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QUARTERLY NETWORK REPORT 84-D
on
Seismicity of Washington and Northern Oregon

October 1 through December 31, 1984

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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 fourth quarterly report of 1984 from the University of Washington Geophysics Program covering seismicity of all of Washington and northern Oregon. From 1975 through 1983 seismicity in eastern Washington has been covered in quarterly and annual reports. Quarterly reports for western Washington and the northern Cascades have been produced since 1983, and annual catalogs covering western Washington since 1969. This report discusses network operations, seismicity of the area, and any unusual events or findings. These reports are preliminary, and not a substitute for detailed technical reports, a regional 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 and northern Oregon and the seismograph stations currently in operation.

NETWORK OPERATIONS

Table 1 shows station outages during the fourth quarter. Brief outages are not shown. Teleseismic arrivals are checked to determine when outages start, and repair records to determine repair date. Because many stations are in the Olympic and Cascade Mountains, where winter conditions are extremely severe, stations cannot be serviced in the winter. Outages and intermittent operation are sometimes caused by snow and ice covering telemetry equipment. Table 3 on page 21 gives location information for stations.

Western Washington and Northern Oregon

Seismographs in western Washington generally operated well in the fourth quarter. The Snow Dome station on Mount Olympus (OSD) which was installed last

TABLE 1
Western Washington Network
Major station outages and changes, October 1, 1983 - December 30, 1984

Station	Outage Dates	Comments
Western Washington		
APW	11/04/84-12/31/84	Dead
STW	10/01/84-12/31/84	Destroyed by machinery in August
RMW	10/01/84-11/07/84	Repaired, VCO
RVW	11/16/84-12/31/84	Dead
Olympic Peninsula		
OBC	10/01/84-12/31/84	Intermittent
OSD		Installed 9/14/84, Began Operation
OSP	10/01/84-12/31/84	Intermittent
ONR	10/01/84-11/10/84	Repaired, VCO
Mt. St Helens		
ASR	10/01/84-12/31/84	Intermittent Entire Quarter
ELK	10/01/84-10/09/84	Repaired, VCO
KOS	10/01/84-12/31/84	Intermittent Entire Quarter
LVP	10/01/84-12/31/84	Dead Entire Quarter
RED	10/01/84-12/31/84	Dead Entire Quarter
Northern Oregon		
AUG	10/01/84-12/02/84	Repaired
KMO	10/01/84-12/31/84	Intermittent
PGO	10/01/84-11/20/84	Repaired, VCO
PHO	10/01/84-11/20/84	Repaired, Seismometer
TDH	10/01/84-12/31/84	Intermittent Entire Quarter
VIP	10/01/84-12/31/84	Intermittent Entire Quarter
VTH	10/01/84-12/31/84	Intermittent Entire Quarter
VBE	10/01/84-12/31/84	Dead Entire Quarter
VBP		Discontinued Permanently in Oct.
VFP	10/01/84-12/31/84	Equipment Removed
VGT	10/01/84-12/31/84	Discontinued
VHO	10/01/84-12/31/84	No Telemetry Path
VLL	10/01/84-12/31/84	Dead Entire Quarter
VLM	10/01/84-12/31/84	Discontinued
VLO		Discontinued Permanently
Eastern Washington		
DYH	10/01/84	Seismometer replaced
ODS	10/01/84-10/30/84	Repaired, Tx
PEN	11/01/84-11/08/84	Batteries
VTG	12/09/84-12/21/84	Batteries
WRD	10/01/84-10/16/84	Batteries

quarter began operation in October, enhancing coverage of the northern Olympic Peninsula. A site has been selected for a new station on McNeil Island in the south Puget Sound area. Site approval is being sought, and radio frequencies have been requested for this site and another new site to be situated near Port Gamble on the Kitsap Peninsula. Station BLS in the Skagit Valley, which was installed in 1983 to replace RPW but never activated, is now operable and awaiting installation of a telemetry link at the Puget Power microwave site on Mt. Erie near Anacortes. Signals from Mt. Erie will be transmitted through Redmond to the University of Washington. A new site is being sought for station LYW lost with RPW in 1982 through termination of a phone line. In southwestern Washington, several stations were inactive or intermittent during the quarter. Most of these were continuing problems from previous quarters, but Alpha Peak station (APW), east of Chehalis, ceased functioning at the beginning of November (probably due to vandalism), RVW also lost function in November, and ELK was repaired in early October. Station STW, on the northern Olympic peninsula, remained out. Several other stations on the Olympic Peninsula were intermittent, and ONR was repaired.

The U.S.G.S. and the D.O.E. have signed a joint use agreement with the Bonneville Power Administration (B.P.A.). Under the agreement, most existing telephone data lines from Washington and northern Oregon will be replaced by microwave links. The new system should be available in summer of 1985. An additional description of planned links is contained in the *Annual Technical Report, 1984, on Earthquake Monitoring of Eastern and Southern Washington, prepared for the U.S. D.O.E. under contract no. EY-76-S-06-2225 and U.S. N.R.C. contract no. NRC-04-81-177, Geophysics Program, University of Washington*. This new system will facilitate a revamping of seismic coverage of northern Oregon, as well as providing an improvement in dynamic range. Because of the planned realignment of stations in northern Oregon to take advantage of microwave transmission and personnel limi-

tations, little maintenance was done in 1984. Three stations in northern Oregon were inoperative for the entire quarter, five others have been discontinued either permanently or temporarily, and four were intermittent during the fourth quarter. The new transmission equipment should dramatically improve data quality for northern Oregon during the next year.. On the positive side, repairs were made to stations AUG and PGO in northern Oregon during this quarter, and a bottoming seismometer at PHO was replaced.

Eastern Washington

The maintenance contract with Stanwyck Corporation covering seismic stations in eastern Washington expired in mid-December. The University of Washington is in the process of hiring a technician who will be based in eastern Washington to maintain these stations. Eastern Washington will also be affected by the shift from phone-line to microwave transmission using Bonneville Power Administration equipment. Equipment changeover will create an extra workload for the technicians. Outages were minimal, and stations in eastern Washington operated well during the fourth quarter.

EARTHQUAKE DATA

There were 427 events processed by the University of Washington seismic network between October 1 and December 31, 1984. We determined locations for 291 of these in Washington and Northern Oregon; 209 were classified as earthquakes and 82 as known or suspected blasts. The remaining unlocatable events were regional events outside the U. W. network, or teleseisms. Routine scanning of film records was discontinued this quarter because film recording is being phased out. As a result only 7 earthquakes were hand-picked from film records. The few events which were hand-picked did not trigger the on-line system, but were detected on helicorder records. Helicorder records are scanned daily to ensure that significant events are not missed by the online system. Table 2 is the event catalog for this quarter. Figure 2 shows all earthquakes greater than magnitude 1.0. Figure 3 shows blasts and probable blasts. Figure 4 shows all earthquakes located in western Washington. Figure 5 shows all earthquakes located in eastern Washington.

Figure 6 shows earthquakes located at Mount St. Helens.

Western Washington and Oregon

During the fourth quarter of 1984 171 events were located between 44° and 49° latitude and between 121° and 125° longitude. The most significant sequence included two felt earthquakes, magnitudes 3.1 and 3.2, which occurred near Concrete in Whatcom County on Dec. 2 and Dec. 3. Five other events were located during the quarter in a tight cluster at the same spot, including a magnitude 2.9 on Dec. 23. A preliminary focal mechanism solution for the December 2nd event indicates thrust faulting with a NW-SE P axis.

On November 17, a low-frequency event of $M_C = 3.1$ was located near Mt. Rainier. This event was well recorded on only four stations, and had a lower peak amplitude than would normally be expected for an earthquake with a long coda, suggesting a landslide or rockfall, which would account for these characteristics. During the quarter, 17 events greater than or equal to magnitude 1.0 occurred in the vicinity of Mt. Rainier, although none were reported felt. The highest activity rate was 15 countable events per month. This can be compared to other swarms in the same area, such as the one in Dec. 82 - Jan. 83. Within three months, 12 earthquakes above M_C 1.0 occurred, with activity rates as high as 50 countable earthquakes per month.

Scattered activity continued as usual in the Puget lowland and Cascades. The largest earthquake in the Puget Basin was a $M_C = 3.2$ event on December 17 located at a depth of 45 km near Henderson Bay on the southeastern part of the Kitsap Peninsula. A preliminary focal mechanism indicates a NE-SW P axis. In the Cascades, there was a clear concentration of earthquakes along a zone extending NNW from Mount St. Helens.

Two unusual deep earthquakes were located in south-western Washington dur-

ing the quarter. One was a $M_C = 2.8$ earthquake at about 35 km depth located on the Olympic Peninsula south of Aberdeen on November 21. Deep events are rare this far south of the Puget Basin. The second event, on October 20, was located at a depth of 50 km near Mist, Oregon (south of Clatskanie, Oregon) with a M_C of 2.0. This event is extremely unusual. South of a line extending from Mt. Rainier to the mouth of the Columbia River, no earthquakes at depths greater than 35 km were located prior to June 1984, when a well located deep event was felt in the Longview-Kelso area. The seismogram for the October 20 event does not resemble seismograms from other deep events; in that first arrivals are less impulsive and the coda frequency appears lower.

An event of M_C 2.5 occurred at a depth of 23 km near Portland, OR on December 11, 1984. It was felt in the western part of Portland. No other earthquakes were detected in the vicinity.

Eastern Washington and Oregon

A very interesting cluster of activity just northwest of Vantage, on the Columbia River began at the end of October, and is continuing into 1985. Eight events of M_C between 1.7 and 2.6 occurred in the fourth quarter of 1984, and several larger events occurred during the first week of 1985. Hypocenters for these events are very tightly grouped.

An earthquake of $M_C = 3.0$ was felt at Grand Coulee Dam and Elmer City on October 10, 1984. This event was located with a depth of approximately 9 km, deeper than is usual in this area. Earthquakes in the southern Lake Chelan-Entiat area continued at their normal background level during this quarter.

Mount St. Helens Area

The fourth quarter was seismically quiet at Mt. St. Helens. By October 1 seismicity associated with the dome-building eruption in September had ceased.