T	N	1.727	0.579	0.780	87.5	2						
20402	45	PSCL	L22	L640	V	P	2.007	0.498	0.797	95.8	2	2.009	0.793	95.5	2.009	0.793	95.5
20402	45	PSCL	L22	L640	V	N	2.011	0.497	0.788	95.1	2						
20402	45	PSCL	L22	L640	L	P	2.101	0.476	0.767	94.8	1	1.978	0.760	92.6	1.886	0.809	92.9
20402	45	PSCL	L22	L640	L	N	1.855	0.539	0.753	90.5	2						
20402	45	PSCL	L22	L640	T	P	1.845	0.542	0.860	94.3	2	1.794	0.859	93.1			
20402	45	PSCL	L22	L640	T	N	1.742	0.574	0.858	91.9	2						
20227	46	PSCL	L22	L949	V	P	2.078	0.481	0.749	93.4	0	2.070	0.752	93.4	2.070	0.752	93.4
20227	46	PSCL	L22	L949	V	N	2.063	0.485	0.755	93.5	0						
20227	46	PSCL	L22	L949	L	P	2.035	0.491	0.763	92.3	0	2.014	0.752	91.1	1.952	0.764	89.6
20227	46	PSCL	L22	L949	L	N	1.992	0.502	0.741	90.0	0						
20227	46	PSCL	L22	L949	T	P	1.820	0.549	0.784	88.5	0	1.891	0.775	88.1			
20227	46	PSCL	L22	L949	T	N	1.961	0.510	0.766	87.8	0						
20314	50	PSCL	L22	L1508	V	P	2.172	0.461	0.767	97.0	1	2.160	0.771	97.4	2.160	0.771	97.4
20314	50	PSCL	L22	L1508	V	N	2.148	0.466	0.776	97.7	1						
20314	50	PSCL	L22	L1508	L	P	2.277	0.439	0.663	88.2	0	2.188	0.652	87.0	2.167	0.694	90.0
20314	50	PSCL	L22	L1508	L	N	2.099	0.476	0.641	85.8	0						

20314	50	PSCL	L22	L1508	T	P	2.226	0.449	0.755	95.0	0	2.146	0.736	93.0		
20314	50	PSCL	L22	L1508	T	N	2.066	0.484	0.717	91.1	0					
20528	51	USGS	L22	L537	V	P	1.993	0.502	0.840	51.5	0	2.000	0.845	51.6	2.000	0.845	51.6
20528	51	USGS	L22	L537	V	N	2.007	0.498	0.850	51.8	0						
20528	51	USGS	L22	L537	L	P	2.093	0.478	0.773	50.1	0	2.073	0.772	50.0	1.915	0.782	50.2
20528	51	USGS	L22	L537	L	N	2.053	0.487	0.772	49.8	0						
20528	51	USGS	L22	L537	T	P	1.700	0.588	0.795	50.5	0	1.757	0.791	50.5			
20528	51	USGS	L22	L537	T	N	1.814	0.551	0.787	50.5	0						
20314	52	PSCL	L22	L957	V	P	2.070	0.483	0.719	89.6	0	2.112	0.746	91.9	2.112	0.746	91.9
20314	52	PSCL	L22	L957	V	N	2.154	0.464	0.772	94.2	0						
20314	52	PSCL	L22	L957	L	P	2.060	0.486	0.753	93.8	0	2.091	0.741	93.2	1.973	0.780	92.3
20314	52	PSCL	L22	L957	L	N	2.121	0.471	0.729	92.6	0						
20314	52	PSCL	L22	L957	T	P	1.842	0.543	0.815	91.2	1	1.856	0.819	91.4			
20314	52	PSCL	L22	L957	T	N	1.871	0.535	0.824	91.6	0						
20528	53	PSCL	L22	L968	V	P	2.074	0.482	0.745	92.5	0	2.069	0.749	92.0	2.069	0.749	92.0
20528	53	PSCL	L22	L968	V	N	2.063	0.485	0.752	91.6	0						
20528	53	PSCL	L22	L968	L	P	2.186	0.457	0.835	99.1	0	2.192	0.828	98.5	1.827	0.918	93.1
20528	53	PSCL	L22	L968	L	N	2.198	0.455	0.822	97.9	0						
20528	53	PSCL	L22	L968	T	P	1.332	0.751	1.015	84.7	2	1.463	1.008	87.6			
20528	53	PSCL	L22	L968	T	N	1.593	0.628	1.002	90.6	2						
20418	54	USGS	L22	L523	V	P	2.253	0.444	0.769	51.5	0	2.285	0.782	52.2	2.285	0.782	52.2
20418	54	USGS	L22	L523	V	N	2.316	0.432	0.794	52.9	0						
20418	54	USGS	L22	L523	L	P	2.028	0.493	0.771	50.9	0	2.038	0.770	50.8	2.061	0.787	51.0
20418	54	USGS	L22	L523	L	N	2.048	0.488	0.768	50.8	0						
20418	54	USGS	L22	L523	T	P	2.055	0.487	0.789	50.4	0	2.083	0.804	51.2			
20418	54	USGS	L22	L523	T	N	2.112	0.474	0.820	52.0	0						
20528	56	USGS	L22	L536	V	P	1.958	0.511	0.799	51.1	0	1.962	0.803	51.2	1.962	0.803	51.2
20528	56	USGS	L22	L536	V	N	1.966	0.509	0.808	51.4	0						
20528	56	USGS	L22	L536	L	P	1.825	0.548	0.834	49.4	0	1.819	0.834	49.5	1.916	0.798	49.6
20528	56	USGS	L22	L536	L	N	1.813	0.552	0.835	49.5	0						
20528	56	USGS	L22	L536	T	P	2.031	0.492	0.770	50.1	0	2.012	0.762	49.7			
20528	56	USGS	L22	L536	T	N	1.993	0.502	0.755	49.3	0						

20314	57PSCL	L22	L951	V	P	2.061	0.485	0.770	92.3	0	2.037	0.754	91.0	2.037	0.754	91.0
20314	57PSCL	L22	L951	V	N	2.013	0.497	0.738	89.7	0						
20314	57PSCL	L22	L951	L	P	2.508	0.399	0.533	84.2	0	2.492	0.547	85.7	2.189	0.656	86.2
20314	57PSCL	L22	L951	L	N	2.477	0.404	0.560	87.1	0						
20314	57PSCL	L22	L951	T	P	1.960	0.510	0.758	86.4	0	1.885	0.766	86.8			
20314	57PSCL	L22	L951	T	N	1.811	0.552	0.773	87.1	0						
20314	58PSCL	L22	L493	V	P	2.107	0.475	0.890	83.6	0	2.123	0.899	83.6	2.123	0.899	83.6
20314	58PSCL	L22	L493	V	N	2.139	0.468	0.907	83.7	0						
20314	58PSCL	L22	L493	L	P	1.742	0.574	0.814	90.1	1	1.806	0.792	90.0	2.270	0.661	88.1
20314	58PSCL	L22	L493	L	N	1.869	0.535	0.770	90.0	0						
20314	58PSCL	L22	L493	T	P	2.765	0.362	0.527	85.6	0	2.734	0.530	86.1			
20314	58PSCL	L22	L493	T	N	2.703	0.370	0.532	86.7	0						
20427	59PSCL	L22	L528	V	P	2.081	0.481	0.835	51.7	0	2.083	0.825	51.6	2.083	0.825	51.6
20427	59PSCL	L22	L528	V	N	2.085	0.480	0.815	51.5	0						
20427	59PSCL	L22	L528	L	P	2.000	0.500	0.975	66.0	0	1.964	0.959	65.3	2.071	0.901	58.5
20427	59PSCL	L22	L528	L	N	1.928	0.519	0.944	64.5	0						
20427	59PSCL	L22	L528	T	P	2.173	0.460	0.834	51.6	0	2.178	0.842	51.8			
20427	59PSCL	L22	L528	T	N	2.182	0.458	0.850	52.1	0						
20314	60PSCL	L22	L733	V	P	1.839	0.544	0.752	89.9	2	1.840	0.742	89.3	1.840	0.742	89.3
20314	60PSCL	L22	L733	V	N	1.842	0.543	0.732	88.7	2						
20314	60PSCL	L22	L733	L	P	1.888	0.530	0.761	90.3	0	1.855	0.763	89.9	2.029	0.696	90.3
20314	60PSCL	L22	L733	L	N	1.822	0.549	0.764	89.5	1						
20314	60PSCL	L22	L733	T	P	2.236	0.447	0.621	89.6	2	2.204	0.629	90.6			
20314	60PSCL	L22	L733	T	N	2.171	0.461	0.637	91.7	2						
20212	61PSCL	L22	L950	V	P	2.051	0.488	0.755	91.0	0	2.057	0.762	91.5	2.057	0.762	91.5
20212	61PSCL	L22	L950	V	N	2.062	0.485	0.770	91.9	0						
20212	61PSCL	L22	L950	L	P	1.973	0.507	0.795	92.3	0	1.974	0.786	92.0	2.072	0.733	90.9
20212	61PSCL	L22	L950	L	N	1.974	0.507	0.777	91.8	0						
20212	61PSCL	L22	L950	T	P	2.161	0.463	0.663	87.9	0	2.170	0.680	89.7			
20212	61PSCL	L22	L950	T	N	2.180	0.459	0.697	91.6	0						
20314	62PSCL	L22	L743	V	P	1.988	0.503	0.727	91.2	0	1.951	0.718	90.2	1.951	0.718	90.2

20314	62	PSCL	L22	L743	V	N	1.914	0.523	0.710	89.1	1						
20314	62	PSCL	L22	L743	L	P	1.664	0.601	0.827	88.7	2	1.821	0.840	92.1	1.805	0.817	91.0
20314	62	PSCL	L22	L743	L	N	1.978	0.506	0.852	95.4	0						
20314	62	PSCL	L22	L743	T	P	1.802	0.555	0.784	89.5	2	1.790	0.794	90.0			
20314	62	PSCL	L22	L743	T	N	1.777	0.563	0.803	90.5	2						
20222	63	USGS	L22	L539	V	P	2.023	0.494	0.812	51.2	0	2.048	0.822	51.8	2.048	0.822	51.8
20222	63	USGS	L22	L539	V	N	2.074	0.482	0.833	52.3	0						
20222	63	USGS	L22	L539	L	P	2.081	0.481	0.831	52.6	0	2.082	0.818	52.2	2.056	0.799	50.7
20222	63	USGS	L22	L539	L	N	2.082	0.480	0.806	51.9	0						
20222	63	USGS	L22	L539	T	P	2.032	0.492	0.789	49.6	0	2.030	0.780	49.3			
20222	63	USGS	L22	L539	T	N	2.027	0.493	0.772	48.9	0						
20418	64	PSCL	L22	L465	V	P	2.304	0.434	0.667	88.5	0	2.268	0.650	87.7	2.268	0.650	87.7
20418	64	PSCL	L22	L465	V	N	2.232	0.448	0.633	86.8	0						
20418	64	PSCL	L22	L465	L	P	1.938	0.516	0.773	90.2	0	1.928	0.787	91.3	1.928	0.802	91.6
20418	64	PSCL	L22	L465	L	N	1.919	0.521	0.801	92.3	1						
20418	64	PSCL	L22	L465	T	P	1.977	0.506	0.805	91.7	0	1.927	0.817	91.9			
20418	64	PSCL	L22	L465	T	N	1.877	0.533	0.829	92.0	0						
20418	65	PSCL	L22	L722	V	P	1.906	0.525	0.737	88.2	0	1.925	0.756	89.9	1.925	0.756	89.9
20418	65	PSCL	L22	L722	V	N	1.944	0.514	0.775	91.5	0						
20418	65	PSCL	L22	L722	L	P	1.675	0.597	0.839	90.1	2	1.817	0.863	93.9	1.979	0.807	95.1
20418	65	PSCL	L22	L722	L	N	1.959	0.510	0.887	97.7	1						
20418	65	PSCL	L22	L722	T	P	2.114	0.473	0.775	98.0	1	2.142	0.751	96.3			
20418	65	PSCL	L22	L722	T	N	2.169	0.461	0.727	94.5	0						
20418	66	PSCL	L22	L861 (961)	V	P	1.975	0.506	0.769	92.6	1	2.010	0.790	94.2	2.010	0.790	94.2
20418	66	PSCL	L22	L861 (961)	V	N	2.046	0.489	0.810	95.8	1						
20418	66	PSCL	L22	L861 (961)	L	P	1.931	0.518	0.761	92.5	1	2.064	0.785	96.1	2.033	0.784	95.2
20418	66	PSCL	L22	L861 (961)	L	N	2.197	0.455	0.809	99.6	1						
20418	66	PSCL	L22	L861 (961)	T	P	2.053	0.487	0.778	94.7	1	2.002	0.782	94.3			
20418	66	PSCL	L22	L861 (961)	T	N	1.952	0.512	0.787	93.8	1						
20418	67	PSCL	L22	L727	V	P	1.954	0.512	0.734	90.6	0	1.943	0.735	90.3	1.943	0.735	90.3
20418	67	PSCL	L22	L727	V	N	1.932	0.518	0.735	90.0	1						
20418	67	PSCL	L22	L727	L	P	1.739	0.575	0.766	86.5	1	1.746	0.785	87.9	1.910	0.800	85.6

20418	67PSCL	L22	L727	L	N	1.754	0.570	0.804	89.2	1						
20418	67PSCL	L22	L727	T	P	2.057	0.486	0.858	85.5	0	2.074	0.815	83.3			
20418	67PSCL	L22	L727	T	N	2.090	0.478	0.772	81.0	0						
20418	68PSCL	L22	L975	V	P	1.985	0.504	0.685	83.9	0	1.985	0.687	83.7	1.985	0.687	83.7
20418	68PSCL	L22	L975	V	N	1.985	0.504	0.688	83.5	0						
20418	68PSCL	L22	L975	L	P	2.498	0.400	0.532	79.0	0	2.517	0.544	80.5	2.247	0.634	83.4
20418	68PSCL	L22	L975	L	N	2.537	0.394	0.557	81.9	0						
20418	68PSCL	L22	L975	T	P	1.984	0.504	0.730	86.3	0	1.977	0.723	86.3			
20418	68PSCL	L22	L975	T	N	1.971	0.507	0.717	86.3	0						
20402	71PSCL	L22	L1506	V	P	2.358	0.424	0.787	101.4	0	2.334	0.787	101.2	2.334	0.787	101.2
20402	71PSCL	L22	L1506	V	N	2.309	0.433	0.787	100.9	1						
20402	71PSCL	L22	L1506	L	P	2.577	0.388	0.629	92.7	0	2.558	0.634	93.6	2.248	0.718	93.4
20402	71PSCL	L22	L1506	L	N	2.538	0.394	0.639	94.5	0						
20402	71PSCL	L22	L1506	T	P	1.949	0.513	0.803	93.5	1	1.938	0.803	93.2			
20402	71PSCL	L22	L1506	T	N	1.927	0.519	0.802	92.9	1						
20402	71PSCL	L22	L1506	V	P	2.353	0.425	0.776	100.8	1	2.331	0.768	100.3	2.331	0.768	100.3
20402	71PSCL	L22	L1506	V	N	2.309	0.433	0.759	99.7	1						
20402	71PSCL	L22	L1506	L	P	2.551	0.392	0.622	91.8	0	2.522	0.625	92.5	2.248	0.722	93.8
20402	71PSCL	L22	L1506	L	N	2.494	0.401	0.628	93.1	0						
20402	71PSCL	L22	L1506	T	P	1.992	0.502	0.825	95.8	1	1.974	0.818	95.1			
20402	71PSCL	L22	L1506	T	N	1.957	0.511	0.811	94.4	1						
20427	74PSCL	L22	L1490	V	P	2.013	0.497	0.748	93.2	1	2.025	0.757	94.0	2.025	0.757	94.0
20427	74PSCL	L22	L1490	V	N	2.037	0.491	0.766	94.7	0						
20427	74PSCL	L22	L1490	L	P	2.232	0.448	0.662	90.0	0	2.194	0.685	91.9	2.208	0.713	92.9
20427	74PSCL	L22	L1490	L	N	2.155	0.464	0.707	93.8	0						
20427	74PSCL	L22	L1490	T	P	2.150	0.465	0752	94.8	0	2.223	0.742	94.0			
20427	74PSCL	L22	L1490	T	N	2.295	0.436	0.732	93.1	0						
30729	74PSCL	L22	L1490	V	P	2.078	0.481	0.794	96.9	1	2.036	0.771	94.8	2.036	0.771	94.8
30729	74PSCL	L22	L1490	V	N	1.994	0.501	0.748	92.7	1						
30729	74PSCL	L22	L1490	L	P	2.273	0.440	0.696	92.6	0	2.192	0.692	92.2	2.180	0.704	91.9
30729	74PSCL	L22	L1490	L	N	2.111	0.474	0.689	91.8	1						
30729	74PSCL	L22	L1490	T	P	2.099	0.477	0.734	93.0	0	2.169	0.715	91.7			

30729	74PSCL	L22	L1490	T	N	2.239	0.447	0.696	90.4		0						
20418	75PSCL	L22	L498	V	P	1.143	0.875	0.031	11.1	bad		1.574	0.399	50.6			
20418	75PSCL	L22	L498	V	N	2.004	0.499	0.767	90.0	bad							
20418	75PSCL	L22	L498	L	P	1.965	0.509	0.754	88.4		0	1.910	0.735	86.7	1.841	0.780	87.7
20418	75PSCL	L22	L498	L	N	1.855	0.539	0.715	85.0		0						
20418	75PSCL	L22	L498	T	P	1.695	0.590	0.805	86.9		1	1.772	0.826	88.7			
20418	75PSCL	L22	L498	T	N	1.848	0.541	0.846	90.5		0						
30729	75PSCL	L22	L498	V	P	10.753	0.093	0.283	83.2	bad		5.948	0.157	47.1			
30729	75PSCL	L22	L498	V	N	1.143	0.875	0.031	11.1	bad							
30729	75PSCL	L22	L498	L	P	2.004	0.499	0.767	90.0		0	1.961	0.763	89.3	1.850	0.782	88.1
30729	75PSCL	L22	L498	L	N	1.918	0.521	0.758	88.6		0						
30729	75PSCL	L22	L498	T	P	1.672	0.598	0.804	86.1		1	1.739	0.802	86.8			
30729	75PSCL	L22	L498	T	N	1.807	0.553	0.800	87.6		0						
20418	76PSCL	L22	L495	V	P	2.042	0.490	0.699	90.3		0	2.015	0.709	90.7	2.015	0.709	90.7
20418	76PSCL	L22	L495	V	N	1.987	0.503	0.720	91.1		1						
20418	76PSCL	L22	L495	L	P	2.074	0.482	0.756	92.2		0	2.002	0.749	91.5	2.072	0.758	94.2
20418	76PSCL	L22	L495	L	N	1.929	0.518	0.743	90.8		1						
20418	76PSCL	L22	L495	T	P	2.276	0.439	0.796	100.4		1	2.142	0.766	96.9			
20418	76PSCL	L22	L495	T	N	2.008	0.498	0.737	93.3		2						
20227	77PSCL	L22	L497	V	P	2.097	0.477	0.791	93.5		0	2.079	0.789	93.5	2.079	0.789	93.5
20227	77PSCL	L22	L497	V	N	2.060	0.485	0.787	93.6		0						
20227	77PSCL	L22	L497	L	P	2.126	0.470	0.768	89.2		0	2.108	0.801	91.2	2.079	0.803	92.2
20227	77PSCL	L22	L497	L	N	2.090	0.479	0.833	93.2		0						
20227	77PSCL	L22	L497	T	P	2.109	0.474	0.797	92.9		0	2.050	0.806	93.3			
20227	77PSCL	L22	L497	T	N	1.990	0.502	0.816	93.7		0						
20227	79PSCL	L22	L451	V	P	2.139	0.467	0.672	86.4		0	2.129	0.685	87.6	2.129	0.685	87.6
20227	79PSCL	L22	L451	V	N	2.119	0.472	0.698	88.7		0						
20227	79PSCL	L22	L451	L	P	2.332	0.429	0.620	86.4		0	2.325	0.643	88.7	2.171	0.693	87.8
20227	79PSCL	L22	L451	L	N	2.317	0.432	0.666	91.1		0						
20227	79PSCL	L22	L451	T	P	2.107	0.475	0.745	87.6		0	2.018	0.743	86.9			
20227	79PSCL	L22	L451	T	N	1.929	0.518	0.741	86.3		0						

20227	80 PSCL	L22	L1499	V	P	2.017	0.496	0.750	93.3	1	2.056	0.762	94.7	2.056	0.762	94.7
20227	80 PSCL	L22	L1499	V	N	2.094	0.478	0.774	96.2	1						
20227	80 PSCL	L22	L1499	L	P	2.307	0.434	0.697	94.6	0	2.258	0.714	95.4	2.217	0.759	97.2
20227	80 PSCL	L22	L1499	L	N	2.209	0.453	0.732	96.3	1						
20227	80 PSCL	L22	L1499	T	P	2.181	0.459	0.820	100.0	1	2.176	0.804	99.0			
20227	80 PSCL	L22	L1499	T	N	2.170	0.461	0.788	98.0	1						
20227	81 PSCL	L22	L958	V	P	2.072	0.483	0.781	93.0	0	2.084	0.792	94.2	2.084	0.792	94.2
20227	81 PSCL	L22	L958	V	N	2.097	0.477	0.803	95.3	0						
20227	81 PSCL	L22	L958	L	P	1.850	0.541	0.760	87.5	0	1.893	0.761	87.8	1.905	0.780	89.0
20227	81 PSCL	L22	L958	L	N	1.935	0.517	0.763	88.0	0						
20227	81 PSCL	L22	L958	T	P	1.952	0.512	0.812	90.7	0	1.917	0.798	90.2			
20227	81 PSCL	L22	L958	T	N	1.883	0.531	0.785	89.7	0						
20418	82 PSCL	L22	L473	V	P	1.918	0.521	0.734	87.0	0	1.890	0.725	85.9	1.890	0.725	85.9
20418	82 PSCL	L22	L473	V	N	1.862	0.537	0.716	84.8	0						
20418	82 PSCL	L22	L473	L	P	2.252	0.444	0.660	93.0	0	2.288	0.651	91.3	2.098	0.730	91.1
20418	82 PSCL	L22	L473	L	N	2.323	0.430	0.642	89.6	0						
20418	82 PSCL	L22	L473	T	P	1.989	0.503	0.811	91.5	0	1.908	0.808	90.9			
20418	82 PSCL	L22	L473	T	N	1.827	0.547	0.804	90.4	1						
20418	83 PSCL	L22	L496	V	P	2.015	0.496	0.798	90.5	0	2.053	0.803	90.5	2.053	0.803	90.5
20418	83 PSCL	L22	L496	V	N	2.091	0.478	0.808	90.6	0						
20418	83 PSCL	L22	L496	L	P	2.300	0.435	0.708	90.2	0	2.353	0.704	89.9	2.258	0.687	89.2
20418	83 PSCL	L22	L496	L	N	2.406	0.416	0.701	89.7	0						
20418	83 PSCL	L22	L496	T	P	2.224	0.450	0.675	89.1	0	2.163	0.669	88.4			
20418	83 PSCL	L22	L496	T	N	2.102	0.476	0.663	87.7	0						
20402	84 PSCL	L22	L781	V	P	2.215	0.452	0.616	82.3	0	2.244	0.659	84.7	2.244	0.659	84.7
20402	84 PSCL	L22	L781	V	N	2.273	0.440	0.701	87.1	0						
20402	84 PSCL	L22	L781	L	P	2.287	0.437	0.745	96.8	0	2.243	0.765	97.7	2.168	0.749	92.8
20402	84 PSCL	L22	L781	L	N	2.198	0.455	0.785	98.7	0						
20402	84 PSCL	L22	L781	T	P	2.149	0.465	0.725	86.8	0	2.094	0.733	87.9			
20402	84 PSCL	L22	L781	T	N	2.039	0.490	0.742	89.1	0						
20402	85 PSCL	L22	L464	V	P	2.264	0.442	0.699	90.3	0	2.217	0.681	89.0	2.217	0.681	89.0
20402	85 PSCL	L22	L464	V	N	2.169	0.461	0.663	87.7	0						

20402	85	PSCL	L22	L464	L	P	2.947	0.339	0.572	90.3	0	2.923	0.570	90.8	2.823	0.554	83.5
20402	85	PSCL	L22	L464	L	N	2.899	0.345	0.568	91.3	0						
20402	85	PSCL	L22	L464	T	P	2.727	0.367	0.540	67.1	0	2.723	0.538	76.3			
20402	85	PSCL	L22	L464	T	N	2.718	0.368	0.537	85.5	0						
20222	96	PSCL	L22	L450	V	P	2.090	0.478	0.728	90.0	0	2.082	0.732	90.9	2.082	0.732	90.9
20222	96	PSCL	L22	L450	V	N	2.074	0.482	0.736	91.7	0						
20222	96	PSCL	L22	L450	L	P	2.606	0.384	0.490	82.2	0	2.523	0.496	81.8	2.313	0.572	84.4
20222	96	PSCL	L22	L450	L	N	2.439	0.410	0.502	81.3	0						
20222	96	PSCL	L22	L450	T	P	4.252	0.235	0.273	4.8	bad	2.104	0.649	86.9			
20222	96	PSCL	L22	L450	T	N	2.104	0.475	0.649	86.9	0						
20427	96	PSCL	L22	L450	V	P	2.075	0.482	0.721	89.1	0	2.066	0.725	89.9	2.066	0.725	89.9
20427	96	PSCL	L22	L450	V	N	2.058	0.486	0.728	90.7	0						
20427	96	PSCL	L22	L450	L	P	2.568	0.389	0.470	78.1	0	2.548	0.474	78.9	2.370	0.564	83.0
20427	96	PSCL	L22	L450	L	N	2.528	0.396	0.478	79.6	0						
20427	96	PSCL	L22	L450	T	P	2.244	0.446	0.641	86.3	0	2.191	0.654	87.1			
20427	96	PSCL	L22	L450	T	N	2.139	0.468	0.667	87.9	0						
20222	98	USGS	L22	L529	V	P	1.929	0.518	0.802	51.5	0	1.931	0.816	52.0	1.931	0.816	52.0
20222	98	USGS	L22	L529	V	N	1.933	0.517	0.829	52.6	0						
20222	98	USGS	L22	L529	L	P	2.006	0.498	0.833	52.3	0	2.002	0.829	52.0	2.129	0.844	55.3
20222	98	USGS	L22	L529	L	N	1.998	0.501	0.824	51.7	0						
20222	98	USGS	L22	L529	T	P	2.280	0.439	0.871	58.6	0	2.256	0.860	58.5			
20222	98	USGS	L22	L529	T	N	2.232	0.448	0.849	58.5	0						
20314	111	PSCL	L22	L959	V	P	2.073	0.482	0.728	90.1	0	2.062	0.727	89.4	2.062	0.727	89.4
20314	111	PSCL	L22	L959	V	N	2.051	0.488	0.726	88.7	0						
20314	111	PSCL	L22	L959	L	P	2.498	0.400	0.574	84.6	0	2.476	0.576	85.2	2.517	0.566	85.3
20314	111	PSCL	L22	L959	L	N	2.454	0.408	0.578	85.8	0						
20314	111	PSCL	L22	L959	T	P	2.616	0.382	0.560	85.9	0	2.559	0.556	85.4			
20314	111	PSCL	L22	L959	T	N	2.501	0.400	0.553	84.9	0						
20314	113	PSCL	L22	L962	V	P	15.723	0.064	0.627	224.9	bad	1.978	0.704	85.4	1.978	0.704	85.4
20314	113	PSCL	L22	L962	V	N	1.978	0.506	0.704	85.4	noisy						
20314	113	PSCL	L22	L962	L	P	2.200	0.455	0.718	85.6	noisy	2.157	0.736	86.9	2.179	0.714	87.6
20314	113	PSCL	L22	L962	L	N	2.113	0.473	0.753	88.3	noisy						

20314	113PSCL	L22	L962	T	P	2.202	0.454	0.693	88.3	noisy	2.202	0.693	88.3			
20314	113PSCL	L22	L962	T	N											
20402	118PSCL	L22	L504	V	P	2.176	0.460	0.772	93.9	0	2.168	0.767	93.7	2.168	0.767	93.7
20402	118PSCL	L22	L504	V	N	2.159	0.463	0.761	93.5	0						
20402	118PSCL	L22	L504	L	P	2.363	0.423	0.698	92.2	0	2.302	0.721	93.4	2.052	0.781	90.8
20402	118PSCL	L22	L504	L	N	2.241	0.446	0.743	94.6	0						
20402	118PSCL	L22	L504	T	P	1.822	0.549	0.846	89.4	0	1.803	0.842	88.2			
20402	118PSCL	L22	L504	T	N	1.784	0.560	0.838	86.9	0						
20402	143PSCL	L22	L1502	V	P	2.058	0.486	0.775	94.9	1	2.058	0.801	96.3	2.058	0.801	96.3
20402	143PSCL	L22	L1502	V	N	2.058	0.486	0.827	97.6	1						
20402	143PSCL	L22	L1502	L	P	1.859	0.538	0.817	91.3	1	1.800	0.818	90.2	1.762	0.841	90.7
20402	143PSCL	L22	L1502	L	N	1.742	0.574	0.818	89.1	2						
20402	143PSCL	L22	L1502	T	P	1.745	0.573	0.855	91.0	2	1.724	0.865	91.2			
20402	143PSCL	L22	L1502	T	N	1.704	0.587	0.874	91.3	2						
30207	143PSCL	L22	L1502	V	P	2.131	0.469	0.831	99.4	1	2.067	0.803	96.7	2.067	0.803	96.7
30207	143PSCL	L22	L1502	V	N	2.003	0.499	0.775	94.0	1						
30207	143PSCL	L22	L1502	L	P	1.893	0.528	0.834	93.2	1	1.824	0.825	91.4	1.770	0.844	91.2
30207	143PSCL	L22	L1502	L	N	1.756	0.570	0.817	89.7	1						
30207	143PSCL	L22	L1502	T	P	1.777	0.563	0.869	92.8	2	1.716	0.862	90.9			
30207	143PSCL	L22	L1502	T	N	1.655	0.604	0.854	89.1	2						
20402	144PSCL	L22	L966	V	P	2.188	0.457	0.751	94.1	0	2.160	0.743	93.1	2.160	0.743	93.1
20402	144PSCL	L22	L966	V	N	2.132	0.469	0.735	92.0	0						
20402	144PSCL	L22	L966	L	P	2.092	0.478	0.689	87.3	0	2.052	0.676	86.1	2.096	0.726	90.5
20402	144PSCL	L22	L966	L	N	2.012	0.497	0.662	84.9	0						
20402	144PSCL	L22	L966	T	P	2.174	0.460	0.803	97.0	0	2.140	0.776	94.8			
20402	144PSCL	L22	L966	T	N	2.105	0.475	0.748	92.6	0						
20402	144PSCL	L22	L966	V	P	2.227	0.449	0.777	96.4	0	2.217	0.777	96.2	2.217	0.777	96.2
20402	144PSCL	L22	L966	V	N	2.208	0.453	0.777	95.9	0						
20402	144PSCL	L22	L966	L	P	2.088	0.479	0.679	86.8	0	2.094	0.697	88.2	2.096	0.722	90.5
20402	144PSCL	L22	L966	L	N	2.101	0.476	0.714	89.5	0						
20402	144PSCL	L22	L966	T	P	2.092	0.478	0.748	92.6	0	2.099	0.748	92.9			
20402	144PSCL	L22	L966	T	N	2.105	0.475	0.747	93.1	0						

20402	148PSCL	L22	L485	V	P	2.167	0.461	0.685	89.4	0	2.188	0.700	91.3	2.188	0.700	91.3
20402	148PSCL	L22	L485	V	N	2.209	0.453	0.715	93.2	0						
20402	148PSCL	L22	L485	L	P	2.283	0.438	0.661	87.3	0	2.173	0.668	87.5	2.173	0.668	87.5
20402	148PSCL	L22	L485	L	N	2.062	0.485	0.675	87.7	0						
20402	148PSCL	L22	L485	T	P	37.736	0.027	0.028	60.8	dead	38.248	0.045	67.0			
20402	148PSCL	L22	L485	T	N	38.760	0.026	0.063	73.2	dead						
20402	169PSCL	L22	L461	V	P	2.294	0.436	0.709	92.2	0	2.283	0.717	93.0	2.283	0.717	93.0
20402	169PSCL	L22	L461	V	N	2.273	0.440	0.725	93.8	0						
20402	169PSCL	L22	L461	L	P	2.794	0.358	0.518	82.5	0	2.748	0.517	82.7	2.588	0.539	82.8
20402	169PSCL	L22	L461	L	N	2.703	0.370	0.516	82.9	0						
20402	169PSCL	L22	L461	T	P	2.465	0.406	0.558	82.1	0	2.427	0.561	82.9			
20402	169PSCL	L22	L461	T	N	2.389	0.419	0.563	83.8	0						
20418	181PSCL	L22	L1496	V	P	1.945	0.514	0.760	91.5	1	1.921	0.747	90.3	1.921	0.747	90.3
20418	181PSCL	L22	L1496	V	N	1.897	0.527	0.735	89.2	1						
20418	181PSCL	L22	L1496	L	P	1.917	0.522	0.828	92.9	0	1.826	0.829	91.4	1.895	0.766	89.8
20418	181PSCL	L22	L1496	L	N	1.735	0.576	0.830	90.0	1						
20418	181PSCL	L22	L1496	T	P	2.035	0.492	0.701	88.5	0	1.964	0.703	88.2			
20418	181PSCL	L22	L1496	T	N	1.893	0.528	0.705	88.0	1						
20418	182PSCL	L22	L457	V	P	2.141	0.467	0.884	93.6	0	2.126	0.859	92.2	2.126	0.859	92.2
20418	182PSCL	L22	L457	V	N	2.111	0.474	0.835	90.8	0						
20418	182PSCL	L22	L457	L	P	1.894	0.528	0.693	85.7	0	1.906	0.705	86.5	1.963	0.694	87.4
20418	182PSCL	L22	L457	L	N	1.919	0.521	0.717	87.4	0						
20418	182PSCL	L22	L457	T	P	2.016	0.496	0.680	87.8	0	2.019	0.683	88.3			
20418	182PSCL	L22	L457	T	N	2.021	0.495	0.686	88.8	0						
20402	183PSCL	L22	L479	V	P	2.117	0.472	0.762	89.3	0	2.115	0.751	89.6	2.115	0.751	89.6
20402	183PSCL	L22	L479	V	N	2.112	0.474	0.741	89.9	0						
20402	183PSCL	L22	L479	L	P	1.985	0.504	0.774	88.3	0	1.961	0.755	87.5	1.961	0.755	87.5
20402	183PSCL	L22	L479	L	N	1.936	0.517	0.735	86.7	0						
20402	183PSCL	L22	L479	T	P	17.513	0.057	0.296	67.9	dead	16.594	0.280	61.9			
20402	183PSCL	L22	L479	T	N	15.674	0.064	0.264	55.9	dead						
20402	186PSCL	L22	L483	V	P	1.845	0.542	0.647	84.8	1	1.837	0.648	84.8	1.837	0.648	84.8

20402	186PSCL	L22	L483	V	N	1.828	0.547	0.648	84.8	1						
20402	186PSCL	L22	L483	L	P	2.558	0.391	0.621	91.8	0	2.526	0.637	93.0	2.526	0.637	93.0
20402	186PSCL	L22	L483	L	N	2.494	0.401	0.653	94.2	0						
20402	186PSCL	L22	L483	T	P	2.212	0.452	0.526	27.1	dead	23.833	0.292	42.4			
20402	186PSCL	L22	L483	T	N	45.455	0.022	0.058	57.7	dead						
20402	186PSCL	L22	L483	V	P	1.845	0.542	0.647	85.0	1	1.866	0.665	86.6	1.866	0.665	86.6
20402	186PSCL	L22	L483	V	N	1.887	0.530	0.682	88.2	1						
20402	186PSCL	L22	L483	L	P	2.571	0.389	0.625	92.5	0	2.532	0.629	93.1	2.425	0.604	90.0
20402	186PSCL	L22	L483	L	N	2.494	0.401	0.632	93.6	0						
20402	186PSCL	L22	L483	T	P	2.347	0.426	0.574	86.0	0	2.318	0.579	87.0			
20402	186PSCL	L22	L483	T	N	2.288	0.437	0.584	88.0	0						
20418	188PSCL	L22	L644	V	P	1.890	0.529	0.811	93.0	2	1.867	0.813	92.6	1.867	0.813	92.6
20418	188PSCL	L22	L644	V	N	1.844	0.542	0.815	92.2	2						
20418	188PSCL	L22	L644	L	P	1.926	0.519	0.781	93.2	2	1.947	0.785	93.7	1.893	0.801	93.2
20418	188PSCL	L22	L644	L	N	1.967	0.508	0.789	94.2	2						
20418	188PSCL	L22	L644	T	P	1.855	0.539	0.824	93.5	2	1.839	0.816	92.7			
20418	188PSCL	L22	L644	T	N	1.823	0.549	0.809	92.0	2						
20314	189PSCL	L22	L1487	V	P	2.127	0.470	0.748	95.0	1	2.134	0.755	95.7	2.134	0.755	95.7
20314	189PSCL	L22	L1487	V	N	2.141	0.467	0.761	96.4	1						
20314	189PSCL	L22	L1487	L	P	2.058	0.486	0.800	95.9	1	1.994	0.777	94.0	2.102	0.731	93.6
20314	189PSCL	L22	L1487	L	N	1.929	0.519	0.753	92.0	2						
20314	189PSCL	L22	L1487	T	P	2.210	0.453	0.658	90.9	0	2.211	0.685	93.3			
20314	189PSCL	L22	L1487	T	N	2.212	0.452	0.711	95.7	1						

TABLE 3: LOCAL EARTHQUAKES RECORDED ON THE SEATTLE SHIPS ARRAY

(Bold, italics indicate events shown in figures 7-14)

Julian day	year	mo	day	time	latitude (degrees north)	longitude (degrees)	depth (km)	mag (coda)	location
26	2002	1	26	14:01:46	47.1305	-122.1325	8.5	2.4	near Enumclaw
28	***2002***	***1***	***28***	***1:57:09***	***47.5197***	***-122.8180***	***19.4***	***2.1***	***near Bremerton***
30	***2002***	***1***	***30***	***4:13:13***	***47.6905***	***-121.9472***	***26***	***2.1***	***near Carnation***
31	2002	1	31	12:42:24	46.8178	-121.9673	6.9	2.1	W. Rainier seismic zone
36	2002	2	5	6:21:34	47.7050	-122.0508	19.3	1.5	near Duvall
43	***2002***	***2***	***12***	***19:16:41***	***48.4133***	***-122.2857***	***18.6***	***3***	***near Mt. Vernon***
44	2002	2	13	7:15:45	46.0070	-122.7150	19	2.2	near Longview
50	2002	2	19	18:07:20	46.8682	-121.7560	1.4	2.5	Mt. Ranier
50	***2002***	***2***	***19***	***18:42:29***	***46.8587***	***-121.7530***	***0***	***3.2***	***Mt. Ranier***
52	2002	2	21	9:48:37	46.1368	-120.5138	16.8	2	near Yakima
53	2002	2	22	9:39:35	47.3895	-121.8152	20.4	1.7	near North Bend
54	2002	2	23	14:28:56	48.9300	-123.0600	19	2.3	Point Roberts, WA
58	2002	2	27	12:06:43	47.5228	-122.7527	21.2	1.6	near Bremerton
59	2002	2	28	9:46:23	46.9687	-121.8935	8.2	1.6	W. Rainier seismic zone
59	***2002***	***2***	***28***	***12:00:51***	***46.9722***	***-121.9028***	***8.4***	***1.6***	***W. Rainier seismic zone***
59	2002	2	28	17:07:34	48.3930	-122.9047	49.4	2.3	near Friday Harbor
60	2002	3	1	11:11:25	47.5222	-122.7492	21.9	1.3	near Bremerton
61	2002	3	2	3:09:37	48.3488	-122.3195	11.6	1.7	near Mt. Vernon
61	***2002***	***3***	***2***	***9:50:37***	***47.9060***	***-122.2117***	***21.3***	***2***	***near Everett***
63	2002	3	4	10:49:11	46.8833	-121.9080	11.7	2.1	W. Rainier seismic zone
64	2002	3	5	18:16:05	47.4147	-122.7047	28	1.8	near Bremerton
64	2002	3	5	20:35:19	47.0693	-122.4992	17.3	1.4	near Tacoma
68	2002	3	9	21:16:28	48.3120	-123.1175	20.9	1.8	near Victoria, BC
69	2002	3	10	11:04:11	47.5305	-121.6392	15.3	1.9	near North Bend
70	2002	3	11	0:43:51	47.5070	-122.7393	22.7	1.7	near Bremerton
70	2002	3	11	2:48:45	46.8507	-119.7433	2.3	2.9	near Vantage, WA

75	2002	3	16	1:08:56	46.8527	-121.9737	9	1.8	W. Rainier
83	***2002***	***3***	***24***	***11:05:12***	***47.4618***	***-122.053***	***19.8***	***2.3***	***Maple Valley***
85	***2002***	***3***	***26***	***8:11:46***	***47.2577***	***-122.809***	***8.6***	***1.9***	***Olympia***
85	***2002***	***3***	***26***	***12:34:02***	***47.2855***	***-122.216***	***18.1***	***2.5***	***Tacoma***
85	***2002***	***3***	***26***	***12:37:10***	***47.289***	***-122.226***	***18.2***	***2.1***	***Tacoma***
88	2002	3	29	8:53:25	47.4265	-122.826	16	1.7	Bremerton
94	***2002***	***4***	***4***	***13:10:01***	***47.4758***	***-122.895***	***19.8***	***1.8***	***Bremerton***
96	2002	4	6	10:00:28	47.4333	-122.365	24.4	1.7	Seattle
99	2002	4	9	17:51:56	48.615	-123.087	8.8	1.5	Friday Harbor
100	2002	4	10	7:38:23	47.6667	-120.119	0.6	2.9	Entiat
100	2002	4	10	22:26:38	46.8698	-121.936	10.9	2.2	Rainier seismic zone
102	***2002***	***4***	***12***	***5:45:12***	***47.3298***	***-123.205***	***43.5***	***2.7***	***Olympia***
104	2002	4	14	22:50:31	47.6968	-122.013	20.1	1.2	Duvall
105	2002	4	15	5:23:09	47.6407	-122.497	26	1.5	Bremerton
106	2002	4	16	13:38:57	48.4815	-121.833	0	2.2	Concrete
110	2002	4	20	10:30:50	48.0063	-121.544	3.8	2	Darrington
112	***2002***	***4***	***22***	***10:38:51***	***47.2953***	***-122.299***	***20.6***	***2.2***	***Tacoma***
116	2002	4	26	19:44:17	47.6897	-121.989	14.7	1.8	Duvall
117	2002	4	27	20:11:28	47.5915	-122.347	55.5	1.9	Seattle
119	2002	4	29	14:05:02	47.774	-121.852	6.2	2	Duvall
121	2002	5	1	6:37:30	47.7523	-121.859	4	1.6	Duvall
121	2002	5	1	9:09:45	48.458	-119.556	3.7	2.9	Okanogan
122	2002	5	2	9:26:31	47.8492	-122.782	24.5	1.8	Poulsbo
123	2002	5	3	0:36:47	45.055	-122.51	21.7	2.4	Canby OR
124	2002	5	4	13:13:50	47.5847	-122.441	25.9	1.5	Seattle
125	2002	5	5	0:36:58	47.3795	-122.362	18.9	2.2	Tacoma
125	2002	5	5	16:40:43	48.2807	-122.213	12.1	2	Mt. Vernon
126	2002	5	6	4:47:53	45.3245	-121.686	5	2.5	Mt. Hood
126	2002	5	6	11:21:58	45.3297	-121.688	5.3	2.8	Mt. Hood
126	2002	5	6	11:28:47	47.3863	-122.07	6.8	1.5	Maple Valley
126	2002	5	6	13:08:27	45.3295	-121.688	4.7	2.5	Mt. Hood
127	2002	5	7	18:23:39	47.6458	-122.758	24.9	1.5	Bremerton
131	2002	5	11	9:26:39	47.0207	-122.006	15.4	1.4	Enumclaw

131	2002	5	11	19:10:01	47.7962	-122.773	23	2.3	Poulsbo
133	***2002***	***5***	***13***	***21:00:38***	***48.3995***	***-123.461***	***42.1***	***2.7***	***Victoria, BC***
134	2002	5	14	17:13:10	47.8505	-123.06	47.7	2.1	Poulsbo
134	2002	5	14	22:50:19	47.0095	-122.006	15.3	1.9	Enumclaw
139	***2002***	***5***	***19***	***17:05:27***	***48.3***	***-122.195***	***13.7***	***2.7***	***Mt. Vernon***
140	2002	5	20	10:44:38	47.7783	-122.864	20.2	2	Poulsbo
140	2002	5	20	12:07:35	47.7708	-122.849	20.5	1.4	Poulsbo
144	2002	5	24	11:17:29	48.0527	-122.618	29.5	1	Everett
147	2002	5	27	19:33:38	46.9300	-121.9600	13.1	2.4	Mt. Rainier

TABLE 4: LOCAL BLASTS RECORDED ON THE SEATTLE SHIPS ARRAY

Julian day	year	month	day	UTC time	latitude (degrees north)	longitude (degrees)	depth (km)	magnitude (coda)	location
50	2002	2	19	23:14:50	46.7027	-122.7753	0	3.2	Centralia blast
52	2002	2	21	22:55:05	46.6927	-122.7748	0	3	Centralia blast
54	2002	2	23	1:46:56	47.8290	-122.2172	0	1.7	near Snohomish
54	2002	2	23	14:28:55	48.9478	-123.0513	0	2.3	near Vancouver, BC
56	2002	2	25	21:52:55	46.6975	-122.7897	0	3.3	Centralia blast
57	2002	2	26	22:59:09	46.7025	-122.7643	0	3.5	Centralia blast
59	2002	2	28	22:09:31	46.7013	-122.7640	0	3.2	Centralia blast
60	2002	3	1	23:25:39	46.6933	-122.7872	0	3.2	Centralia blast
64	2002	3	5	22:54:06	46.6995	-122.7642	0	3.3	Centralia blast
65	2002	3	6	23:06:49	46.7412	-122.7753	0	2.9	Centralia blast
66	2002	3	7	21:03:07	46.7027	-122.7663	0	3.3	Centralia blast
70	2002	3	11	22:56:06	46.7015	-122.7680	0	3	Centralia blast
73	2002	3	14	23:08:57	46.7032	-122.7700	0	3.1	Centralia blast
74	2002	3	15	22:56:05	46.7337	-122.7745	0	2.7	Centralia blast
77	2002	3	18	23:06:53	46.7095	-122.7743	0	2.9	Centralia blast
78	2002	3	19	23:10:30	46.7352	-122.78	0	2.7	Centralia blast

79	2002	3	20	23:53:40	46.7163	-122.727	0	3.1	Centralia blast
80	2002	3	21	22:07:27	46.7045	-122.765	0	3.1	Centralia blast
84	2002	3	25	22:51:11	46.6997	-122.772	0	3.2	Centralia blast
85	2002	3	26	22:44:07	46.7068	-122.759	0	3.1	Centralia blast
86	2002	3	27	22:19:22	46.7037	-122.763	0	3.1	Centralia blast
93	2002	4	3	22:51:34	46.7052	-122.776	0	3.1	Centralia blast
94	2002	4	4	22:16:47	46.706	-122.763	0	3.3	Centralia blast
95	2002	4	5	22:49:17	46.701	-122.765	0	3.3	Centralia blast
98	2002	4	8	21:21:47	46.7017	-122.766	0	3.4	Centralia blast
100	2002	4	10	21:35:00	46.6998	-122.772	0	3.2	Centralia blast
101	2002	4	11	21:51:02	46.7033	-122.763	0	3.3	Centralia blast
102	2002	4	12	21:37:54	46.7027	-122.773	0	3.2	Centralia blast
105	2002	4	15	21:26:33	46.7075	-122.76	0	3.2	Centralia blast
108	2002	4	18	20:45:33	46.7382	-122.806	0	3	Centralia blast
109	2002	4	19	21:19:56	46.7395	-122.802	0	3.3	Centralia blast
112	2002	4	22	21:46:16	46.7377	-122.812	0	3	Centralia blast
121	2002	5	1	21:47:14	46.7037	-122.764	0	3.1	Centralia blast
122	2002	5	2	21:24:27	46.6992	-122.762	0	3.1	Centralia blast
123	2002	5	3	21:31:40	46.705	-122.767	0	3.3	Centralia blast
124	2002	5	4	21:37:12	46.6975	-122.788	0	3.2	Centralia blast
126	2002	5	6	20:47:26	46.7045	-122.781	0	2.7	Centralia blast
127	2002	5	7	21:51:19	46.7025	-122.763	0	3.5	Centralia blast
128	2002	5	8	21:21:18	46.7057	-122.765	0	3.5	Centralia blast
129	2002	5	9	21:47:46	46.7387	-122.813	0	3.5	Centralia blast
130	2002	5	10	21:13:18	46.7387	-122.817	0	3.2	Centralia blast
131	2002	5	11	19:56:49	46.704	-122.768	0	3.2	Centralia blast
132	2002	5	12	18:39:31	46.7145	-122.764	0	3	Centralia blast
133	2002	5	13	21:21:47	46.7065	-122.77	0	3.5	Centralia blast
135	2002	5	15	21:31:32	46.7	-122.753	0	2.7	Centralia blast
142	2002	5	22	20:55:15	46.707	-122.762	0	3.2	Centralia blast
143	2002	5	23	21:02:10	46.701	-122.763	0	3	Centralia blast
144	2002	5	24	21:07:56	46.7002	-122.768	0	3.3	Centralia blast

TABLE 5: TELESEISMS RECORDED ON THE SEATTLE SHIPS ARRAY

(Bold, italics indicate events shown in figures 15-20)

Jul day	yr	mo	day	UTC time	lat (deg)	long (deg)	depth (km)	mag (mb or MS)	epicentral dist (deg)	location
27	2002	1	27	7:09:14	39.288	142.327	49	5.3	65	Japan
28	2002	1	28	13:50:29	49.381	155.594	33	6.1	52	Kuril Islands
28	2002	1	28	15:09:55	-15.3040	-173.2250	33	6.1	78	Tonga Islands
30	2002	1	30	8:42:02	18.1990	-95.6910	106	5.6	37	Veracruz, Mexico
30	2002	1	30	12:58:19	-6.2460	150.8370	33	6	93	New Britain region, New Guinea
31	2002	1	31	16:27:16	-12.6650	169.5370	626	5.3	85	Santa Cruz Islands region
32	2002	2	1	21:55:20	45.5440	136.6560	353	6.1	64	Primorye, Russia
34	***2002***	***2***	***3***	***7:11:28***	***38.4900***	***31.3050***	***10***	***6.5***	***91***	***Turkey***
34	2002	2	3	9:26:43	38.6280	30.8050	10	5.8	90	Turkey
36	2002	2	5	13:27:24	-5.3430	151.3020	39	6.3	92	New Britain region, New Guinea
37	2002	2	6	17:18:43	61.2710	-149.8690	45	4.9	21	southern Alaska
40	2002	2	9	17:19:26	61.3470	-149.8810	45	4.9	21	southern Alaska
40	2002	2	9	16:56:03	46.1550	142.7700	300	5	60	Sakhalin Island, Russia
40	2002	2	9	18:49:58	43.447	-126.7520	10		5	off coast of Oregon
41	2002	2	10	1:47:06	-55.9280	-29.0860	192	5.6	129	South Sandwich Islands
42	2002	2	11	3:39:32	-17.9970	-178.4840	562	4.9	83	Fiji
43	2002	2	12	3:27:23	23.7130	121.5550	33	5.9	89	Taiwan
43	2002	2	12	13:44:35	36.5860	140.9190	33	5.6	68	Honshu, Japan
44	2002	2	13	14:17:10	-12.7010	169.6200	600	4.8	85	Santa Cruz Islands region
45	2002	2	14	1:12:21	41.5260	141.9930	62	5.1	64	Hokkaido, Japan
45	2002	2	14	23:23:13	14.9750	-92.4700	74	5.3	41	Chiapas, Mexico
46	2002	2	15	1:46:38	-36.1540	-100.2390	10	5.4	86	Easter Island
49	2002	2	18	13:52:36	-21.0070	-179.2120	625	4.8	86	Fiji
50	2002	2	19	0:35:49	-3.8160	150.9480	33	6	91	New Ireland, New Guinea
50	2002	2	19	12:33:24	-56.7210	-25.4840	33	5.4	131	South Sandwich Islands
51	2002	2	20	3:17:16	51.4480	-130.6300	10	4.5	7	Queen Charlotte Islands
51	2002	2	20	19:07:16	-7.7090	31.9860	37	5.6	134	Lake Tanganyika
52	2002	2	21	8:57:46	-31.5320	-67.1480	120	5.2	93	San Juan province, Argentina

52	2002	2	21	9:15:17	18.5920	145.4650	209	5	78	Mariana Islands
53	2002	2	22	19:32:41	32.3750	-115.3520	10	5.5	16	Baja California
54	2002	2	23	19:37:14	-4.4700	152.0350	159	5.6	90	New Britain region, New Guinea
56	2002	2	25	21:19:26	60.5690	-147.4440	33	4.8	19	southern Alaska
59	2002	2	28	1:50:50	-5.6020	151.2460	45	6.4	92	New Britain region, New Guinea
62	2002	3	3	7:16:19	-45.8250	-75.8320	33	6	102	southern Chile
62	***2002***	***3***	***3***	***12:08:12***	***36.4710***	***70.4010***	***256***	***7.4***	***95***	***Hindu Kush, Afghanistan (2 events)***
63	2002	3	4	20:21:21	28.4150	143.2950	33	5.5	72	Bonin Islands, Japan
63	2002	3	4	20:37:14	28.4030	143.2290	33	5.2	72	Bonin Islands, Japan
64	2002	3	5	8:25:04	20.7050	145.1910	105	5.1	76	Mariana Islands
64	***2002***	***3***	***5***	***21:16:09***	***6.1710***	***124.2840***	***31***	***7.5***	***101***	***Mindanao, Philippines (21:48 also)***
66	2002	3	7	0:07:07	47.9440	146.8920	442	5.6	57	Kuril Islands
67	2002	3	8	18:27:53	5.8460	124.2720	23	6	101	Mindanao, Philippines
67	2002	3	8	19:08:25	5.9270	124.3700	33	5	101	Mindanao, Philippines
68	2002	3	9	3:39:17	-17.9450	-178.9280	500	4.6	83	Fiji Islands
68	2002	3	9	7:42:57	56.6600	-159.6120	147	4.5	24	Alaska Peninsula (7:43.00 also)
68	2002	3	9	12:27:11	-56.0810	-27.4940	118	6	130	South Sandwich Islands
70	2002	3	11	1:46:20	30.6310	141.5610	33	5.8	72	Honshu, Japan
73	2002	3	14	16:08:32	51.6920	-173.1500	33	5.9	32	Andreanof Islands, Aleutian Islands
75	2002	3	16	20:50:04	-6.2290	151.3870	56	5.6	92	New Britain region, New Guinea
76	2002	3	17	3:37:18	0.6350	122.3340	72	5.8	106	Minahassa Peninsula, Sulawesi
76	2002	3	17	3:57:47	51.4640	-173.2710	33	5.5	33	Andreanof Islands, Aleutian Islands
76	2002	3	17	9:00:59	12.5050	-87.9700	69	5	45	Nicaragua
76	2002	3	17	17:51:47	-23.5890	178.8460	527	4.5	89	Fiji
76	2002	3	17	19:33:34	-45.1430	34.7600	10	6	164	Prince Edward Islands
76	2002	3	17	20:50:32	-33.2370	-179.7500	33	5.6	96	Kermadec Islands
76	2002	3	17	21:43:30	-37.1150	-179.7390	33	5.6	99	North Island, New Zealand
76	2002	3	17	22:13:17	-37.1860	-179.9080	33	5.5	99	North Island, New Zealand
77	2002	3	18	3:09:57	-20.3530	-68.8400	93	5.5	83	Chile/Bolivia
77	2002	3	18	22:24:36	-4.8000	-102.1610	33	5.3	55	Sumatera, Indonesia
78	2002	3	19	5:03:47	62.9220	-151.4380	33	5.1	22	central Alaska
78	2002	3	19	17:32:14	60.419	-153.716	177	4.5	22	southern Alaska
78	2002	3	19	20:06:19	22.238	143.613	140	4.9	76	Volcano Islands, Japan

79	2002	3	20	4:00:21	30.5730	141.8800	33	5.9	71	southeast Honshu, Japan
79	2002	3	20	11:37:43	126.58	-152.9940	90		76	southern Alaska
79	2002	3	20	11:40:20	-23.18	-179.893	327	4.8	88	south of Fiji Islands
79	2002	3	20	14:29:58	-3.4080	144.9290	33	5.2	94	north coast of New Guinea
81	2002	3	22	9:10:14	-3.1340	142.3090	33	5	96	north coast of New Guinea
81	2002	3	22	9:22:33	-3.1350	142.3370	33	5.2	96	north coast of New Guinea
81	2002	3	22	12:21:10	-18.459	178.336	558	4.6	85	Fiji Islands
81	2002	3	22	17:36:54	4.5970	126.3340	33	5.5	101	Talud Islands, Indonesia
82	2002	3	23	3:06:18	12.054	142.922	33	4.9	84	Mariana Islands
82	2002	3	23	3:30:16	-16.041	-177.964	500	4.8	81	Fiji
82	2002	3	23	5:15:51	1.3880	128.0410	117	5.7	102	Indonesia
83	2002	3	24	13:19:50	43.364	-126.58	10		5	offshore Oregon
83	2002	3	24	16:42:37	-57.7650	-66.4890	10	5.6	115	Drake Passage
83	2002	3	24	18:48:53	-23.88	-66.489	214	4.6	87	Jujuy province, Argentina
85	2002	3	26	3:45:49	23.466	124.063	33	6.4	87	Ryukyu Island, Japan
85	2002	3	26	10:15:10	-18.85	169.145	130	5.1	90	Vanuatu Islands (New Hebrides)
86	2002	3	27	3:52:50	40.38	-126.359	10	4	8	offshore northern California
86	2002	3	27	12:15:24	44.952	147.581	121	5.1	59	Kuril Islands
87	2002	3	28	4:56:21	-20.336	-68.13	122	6.3	84	Chile/Bolivia border
87	2002	3	28	5:48:24	22.559	-45.006	10	5.5	65	Mid Atlantic Ridge (05:50:37 also)
90	***2002***	***3***	***31***	***6:52:50***	***24.439***	***122.201***	***33***	***7.1***	***88***	***Taiwan***
91	2002	4	1	8:44:22	44.109	-128.886	10	4.5	6	offshore Oregon
91	2002	4	1	14:11:40	43.332	-126.245	10		5	offshore Oregon
91	2002	4	1	19:59:32	-29.483	-71.069	67	6.4	90	central Chile
92	2002	4	2	17:09:58	-49.566	-116.024	10	5.6	97	southern east Pacific rise
93	2002	4	3	23:42:13	41.656	141.853	72	5.7	64	Hokkaido, Japan
94	2002	4	4	4:29:11	50.765	-129.879	10	4.5	6	Vancouver Island
95	2002	4	5	2:41:12	-6.317	130.086	33	5.8	106	Banda Sea
95	2002	4	5	23:02:29	-15.204	-173.433	33	5.7	78	Tonga Islands
97	2002	4	7	1:41:25	-60.966	154.818	10	6.2	127	west of McQuarie Island
97	2002	4	7	12:09:41	-10.791	164.178	33	5.8	87	Santa Cruz Islands region
98	2002	4	8	3:48:54	-50.999	139.263	10	6.2	130	west Indian-Antarctic Ridge
100	2002	4	10	10:04:50	-44.008	-15.825	10	5.7	131	south mid-Atlantic ridge

100	2002	4	10	10:09:21	-20.797	169.232	33	5.9	92	Vanuatu Islands
101	2002	4	11	21:56:56	-14.386	167.623	10	6.2	88	Vanuatu Islands (also 4 min later)
102	2002	4	12	4:00:23	35.914	69.228	10	5.9	96	Afghanistan
103	2002	4	13	15:36:00	1.099	15.335	33	5.5	119	northern Molucca sea
104	2002	4	14	2:04:28	38.608	73.29	178	5.5	93	Tajikistan
104	2002	4	14	4:05:23	7.319	126.651	33	5.6	98	Philippines
105	2002	4	15	3:52:07	13.142	143.76	123	5.4	83	Mariana Islands
106	2002	4	16	13:25:25	52.0470	-170.0620	33	4.8	31	Fox Island, Aleutians
108	2002	4	18	5:02:47	16.9450	-100.8160	33	6.3	35	Guerrero, Mexico
108	2002	4	18	14:17:27	-60.7320	-26.0840	33	5.8	133	South Sandwich Islands
108	***2002***	***4***	***18***	***16:08:36***	***-27.5350***	***-70.6000***	***62***	***6.7***	***88***	***northern Chile***
110	2002	4	20	10:50:45	44.4670	-73.6900	11	5	33	New York (also 14 minutes later)
110	2002	4	20	15:59:57	-16.4140	173.2350	33	6	86	Fiji
111	2002	4	21	16:37:38	43.5370	-126.6840	10	4.1	5	offshore Oregon
113	2002	4	23	15:05:32	-12.4610	166.9300	218	5.6	87	Santa Cruz Islands region
114	2002	4	24	7:08:16	51.1310	-177.8820	33	5.2	35	Andreanof Islands, Aleutian Islands
114	2002	4	24	10:51:50	42.4100	21.4200	10	5.7	84	northwest Balkan region
114	2002	4	24	11:00:00	-56.1620	-122.0250	10	6.2	104	east Pacific rise
116	2002	4	26	7:15:08	53.6140	160.4770	33	5.8	47	Kamchatka
116	***2002***	***4***	***26***	***16:06:06***	***13.1450***	***144.5850***	***80***	***7.1***	***82***	***Mariana Islands***
118	2002	4	28	13:23:49	24.2130	122.7090	33	5.4	87	Taiwan
121	2002	5	1	14:31:37	44.3600	129.3400	10	4.8	69	offshore Oregon
123	2002	5	3	22:32:04	-18.181	-178.308	619	4.8	83	Fiji
124	2002	5	4	7:00:48	-17.898	-178.737	560	5.8	83	Fiji
124	2002	5	4	12:51:38	-23.072	-64.492	87	5.6	88	Argentina
127	2002	5	7	15:16:07	-19.033	168.665	36	5.9	91	Vanuatu
127	2002	5	7	20:36:48	44.19	-128.921	10	4	6	offshore Oregon
128	2002	5	8	5:26:00	-17.948	-174.573	128	5.4	81	Tonga Islands
128	2002	5	8	11:20:36	51.63	175.311	33	4.8	39	Andreanof Islands, Aleutian Islands
128	2002	5	8	19:45:18	53.813	160.774	39	5.9	47	Kamchatka
129	2002	5	9	23:41:31	2.6460	128.3030	173	5.7	101	Indonesia
131	2002	5	11	10:43:08	-10.424	-78.506	47	5.7	70	Peru
132	2002	5	12	1:29:35	39.225	140.995	96	5.3	66	Honshu, Japan

132	2002	5	12	23:12:53	-1.143	127.087	19	5.9	105	Indonesia
133	2002	5	13	3:32:51	50.46	-130.26	10	4.3	6	Vancouver Island
133	2002	5	13	19:57:23	19.132	121.238	32	5.8	92	Philippines
134	2002	5	14	5:00:29	36.967	-121.6	8	4.7	11	Gilroy, CA
135	2002	5	15	3:27:39	-21.4	-174.314	3	5.9	83	Tonga Islands
135	2002	5	15	7:06:20	43.41	-127.076	10	5	5	offshore Oregon
135	2002	5	15	17:54:48	42.231	-121.901	8	4.2	5	Klamath Falls, Oregon
136	2002	5	16	14:44:25	43.365	-126.777	10	4.1	5	offshore Oregon
137	2002	5	17	10:40:11	48.193	-27.816	14	5.7	59	Mid Atlantic Ridge (Azores)
141	2002	5	21	6:03:00	17.779	-81.915	13	5.7	44	Honduras
141	2002	5	21	20:04:17	44.619	146.517	142	5.5	59	Kuril Islands
141	2002	5	21	23:45:35	14.126	144.954	119	5.4	81	Mariana Islands
142	2002	5	22	18:57:19	-36.344	-97.908	10	5.3	87	Easter Island
143	2002	5	23	15:52:16	-30.649	-71.15	39	6	91	Chile
143	2002	5	23	22:05:55	-5.808	101.988	20	5.6	124	Sumatera, Indonesia
144	2002	5	24	0:23:15	-31.868	-70.882	52	5.7	92	Chile

TABLE 6. PASSCAL SEGY TRACE HEADER FORMAT

Byte #	Description
1 - 4	Trace sequence number within data stream
5 - 8	Trace sequence number within reel (same as above)
9 - 12	Event number
13 - 16	Channel number = 1 or 4 for the vertical component, 2 or 5 for the N-S horizontal component, 3 or 6 for the E-W horizontal component
|	
29 - 30	Trace identification code = 1 for seismic data
|	
53 - 56	datumElevRec = UTM Easting (m)
56 - 60	datumElevSource = UTM Northing (m)
69 - 70	Elevation constant = 1
71 - 72	Coordinate constant = 1
|	
81 - 84	recLongOrX = receiver longitude*3600
85 - 88	recLatOrY = receiver latitude*3600
89 - 90	Coordinate units = 2 for Lat/Long
|	
103 - 104	Low 2 bytes of the total shift in milliseconds
|	
115 - 116	Number of samples in this trace
	(note if equal 32767 see bytes 229 - 232)
117 - 118	Sample interval in microsecs for this trace
	(note if equal 1 see bytes 201 - 204)
119 - 120	Fixed gain flag = 1
121 - 122	Gain of amplifier
|	
157 - 158	Year data recorded
159 - 160	Day of year
161 - 162	Hour of day (24 hour clock)
163 - 164	Minute of hour
165 - 166	Second of minute
167 - 168	Time basis code: 1=local 2=GMT 3=other
|	
181 – 186*	Station Name (6 chars)
187 - 194*	Sensor Serial number (7 chars + 1 for termination)
195 - 198*	Channel Name code (3 chars +1 for termination)
199 - 200*	Extra bytes (2 chars)
201 - 204*	Sample interval in microsecs as a 32 bit integer
205 - 206*	Data format flag: 0=16 bit integer 1=32 bit integer
207 - 208*	Milliseconds of second for first sample

209 - 210*	Trigger time year
211 - 212*	Trigger time Julian day
213 - 214*	Trigger time hour
215 - 216*	Trigger time minutes
217 - 218*	Trigger time seconds
219 - 220*	Trigger time milliseconds
221 - 224*	Scale factor (IEEE 32 bit float) (true amplitude = (data value)*(scale factor)/gain
225 - 226*	Instrument Serial Number
229 - 232*	Number of Samples as a 32 bit integer
233 - 236*	Max value in counts.
237 - 240*	Min value in counts.

*Header values not specified in the standard SEGY format

FIGURES

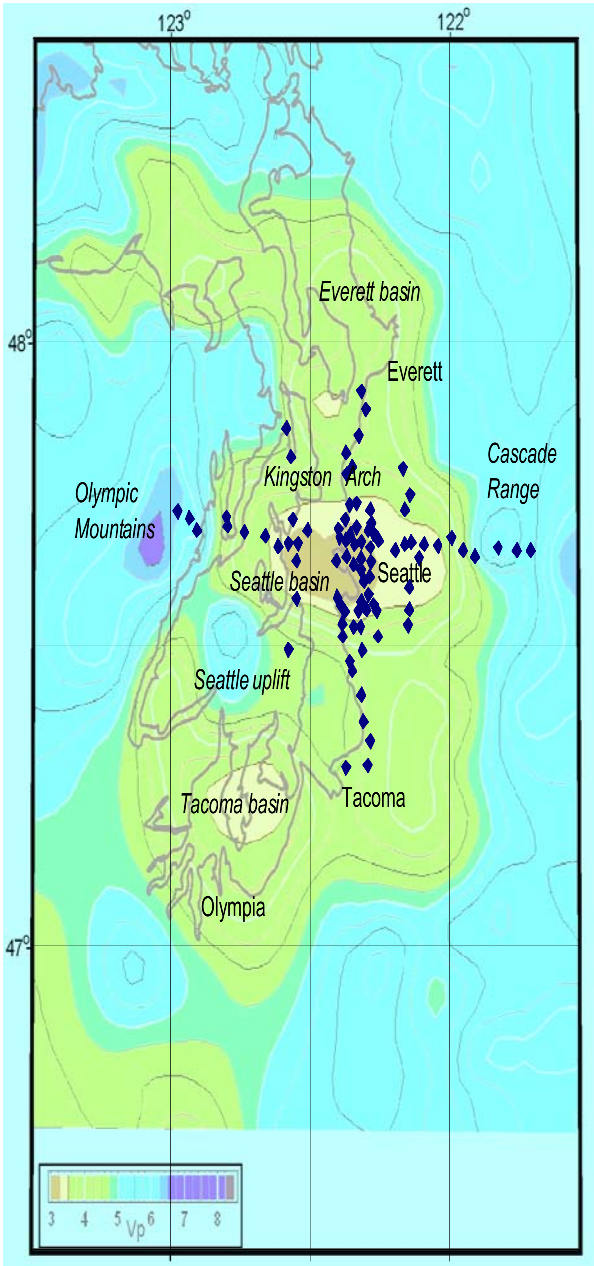

Figure 1: Stations locations superimposed on a tomography map. The colored background shows the speed of sound at 2.5 km depth derived from a regional tomographic study (VanWagoner et al., 2002). The blue dots are the locations of the Seattle SHIPS seismometer sites. The sites span the basin in both the north-south and east-west directions, and provide some 3-dimensional control over the basin.

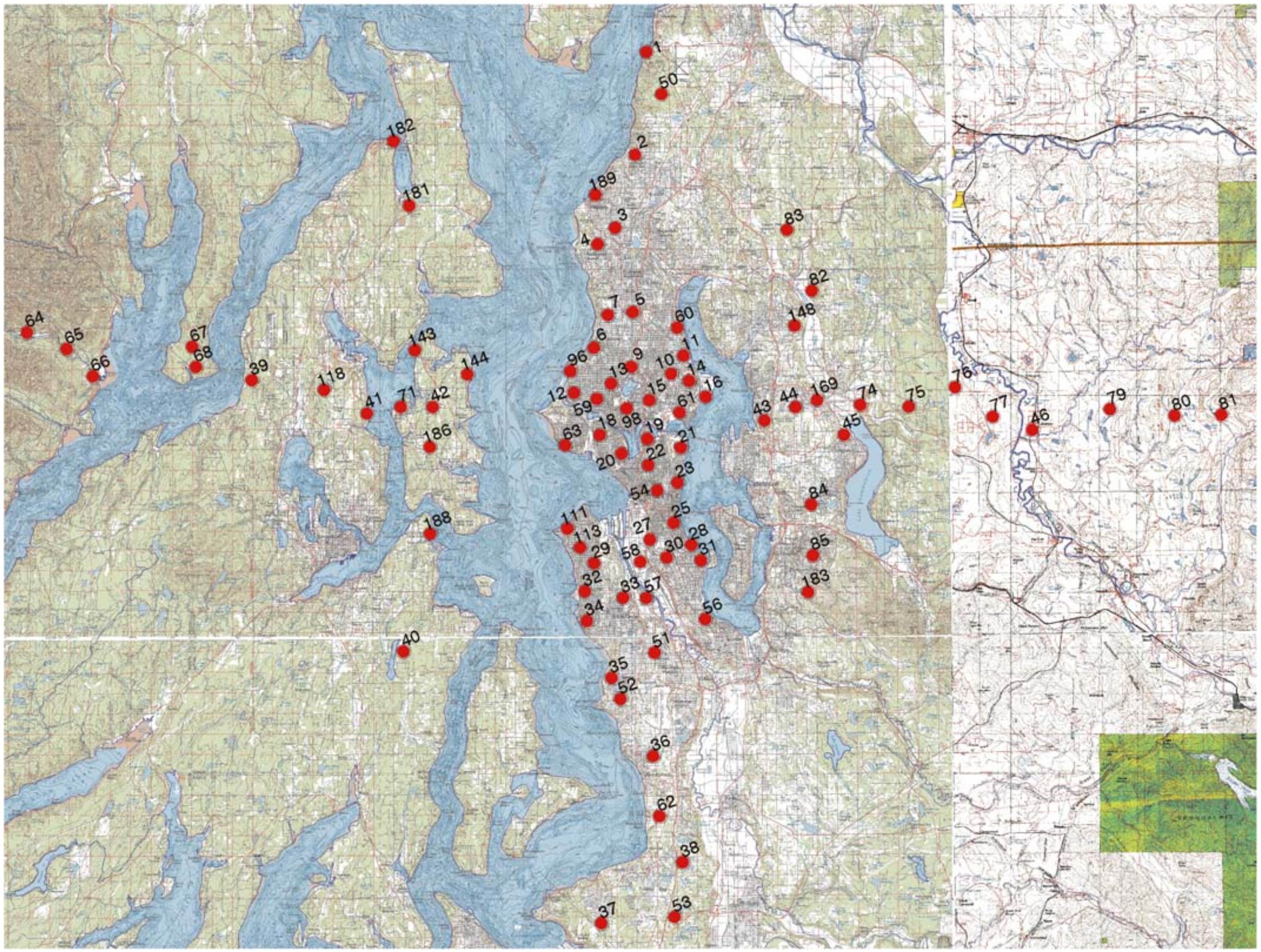

Figure 2: Topographic map showing the stations occupied during the 2002 Seattle Ships experiment.

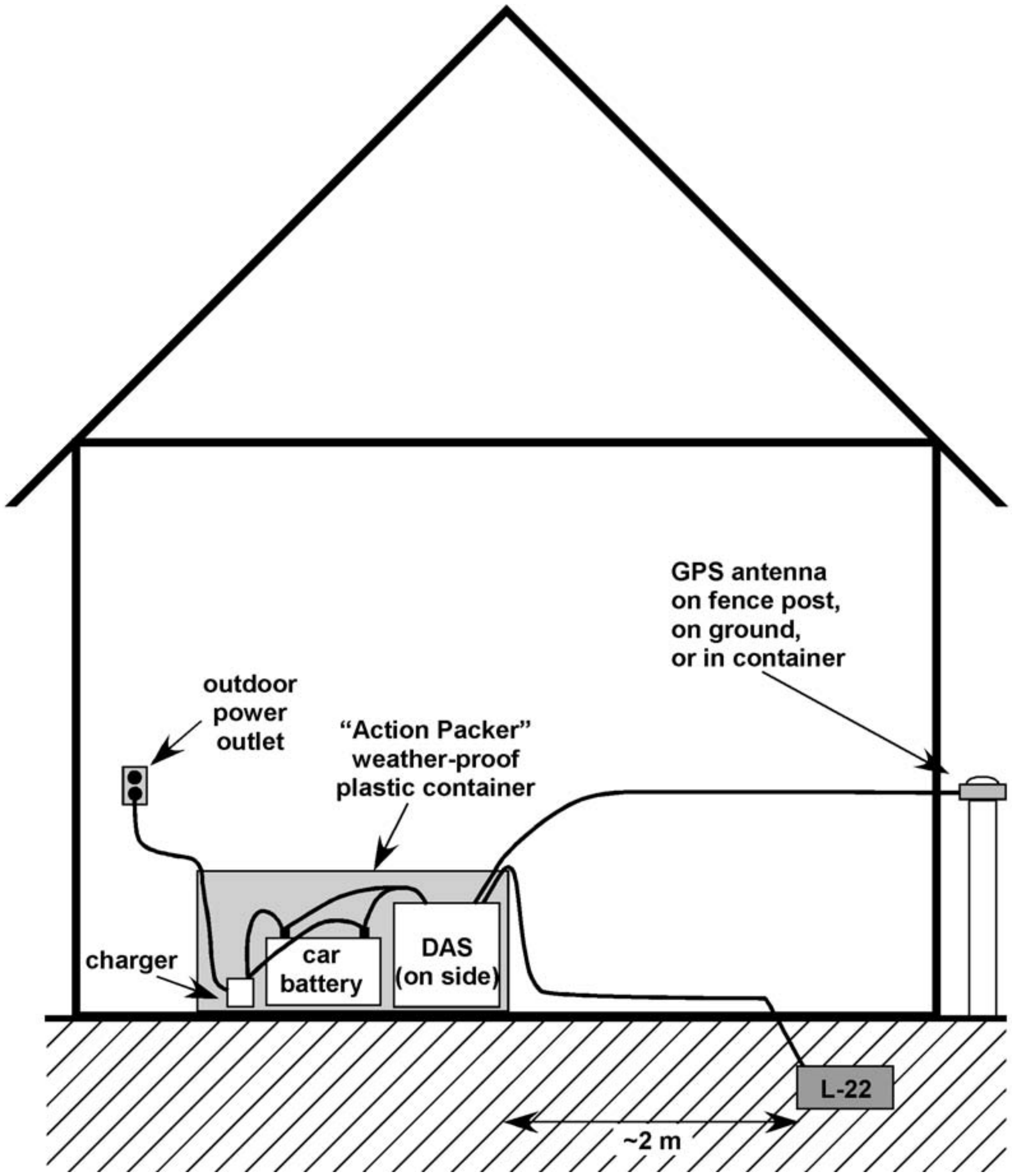

Figure 3: Instrumentation placement at each site. The DAS, car battery, and battery charger were placed in a plastic storage container outside of the house or garage. The sensor was buried about 2 m from the storage container, and the GPS antenna (or external clock) was placed wherever it would have an unobstructed view of the sky. Electrical power was provided to the battery charger from an outdoor power outlet.

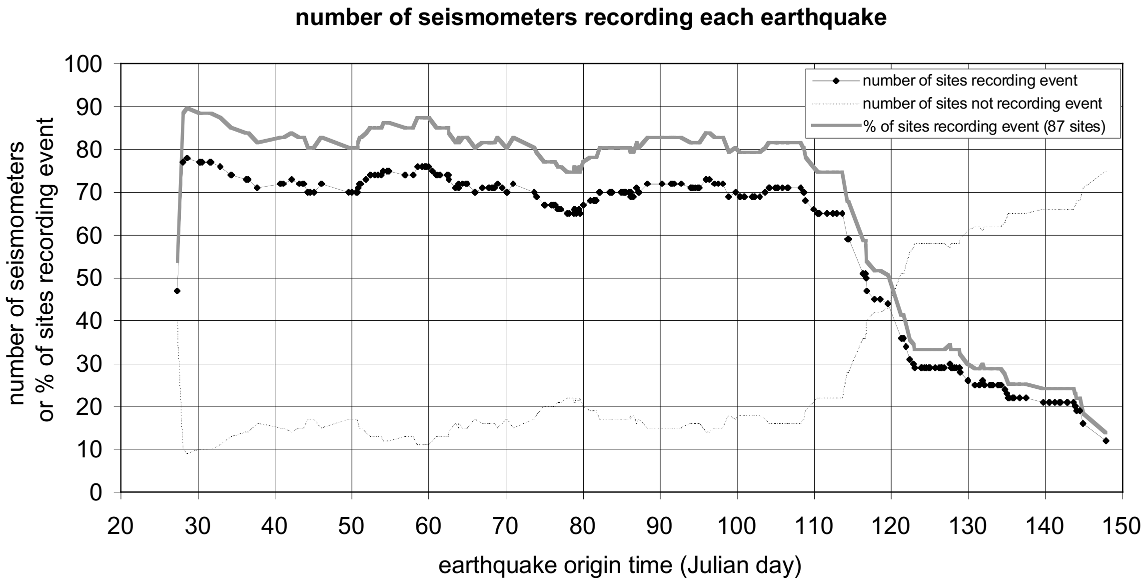

Figure 4: Number of seismometers recording each event. Each data point represents one event (tables 3-5) plotted by origin time. The vertical scale shows the number of instruments that recorded each event. We began removing instruments at day 108, resulting in a decrease in the number of instruments recording events after day 108. The dashed line shows the number of sites that did not record the event because of malfunctioning or missing instruments. The gray line shows the percentage of sites that recorded each event.

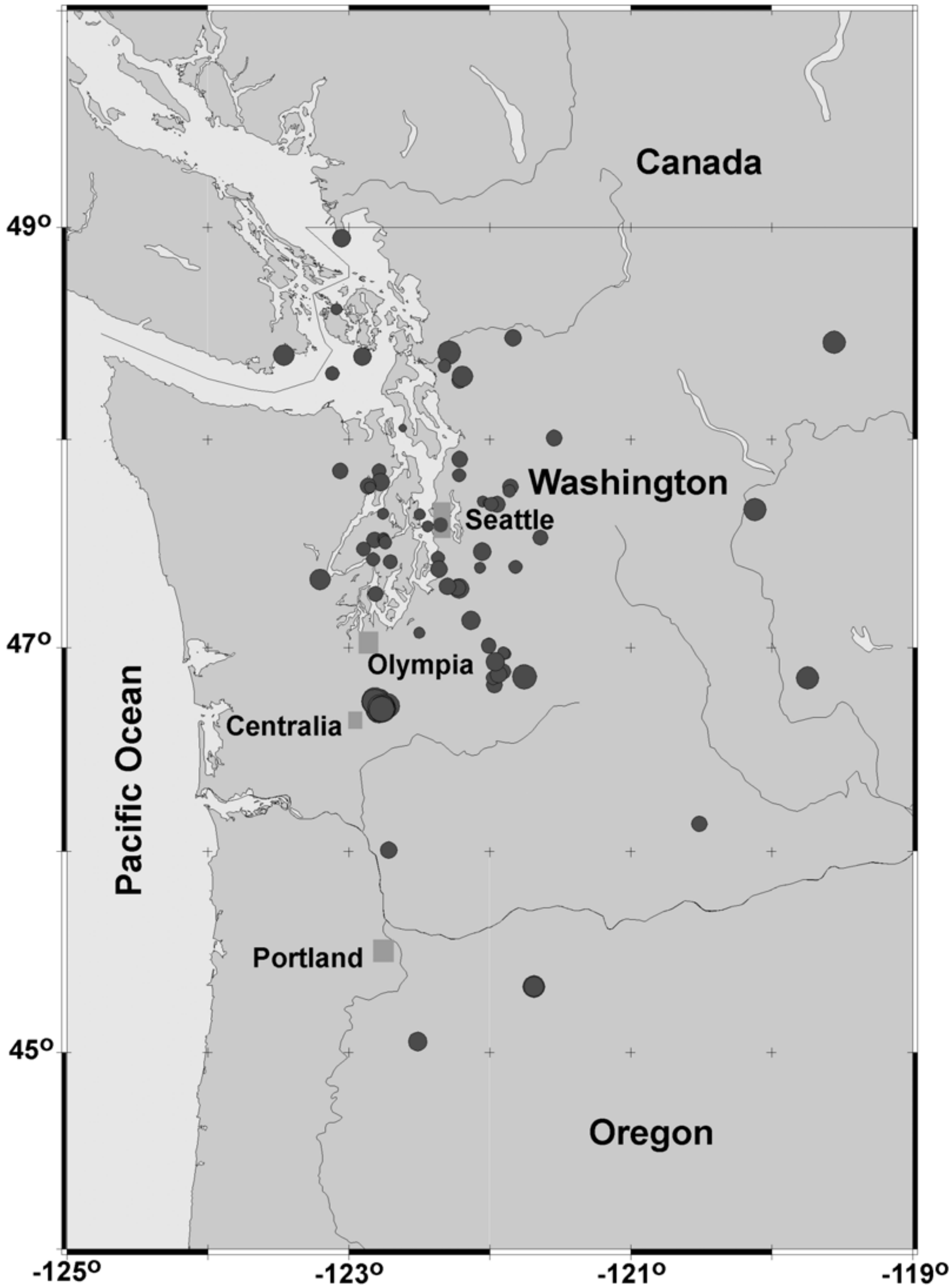

Figure 5: Map showing the locations of the local earthquakes recorded on the Seattle SHIPS array, with the size of the dot proportional to the earthquake magnitude. The collection of magnitude 3 events near Centralia are mine blasts; nearly all of the other events are earthquakes.

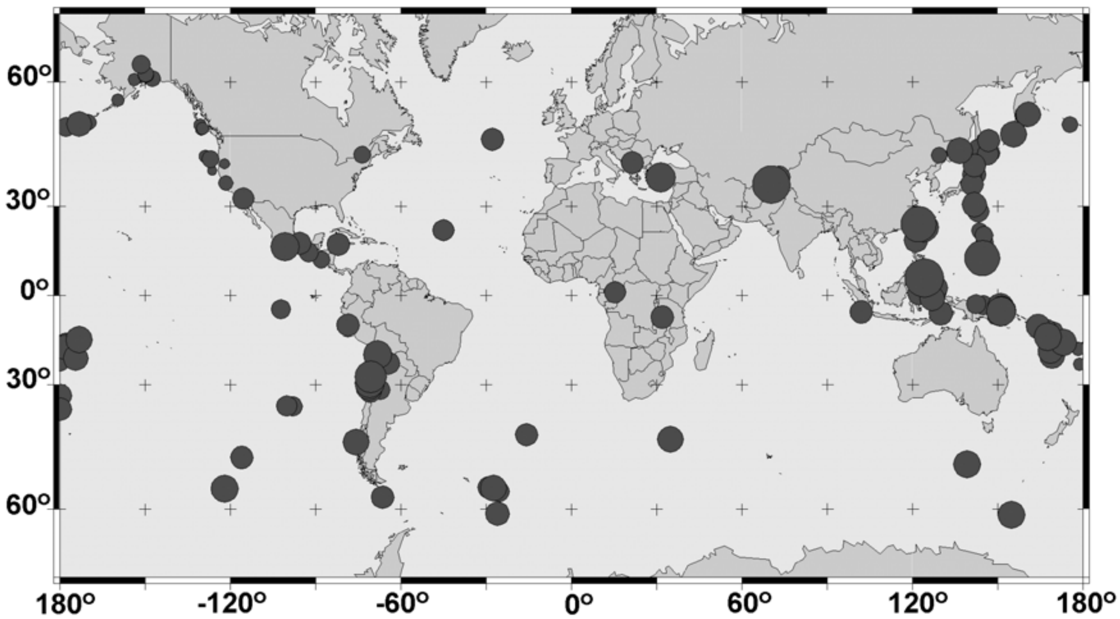

Figure 6: Map showing the locations of teleseisms recorded on the Seattle SHIPS array, with the size of the dot proportional to the earthquake magnitude.

Figs 7-14: Plots of local earthquakes. Data have a 1-14 Hz bandpass filter. Data are arranged by increasing source-receiver distance, with vertical traces on the left, north-south traces in the center, and east-west traces on the right. The number beneath each figure is the origin time of the event, listed as year.day.hour.minute.second.

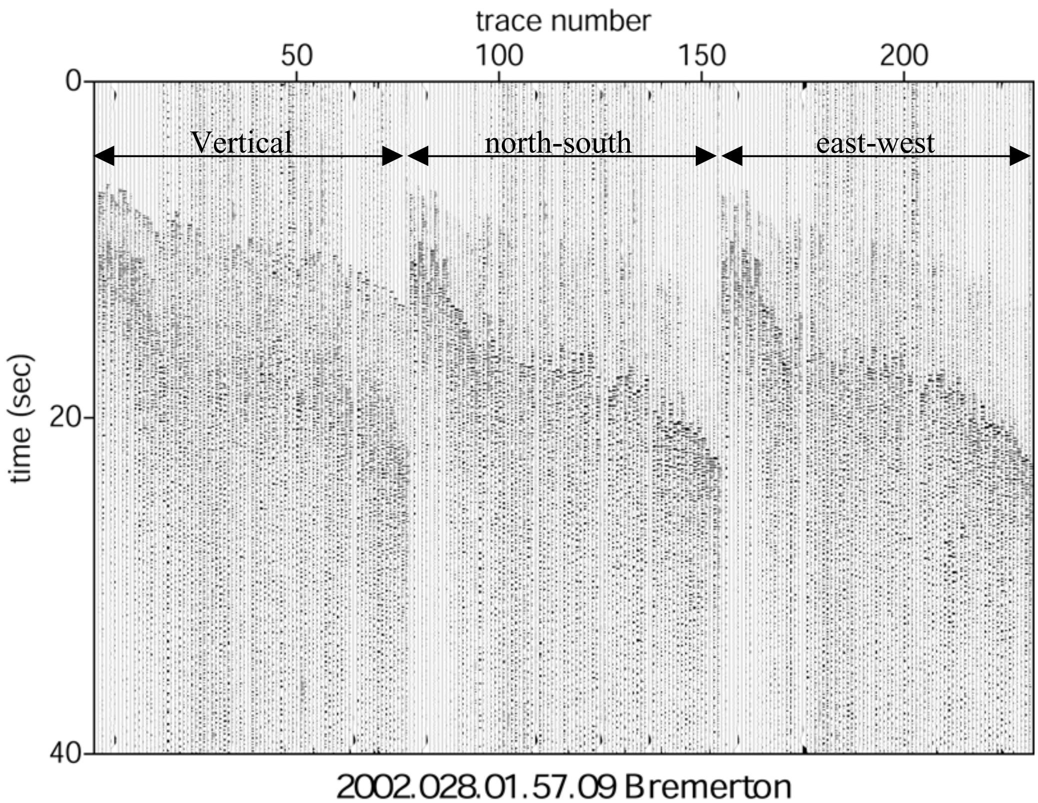

Figure 7a: M2.1 earthquake beneath Bremerton, 19 km deep.

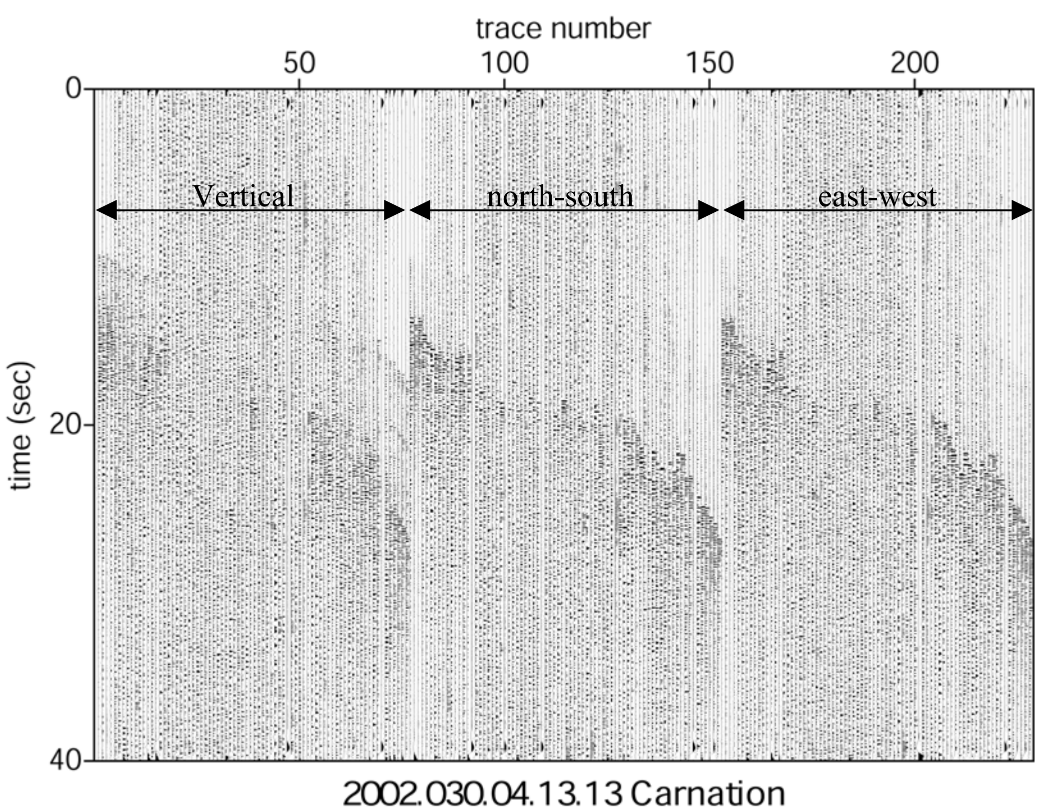

Figure 7b: M2.1 earthquake beneath Carnation, 26 km deep.

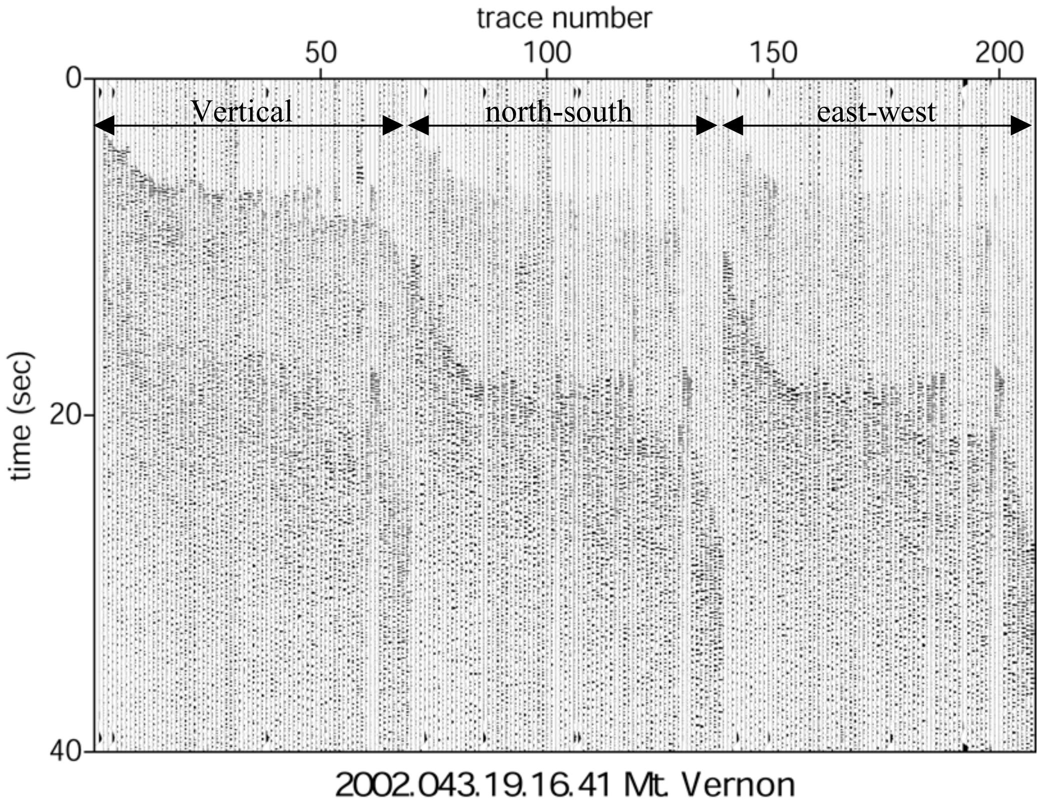

Figure 8a: M3.0 earthquake beneath Mt. Vernon, 19 km deep.

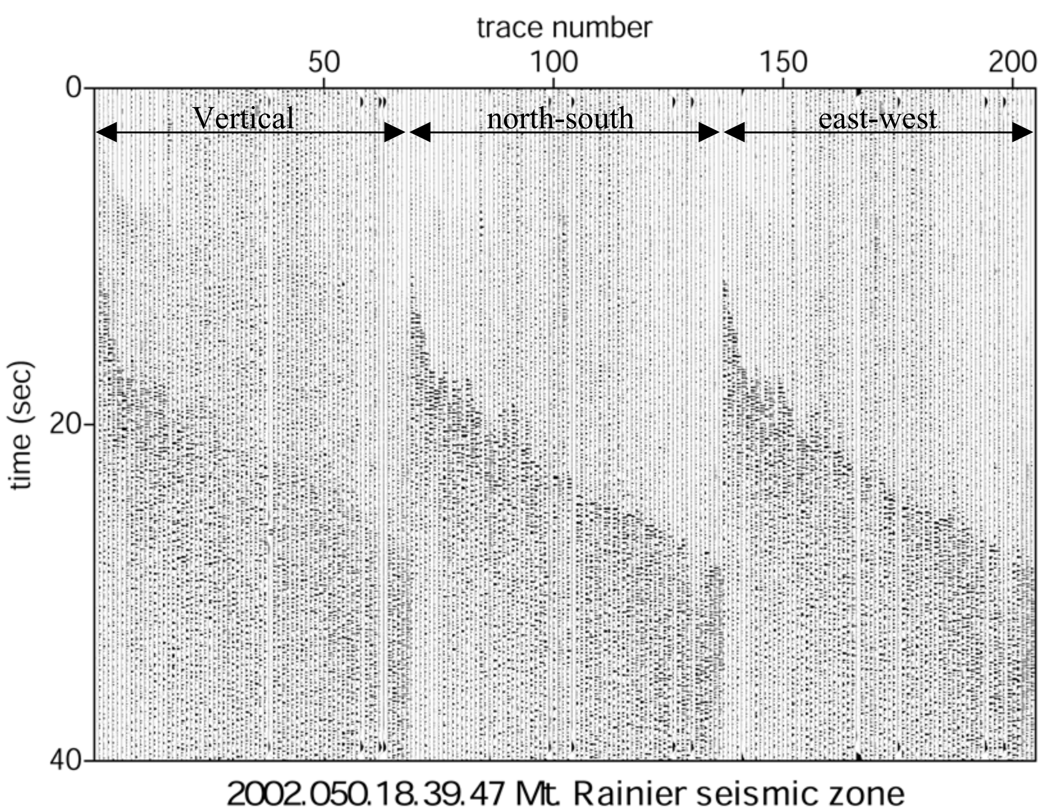

Figure 8b: M3.2 earthquake beneath Mt. Rainier, 0 km deep.

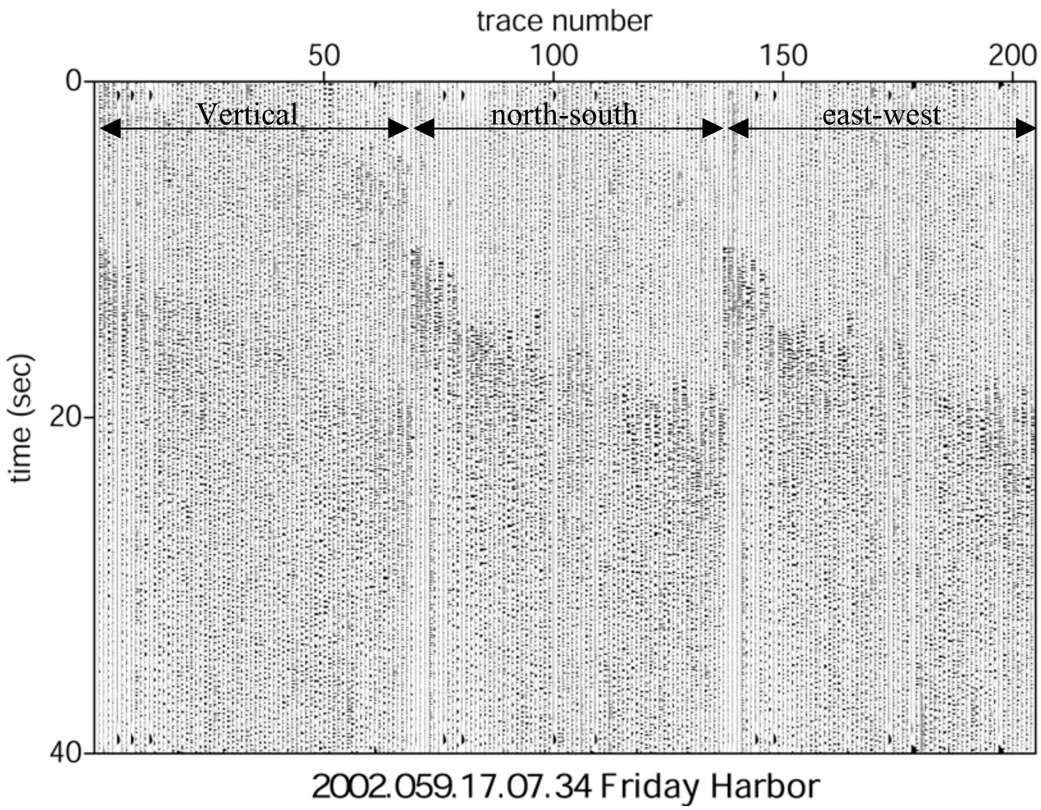

Figure 9a: M2.3 earthquake beneath Friday Harbor, 49 km depth.

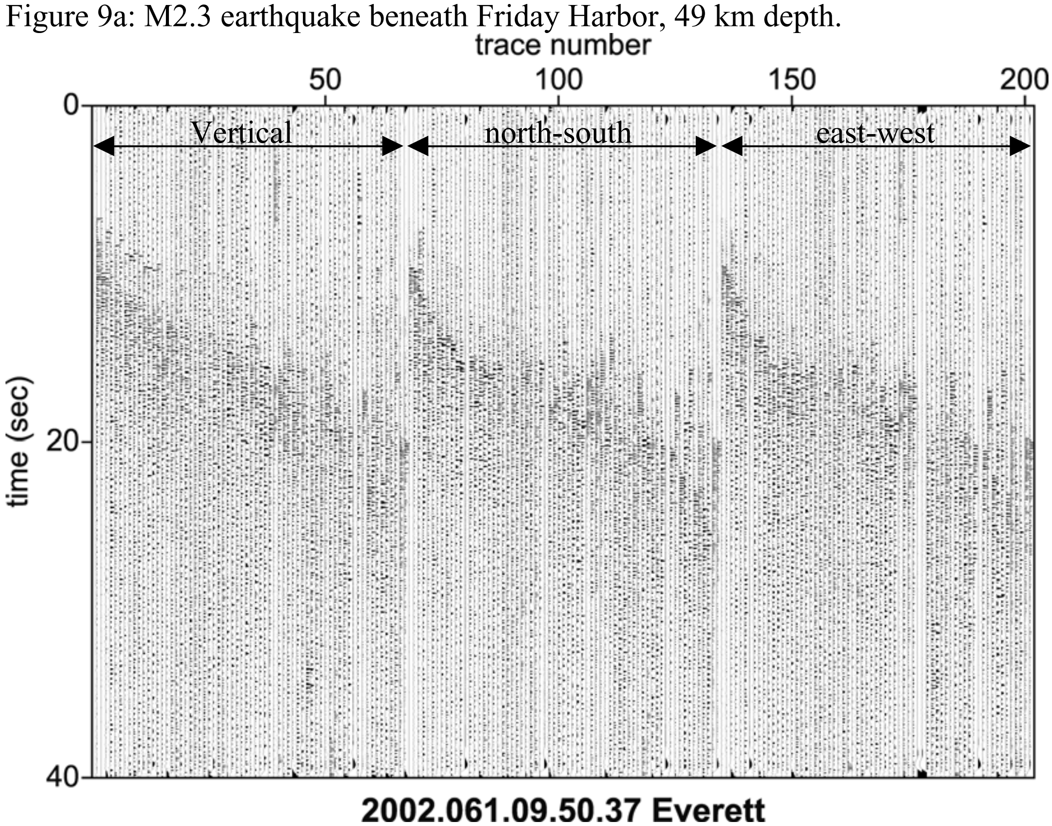

Figure 9b: M2.0 earthquake beneath Everett, 21 km depth.

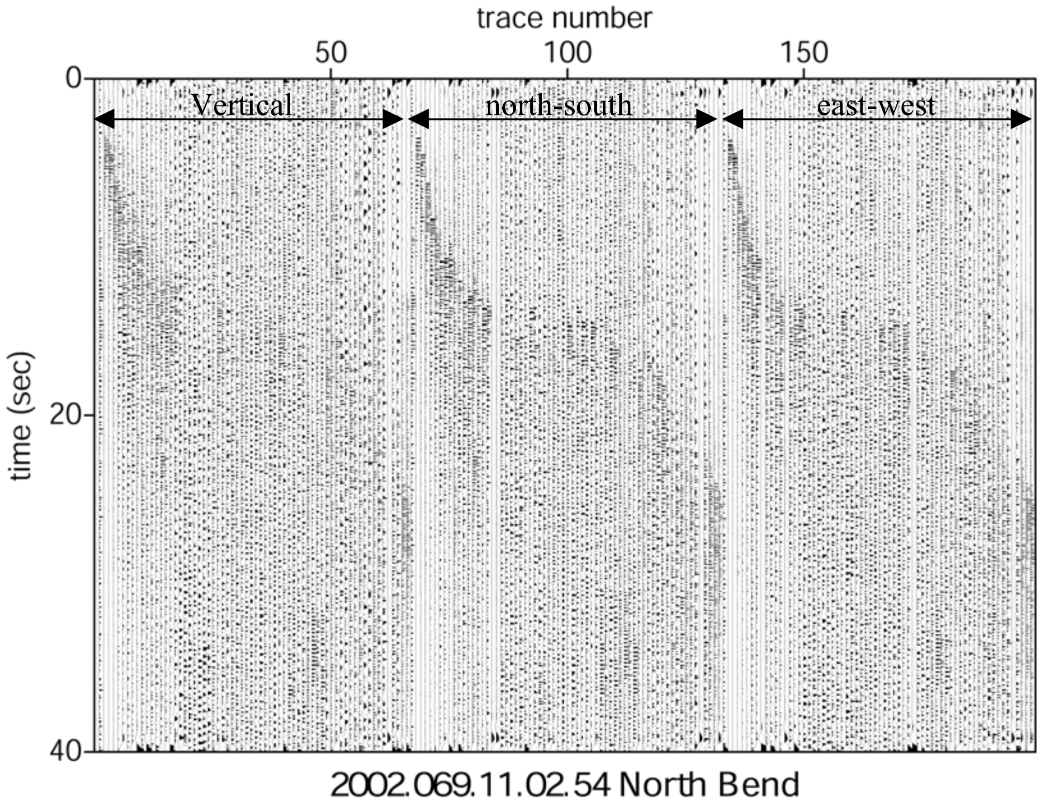

Figure 10a: M1.9 earthquake beneath North Bend, 15 km deep.

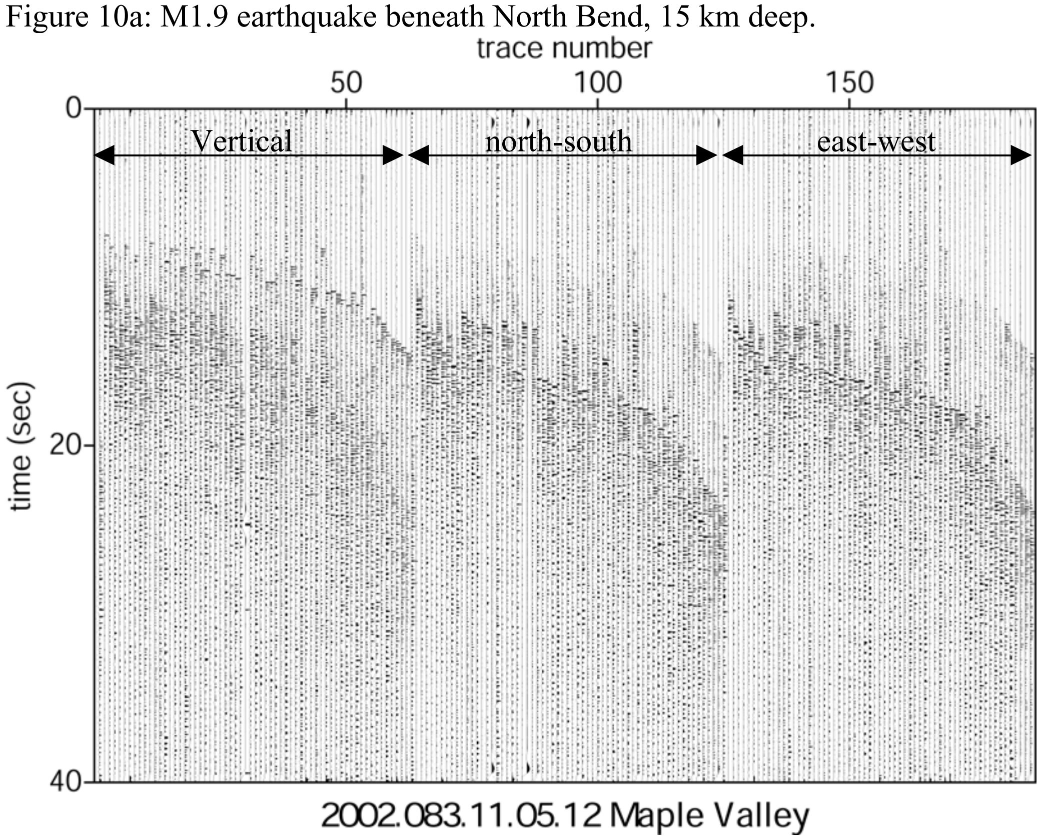

Figure 10b: M2.3 beneath Maple Valley, 20 km deep.

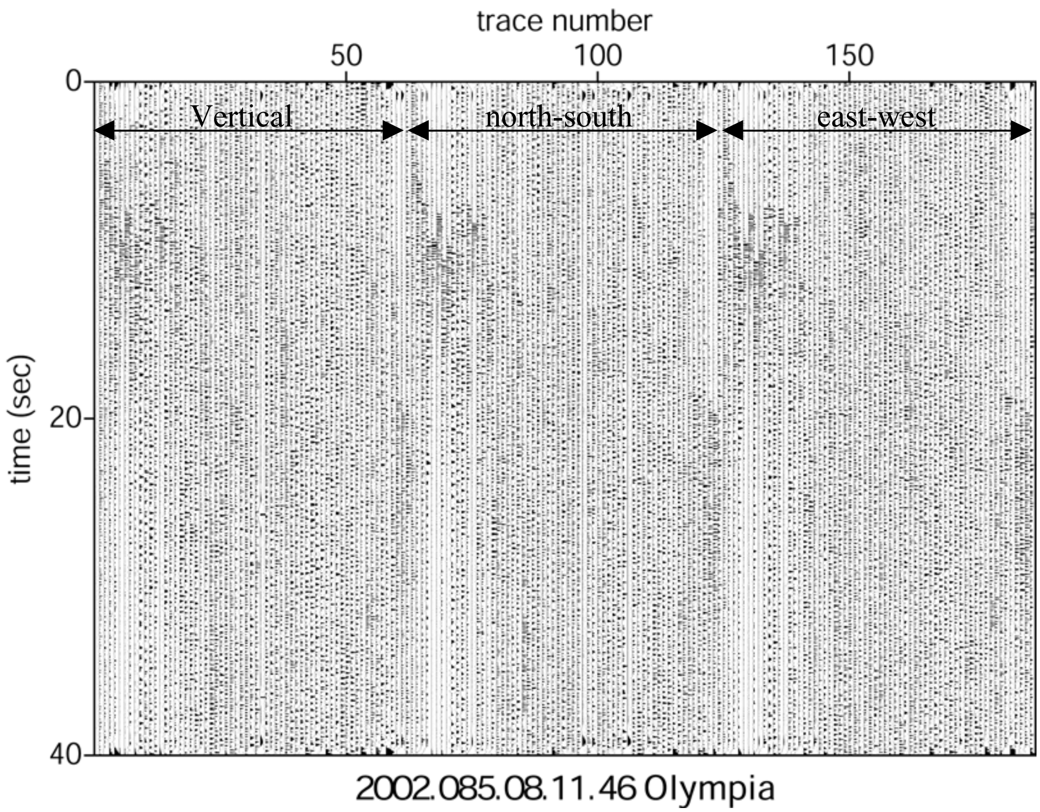

Figure 11a: M1.9 earthquake beneath Olympia, 9 km deep.

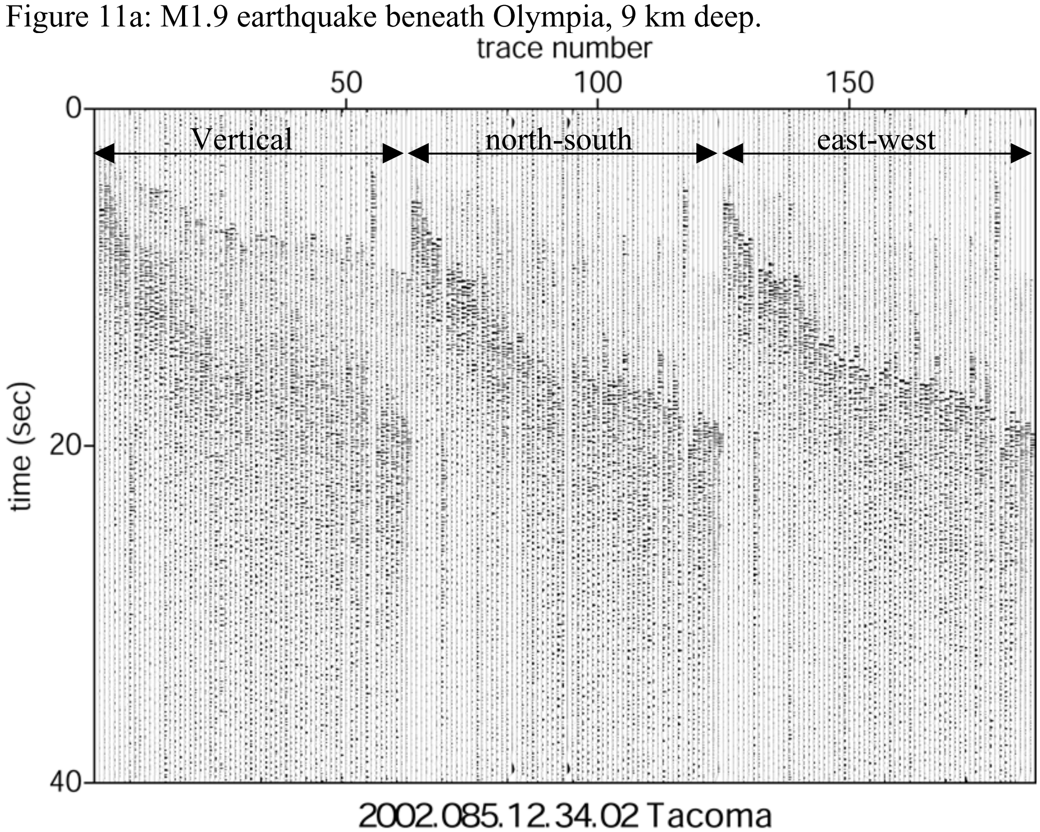

Figure 11b: M2.5 earthquake beneath Tacoma, 18 km deep.

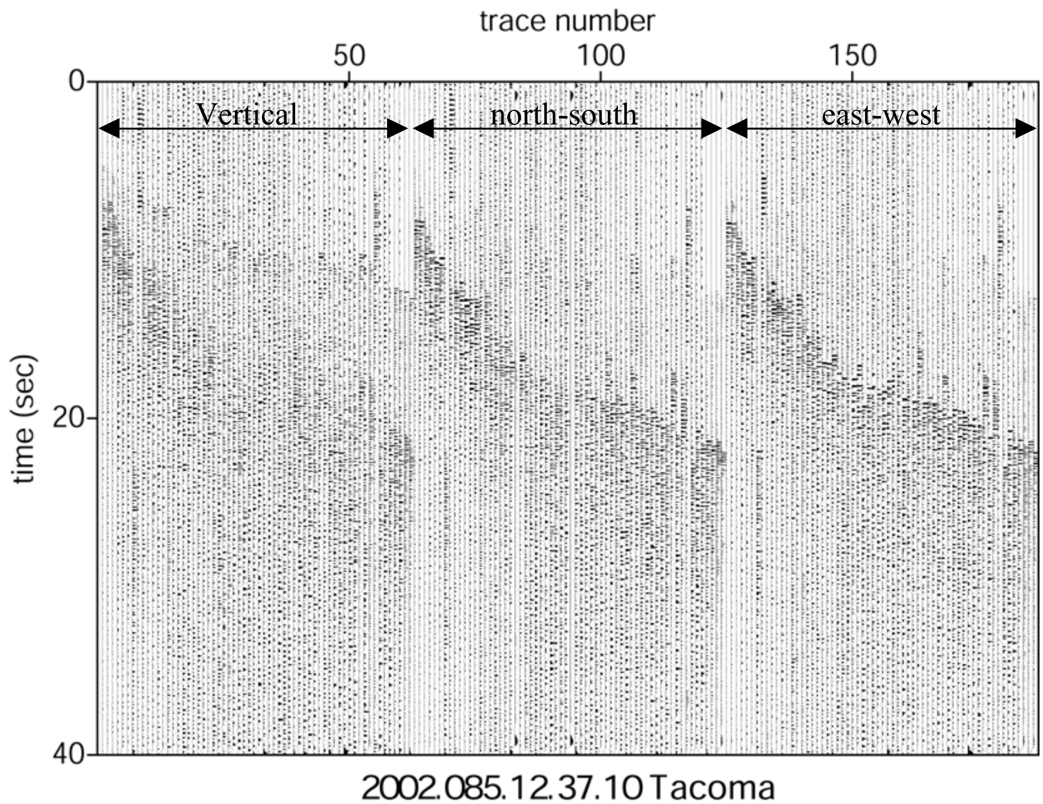

Figure 12a: M2.1 earthquake beneath Tacoma, 18 km deep.

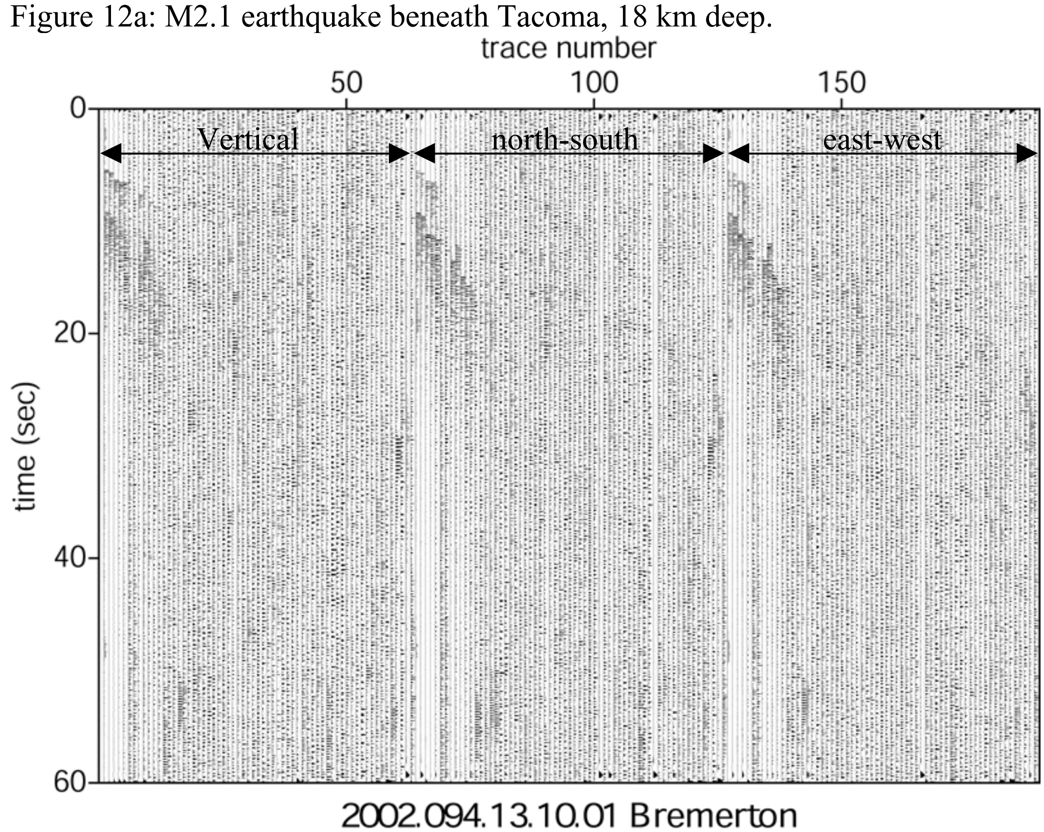

Figure 12b: M1.8 earthquake beneath Bremerton, 20 km deep.

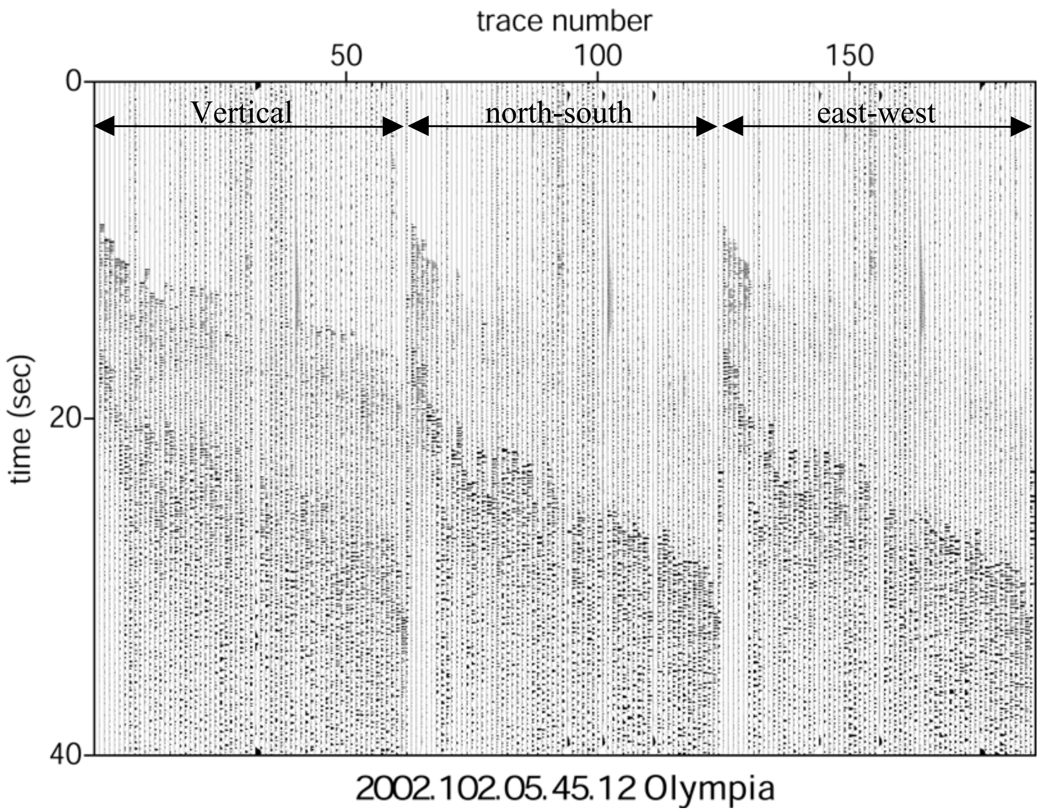

Figure 13a: M2.7 earthquake beneath Olympia, 43 km deep.

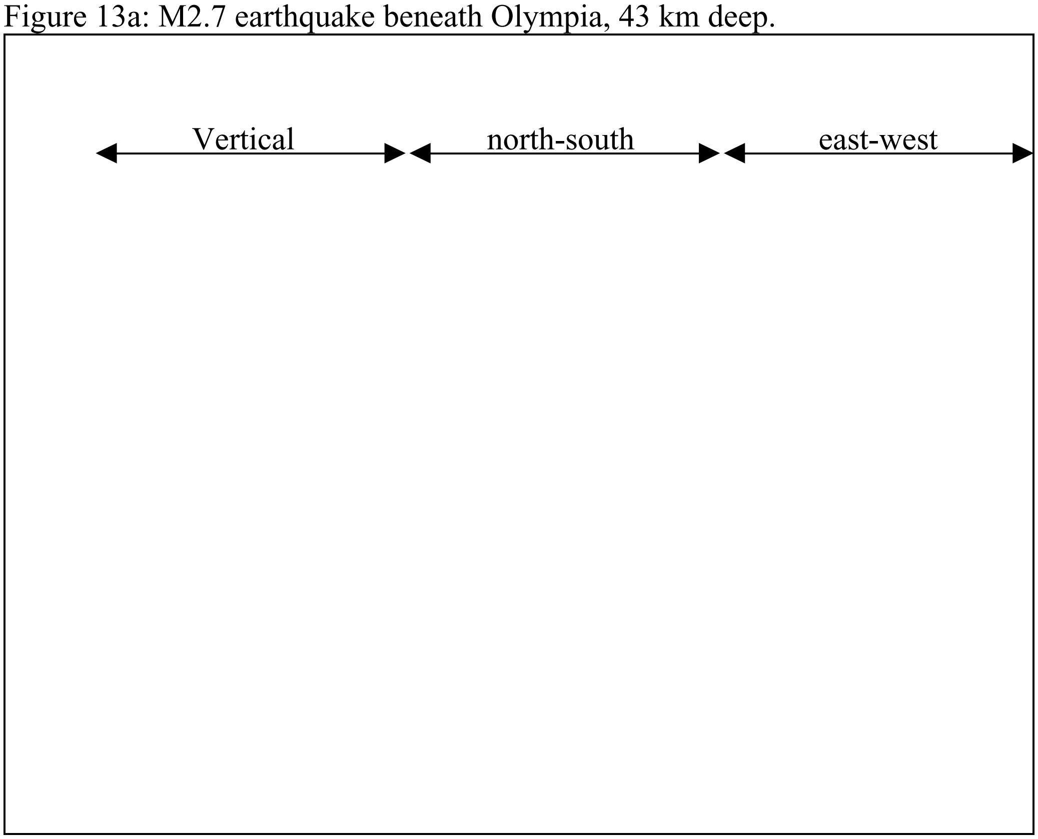

Figure 13b: M2.2 earthquake beneath Tacoma, 20 km deep.

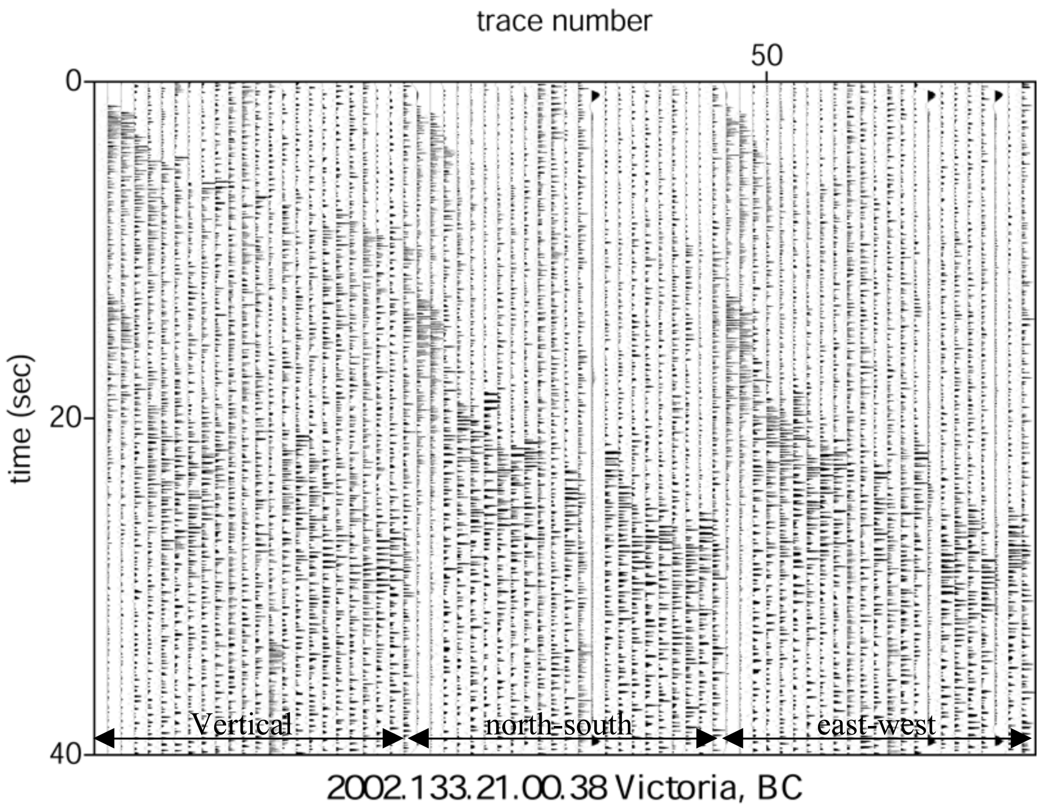

Figure 14a: M2.7 earthquake beneath Victoria, Canada, 43 km deep. Only 23 stations remaining.

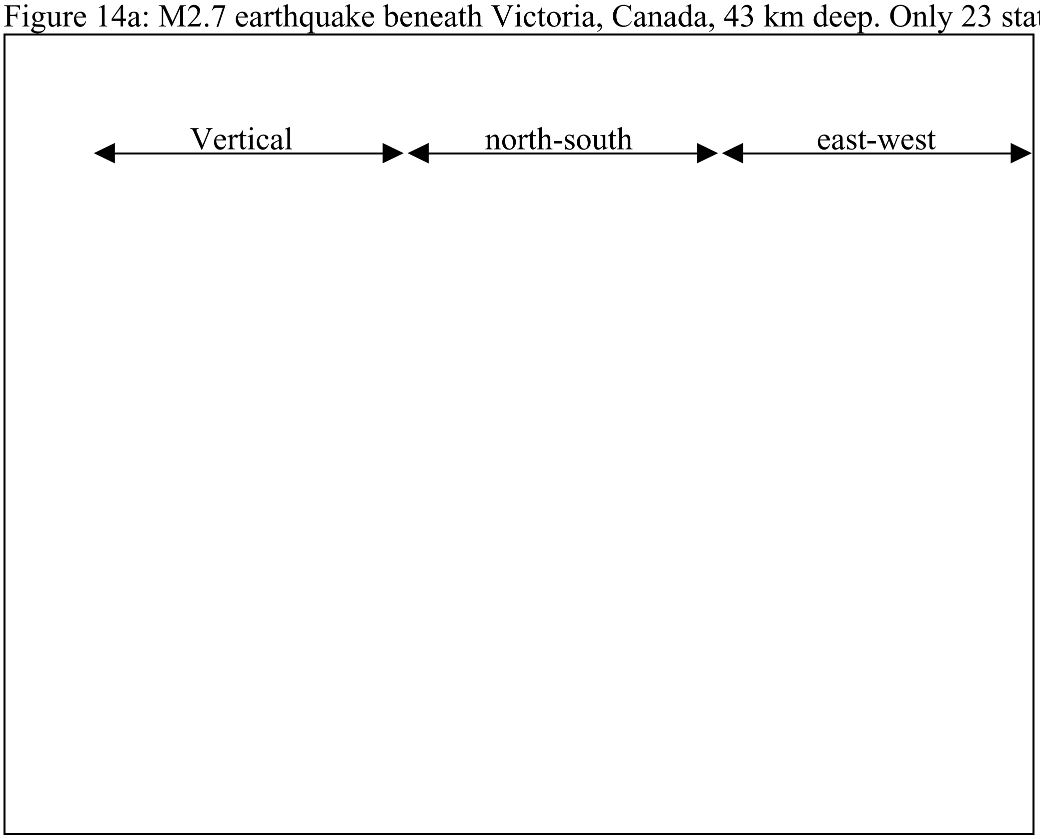

Figure 14b: M2.7 earthquake beneath Mt. Vernon, 14 km deep. Only 20 stations remaining.

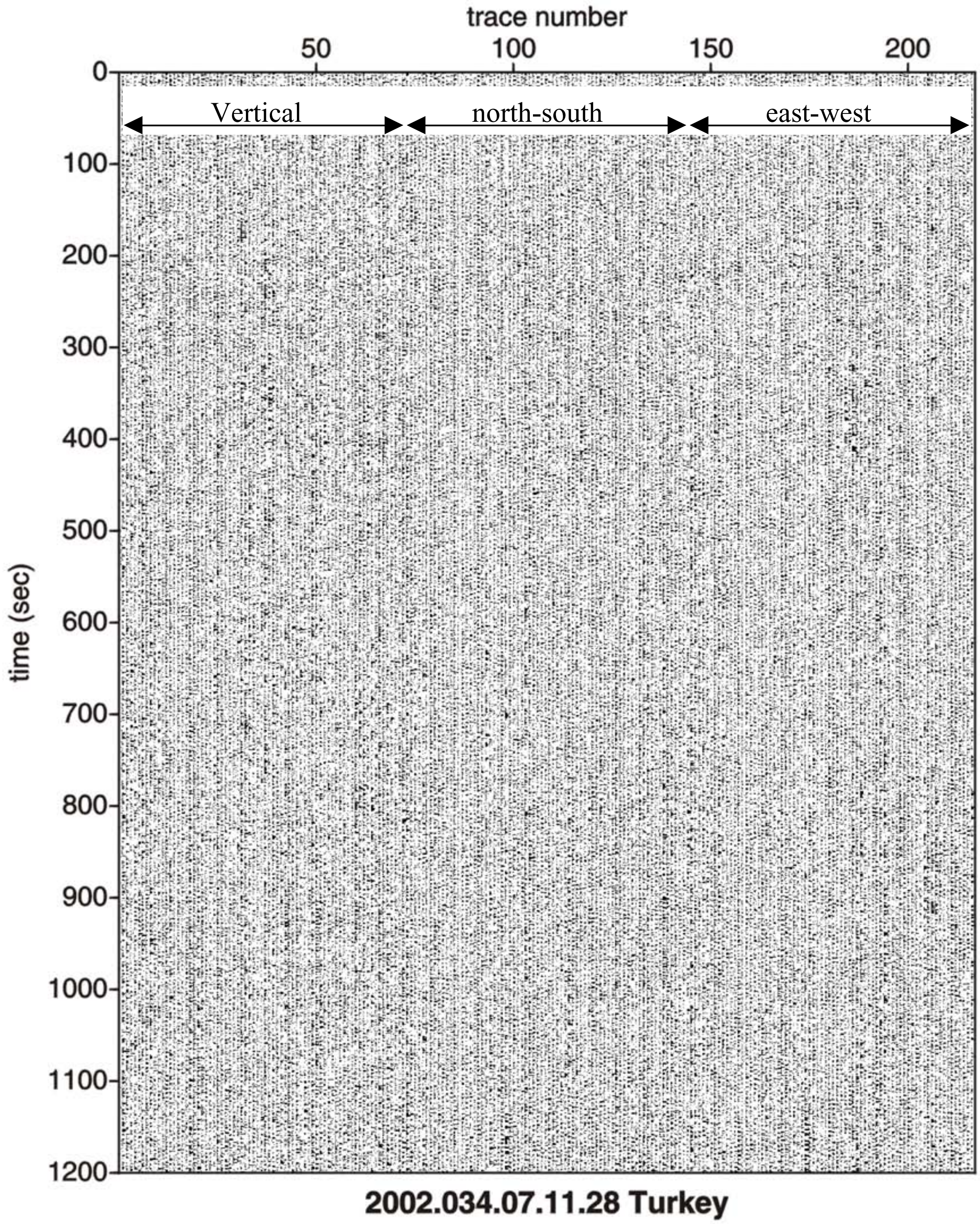

Figure 15: M6.5 earthquake in Turkey recorded on the SHIPS seismic array, with the vertical component data on the left third of the plot, the north-south component data in the middle third, and the east-west component data on the right third. The earthquake occurred at 7:11 GMT (23:11 local time) and has an epicentral distance of about 91…. Note that little signal is recorded, as was the case for most of the teleseisms with magnitudes of 6.5 or less. The data have a 0.05, 0.1, 0.8, 1.4 Hz trapezoidal bandpass filter.

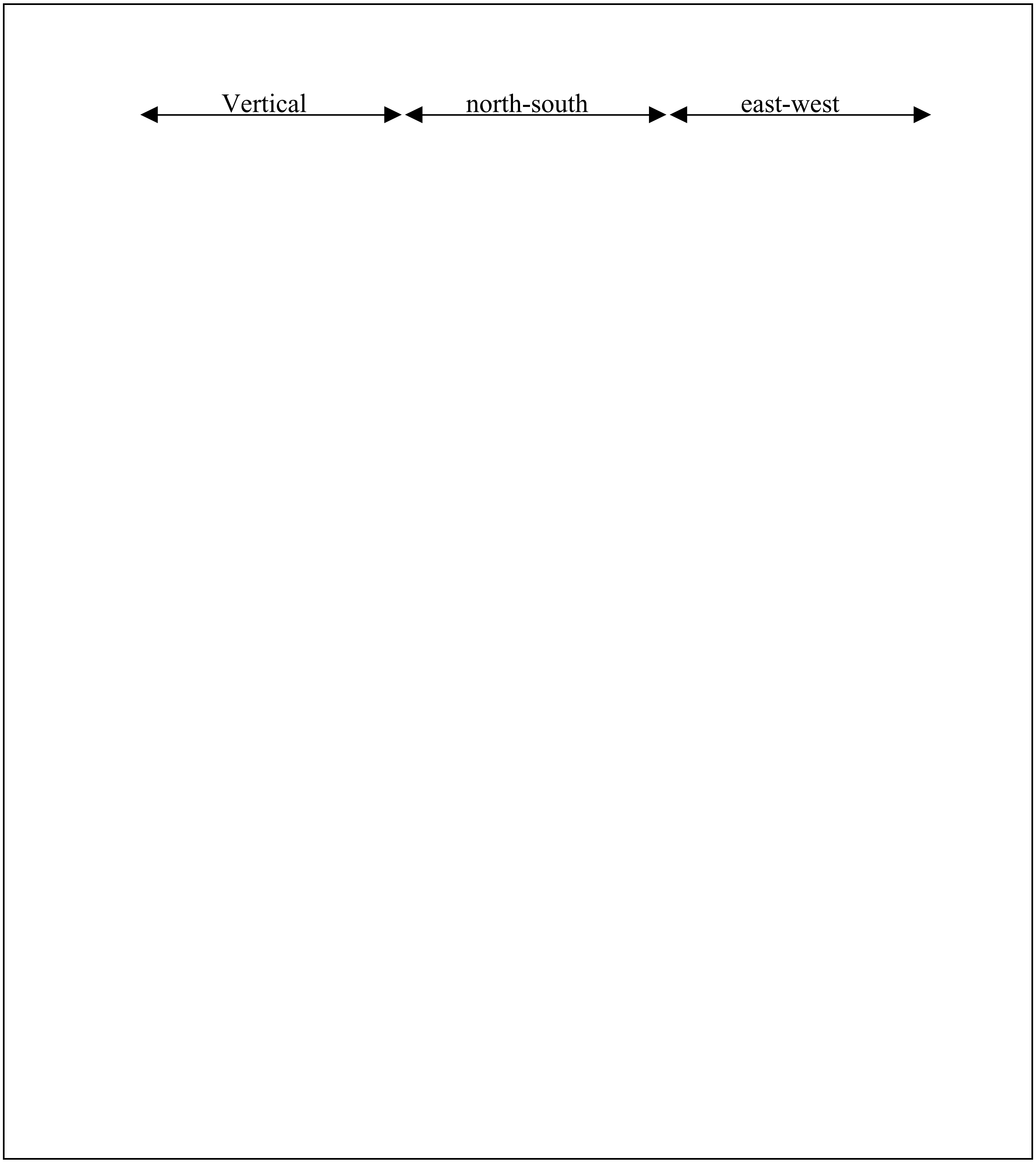

Figure 16: M7.4 earthquake in Afghanistan recorded on the SHIPS seismic array, with the vertical component data on the left third of the plot, the north-south component data in the middle third, and the east-west component data on the right third. The earthquake occurred at 12:08 GMT (4:08 local time) and has an epicentral distance of about 95…. There is a high signal-to-noise ratio because of low noise levels at 4 a.m. local time. The event was at a depth of about 250 km, and the P, sP, PP, pPP, SkS, S and PS phases (listed in order of arrival time) are visible. The data have a 0.05, 0.1, 0.8, 1.4 Hz trapezoidal bandpass filter.

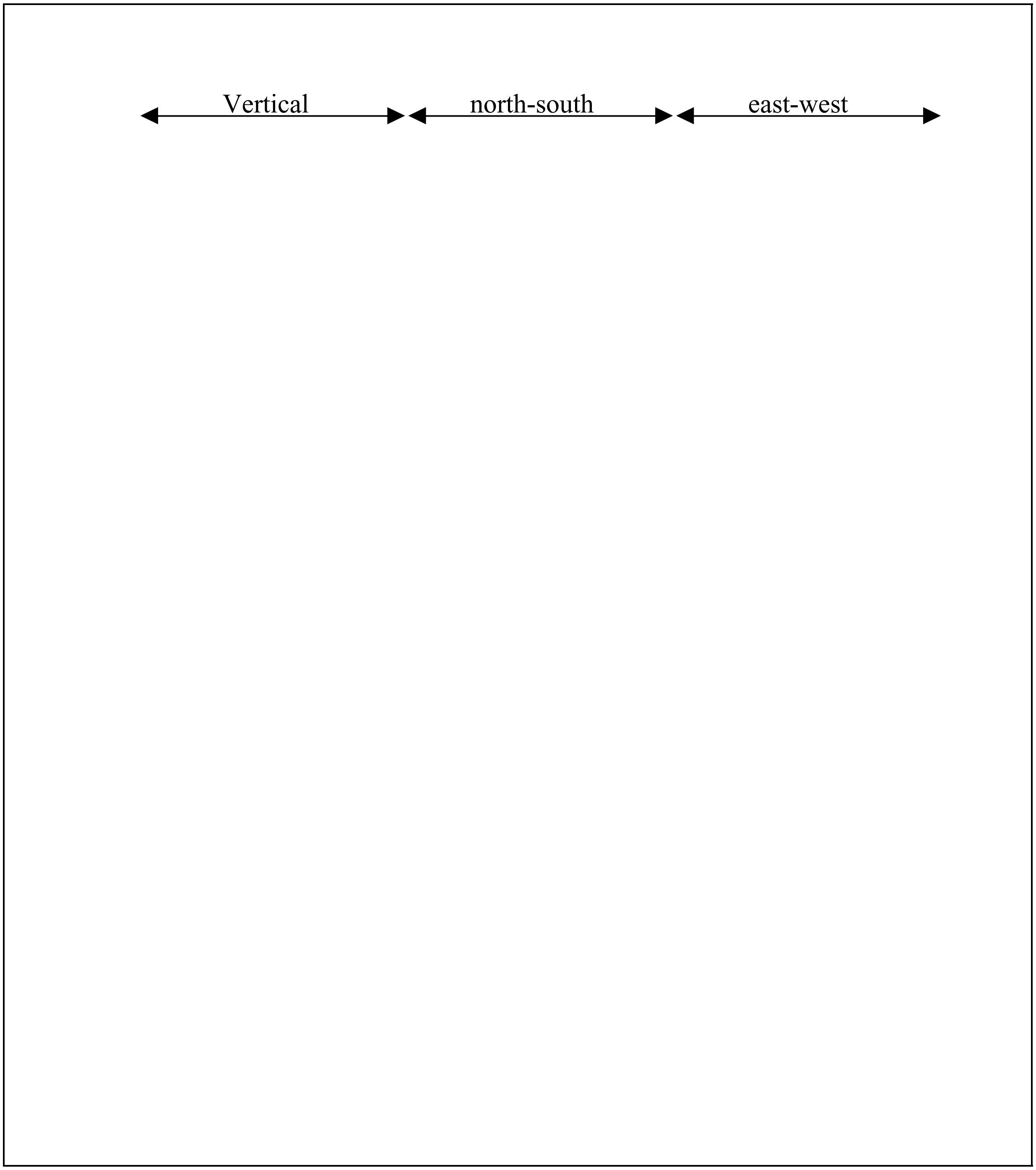

Figure 17: M7.5 earthquake in the Philippines recorded on the SHIPS seismic array, with the vertical component data on the left third of the plot, the north-south component data in the middle third, and the east-west component data on the right third. The earthquake occurred at 21:16 GMT (13:21 local time) and has an epicentral distance of about 101…. The P and S waves arrivals are obvious, although the signal-to-noise ratio is only moderately good because of high noise levels in the early afternoon. The data have a 0.05, 0.1, 0.8, 1.4 Hz trapezoidal bandpass filter.

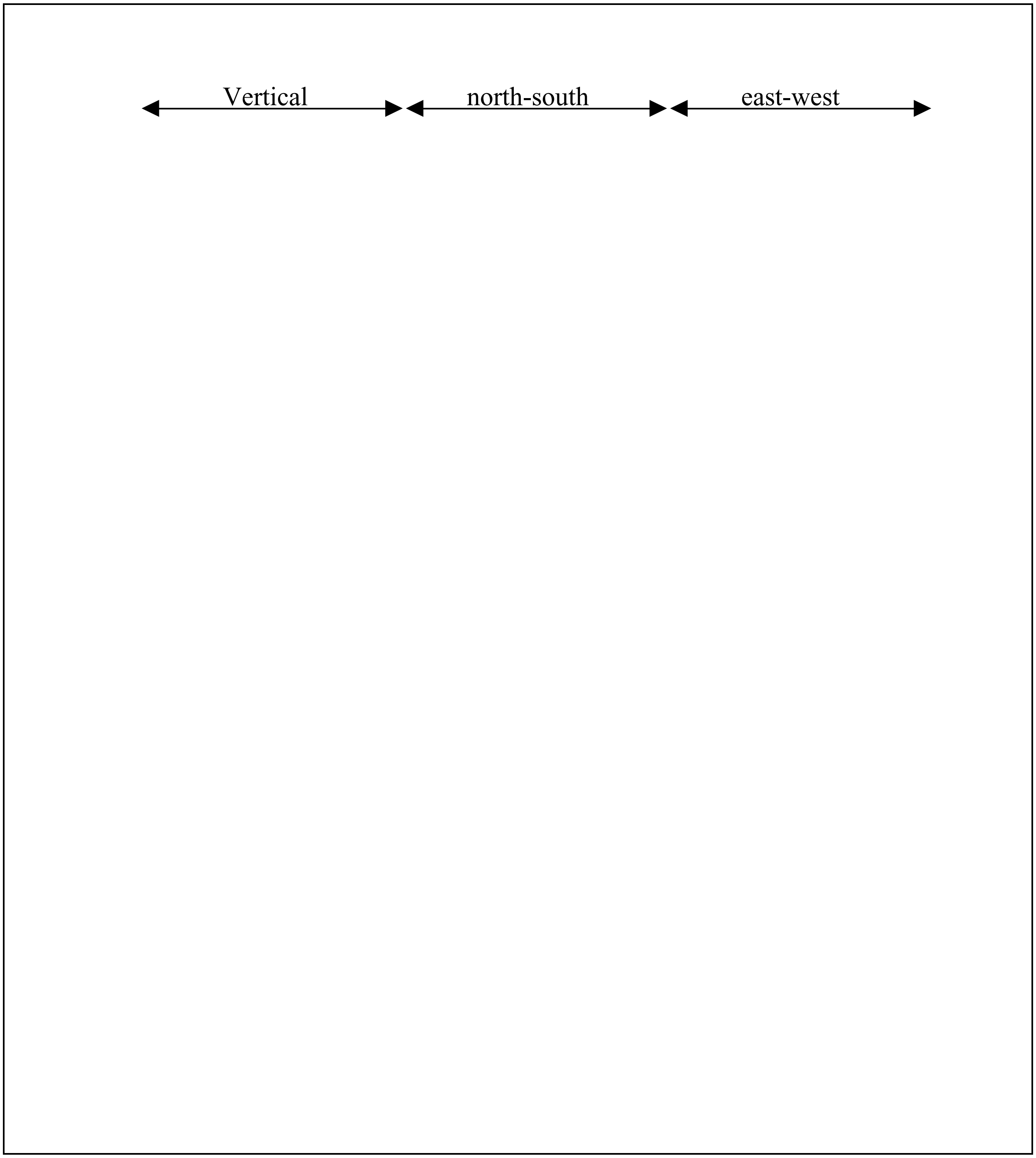

Figure 18: M7.1 earthquake in Taiwan recorded on the SHIPS seismic array, with the vertical component data on the left third of the plot, the north-south component data in the middle third, and the east-west component data on the right third. The earthquake occurred at 6:52 GMT (22:52 local time) and has an epicentral distance of about 88…. The P and S waves arrivals are obvious and have a good signal-to-noise ratio. The data have a 0.05, 0.1, 0.8, 1.4 Hz trapezoidal bandpass filter.

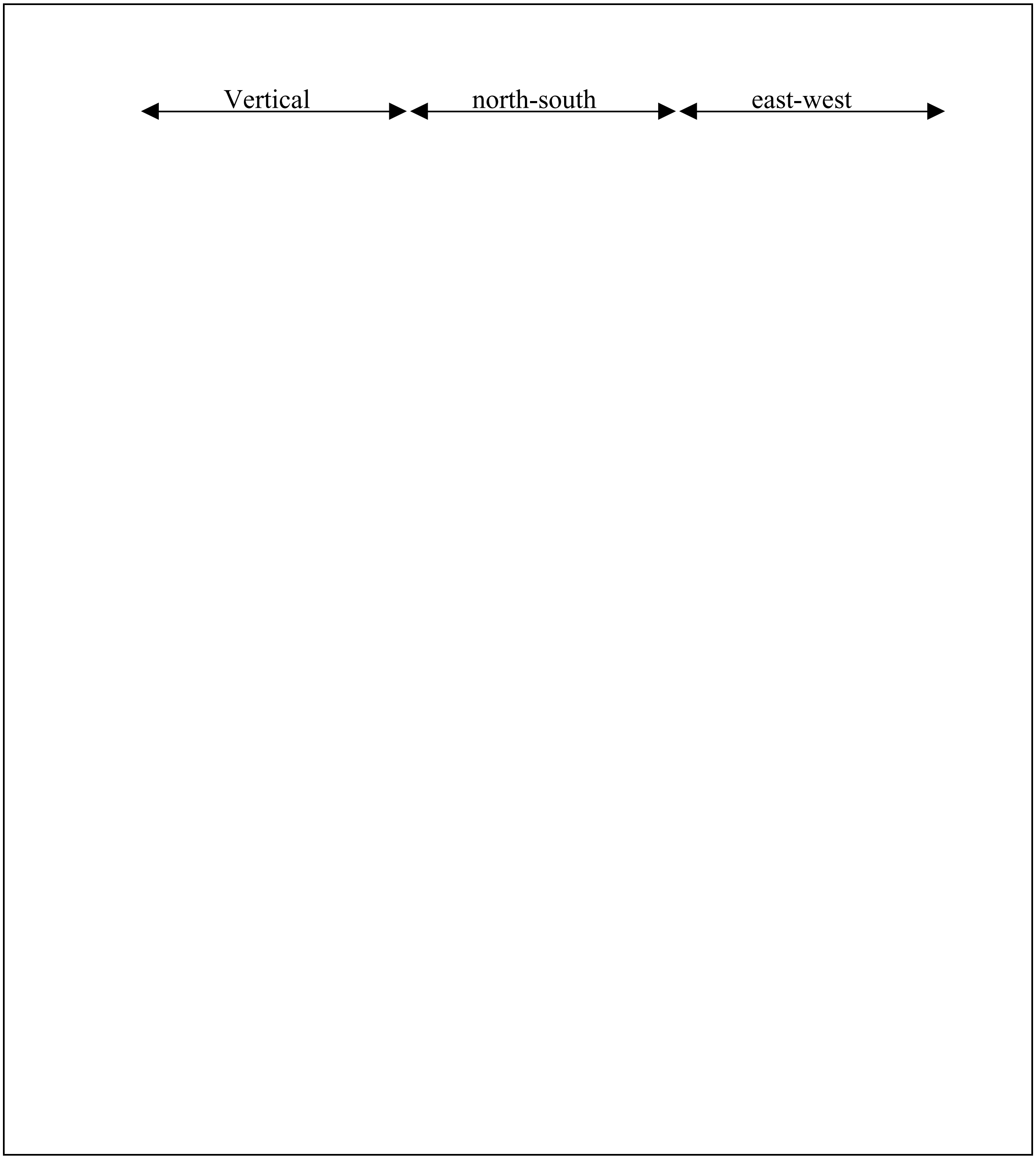

Figure 19: M6.7 earthquake in northern Chile recorded on the SHIPS seismic array, with the vertical component data on the left third of the plot, the north-south component data in the middle third, and the east-west component data on the right third. The earthquake occurred at 16:08 GMT (8:08 local time) and has an epicentral distance of about 88…. The P wave arrivals are obvious and have a good signal-to-noise ratio, but the S-wave arrivals are barely visible at about 800 sec on this plot. The data have a 0.05, 0.1, 0.8, 1.4 Hz trapezoidal bandpass filter.

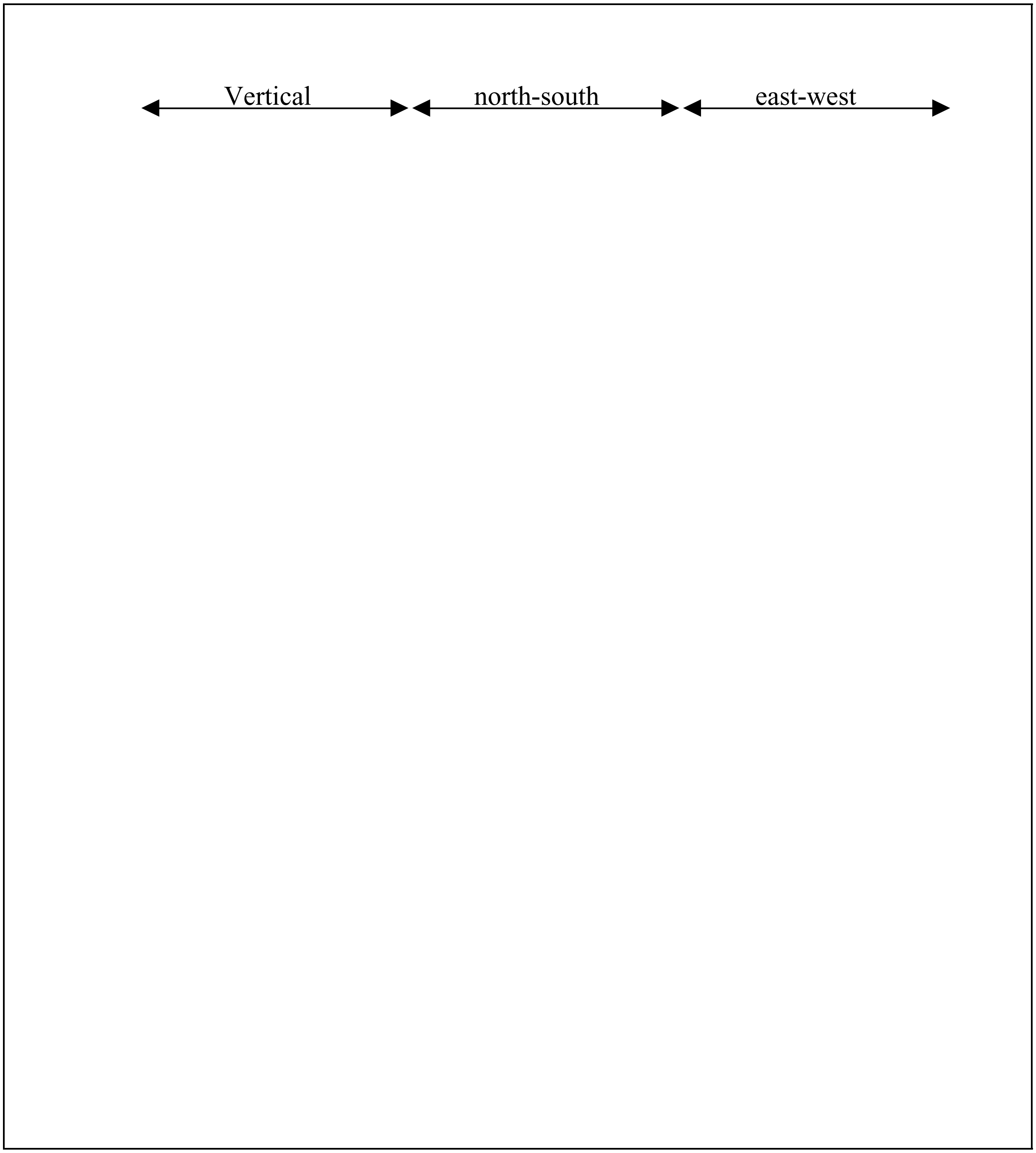

Figure 20: M7.1 earthquake in the Marianas recorded on the SHIPS seismic array, with the vertical component data on the left third of the plot, the north-south component data in the middle third, and the east-west component data on the right third. The earthquake occurred at 16:06 GMT (8:06 local time) and has an epicentral distance of about 82…. The P and S wave arrivals are obvious and have a good signal-to-noise ratio, despite high noise levels at the 8:06 a.m. local time of the arrivals. The data have a 0.05, 0.1, 0.8, 1.4 Hz trapezoidal bandpass filter. Only about 50 stations were operating at the time of the earthquake, so there are fewer traces on this plot than on previous plots.

APPENDIX A: SITE VISITS, INSTRUMENT STATUS, AND DOWNLOADS

(Following pages.) Graph showing the time of station operation, maintenance visits, and instrument status. Rows list each site, instrument (DAS) number, maintenance route (team) number, disk size, and instrument status each day (columns). Colors represent the instrument status, with green meaning everything working, blue meaning the GPS was not functioning, yellow meaning there were sensor problems, red meaning DAS failure (no data), and salmon meaning that no instrument was present at the site. Each maintenance visit is labeled with the number of megabytes of data that were downloaded. The label in marks when instruments were installed, dead/in, pull/in and ###/in mark days in which instruments were changed at the site (instrument numbers listed sequentially in 4th column). Significant GPS locks, preceding or following long periods with no locks, are denoted by the ^^ symbols. Full denotes days when disks were predicted to fill, but can be ignored because data were downloaded before the disks filled.

STA	Lat	Long	DAS	team	disk	1/26	1/27	1/28	1/29	1/30	1/31	2/1	2/2	2/3	2/4	2/5	2/6	2/7	2/8
				0	size	26	27	28	29	30	31	32	33	34	35	36	37	38	39
64	47.71952	-122.9731	7319	1	4		in												
65	47.70775	-122.931	7294	1	1		in												
66	47.68831	-122.9035	7618	1	1		in												
67	47.70918	-122.7984	7591	1	2			in											
68	47.69476	-122.7945	7595	1	1	in													
181	47.80935	-122.5682	7609	1	1	in													
182	47.85551	-122.5844	7299/7296	1	2	in						volt	drop						
39	47.68523	-122.7356	7331	2	1		in												
41	47.661	-122.6142	7597	2	2		in												
42	47.66539	-122.5447	7333	2	1	in													
143	47.70604	-122.563	7325	2	1		in												
71	47.66556	-122.5785	7441/7321	2	4		in												
186	47.63697	-122.5479	7599	2	1		in												
118	47.67797	-122.6592	7446/7604	2	2		in												
144	47.6886	-122.5079	7630	2	1	in													
35	47.471	-122.358	7279/7466	3	0.5		in												341
36	47.415	-122.315	7450	3	0.5		in												389
37	47.296	-122.371	7445	3	0.5	in													
38	47.339	-122.285	7467/6111/7608	3	2	in													391
40	47.491	-122.577	7596/7303	3	2		in												322/in
52	47.456	-122.349	7466	3	0.5			in											347
53	47.300	-122.294	7610/7611	3	0.5	in	^^												396
62	47.372	-122.309	7448	3	0.5	in													389
188	47.57499	-122.548	7431	3	2														in
27	47.56957	-122.3164	7090/7451	4	1	in						block?							
29	47.55313	-122.3755	7048	4	1	in													
32	47.53314	-122.3855	7079	4	1	in		overwritten											^ ^
33	47.52818	-122.3452	7081	4	1	in													
34	47.51188	-122.3835	7065	4	1	in							died						
57	47.52795	-122.3208	7103	4	2		in												
58	47.55386	-122.3267	7091	4	1		in												
111	47.57796	-122.4033	7107	4	1	in													^^
113	47.56443	-122.39	7064	4	1	in													
21	47.63512	-122.28295	7462	5	0.5	in											338		
22	47.62278	-122.3173	7365	5	0.5	in									died			257	
23	47.61021	-122.28676	7429	5	0.5	in												332	
25	47.58147	-122.29131	7594	5	0.5	in												353	
28	47.56566	-122.2728	6021/6084	5	0.5	in	died											0.5	
30	47.55669	-122.2989	7317	5	2		in											313	
31	47.55442	-122.2628	7449	5	0.5			in										305	
51	47.48886	-122.3126	7458	5	0.5		in	^^											346
54	47.60473	-122.3083	7098	5	0.5	in													
56	47.51247	-122.2589	7327/6126	5	0.5		dead	in											287
6	47.7069	-122.3737	7335	6	0.5	in										302			
12	47.67488	-122.3953	7457	6	0.5	in	died									302			
13	47.68125	-122.356	7433	6	0.5	in										299			
18	47.6447	-122.3684	6088	6	1		in									247			
19	47.64158	-122.3181	6096	6	1		in									238			
20	47.63134	-122.3455	6042	6	1		in									247			
59	47.67034	-122.3711	6019	6	1	in										267			
63	47.63751	-122.4051	6039/6085	6	1		in									269	dead		
96	47.69022	-122.3989	7336/7596	6	0.5	in						drop				301	no data		
98	47.6635	-122.3396	6132	6	1	in										268			
5	47.73219	-122.3325	7432	7	1	in									272				
7	47.73028	-122.3587	7626	7	2	in		died							58				
9	47.69301	-122.3347	7629	7	1		in								244				
10	47.68784	-122.2925	7281	7	1			in							233				
11	47.70079	-122.2793	7343	7	2	in									267				
14	47.68275	-122.2736	7443	7	4	in									260				
15	47.6691	-122.3156	7354/7446	7	4		in								242				
16	47.67128	-122.2562	7439	7	4		in								198				
60	47.72081	-122.2854	7280/7336	7	1	in							died		206				
61	47.66012	-122.2839	7344	7	2		in								232				
1	47.91782	-122.3157	16/7613/7280	8	1	in												299	
2	47.84439	-122.325	7348/7288	8	2		in											pull	
3	47.79254	-122.3502	7285/7318	8	2		in		died									52	
4	47.78088	-122.369	7284	8	2		in												
189	47.81623	-122.3709	7355	8	2		in												
50	47.88772	-122.3	7460	8	2	in												355	
82	47.74619	-122.1428	7619	8	1	in													
83	47.78991	-122.1683	7444	8	1	in													
43	47.65393	-122.1942	7316	9	1		in												
44	47.66327	-122.1614	7437	9	4		in												
45	47.64303	-122.1106	7601	9	2	in													
148	47.72134	-122.1615	7442	9	2		in												
84	47.59352	-122.1459	7453	9	1	in						^^							
85	47.55726	-122.1447	7352	9	1	in													
183	47.5311	-122.1503	7288	9	2	in													
169	47.66812	-122.1386	7283	9	1		in												
46	47.64487	-121.9117	7620	10	2	in													
74	47.66443	-122.093	7602	10	1		in												
75	47.66255	-122.0418	7328/7613	10	0.5		in												
76	47.67601	-121.9927	7302	10	1	in													
77	47.6547	-121.9532	7617/6119	10	1	in													
79	47.65888	-121.8295	7605/7467	10	0.5														
80	47.65353	-121.7614	7295	10	1														
81	47.6536	-121.7119	08/7327/7467	10	0.5														

everything working well

GPS not functioning

sensor problems

EQUIPMENT FAILURE

^ ^ significant locks

NO INSTRUMENT IN GROUND


STA
2/9 2/10 2/11 2/12 2/13 2/14 2/15 2/16 2/17 2/18 2/19 2/20 2/21 2/22 2/23 2/24 2/25 2/26 2/27 2/28 3/1 3/2 3/3 3/4 3/5 3/6 3/7 3/8
40 41 42 43 44 45 46 47 48 49 50 51 52 53 54 55 56 57 58 59 60 61 62 63 64 65 66 67
everything working well
GPS not functioning
sensor problems
EQUIPMENT FAILURE
^ ^ significant locks

X