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QUARTERLY TECHNICAL REPORT 81-D

on

Earthquake Monitoring of Eastern Washington and Northern Oregon

October 1 through December 31, 1981

Geophysics Program

University of Washington

Seattle, Washington

PREPARED FOR THE U.S. DEPARTMENT OF ENERGY
UNDER CONTRACT NO. EY-76-S-06-2225
TASK AGREEMENT NO. 39

and

THE U.S. NUCLEAR REGULATORY AGENCY
UNDER CONTRACT NO. NRC-04-81-177

and

WASHINGTON PUBLIC POWER SUPPLY SYSTEM
CONTRACT NO. C-10976

Operations

a. Eastern Washington

Operation of the eastern Washington seismic network continued normally except for a few persistent trouble spots. Our transmitter at Chelan Butte caused serious interference problems for other users at the site, and a great deal of outage time for the stations relayed through this transmitter occurred in September and October. We have made an arrangement with a local radio station (KOZI) to use a spare circuit of theirs into the town of Chelan, thus eliminating the transmitter entirely. Other difficulties arose with 60 Hz noise on the butte affecting the local seismometer site. Bad weather and poor road conditions on the butte have rendered the site nearly inaccessible since these problems were noted.

Numerous problems have occurred in the Hanford area net. The Midway (MDW) site has been inoperational much of the time. The station became very noisy in September, probably due to poor cable splices on the long run to the phone drop. Not all the defective splices could be repaired, so it was decided to eliminate the cable run and radio MDW to Gable Mountain. Defective equipment caused some difficulties; these were finally cleared up in early January.

A newly-installed Battelle weather transmitter at Gable Mountain has caused severe pulsing problems on the two stations (MDW and WA2) received there. Inquiries to Battelle indicated that Rockwell handles their radios. Rockwell informed us that their 30W transmitter was operating correctly, that our radios were not famous for their selectivity, and that if we did not like the situation we were welcome to remove our equipment from Gable Mountain. Further tests on the interference problem will be made soon, and we may move our equipment at least a short distance from the Battelle transmitter.

The Patterson station (PAT) has been inoperational much of December, due to a seemingly temperature-sensitive radio pair which does not operate under the

cold conditions experienced this winter. The Rattlesnake and Prosser stations were also down for about a week in late November due to a cut phone cable.

These problems are mainly recurrent problems at a small number of sites. They are magnified by the fact that some of the sites involved are multiplex sites for several stations. Many problems have occurred because central receive sites located on high ridges are inaccessible or virtually so under prevailing winter weather conditions. Resolution of other problems has been hampered by a lack of available spare components, particularly radios of suitable frequencies. The majority of stations are operating fairly well, and replacement of defective summing amplifiers at Yakima and Ellensburg has vastly improved the signal-to-noise characteristics at stations relayed through those points. Some new, low noise telemetry components are presently being tested and calibrated at the University, and will be installed at Entiat and Gable Mountain in February 1982.

b. Northern Oregon

In northern Oregon, site tests were made and permission obtained for installations at Jordan Butte and Squaw Butte. Permission was obtained from Portland General Electric to telemeter their 3-station Pebble Springs network from the central receive point in Arlington to Seattle. The receive site was visited to insure our installation would be compatible with their existing equipment. The phone line for the Portland area stations was installed in December.

Further operations in Oregon have been delayed as a result of discussions with Andrew Murphy, who indicated that funding for the project would be terminated before the 3-year limit specified in the contract. We plan at present to install the two stations planned for the immediate Portland area, and to go ahead with installation of the telemetry links required to receive the Pebble Springs network. The sites in northeastern Oregon, Squaw Butte and Jordan Butte, are rather remote and would be a maintenance problem. Therefore, we do not plan to install them

unless the funding situation changes favorably. The USGS northern Oregon net, which is monitored at the University, has continued in operation although nearly half the stations are malfunctioning. Fortunately, the inoperative stations are randomly distributed throughout the net, so there has been little effect on our overall detection capabilities. Location accuracy has suffered somewhat.

Down Hole Seismometer

During the past quarter the Geospace 3-component downhole seismometer was successfully deployed and has been operating continually since the first of December. Although a good signal is being received from the seismometer, it is hoped that by placing amplifiers in the downhole package, the signal-to-noise ratio may be enhanced. Long-term installation of electronics and batteries in a downhole package decreases the system reliability, thus it is not clear that this is an effective solution. Transmitting AC power down the cable to supply the amplifiers is a third solution, and will be investigated.

The Geophysics Program owns a second downhole sesimometer which may be deployed in the Hanford area. This unit has a resonant frequency of one second, and is a variable reluctance type seismometer. Current activity is to attempt to rehabilitate this unit and devise an effective deployment method for a shallow (~200-300 foot) hole.

Data

This reporting period has been relatively quiet in Eastern Washington and Northern Oregon. Similar to last quarter's report, we cover earthquakes east of longitude 121.5 and south of latitude 46.5 excluding the immediate Mount St. Helens area. There have been 150 events located in this area of interest, 64 of them are know or probable blasts and 86 are earthquakes. The St. Helens area alone had 121 earthquakes located this quarter, which is less then half the number

for any quarter since early 1980. Figures 1-4 show the earthquakes and blasts in Eastern Washington and the Oregon-Washington boarder area. Table I is the event catalog for this quarter.

The largest events of this quarter were two magnitude 2.6 events; one in the Entiat area on October 25 was lightly felt. The other on October 7 in the Goat Rocks Wilderness area was not reported felt. A magnitude 2.4 earthquake near Camas, Washington was reported lightly felt on November 8. Blasting operations near Ice Harbor Dam began again about the 1st of December. There are an average of 10 of these blasts per day that are locatable. To keep the size of the catalog manageble we locate and report only the best recorded shots.

Thirteen of the events in the catalog were hand picked from the develocorder films because the computer did not pick them up for one reason or another. All were less than magnitude 1.6 and were mostly in the area of the east flank of the Washington Cascades where the network is fairly sparse. The Oregon network stations are recorded on the computer here and on develocorders in Menlo Park. We do not have their locations from the film records yet, and thus can not compare the computer detection in this area with hand picked events.

In the following earthquake catalog there are several symbols which have special meaning. Following the depth of an earthquake a * means the depth has been fixed; a $ means that a convergent solution was not obtained with the depth free and it may be greatly in error; a # means that the depth was fixed but still no convergent solution was obtained and the epicenter may be greatly in error. Under the "TYPE" column the symbols have the following meaning: X means a known explosion; a P means a probable explosion usually based on signal character; an F means the event was reported to have been felt, and an H means the event was hand picked from develocorder films rather than digital records.

CATALOG Oct - Dec, 1981

Oct 1981

DAY	TIME	SEC	LAT	LON	DEPTH	MAG	NS/NP	RMS	Q	MODEL	TYPE
1	15:18	47.20	46 32.93	121 26.84	13.51	0.7	8/10	0.25	BB	C1	
1	23:10	50.79	46 11.79	121 47.61	1.20	0.7	14/16	0.23	BC	C1	P
2	21:42	11.32	47 41.28	118 16.79	0.05*	1.9	14/17	0.49	CD	N1	
2	21:43	10.78	48 0.47	118 44.39	0.06*	1.4	13/14	0.33	CD	N1	X
2	22:22	26.37	46 5.31	121 40.04	8.53*	0.9	14/14	0.13	AD	C1	
5	1:51	66.40	46 40.13	119 46.91	17.75	1.3	12/16	0.09	AB	E1	
5	3: 8	20.02	47 45.32	119 47.79	10.71	0.8	5/09	0.47	CD	N1	H
5	10:57	31.39	46 49.07	119 28.47	1.24*	0.4	5/07	0.15	AD	E1	
6	10:38	18.83	47 9.40	119 0.60	0.92	1.4	5/08	0.13	BD	E1	H
6	19:29	11.98	45 42.55	122 58.72	7.92	1.0	15/17	0.26	BD	P1	
7	10:27	0.42	46 11.85	119 26.90	3.30	1.1	4/05	0.04	AD	E1	H
7	12:10	57.20	46 31.78	121 24.36	4.08	2.6	45/53	0.21	BC	C1	
7	17:40	47.17	46 51.82	119 36.91	0.05*	1.0	8/09	0.34	CC	C1	
7	19: 1	44.29	47 40.53	120 19.66	3.53	0.8	7/09	0.13	AB	N1	
8	23:59	-1.87	47 39.17	118 17.15	0.05*	1.6	9/11	0.50	DD	N1	
9	16:37	14.23	46 32.85	121 27.35	8.58	0.6	5/07	0.33	CD	C1	
10	13:40	58.56	47 0.38	120 39.33	6.21$	1.6	8/09	0.32	BD	E1	H
10	15: 4	66.05	47 9.98	119 30.44	9.47	0.9	10/13	0.11	AC	E1	
10	20:25	49.96	46 19.97	122 38.65	0.77	1.2	19/20	0.12	AC	S1	P
12	8:59	28.23	46 8.63	120 27.65	13.32	1.9	32/34	0.28	BC	C1	
13	23:31	27.75	47 51.92	118 4.68	0.05*	1.5	9/09	0.44	DD	N1	X
14	18: 5	64.26	46 17.51	122 24.07	0.10*	0.3	7/09	0.11	AB	S1	X
14	21:33	23.71	46 17.40	121 58.02	0.06*	0.9	14/16	0.14	AC	S1	P
15	8:49	18.21	46 59.17	120 25.69	7.38#	2.3	30/31	0.27	AB	E1	
15	13:33	11.58	46 58.89	120 24.87	8.22#	1.2	5/06	0.05	BD	E1	H
15	21:27	12.50	47 10.13	118 22.23	0.04*	1.6	11/12	0.45	DD	N1	
15	22:19	45.20	46 53.25	119 35.22	0.09*	1.4	11/12	0.28	BD	E1	
17	5:34	25.00	46 32.67	121 25.90	9.16	1.0	8/10	0.22	BC	C1	
18	6:47	57.91	46 59.37	120 24.26	0.07*	0.9	7/09	0.17	BD	C1	H
18	20: 3	27.35	46 31.02	121 21.75	6.21	0.8	5/07	0.06	AD	C1	
19	20: 2	58.83	46 34.46	121 23.58	10.34	1.6	22/25	0.43	BB	C1	
20	12:59	19.38	46 33.11	121 25.08	9.56	1.1	17/19	0.22	BB	C1	
20	21:11	9.25	47 43.22	121 21.07	5.35	0.9	6/08	0.07	AC	C1	
21	1:51	28.10	46 36.98	117 46.10	16.31	2.0	17/20	0.73	DD	E1	P
21	23:43	65.43	46 52.44	119 35.57	0.82	1.6	9/10	0.09	AC	E1	
22	23:29	-4.37	47 54.28	118 4.77	2.93	1.8	7/11	0.46	CC	N1	X
23	17: 6	66.18	46 27.37	121 51.59	0.13	1.2	16/16	0.29	BC	S1	P
23	22:17	55.40	46 3.86	122 3.97	0.62	-0.1	6/06	0.22	BC	S1	P
24	0:57	19.14	45 55.18	122 7.00	5.54	1.5	19/20	0.25	BC	S1	P
25	3:20	63.36	47 46.13	120 11.69	0.06*	2.6	25/25	0.44	CC	S1	F
25	7:48	20.53	47 38.60	121 20.66	9.55$	1.1	5/06	0.26	DD	S1	
25	12:50	49.71	46 32.31	121 25.26	7.09	0.9	8/09	0.18	BC	S1	
26	18:53	24.62	46 32.90	121 26.23	9.90	0.9	12/14	0.22	BB	C1	
27	20:28	12.74	46 7.86	122 30.27	6.91$	-0.2	5/08	0.20	BD	P1	
27	22:19	40.64	46 29.19	117 12.87	0.04*	0.	16/21	0.77	DD	E1	
29	17:40	59.98	46 13.43	122 24.90	1.24	0.	15/16	0.15	AB	S1	P

Oct 1981

DAY	TIME	SEC	LAT	LON	DEPTH	MAG	NS/NP	RMS	Q	MODEL	TYPE
29	23:10	49.37	46 59.19	120 26.15	7.43	2.1	13/15	0.24	AB	C1	
29	23:25	12.39	46 58.07	119 47.79	0.79*	1.1	5/07	0.08	AD	E1	H
29	23:45	38.56	46 56.50	119 47.76	0.76	1.4	5/05	0.11	BD	E1	P
30	0:11	11.53	48 2.87	118 42.38	0.37	2.4	12/16	0.36	BD	N1	X

Nov 1981

DAY	TIME	SEC	LAT	LON	DEPTH	MAG	NS/NP	RMS	Q	MODEL	TYPE
3	8:44	57.56	46 32.48	121 26.13	11.00	0.9	8/10	0.17	BC	C1	
4	0:32	45.08	46 26.99	121 57.03	1.46#	1.4	15/18	0.15	AB	S1	P
4	17: 1	36.30	46 11.64	121 59.61	0.07*	0.5	9/10	0.15	BC	C1	P
5	21:29	47.97	46 2.74	122 2.82	0.06*	0.2	4/05	0.15	BD	S1	
5	21:36	67.37	46 27.13	121 57.25	0.07*	1.9	28/33	0.23	BB	C1	P
8	4:43	71.18	47 46.14	120 9.64	0.04*	2.0	25/28	0.53	BC	N1	
8	7:53	61.09	45 36.22	122 29.48	6.77	2.4	35/43	0.17	AC	C1	F
9	12: 3	57.33	45 7.05	120 56.02	9.68	1.3	6/07	0.10	BC	C1	
9	20:20	24.79	46 4.82	122 4.76	1.03	0.5	8/09	0.17	AC	S1	P
9	22:42	50.67	46 18.65	122 24.93	0.28	0.5	15/18	0.16	AB	S1	P
9	23:52	24.23	47 43.48	120 17.79	1.93	0.6	5/08	0.08	BD	N1	
10	15:44	42.47	45 56.48	122 24.13	12.70	0.8	12/16	0.25	BC	P1	
11	4:33	15.87	46 50.58	119 43.23	0.66	1.8	22/23	0.34	BB	E1	
11	5: 1	15.75	47 16.48	121 29.82	13.52	1.3	8/10	0.29	BB	C1	
11	13: 6	56.56	47 42.36	120 4.76	0.07*	1.8	14/18	0.41	BB	N1	
12	0:25	37.47	46 27.26	122 35.92	0.06*	1.4	9/09	0.11	AB	S1	P
13	22:25	51.07	46 31.97	121 25.37	13.14	0.8	6/08	0.13	BD	C1	
14	0:48	22.23	46 27.13	121 57.55	0.08*	1.0	19/19	0.23	AB	C1	X
14	9:33	19.71	46 50.61	119 43.35	1.27$	1.6	19/22	0.21	BB	E1	
14	22: 7	58.17	45 25.61	121 35.92	14.79	1.7	6/07	0.33	CC	C1	P
16	19:19	32.13	47 51.92	118 5.76	0.08*	2.0	11/12	0.34	BC	N1	X
17	20:48	26.68	46 24.56	121 55.45	1.90*	0.7	10/12	0.18	BC	S1	P
18	14:30	59.11	46 31.85	121 24.83	8.78	0.6	8/10	0.17	BC	C1	
19	1:10	31.84	46 31.29	121 24.23	3.87	1.9	26/28	0.21	BC	C1	
19	18:43	24.02	45 53.52	118 17.57	5.56	1.5	5/07	0.29	BD	E1	H
20	3:49	46.63	46 22.30	121 8.56	2.65*	1.2	20/22	0.29	BC	C1	
20	20:16	46.59	45 34.53	118 42.98	0.08*	2.1	12/12	0.37	DD	E1	
20	23:59	16.91	45 48.00	118 18.93	0.08*	2.2	13/14	0.39	CD	E1	
21	6: 3	2.81	46 50.73	119 44.10	0.07*	0.1	4/06	0.12	BD	E1	H
21	15:43	59.47	45 52.93	122 48.27	6.58	1.7	24/26	0.22	BC	P1	P
22	13:10	25.49	46 10.23	119 28.81	17.79	0.8	5/07	0.14	BD	E1	H
23	11:10	21.22	46 13.65	123 18.45	20.78	1.6	25/28	0.14	AC	P1	
23	11:10	21.78	46 14.23	123 17.62	15.90$	0.9	11/11	0.14	BD	S1	
23	21:23	-2.58	47 52.57	118 7.13	0.05*	2.0	19/20	0.52	BC	N1	X
24	12:51	14.11	46 46.74	119 17.24	1.23	1.1	6/08	0.15	AC	E1	
25	10:22	38.95	46 52.71	119 26.47	0.07*	1.2	8/12	0.07	AB	E1	
27	11:20	71.65	47 41.19	120 20.13	0.06*	1.4	14/16	0.23	BA	N1	
28	16:53	57.59	46 34.12	119 13.58	10.80	0.5	5/09	0.15	BD	E1	H
29	13:33	47.47	47 40.04	120 17.36	0.51	0.6	5/09	0.21	BD	N1	
29	22: 2	69.55	45 12.99	120 53.36	2.80	2.0	16/17	0.24	AC	C1	X

Dec 1981

DAY	TIME	SEC	LAT	LON	DEPTH	MAG	NS/NP	RMS	Q	MODEL	TYPE
1	14:39	16.50	47 40.58	120 2.53	0.51*	1.6	17/21	0.30	BB	N1	
1	22:14	7.28	46 13.88	118 56.48	1.29	1.3	9/10	0.32	BC	E1	X
2	8: 5	19.01	46 14.21	118 57.09	1.95	0.7	10/11	0.21	BC	E1	X
2	16:13	54.38	46 14.39	118 56.43	0.07*	1.2	10/11	0.24	BC	E1	X
2	20: 1	51.68	46 14.17	118 55.43	1.72*	1.0	10/12	0.32	CC	E1	X
2	22:42	60.31	46 14.53	118 56.51	0.03*	1.0	12/12	0.27	CC	E1	X
3	2:25	14.65	46 14.49	118 56.70	0.08*	1.2	10/11	0.19	BC	E1	X
3	3:27	16.09	46 14.63	118 57.18	0.07*	1.2	14/16	0.12	AC	E1	X
3	5:16	47.83	46 14.61	118 56.99	0.06*	1.4	10/11	0.11	BC	E1	X
3	14:36	29.19	46 14.69	118 56.67	0.03*	1.2	13/13	0.22	CC	E1	X
3	15: 5	65.13	46 14.55	118 57.02	0.07*	1.1	8/09	0.12	AC	E1	X
3	18:15	44.92	46 14.53	118 57.22	0.15	1.0	8/10	0.12	AC	E1	X
3	20:20	9.03	46 14.43	118 56.89	0.09*	1.2	11/12	0.14	AC	E1	X
3	21:52	56.42	46 14.58	118 56.85	0.06*	1.0	10/12	0.17	BC	E1	X
3	22:21	8.75	47 52.48	118 7.18	0.09*	2.1	14/15	0.42	BC	N1	X
3	23: 2	59.27	46 14.49	118 56.65	0.05*	1.0	10/11	0.16	BC	E1	X
4	1:16	15.83	46 14.51	118 57.25	0.09*	1.4	10/12	0.14	AC	E1	X
4	1:58	16.94	46 14.50	118 56.92	0.05*	1.3	10/12	0.14	AC	E1	X
4	3:39	15.81	46 14.60	118 56.86	0.10*	1.2	12/14	0.11	AC	E1	X
4	5: 4	49.43	46 14.29	118 57.06	1.29	1.2	13/14	0.19	BC	E1	X
4	23:44	30.84	44 31.02	121 33.76	0.05*	2.2	6/08	0.32	DD	C1	
5	0:50	11.02	46 15.91	122 29.30	15.20	0.8	11/16	0.18	BB	S1	
5	1:40	48.99	46 14.70	118 56.35	0.73	1.3	16/18	0.26	BC	E1	X
5	5:31	47.08	46 14.39	118 56.77	0.06*	1.3	13/14	0.27	BC	E1	
5	6:48	15.37	46 14.65	118 56.80	0.05*	1.1	13/14	0.18	BC	E1	X
6	13:39	42.34	48 7.95	120 50.21	0.51$	1.6	7/11	0.30	CC	C1	
7	3:13	31.63	47 13.79	121 15.50	9.18	1.5	8/12	0.17	BB	C1	
7	16:52	29.88	46 14.71	118 56.60	0.12	1.1	15/17	0.26	BC	E1	X
7	21:12	25.67	45 27.25	121 35.36	0.06*	1.7	9/10	0.27	CB	C1	L
8	0:19	26.55	47 40.22	120 7.11	4.87	0.9	5/08	0.17	AD	N1	
8	1:43	43.64	46 14.66	118 56.02	0.04*	1.5	20/21	0.27	BC	E1	X
8	3:16	41.13	48 24.74	120 9.95	0.07*	1.9	11/14	0.81	CC	N1	
8	4:11	14.84	46 14.79	118 56.10	0.09*	1.4	21/23	0.41	BC	E1	X
8	7:38	13.78	46 14.71	118 55.86	0.05*	1.3	15/16	0.20	BC	E1	X
8	21:52	29.49	47 52.10	118 6.11	0.07*	2.1	12/13	0.56	BC	N1	X
8	23: 3	52.12	46 14.71	118 56.11	0.08*	1.3	17/18	0.39	BC	E1	X
9	2: 0	12.23	46 14.51	118 55.90	0.09*	1.4	17/18	0.38	BC	E1	X
9	17:55	66.02	45 53.25	122 13.04	0.09*	0.9	11/11	0.19	CD	S1	P
10	9:16	11.66	46 15.12	118 55.54	0.05*	1.6	13/15	0.30	BC	E1	X
11	1:58	10.85	46 14.69	118 55.97	0.04*	1.5	15/16	0.26	BC	E1	X
14	23:38	36.60	45 26.27	121 36.17	0.10*	1.7	13/13	0.28	BB	C1	L
15	3: 3	68.34	46 32.46	121 24.90	8.43	0.9	13/15	0.26	BB	C1	
15	13:14	21.39	46 49.24	119 21.33	0.09*	0.6	5/08	0.13	AD	E1	
16	20:10	16.92	46 51.43	119 14.08	13.26	0.9	7/10	0.14	AB	E1	
17	5:14	19.73	46 5.88	118 50.60	6.11$	1.4	10/13	0.68	CC	E1	
18	6:57	42.50	46 31.00	121 23.78	4.55	2.0	42/46	0.28	BC	C1	
18	23:18	14.58	45 36.62	121 16.33	0.84$	1.7	5/06	0.19	CD	E1	
18	23:43	21.05	46 26.85	121 56.95	0.48	2.0	20/23	0.29	BB	S1	P
21	2:46	60.99	47 49.48	119 36.71	0.06*	2.2	25/28	0.46	BC	N1	
21	3:13	10.69	46 36.77	119 46.65	12.26	0.9	7/10	0.29	BD	E1	H
21	3:14	61.35	45 5.58	121 0.35	12.27*	0.5	5/07	0.24	CD	C1	
21	13:23	15.48	45 11.04	121 49.29	5.22$	1.2	8/13	0.35	BC	C1	

Dec 1981

DAY	TIME	SEC	LAT	LON	DEPTH	MAG	NS/NP	RMS	Q	MODEL	TYPE
22	21:42	58.79	46 18.83	122 24.57	1.91	-0.1	13/17	0.19	BB	S1	P
22	22:36	23.38	46 19.97	122 57.32	23.09*	1.8	10/12	0.45	CB	P1	P
23	21:18	18.61	46 11.61	122 42.65	4.68	1.1	20/23	0.19	AB	P1	X
28	19:59	49.77	46 14.68	118 55.84	0.08*	1.6	11/12	0.18	BC	E1	X
29	7: 9	60.09	46 14.84	118 55.11	0.10*	1.6	18/19	0.27	BC	E1	X
29	14:11	23.14	46 24.68	119 15.83	1.97	0.3	4/04	0.	AD	E1	H
29	15:40	14.42	46 14.66	118 55.53	0.06*	1.5	14/15	0.24	BC	E1	X
30	22:45	45.47	46 18.72	122 58.38	23.56	1.5	6/08	0.20	BC	P1	P

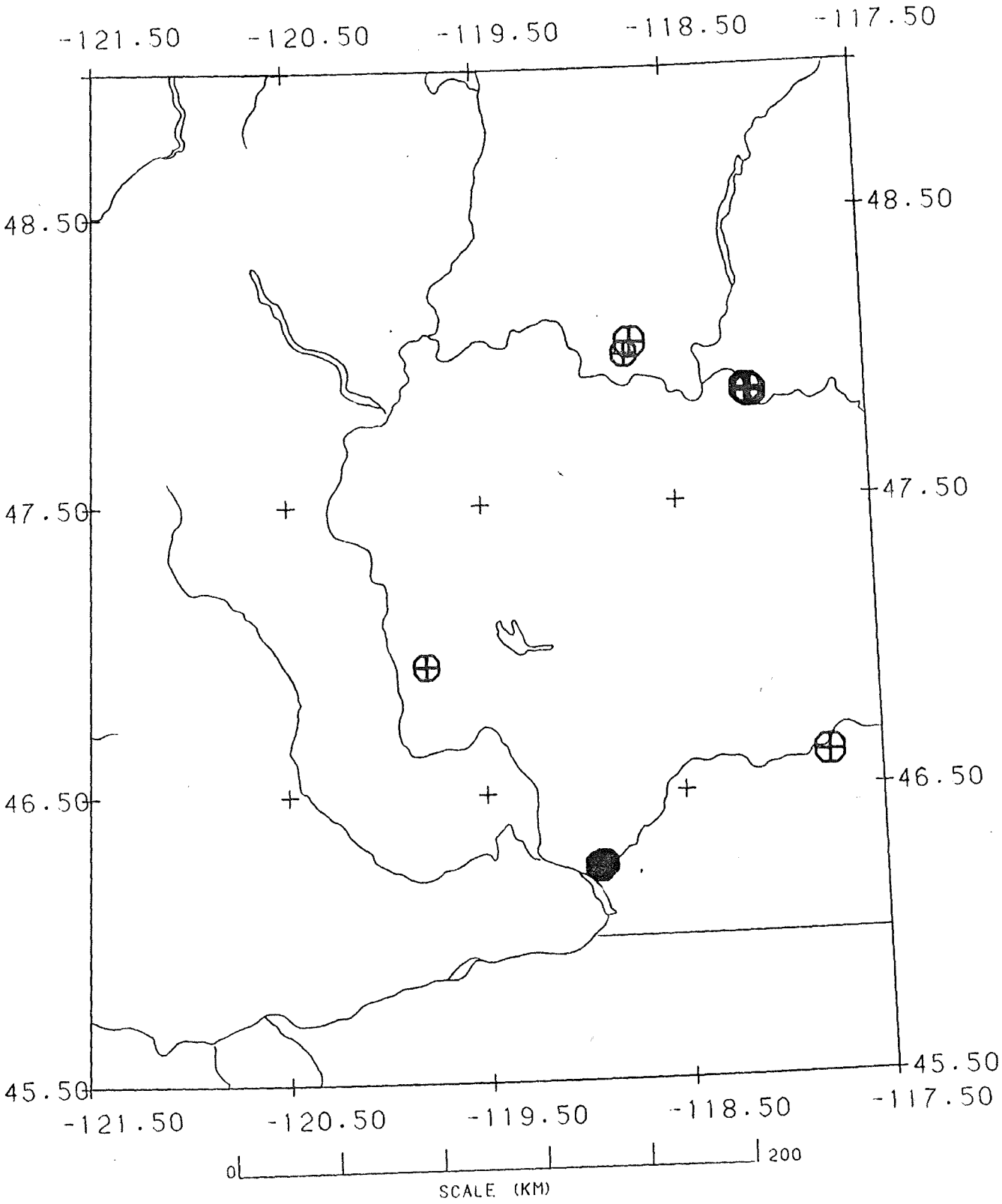

Fig. 1: Eastern Washington known and probable explosions

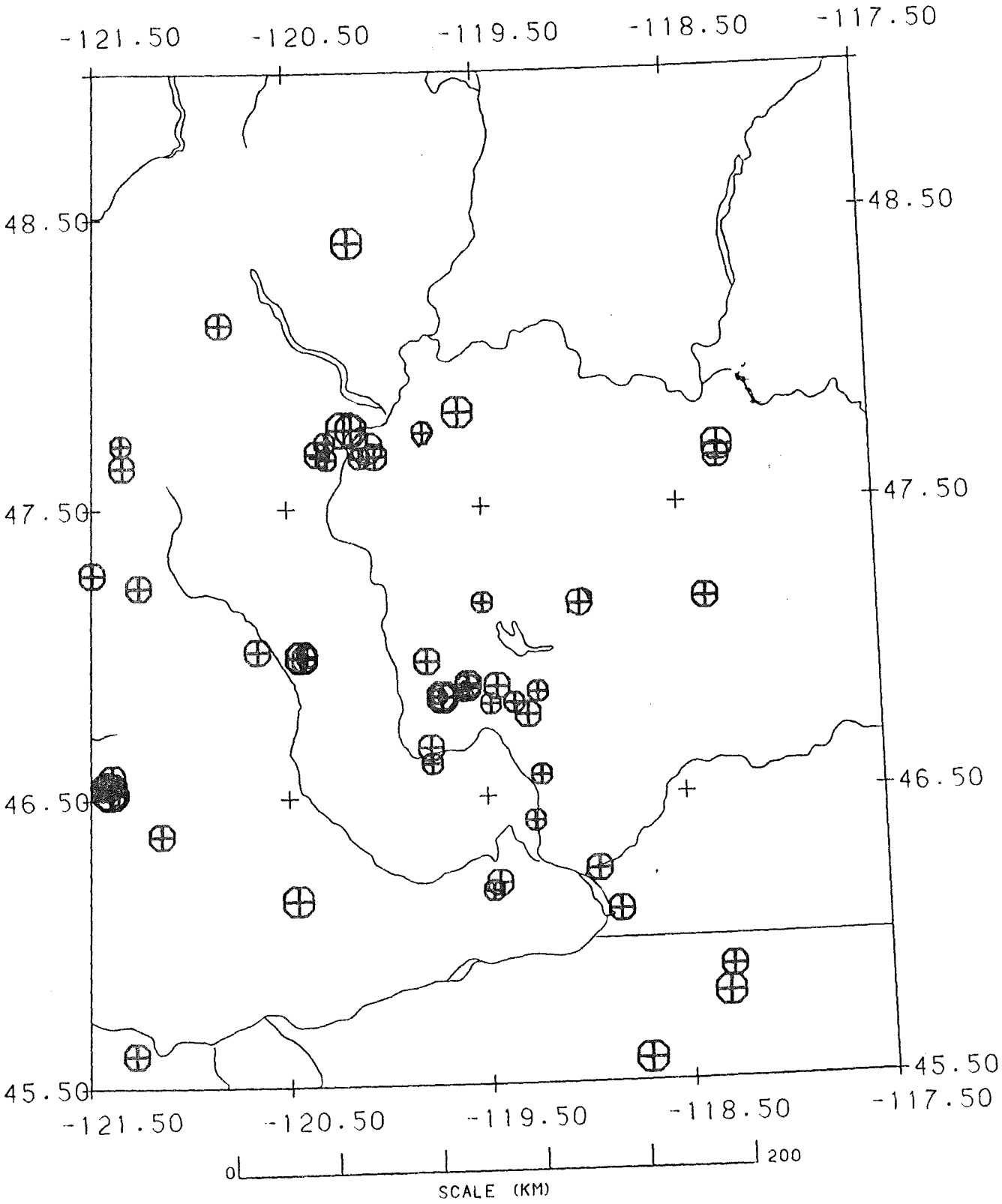

Fig. 2: Eastern Washington Earthquakes, Oct - Dec 1981

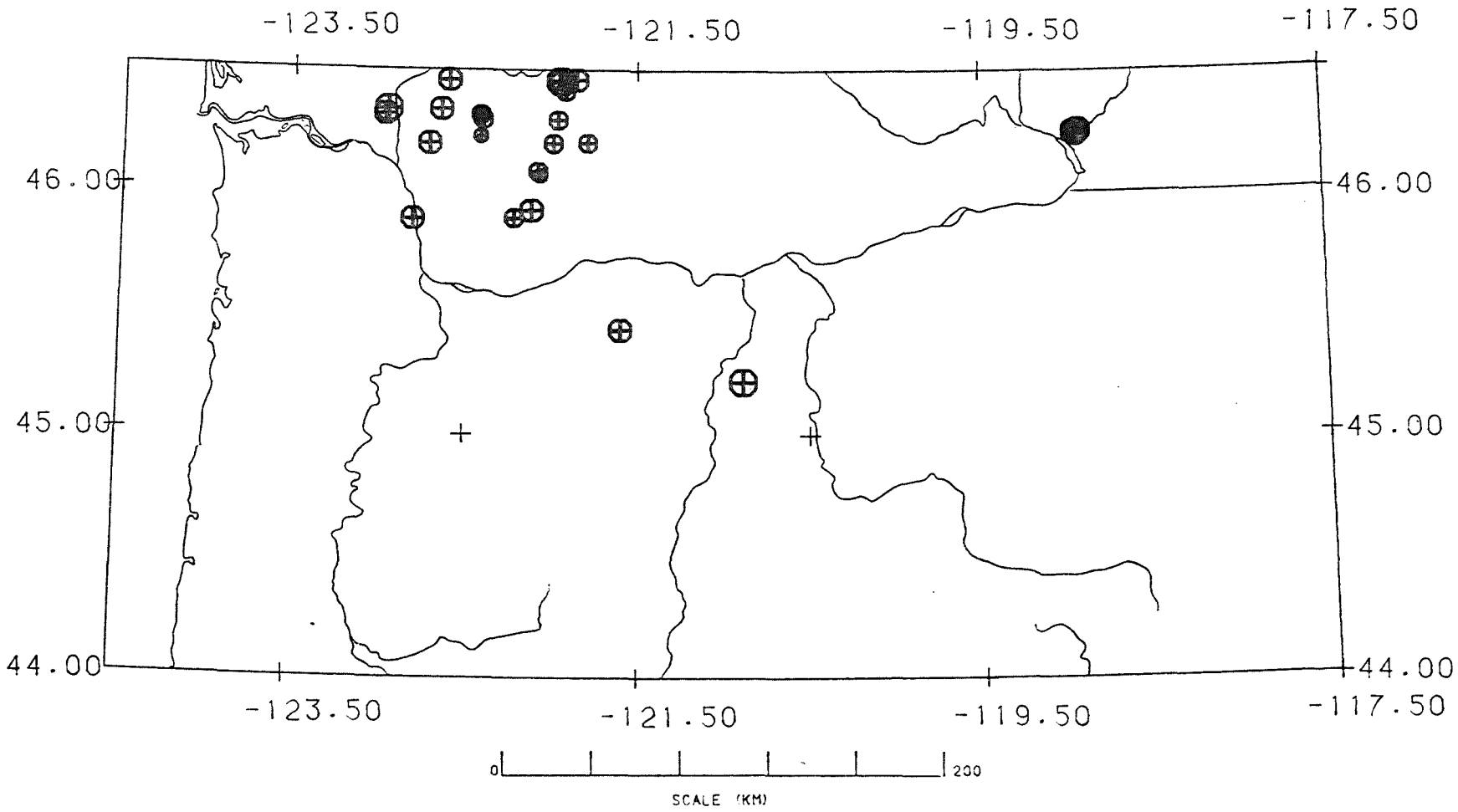

Fig. 3: Southern Washington - Northern Oregon known and probable explosions

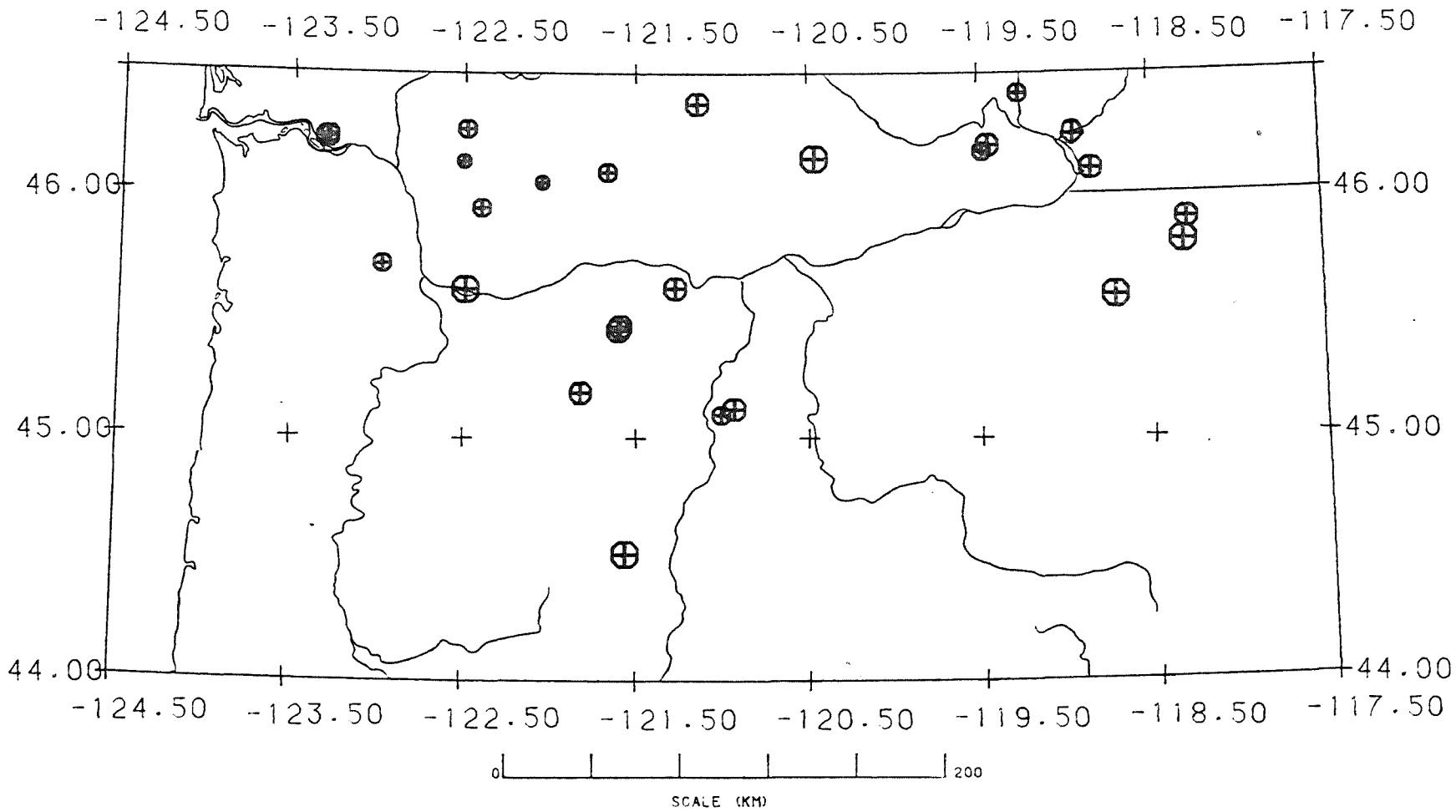

Fig. 4: Southern Washington - Northern Oregon Earthquakes Oct - Dec 1981