QUARTERLY NETWORK REPORT 85-C
on
Seismicity of Washington and Northern Oregon

July 1 through September 30, 1985

Geophysics Program
University of Washington
Seattle, Washington

This report is prepared as a preliminary description of the seismic activity in the state of Washington and northern Oregon. Information contained in this report should be considered preliminary, and not cited for publication. Seismic network operations in Washington and northern Oregon is supported by the following contracts:

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INTRODUCTION

This is the third quarterly report of 1985 from the University of Washington Geophysics Program covering seismicity of all of Washington and northern Oregon. These comprehensive quarterlies have been produced since the beginning of 1984. Prior to that we published quarterlies for western Washington in 1983 and for eastern Washington from 1975 to 1983. We have produced annual reports covering seismicity in western Washington since 1969 and in eastern Washington since 1975. In collaboration with the University of Washington the State Department of Natural Resources has published catalogs of earthquake activity in western Washington for the period 1970-1979. We will soon continue this series with annual catalogs for the whole state beginning with the year 1980.

This quarterly report discusses network operations, seismicity of the region, and unusual events or findings. This report is preliminary, and not a substitute for detailed technical reports, an annual catalog, or technical papers. In particular, event magnitudes are preliminary, and subject to revision. Some earthquake locations may be revised if new data become available, such as P and S readings from Canadian seismic stations. Findings mentioned in these quarterly reports should not be cited for publication. Figure 1 shows the major geographical features in the state of Washington, southern Canada, and northern Oregon and the seismograph stations operating at the end of the quarter.

NETWORK OPERATIONS

Table 1 gives approximate periods of time when stations were not operating. Data for Table 1 are compiled from weekly plots of network-wide teleseismic arrivals, automatic dignostics from our on-line P-picker, and records of maintenance and repair visits.

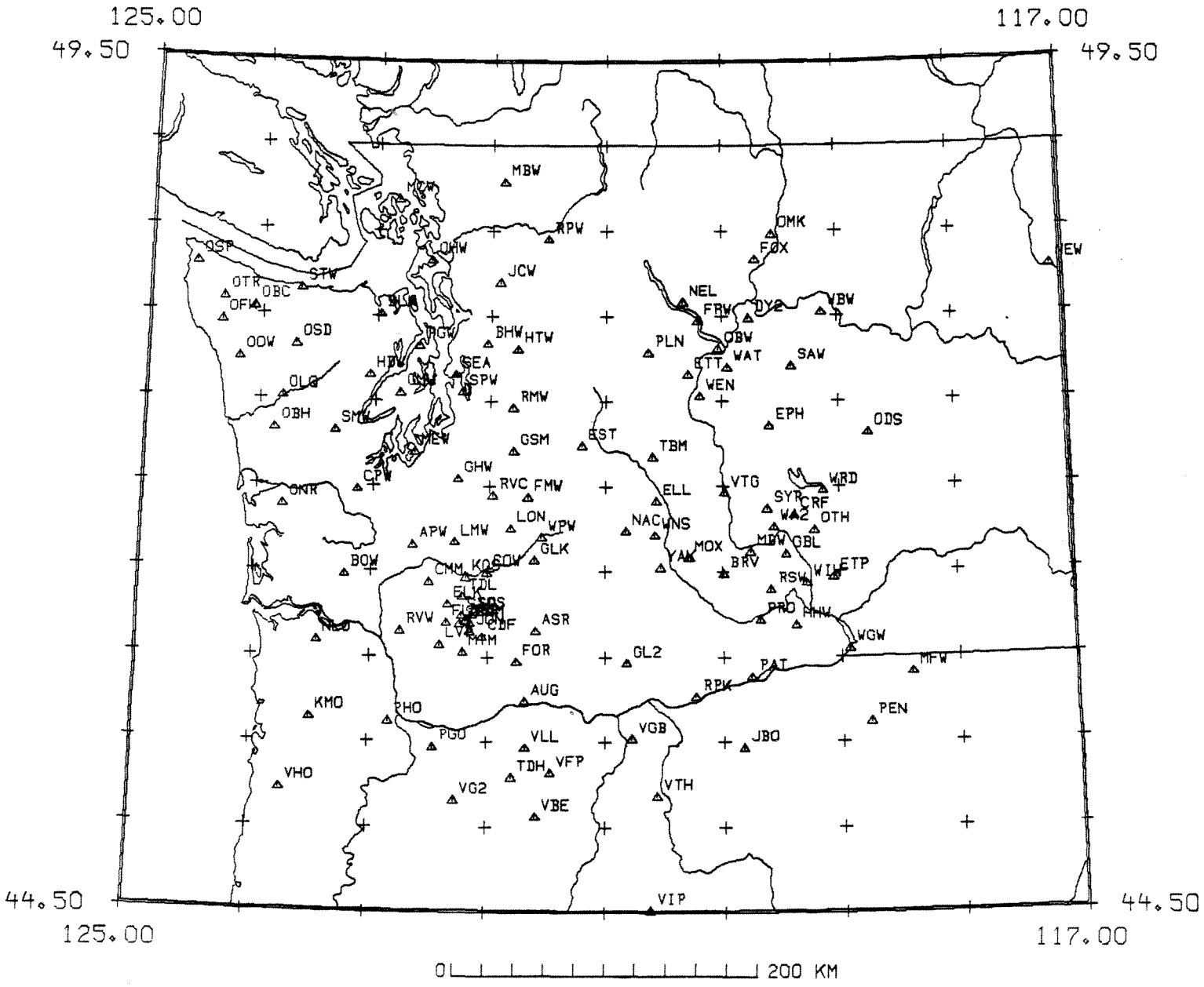

Figure 1. Seismograph stations operating at the end of the third quarter 1985.

TABLE 1
Washington Seismograph Network
Major station outages and changes, July 1, 1985 - September 30, 1985

Station	Outage Dates	Comments
APW	Jul10-Aug30	
AUG	Sep10-Sep30	
BHW	Jul02-Jul30	
BLS		Station removed Aug 8
CBW	Sep12-Sep19	
DYH	Jul01-Jul12	
EDM	Jul01-Jul24	
FOR		New Station Jul 3
GHW	Aug11-Sep06	
GL2	Aug29-Sep19	
HHW	Jul04-Jul12	
HSR		New station Aug 15
HTW	Jul01-Aug15	
HTW	Sep18-Sep30	
JUN	Aug04-Sep30	Transmitter Prob
KMO	Jul17-Aug26	Bad most of time
LVP	Sep21-Sep30	
MTM	Aug24-Sep21	Sporadic
NEL	Jul07-Sep30	Dead or noisy
NLO	Jul01-Jul18	
NSP		New Station Oct 1
OBC	Sep20-Sep30	Sporadic
ODS	Jul01-Aug05	Radio fixed
OFK	Jul02-Jul08	
OFK	Aug02-Aug24	
OSD	Sep04-Sep15	Bad Battery
RED	Jul01-Jul31	Replaced by FOR
RPW		New station Aug 22
SAW	Sep12-Sep19	
SUG	Jul01-Sep30	Moved to NSP
TDH	Jul01-Aug30	Sporadic or dead
VBE	Jul16-Jul30	
VFP	Jul01-Jul31	
VGT	Jul01-Sep18	Replaced by VG2
VG2		New Station Sep 18
VHO	Jul01-Sep30	
VLL	Jul16-Jul30	
VLM	Jul01-Sep30	
WAT	Sep12-Sep19	

On September 22 we began recording station RPW in the Skagit valley as a replacement for BLS which turned out to be a poor site. The new site will also have better access to microwave telemetry. We are awaiting permission to install another station south of the Skagit river near Mount Vernon. A temporary signal loss from the Olympic peninsula station OSD was caused by low battery voltage.

Other changes in western Washington include a rerouting of the telemetry for OBH through the SMW site on July 11 and the installation of new VCOs at APW and SHW. We have noted an intermittent noise problem at station SHW which may be due to external radio interference but we have not yet traced the source. In Oregon a new station, VG2, was installed a short distance from the the old VGT station which hasn't operated for the last year.

In southwest Washington FOR was installed as a replacement for RED. The USGS station at Sugarbowl (SUG) was inoperative during the quarter and was moved onto the dome within the crater (station NSP) on October 1. We installed a station on the south ridge of Mount St. Helens (HSR) but so far it has not operated sucessfully for more than a few days. The new station is in a remote location and we must await better weather for repairs.

We tested a digital seismic telemetry system manufactured by Earth Data Limited of England. All of our other stations currently utilize analog telemetry methods. We found that the Earth Data Limited unit worked well at a site near RMW which is one of our standard stations. We were able to transmit 3 components of ground motion sampled at 120 samples/sec and record the data on our 11/34 event detection system. To do this we had to convert the digital data to analog signals using equipment provided by Earth Data Limited before it was redigitized by our recording system. Because of this we were not able to utilize the full dynamic range of the 12 bit digital data (10 bit plus 2 bits gain ranging) but the the equipment operated well. We found in another test, however, that we could transmit the

digital data only with the radios supplied by Earth Data Limited but not using standard voice grade telephone lines.

EARTHQUAKE DATA

There were 565 events processed by the University of Washington digitally recording seismic network between July 1 and September 30, 1985. We determined locations for 391 of these in the area of Washington, southern Canada and northern Oregon shown in Figure 1; 347 were classified as earthquakes and 44 as known or suspected blasts. The remaining events were regional earthquakes outside the U. W. network, or teleseisms. Helicorder records are scanned daily to ensure that significant events are not missed by the on-line digital system. Table 2 is the event catalog for this quarter. Fig. 2 shows all earthquakes greater than magnitude 1.0. Fig. 3 shows blasts and probable blasts. Fig. 4 shows all earthquakes located in western Washington. Fig. 5 shows all earthquakes located in eastern Washington. Fig. 6 shows earthquakes located at Mount St. Helens.

Western Washington and Oregon

During the second quarter of 1985 247 earthquakes were located between 44.5° and 49.5° latitude and between 121° and 125° longitude. Felt earthquakes include one near Victoria, B.C. (M = 3.3) on July 30, one near Darrington, in northwest Washington on July 29 (M = 3.2) and one felt at Mercer island just east of Seattle on July 6, 1985 (M = 3.1). In addition, a small (M = 2.2) earthquake was reported felt at Issaquah on September 25, 1985.

The July 29 (M = 3.2) Darrington earthquake was the first of a series of shocks which occurred over a two month period.

From August 19 to September 4 we recorded a swarm of 17 earthquakes which occurred about 20 kilometers east of Bellingham (magnitudes 1.3 to 2.5). This area is just south of the swarm activity which occurred last quarter. At the beginning of

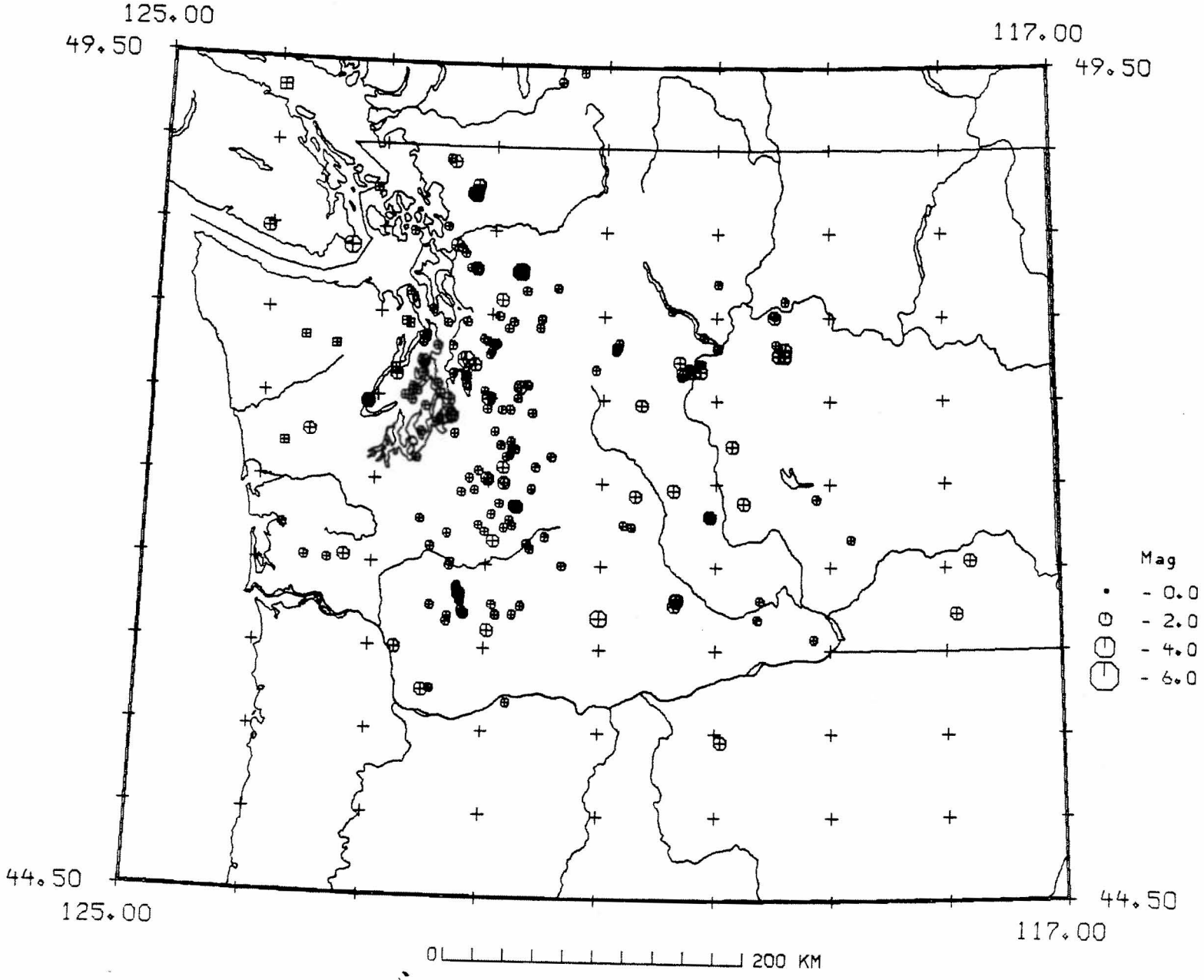

Figure 2. Earthquakes located in the state of Washington and northern Oregon with magnitudes greater than 1.0 from July 1 through September 30 , 1985. Earthquakes with focal depths exceeding 30 km are shown by squares.

the swarm on August 19 the 11/34 computer was inoperative for 14 hours. We would have recorded at least 4 more earthquakes in the swarm during this period if the 11/34 had been operating.

As usual, a number of earthquakes occurred in the southern Puget sound and along the western front of the Cascade mountains east of Seattle. Just to the north of Mount St Helens near Elk lake, Washington about 17 earthquakes occurred in the magnitude range 0.2 to 2.5. This is the site of a magnitude 5.5 earthquake which occurred in February, 1981.

One moderate earthquake (M = 3.2) occurred 40 kilometers east of Mount Adams, Washington in the middle of the Yakima Indian Reservation.

Eastern Washington and Oregon

We determined locations for 70 earthquakes in eastern Washington, none of which exceeded magnitude 2.7. The spatial distribution of epicenters followed previous patterns with concentrations of earthquakes near Entiat (south of Lake Chelan) and southwest of Grand Coulee Dam. The area just north of Vantage which had a swarm of earthquakes beginning in December 1984 was quiet this quarter. A cluster of 4 earthquakes (magnitudes 1.7 to 2.2 occurred southwest of Vantage. A cluster of 7 shallow earthquakes occurred southwest of Yakima (near Toppenish) in the eastern portion of the Yakima Indian reservation.

Mount St. Helens Area

Seismicity at Mount St. Helens remained low throughout the third quarter after the eruption of May-June 1985 which was the most seismically energetic eruption since 1980. Besides an average of 100-200 rockfalls per month that we recorded within the crater we only detected scattered small earthquakes shown in Figure 6.

Catalog

Table 2 is a catalog of located events between July 1, 1985 and September 30, 1985 in the state of Washington, in southern Canada and in northern Oregon. The columns are generally self-explanatory except that the following features should be noted:

a) The origin time listed is that calculated for the earthquake on the basis of multistation arrival times. It is given in Coordinated Universal Time (UTC), identical to Greenwich Civil Times; in hours:minutes (TIME); and seconds (SEC). To convert to Pacific Standard Time (PST) subtract eight hours, or to Pacific daylight time subtract seven hours.

b) The epicenter location is given in north latitude (LAT) and west longitude (LONG) in degrees and minutes.

c) In most cases the DEPTH, which is given in kilometers, is freely calculated by computer from the arrival-time data. In some instances, the depth must be fixed arbitrarily to obtain a convergent solution. Such depths are noted by an asterisk (*) in the column immediately following the depth. A $ or a # following the depth mean that the maximum number of iterations has been exceeded without meeting convergence tests and both the location and depth have been fixed.

d) MAG is an estimate of local Richter magnitude as calculated using the coda length-magnitude relationship determined for Washington. Where blank, data were insufficient or impossible to obtain for a reliable magnitude determination. Normally, the only earthquakes with undetermined magnitudes are very small ones. Magnitudes are preliminary only and may be revised as we improve our analysis procedure.

e) NS/NP is the number of station observations (NS) and the number of P and S phases (NP) used to calculate the earthquake location. A minimum of three stations and four phases are required. Generally the greater the number of