Investigations

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Results

Network operation for stations in western Washington continued normally. No unusual regional earthquake activity was recorded and the Mt. St. Helens region remained generally quiet. A new station (MEW) sited on McNeil Island in the south part of Puget Sound began operation in early 1985, improving coverage of the central Puget Sound region. A nearby station on the Kitsap Peninsula near Port Gamble is presently being installed, and should further enhance the network. Network coverage in the northeast part of the Puget Sound basin will improve with the installation and reinstallation of stations in the Skagit Valley. The telemetry link for these stations is now available, and one station in the Skagit Valley, BLS, is operational but noisy. Signal quality should be improved by a planned telemetry re-routing. Station RMW was restored in November, 1984 after an outage of several months. Stations APW (vandalized in late 1984) and STW (destroyed by machinery in July, 1984) were repaired in March, 1985. Stations RVW, NLO, and HDW ceased operation during the winter and are scheduled for repair. Loss of several stations is typical in winter months, and stations are restored as good weather permits. A skeletal network of calibrated stations is being installed, to improve our ability to study earthquake spectra, source parameters and transmission characteristics.

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Earthquake Hazard Investigations in the Pacific Northwest

14-08-0001-21862

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Investigations

The objectives of this research are to provide fundamental data and interpretations for earthquake hazard investigations. Currently, we are focusing on seismicity, structure, and tectonic questions related to the occurrence of a hypothetical major subduction earthquake on the Juan de Fuca - North American plate boundary. Specific tasks which we have worked on in this contract period are:

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Articles:

Crosson, R.S., 1985 (in preparation), A New Algorithm for Automated Determination of Phase Arrival Times and its Application to Regional Network Data, to be submitted to B.S.S.A.


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14-08-0001-21862

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Abstracts:


Reports:


Earthquake Hazard Investigations in the Pacific Northwest
14-08-0001-22007

R.S. Crosson
Geophysics Program
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Seattle, WA 98195
(202) 543-8020

Investigations

The objectives of this research are to provide fundamental data and interpretations for earthquake hazard investigations. Currently, we are focusing on seismicity, structure, and tectonic questions related to the occurrence of a hypothetical major subduction earthquake on the Juan de Fuca - North American plate boundary. Specific tasks which we have worked on in this contract period are:

1. Compiling a uniform data-base of all arrival time data available for Washington and northern Oregon from 1970 to the present.

2. Calibration of computer determined codas for magnitude determination.

3. Initial studies of tomographic inversion of travel times to determine three-dimensional earth structure.

4. Locations, focal mechanisms and occurrence characteristics of crustal and subcrustal earthquakes beneath western Washington and their relationship to subduction processes.

5. Re-examination of teleseismic travel-times of large events in the Pacific Northwest for evidence of slab location and orientation.

6. Analysis and interpretation of Pn observations.

7. Study of three-dimensional seismic attenuation (Q) structure of the Puget Sound area (primarily funded under another project).

Results

1. We are establishing a uniform base of arrival time data for all network data from 1970 to the present. From 1970 through 1979, data were archived in several different formats, at several sites. 'Pickfiles' of arrival times have been reformatted and events relocated using updated velocity models and location routines. The western Washington data from 1970-1979 are complete, and are being used in research. Eastern Washington data from 1975-1979 have been reformatted, and are being checked for completeness.

2. We have completed calibration of our computer coda magnitude determination algorithm using 18 earthquakes for which $M_p$ was available. Routine use of this procedure may improve the consistency of magnitude estimates.

3. We are investigating the feasibility of a tomographic inversion of arrival-time data to determine the velocity structure of the Puget Sound area using P and S-wave data recorded by the
University of Washington seismic network. We hope to use local events to determine crustal velocity structure shallower than about 40 km. We are presently exploring the effect of a non-isotropic data set, and calculating the approximate resolution which could be achieved with this method.

4. A data base of focal mechanisms is being established. We have plotted stereographic projections of first-arrival polarities for about 60 of the largest earthquakes in Washington. These projections are being checked against data traces, and focal mechanisms determined when possible. A grading scheme will be implemented to indicate the quality of focal mechanism solutions. Such a grading scheme will consider inconsistent or ambiguous arrivals, and the range of feasible focal mechanisms. Once completed, the data base will be used to determine the most probable set of regional tectonic stresses in western Washington.

5. Teleseismic residuals from the 1965 Puget Sound earthquake were interpreted by McKenzie and Julian (1971) to indicate a north-south striking slab dipping 50 degrees East. These residuals were calculated using the Jeffreys-Bullen travel-time tables. We are redoing these calculations using several travel-time models and additional earthquakes in an attempt to determine if slab effects are indeed detectable.

6. Previously reported results from Pn analysis have been submitted to the BSSA in an article by C. Zervas and R. S. Crosson.

7. Under another contract, we are undertaking an evaluation of seismic attenuation in western Washington. In cooperation with Dr. W.H.K. Lee of the USGS, we are using spectral estimates of coda waves to determine regional coda Q. A preliminary data set of fifty events has been processed, and results are being analyzed.

Articles


Zervas, C.E., and R.S. Crosson, 1985 (submitted to BSSA), Pn Observations and Interpretations in Washington

Reports

Univ. of Wash. Geophysics Program, 1984, Quarterly Network Report 85-A on Seismicity of Washington and Northern Oregon

Univ. of Wash. Geophysics Program, 1984, Quarterly Network Report 85-B on Seismicity of Washington and Northern Oregon
Regional Seismic Monitoring in Western Washington

14-08-0001-21861

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(202) 543-8020

Investigations

Operation of the western Washington regional seismograph network and routine preliminary analysis of earthquakes in western Washington are carried out under this contract. Quarterly catalogs of seismic activity in Washington and Northern Oregon are available for 1984 and for the first two quarters of 1985, and are funded jointly by this contract and others. The time period covered by this summary is the six months from April 1, 1985 through September 30, 1985. Data are provided for USGS contract 14-08-0001-22007 as well as for other research programs. Network calibration and data assembly efforts are closely related to and overlap objectives under contract 22007, also summarized in this volume. Publications are listed in the 22007 summary.

Results

Network operation for stations in western Washington continued normally. No unusual regional earthquake activity was recorded. In late May and early June Mount St. Helens underwent a non-explosive eruptive phase accompanied by energetic seismicity. A new station (PGW) sited on the Kitsap Peninsula near Port Gamble began operation on April 12, 1985. This station, along with station MEW on McNeil Island, provide improved coverage of the central Puget Sound Basin. Station RPW in the Skagit Valley, lost in 1982, was reinstalled and began operation in September. An additional station in this region is being planned. A temporary station in the same area, BLS, was discontinued due to noise problems.

Since early 1982, some stations in the telemetered network have been calibrated so that recovery of absolute ground motion is possible. Figure 1 shows sites at which calibrated equipment is currently operating. Additional calibrated equipment will gradually be installed at selected stations as part of our program to upgrade data quality and increase operational reliability.

Equipment at each calibrated station consists of a Geotech S-13 seismometer and a Morrissey-Interface Technology amplifier/VCO package. Standard damping is 0.70 critical. Most calibrated stations use a Morrissey-Interface Technology discriminator, but some use Emtel discriminators which have similar response characteristics. The complete systems should all have similarly-shaped response curves differing only in absolute gain level. Figure 2 shows an approximate response curve for the whole system (with a 1-second seismometer free period) as recorded on the digital system at the University of Washington.
Figure 1. Calibrated stations currently in operation. Station DIG is a three component station. Other stations consist of one vertical S-13 seismometer, a "SLU" type VCO and use Emtel or Morrissey-Interface Technology discriminators.
Figure 2. Approximate relative amplitude magnification curve for complete calibrated short-period system into online computer.
Investigations

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