

RAINIER

SEISMIC VELOCITY STRUCTURE OF THE GREATER MOUNT RAINIER AREA

Submitted By

Dr. Stephen D. Malone
University of Washington

PASSCAL Data Report 96-012



Distributed by

*Incorporated Research Institutions for Seismology
Data Management Center
1408 NE 45th Street
Suite 201
Seattle, Washington 98105*

Experiment Name: Seismic Velocity Structure of the Greater Mount Rainier Area

Principal Investigator: Dr. Stephen D Malone

Date of Start of Field Work: 7/16/94

End Date of Field Work: 8/19/94

Short Description of Experiment:

The goal of our experiment was to construct an east-west refraction profile across the Southern Washington Cascades, stretching from the Puget Sound basin across Mount Rainier to the Columbia River Plateau. The profile was unreversed; our only sources were from daily blasts at a coal-mining operation in Centralia, WA, on the western end of our profile. We occupied a total of 47 temporary sites for ~1 week at a time, including two sites at the coal mine that were in operation for all but the first week of the experiment (these two sites were used for origin time determination). Data from these sites were later combined with records from 15 permanent seismographs in the Pacific Northwest Seismic Network (PNSN) to form a composite record section along a ~175km-long line. 33 blasts of varying quality were recorded during our experiment. The temporary sites also recorded signals from 34 earthquakes that were well located by the PNSN, which are included in this dataset.

Number of Stations: 47

Coordinates of Refraction Line:

46N4560 122W5040

47N0300 119W5160

Recording Parameters:

Number of Channels: 3

Data Format: Compressed

Sample Interval: 100 samples/sec

Recording Mode: Triggered

Number of Channels for Trigger: 1

Normal Operating Parameters:

Pre-trigger window: 15 seconds

Post-trigger window: Nothing

Recording Length: 30 seconds

STA Length: 1 second

LTA Length: 20 seconds

Mean Removal: 10 seconds

Trigger Ratio: 2.7

Detrigger Ratio: Nothing

LTA Hold: Off

Approximate Amount of Data: 50 Mbytes

Known Problems in the Data:

1) The data from the blasts are of low quality. Only a few blasts generated good

impulsive arrivals at a significant number of stations, and the waveforms from blast to blast varied enough to make identification of secondary arrivals difficult on the composite record section.

2) For the first 2.5 weeks we had trouble with DAS acquisition shutting off after a few hours-to-days of recording time. We determined that the problem was caused by setting the dettrigger ratio to be something other than 0.0. Our solution was to not set the dettrigger ratio. This problem resulted in a significant loss of data.

Expected Date of Submission to DMC: 07/31/96

Format Data will be in?: SEG-Y

Experiment Name: Seismic Velocity Structure of the
Greater Mount Rainier Area

Principal Investigator: Dr. Stephen D Malone

Date of Start of Field Work: 7/16/94

End Date of Field Work: 8/19/94

Short Description of Experiment:

The goal of our experiment was to construct an east-west refraction profile across the Southern Washington Cascades, stretching from the Puget Sound basin across Mount Rainier to the Columbia River Plateau. The profile was unreversed; our only sources were from daily blasts at a coal-mining operation in Centralia, WA, on the western end of our profile. We occupied a total of 47 temporary sites for roughly 1 week at a time, including two sites (NRTH and SOTH) at the coal mine that were in operation for all but the first week of the experiment (these sites were used for origin time determination). Data from these sites were later combined with records from 15 permanent seismographs in the Pacific Northwest Seismic Network (PNSN) to form a composite record section along an approximately 175km-long line. 33 blasts of varying quality were recorded during our experiment. The temporary sites also recorded signals from 34 earthquakes that were well-located by the PNSN. This dataset includes waveforms of these blasts and earthquakes recorded at the temporary sites only.

STATION LIST

| Station | Latitude | Longitude | Elevation |
|---------|----------|-----------|-----------|
| RGHT | 47.3496 | -120.7660 | 1.018 |
| WREK | 47.3458 | -120.7500 | 1.109 |
| PINE | 47.3326 | -120.8360 | 0.821 |
| TRGT | 47.3438 | -120.7720 | 0.970 |
| INTR | 47.3259 | -120.8510 | 0.791 |
| PATH | 47.3307 | -120.8452 | 0.809 |
| EPHM | 47.3349 | -120.8270 | 0.848 |
| GRAV | 47.3469 | -120.8031 | 0.903 |
| SLSH | 47.3477 | -120.7919 | 0.921 |
| COWP | 47.3423 | -120.8156 | 0.873 |
| WREN | 46.9021 | -121.5522 | 1.079 |
| TAMT | 46.8902 | -121.5961 | 1.167 |
| WRCP | 46.9013 | -121.6487 | 1.333 |
| XTAL | 46.9309 | -121.4745 | 1.345 |
| KLAP | 46.8482 | -121.9197 | 1.236 |
| CM24 | 46.8424 | -121.9703 | 0.909 |
| CM33 | 46.8548 | -122.0579 | 0.833 |
| MOW2 | 46.8757 | -121.8202 | 2.455 |
| MOW1 | 46.8741 | -121.8139 | 2.515 |
| LDGE | 46.9363 | -121.3544 | 1.042 |
| FIFE | 46.9627 | -121.2851 | 1.030 |
| VIEW | 46.9914 | -121.0781 | 0.982 |
| LAWN | 46.9961 | -121.0303 | 1.279 |
| CHIP | 46.9510 | -121.1934 | 0.921 |
| NRTH | 46.7656 | -122.8349 | 0.110 |
| SOTH | 46.7379 | -122.8193 | 0.110 |
| RAVN | 47.0255 | -121.3349 | 1.806 |

| | | | |
|------|---------|-----------|-------|
| BOLT | 47.0350 | -121.3111 | 1.612 |
| FIRE | 47.0344 | -121.2899 | 1.479 |
| CORD | 47.0344 | -121.2714 | 1.352 |
| ELKS | 47.0421 | -121.2618 | 1.236 |
| BURN | 47.0435 | -121.2428 | 1.152 |
| KAYP | 47.0327 | -121.2176 | 1.067 |
| HRPN | 47.0343 | -121.1975 | 1.061 |
| RCKS | 47.0291 | -121.1771 | 0.927 |
| BLOG | 47.0250 | -121.1583 | 0.897 |
| SGBA | 47.0093 | -121.4991 | 1.300 |
| FLAT | 47.0092 | -121.4877 | 1.500 |
| CRLP | 47.0140 | -121.4698 | 1.700 |
| CULV | 46.9131 | -121.4576 | 1.394 |
| BPRW | 46.9104 | -121.4371 | 1.321 |
| TREE | 46.9160 | -121.3912 | 1.090 |
| VIEW | 46.9914 | -121.0781 | 0.982 |
| LAWN | 46.9961 | -121.0304 | 1.279 |

Calibration Information Acquired:

We did not acquire any calibration information.

Timing Corrections Made to Data:

No corrections have been made to the data. Time was tracked by GPS receivers, and we saw no evidence for significant clock drift at any site.

Known Problems in the Data:

There are no problems with the data included in this report that we are aware of. However, two comments are worth making regarding problems we had recording the data:

1) The data from the blasts are of low quality. Only a few blasts generated good impulsive arrivals at a significant number of stations, and the waveforms from blast to blast varied enough to make identification of secondary arrivals difficult on the composite record section.

2) For the first 2.5 weeks we had trouble with DAS acquisition shutting off after a few hours-to-days of recording time. We determined that the problem was caused by setting the dettrigger ratio to be something other than 0.0. Our solution was to not set the dettrigger ratio. This problem resulted in a significant loss of data.

LIST OF EVENTS:

Blasts from Centralia Coal Mine:

| Date | Time(*) | Latitude(**) | Longitude | Depth |
|------------|---------|--------------|-----------|-------|
| 9407182224 | 55.85 | 46.7725 | -122.8385 | -0.10 |
| 9407192203 | 10.52 | 46.7725 | -122.8385 | -0.10 |
| 9407202147 | 63.94 | 46.7725 | -122.8385 | -0.10 |
| 9407212151 | 15.93 | 46.7725 | -122.8385 | -0.10 |
| 9407221646 | 24.05 | 46.7725 | -122.8385 | -0.10 |
| 9407222203 | 37.75 | 46.7725 | -122.8385 | -0.10 |
| 9407262314 | 50.03 | 46.7725 | -122.8385 | -0.10 |
| 9407272139 | 62.12 | 46.7725 | -122.8385 | -0.10 |
| 9407282126 | 12.58 | 46.7725 | -122.8385 | -0.10 |
| 9407292128 | 60.42 | 46.7725 | -122.8385 | -0.10 |

| | | | | |
|------------|-------|---------|-----------|-------|
| 9407302144 | 49.32 | 46.7725 | -122.8385 | -0.10 |
| 9407311816 | 46.92 | 46.7725 | -122.8385 | -0.10 |
| 9408012147 | 41.42 | 46.7725 | -122.8385 | -0.10 |
| 9408022101 | 62.17 | 46.7725 | -122.8385 | -0.10 |
| 9408032103 | 37.62 | 46.7725 | -122.8385 | -0.10 |
| 9408041847 | 21.86 | 46.7725 | -122.8385 | -0.10 |
| 9408042159 | 58.91 | 46.7725 | -122.8385 | -0.10 |
| 9408052122 | 55.06 | 46.7725 | -122.8385 | -0.10 |
| 9408062006 | 65.21 | 46.7725 | -122.8385 | -0.10 |
| 9408062154 | 63.41 | 46.7725 | -122.8385 | -0.10 |
| 9408082122 | 20.31 | 46.7725 | -122.8385 | -0.10 |
| 9408092204 | 71.59 | 46.7725 | -122.8385 | -0.10 |
| 9408102137 | 55.88 | 46.7725 | -122.8385 | -0.10 |
| 9408112111 | 29.89 | 46.7725 | -122.8385 | -0.10 |
| 9408122140 | 55.56 | 46.7725 | -122.8385 | -0.10 |
| 9408131635 | 70.08 | 46.7725 | -122.8385 | -0.10 |
| 9408132117 | 55.05 | 46.7725 | -122.8385 | -0.10 |
| 9408142124 | 51.57 | 46.7725 | -122.8385 | -0.10 |
| 9408142233 | 48.25 | 46.7725 | -122.8385 | -0.10 |
| 9408152124 | 70.47 | 46.7725 | -122.8385 | -0.10 |
| 9408162133 | 56.36 | 46.7725 | -122.8385 | -0.10 |
| 9408172211 | 43.52 | 46.7725 | -122.8385 | -0.10 |
| 9408182236 | 42.17 | 46.7725 | -122.8385 | -0.10 |

(*) Origin time is from network locations, & may be in error. We calculated origin times by computing travel time from source to nearest receiver (NRTN) and subtracting this from arrival time at receiver.

(**) Latitude and longitude and depth are for the coordinates and elevation of the center of the coal mine pit, which is roughly 1 km long (east-west) by 0.25 km wide. We never received surveyed locations from the coal mine, so these locations represent our best estimate. Depth is relative to sea level.

Earthquakes:

| Date | Time | Latitude(*) | Longitude | Depth |
|------------|-------|-------------|-----------|-------|
| 9407201506 | 55.59 | 46.7887 | -120.0078 | 0.02 |
| 9407220557 | 54.86 | 46.6488 | -121.0093 | 5.75 |
| 9407220956 | 58.99 | 47.6293 | -122.0087 | 6.04 |
| 9407221141 | 24.11 | 47.6303 | -122.0088 | 8.21 |
| 9407221335 | 14.61 | 47.6368 | -122.0073 | 11.87 |
| 9407221445 | 15.71 | 47.6288 | -122.0073 | 2.70 |
| 9407221725 | 21.92 | 46.8583 | -119.0032 | 2.02 |
| 9407271311 | 25.97 | 46.7997 | -121.0093 | 5.88 |
| 9407282012 | 54.66 | 47.9168 | -122.0163 | 23.16 |
| 9407282020 | 58.95 | 47.0288 | -122.0032 | 5.18 |
| 9407300909 | 52.83 | 46.7390 | -121.0090 | 9.18 |
| 9407301925 | 68.11 | 46.8527 | -121.0092 | 12.79 |
| 9408010534 | 62.47 | 46.5202 | -122.0043 | 18.18 |
| 9408011458 | 51.05 | 46.0210 | -122.0107 | 6.77 |
| 9408060643 | 53.26 | 47.3797 | -122.0065 | 22.62 |
| 9408070517 | 66.19 | 47.6582 | -120.0165 | 5.95 |
| 9408080230 | 14.99 | 46.8530 | -121.0095 | 13.52 |
| 9408080638 | 30.47 | 46.9718 | -123.0053 | 32.58 |
| 9408091403 | 20.07 | 48.3115 | -123.0038 | 19.92 |
| 9408100725 | 9.09 | 47.5205 | -121.0080 | 13.16 |
| 9408100726 | 67.63 | 46.8573 | -121.0075 | 3.59 |
| 9408122043 | 19.33 | 46.9628 | -120.0090 | 3.77 |
| 9408130224 | 17.95 | 46.7857 | -120.0080 | 0.58 |
| 9408130443 | 10.17 | 46.9718 | -120.0090 | 2.98 |
| 9408130635 | 53.74 | 46.6465 | -122.0052 | 14.39 |

| | | | | |
|------------|-------|---------|-----------|-------|
| 9408131149 | 27.90 | 46.7568 | -121.0090 | 11.67 |
| 9408131221 | 17.88 | 46.7808 | -120.0078 | 1.28 |
| 9408140329 | 11.30 | 47.2812 | -122.0037 | 14.39 |
| 9408141608 | 22.30 | 46.3383 | -122.0023 | 10.13 |
| 9408151504 | 54.99 | 46.7025 | -122.0108 | 17.67 |
| 9408160639 | 41.91 | 47.5873 | -121.0095 | 12.70 |
| 9408170515 | 43.61 | 46.5175 | -122.0042 | 20.20 |
| 9408171256 | 21.97 | 46.8628 | -121.0073 | 0.02 |
| 9408172050 | 43.76 | 47.6313 | -121.0033 | 19.37 |

(* Time and locations were determined by the PNSN using permanent PNSN stations only. Depth is relative to an elevation of 1 km above sea level (the average PNSN station elevation).