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GEOLOGICAL SURVEY

SEISMIC ACTIVITY IN THE HANFORD REGION, WASHINGTON
March 23, 1969 to June 30, 1971

by

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Introduction

The U. S. Geological Survey began to monitor earthquake activity in the region of the Atomic Energy Commission's Hanford Reservation in south-central Washington in March 1969. The Division of Reactor Development and Technology, of the Atomic Energy Commission (AEC), supported the operation of a network of 6 (later 7) short-period, high-gain seismograph stations (Figure 1) through June 1970. Then the Chemical Processing Division of the AEC assumed support of the original 7-station network and added 9 additional stations (Figure 1). The network was further enlarged to 24 stations in October 1971. Some preliminary results from the 7-station network covering the period March 23, 1969 to December 31, 1969 were released in the USGS open-file report "Geologic Investigation of Faulting in the Hanford Region, Washington" by James W. Bingham, Clark J. Londquist, and Elmer H. Baltz. A second open-file report, "Microearthquake Activity in the Vicinity of Wooded Island, Hanford Region, Washington" by Andrew M. Pitt, described a series of earthquakes occurring near Wooded Island on the Columbia River (Figure 1) from March 23, 1969 to February 28, 1971. Monthly reports on the results from the seismograph network through February 1972 have been submitted to the AEC. This report covers preliminary results obtained from the seismograph network from March 23, 1969 to June 30, 1971. The results presented in this report will be refined as additional data are utilized to increase the knowledge of the crustal structure in the Hanford region and thereby improve the accuracy of earthquake hypocenter determinations.

Figure 1. Hanford Region of south central Washington with the U.S. Geological Survey seismograph network indicated by triangles. Solid triangle stations began operating in March 1969 (except Station A which began operating in August 1969), open triangle stations began operating in July 1970, and broken-sided triangle stations L and P began operating in November 1970. Station P was shifted to the Station D location in February 1971. Some pertinent geologic structures of the region from the U.S. Geological Survey report, "Geologic Investigation of Faulting in the Hanford Region, Washington", by James W. Bingham, Clark J. Londquist, and Elmer H. Baltz are shown.

Distribution, Number, and Magnitude of Earthquakes

Within the seismograph network, earthquakes with Richter magnitudes as low as 0.5 can be located when the background noise level is low. At a distance of 200 km from Cable mountain (Figure 1), the practical limit at which epicenters can be determined by the 16 station network, earthquakes of magnitude 2.5 or greater can usually be located. The accuracy of epicenter determination (Footnote 1) is greatest for earthquakes occurring within the network (the uncertainty is generally less than 5 km) and decreases rapidly as the distance of the earthquake from the network increases.

The seismograph network was used to locate 672 events. The events were classified as: 524 earthquakes, 92 probable or definite explosions, and 56 possible explosions. The latter are events occurring along the edge of, or outside of the network for which there are presently insufficient data to identify their origin. In this discussion, they are presumed to be earthquakes. The located events (Table 1) have been divided into 2 series: those occurring through June 30, 1970 (Figure 2) and those occurring from July 1, 1970 onward (Figure 3). Figures 2 and 3 are attached to the end of the report.

With the exception of the large number of events near station I, most of the earthquakes occurred to the east, northeast and north of the Hanford Reservation (Figures 2 and 3) in a broad, northwest trending zone. Within this broad zone, most of the earthquakes were concentrated

Footnote 1:
Some comments on locating earthquakes with the Hanford seismograph network and a description of the crustal model currently being used for the Hanford region are discussed in Pitt, 1971.

Table 1. HANFORD SEISMIC EVENTS - MAR 23, 1969 TO JUNE 30, 1971

Further adjustments may be made in the epicenters of these events as more accurate knowledge of the crustal structure in the Hanford Region is obtained. Origin time is given in Greenwich Mean Time; MAG is Richter magnitude, DEPTH is in kilometers; and QUAL indicates the reliability of the epicenter. QUAL is based upon the quality of P and S arrivals, the distribution of stations, the number of stations available, and the P-arrival time residuals at the stations used to determine the epicenter. The letters indicate the following maximum probably epicentral errors: A-1 km, B-3 km, C-5 km, D-10 km, E-15 km, F-25 km.

Events in sequence A are shown on Figure 2 and events in sequence B are shown on Figure 3.

Sequence A

NUM	1969 MO	DY	HRMN	SEC	LAT N °	'	LONG W °	'	MAG	DEPTH	QUAL	REMARKS
1	3	24	2232	19.5	46	34.8	118	55.4	0.7		D	EXPLOSION
2	3	25	1912	12.0	47	41.6	120	19.2	1.9		F	PROBABLE EXPLOSION
3	3	26	2232	4.8	47	7.8	118	58.5	2.2		E	POSSIBLE EXPLOSION
4	3	27	4	3 1.7	48	16.8	119	16.2	2.6		F	POSSIBLE EXPLOSION
5	3	27	2240	48.1	46	36.1	119	10.1	0.6		D	PROBABLE EXPLOSION
6	3	31	1715	23.4	46	39.2	119	6.3	1.6	<10	C	
7	4	1	311	17.1	47	59.5	118	50.5	2.6		F	POSSIBLE EXPLOSION
8	4	1	419	54.8	46	39.3	119	6.6	1.5	<10	D	
9	4	1	20	3 49.4	46	33.4	118	52.6	0.9		E	PROBABLE EXPLOSION
10	4	5	15	5 50.8	47	10.4	119	43.4	2.0		F	POSSIBLE EXPLOSION
11	4	6	1515	57.9	46	59.4	119	11.4	1.5		F	POSSIBLE EXPLOSION
12	4	8	226	4.3	47	2.8	119	3.5	1.7		F	POSSIBLE EXPLOSION
13	4	8	649	17.3	47	10.4	119	59.1	1.8		E	POSSIBLE EXPLOSION
14	4	8	1115	54.4	47	1.5	119	34.9	1.7		E	
15	4	10	111	11.9	46	42.4	117	46.8	2.4		E	EXPLOSION
16	4	11	035	39.0	46	59.1	119	1.9	1.7		E	POSSIBLE EXPLOSION
17	4	12	321	45.0	47	8.1	119	2.8	1.8		E	POSSIBLE EXPLOSION
18	4	12	1110	29.3	46	59.1	120	27.4	2.0		C	
19	4	19	546	2.2	45	47.3	119	41.5	2.7		E	
20	4	20	219	14.1	48	17.5	118	53.6	3.2		F	POSSIBLE EXPLOSION
21	4	21	1416	34.3	47	11.9	119	43.2	2.6		E	POSSIBLE EXPLOSION
22	4	22	2059	50.6	46	36.1	119	8.8	1.9		D	EXPLOSION
23	4	24	143	0.9	46	43.6	117	42.0	2.7		E	EXPLOSION
24	4	24	12	3 56.7	47	9.5	119	41.3	2.0		E	POSSIBLE EXPLOSION
25	4	24	12	9 34.8	47	10.9	119	41.8	2.0		E	POSSIBLE EXPLOSION
26	4	29	15	8 0.8	46	36.1	119	9.4	0.8		D	
27	4	30	2033	1.7	47	9.9	119	36.8	1.9		F	POSSIBLE EXPLOSION
28	4	30	2143	58.2	46	39.8	119	6.2	1.3		D	
29	5	1	052	36.4	48	7.8	118	44.8	2.8		F	EXPLOSION
30	5	1	1652	3.1	46	59.1	119	49.2	2.0		E	

Table 1. (continued)

Sequence A

1969

NUM	MO	DY	HRMN	SEC	LAT N ° '	LONG W ° '	MAG	DEPTH	QUAL	REMARKS
31	5	2	1836	59.8	46 35.9	119 9.7	0.7	<10	D	
32	5	4	925	3.8	47 9.8	119 41.2	2.0		E	POSSIBLE EXPLOSION
33	5	5	1835	4.6	46 36.1	119 10.0	0.8		D	
34	5	5	1926	25.3	48 11.1	118 49.8	2.5		F	EXPLOSION
35	5	6	034	0.8	46 38.4	117 43.9	2.4		F	EXPLOSION
36	5	7	543	37.3	46 40.5	119 20.8	1.2		E	
37	5	7	2036	20.2	46 25.7	119 37.5	0.9		E	
38	5	8	1556	21.3	46 36.2	119 9.6	0.9		D	
39	5	9	19 6	8.2	47 41.0	119 47.6	2.9		E	PROBABLE EXPLOSION
40	5	10	1441	12.5	46 41.5	117 26.1	2.6		F	EXPLOSION
41	5	10	1937	21.6	46 49.8	119 35.5	2.5	<10	C	
42	5	10	1955	34.9	46 49.5	119 36.8	0.6	<10	D	
43	5	11	350	11.1	48 11.0	118 58.7	2.8		F	POSSIBLE EXPLOSION
44	5	14	2321	47.5	47 1.7	119 34.4	1.7		E	
45	5	17	0 1	28.5	46 39.1	119 7.8	0.9		D	
46	5	18	145	41.6	46 49.3	119 38.8	0.6		D	
47	5	18	3 0	32.7	46 51.1	119 45.1	0.6		D	
48	5	19	1859	24.5	47 49.6	118 3.4	3.4		E	PROBABLE EXPLOSION
49	5	22	148	1.9	46 44.7	117 33.7	2.6		F	EXPLOSION
50	5	22	933	22.6	46 44.3	119 20.9	0.9	<10	D	
51	5	23	945	42.3	46 51.6	119 46.2	0.8		D	
52	6	1	1216	45.0	46 25.3	119 16.7	0.9	<10	B	
53	6	3	413	3.1	46 42.8	119 35.5	0.6		C	
54	6	6	926	43.2	47 7.6	119 5.1	1.8		E	POSSIBLE EXPLOSION
55	6	8	9 3	58.9	46 49.2	119 23.6	1.3		D	
56	6	8	1236	12.3	46 25.2	119 16.2	1.2	<10	B	
57	6	10	1450	27.3	46 25.4	119 16.4	2.1	<10	B	
58	6	15	453	36.4	46 25.3	119 16.1	1.0	<10	B	
59	6	23	5 7	45.0	46 56.5	119 42.3	1.7		D	
60	6	27	241	20.3	46 25.5	119 16.3	1.4	<10	B	
61	7	1	622	38.2	46 25.6	119 16.7	1.2		B	
62	7	2	2333	21.4	46 35.9	117 55.1	2.3		F	EXPLOSION
63	7	11	2340	45.1	46 35.4	117 58.5	2.4		F	EXPLOSION
64	7	15	430	1.0	46 25.1	119 15.5	2.0	<10	B	
65	7	15	2354	10.5	46 25.4	119 16.3	1.8	<10	B	
66	7	18	431	39.7	46 47.4	120 24.9	2.5		D	
67	7	23	255	14.6	47 3.0	119 14.6	1.9		E	POSSIBLE EXPLOSION
68	7	23	257	38.5	47 2.7	119 14.7	1.9		E	POSSIBLE EXPLOSION
69	7	24	7 8	10.7	47 41.8	120 22.2	2.4		F	PROBABLE EXPLOSION
70	7	24	1013	36.3	46 25.3	119 16.3	1.6	<10	B	
71	7	28	1555	1.2	47 3.8	119 12.9	1.9		E	POSSIBLE EXPLOSION
72	7	29	1429	24.0	46 19.3	119 32.4	0.8		E	POSSIBLE EXPLOSION
73	7	31	614	22.1	46 25.4	119 17.0	2.5	<10	B	
74	7	31	21 9	45.6	46 25.5	119 16.5	2.0	<10	B	
75	8	1	1036	52.8	46 25.3	119 16.3	1.5	<10	B	
76	8	1	1248	20.2	46 25.6	119 16.2	2.0	<10	B	
77	8	1	1558	23.8	47 47.2	119 35.7	3.1		F	PROBABLE EXPLOSION
78	8	2	3 4	14.7	47 11.9	117 22.5	3.4		E	POSSIBLE EXPLOSION
79	8	2	2141	39.1	46 25.4	119 16.6	1.7	<10	B	
80	8	4	1532	8.4	47 47.4	119 56.9	3.2		F	PROBABLE EXPLOSION

Table 1. (continued)

Sequence A

1969

NUM	MO	DY	HRMN	SEC	LAT N °	'	LONG W °	'	MAG	DEPTH	QUAL	REMARKS
81	8	4	2339	24.8	46	35.5	118	3.7	2.5		E	EXPLOSION
82	8	6	1918	27.6	47	0.6	119	22.5	1.6		E	POSSIBLE EXPLOSION
83	8	8	7 5	48.1	47	36.2	119	8.9	2.6		F	PROBABLE EXPLOSION
84	8	8	17 4	50.6	47	46.4	119	34.0	3.1		F	PROBABLE EXPLOSION
85	8	8	2240	17.0	46	15.1	118	0.6	2.2		F	POSSIBLE EXPLOSION
86	8	11	550	15.6	46	25.5	119	15.7	1.7	<10	B	
87	8	11	1336	34.9	46	42.3	119	55.5	2.2	5-15	D	
88	8	12	1418	3.1	46	25.5	119	16.1	1.3		B	
89	8	14	1631	45.3	47	41.3	119	33.9	3.3		E	PROBABLE EXPLOSION
90	8	15	1141	53.8	46	25.5	119	16.3	1.2		B	
91	8	15	1623	4.1	46	25.2	119	16.7	2.2	<10	B	
92	8	18	1439	18.6	46	48.9	119	29.0	1.0	<10	C	
93	8	18	1850	57.3	46	25.3	119	16.1	1.2		B	
94	8	21	148	30.0	46	25.7	119	16.9	1.3		B	
95	8	22	844	1.5	46	25.4	119	14.9	1.8	<10	B	
96	8	31	252	28.1	46	25.6	119	16.7	0.9	<10	B	
97	8	31	1118	7.7	46	25.7	119	16.9	2.3	<5	B	
98	8	31	1119	31.3	46	25.4	119	17.2	2.2	<10	B	
99	8	31	1627	32.9	46	16.8	120	53.3	2.7		F	POSSIBLE EXPLOSION
100	9	1	035	48.0	46	25.4	119	16.8	1.2	<10	B	
101	9	1	2027	43.2	46	25.4	119	16.8	0.9	<10	B	
102	9	2	034	10.3	46	25.2	119	16.1	1.8	<10	B	
103	9	2	1241	52.5	46	25.9	119	16.8	1.9	<10	B	
104	9	2	2150	30.7	46	41.4	119	35.7	2.3	19-23	A	
105	9	4	1817	11.3	46	25.5	119	15.5	1.8	<10	B	
106	9	6	2228	34.9	46	25.5	119	15.5	1.9	<10	B	
107	9	10	1214	58.2	46	57.6	119	37.1	2.3		D	
108	9	12	021	52.4	46	35.4	118	22.8	2.4		E	EXPLOSION
109	9	13	830	46.0	47	47.9	119	23.6	3.0		E	PROBABLE EXPLOSION
110	9	21	1021	21.1	46	25.9	119	16.8	1.2	<10	B	
111	9	26	1436	6.3	46	42.6	119	34.3	0.7		C	
112	9	27	1 2	45.4	46	38.3	118	1.5	2.7		E	EXPLOSION
113	10	2	059	1.6	46	58.7	118	18.1	2.5		F	PROBABLE EXPLOSION
114	10	2	214	27.5	46	26.0	119	16.3	1.7	<5	B	
115	10	2	3 0	47.8	46	42.3	119	21.4	1.1	<10	C	
116	10	2	637	45.2	46	25.9	119	16.3	0.9	<10	B	
117	10	3	156	51.0	46	41.2	119	14.4	1.3	<10	C	
118	10	6	1158	6.0	46	25.8	119	17.7	1.3	<10	B	
119	10	6	12 4	1.3	46	25.6	119	17.5	1.3	<10	B	
120	10	7	2230	18.1	46	52.5	120	34.6	2.5		E	EXPLOSION
121	10	14	724	57.7	46	41.0	119	15.9	1.5	<10	B	
122	10	15	834	58.3	47	19.1	122	5.9	3.7		F	
123	10	15	1952	58.3	46	49.7	119	2.9	1.5		D	
124	10	15	2046	6.8	46	40.8	117	41.7	2.2		F	EXPLOSION
125	10	16	1530	45.9	46	48.9	120	29.8	2.2		E	EXPLOSION
126	10	16	1913	43.3	46	41.5	119	14.5	1.9	<10	B	
127	10	17	1810	36.4	46	48.8	120	28.6	2.3		E	EXPLOSION
128	10	17	20 8	0.1	46	42.4	117	50.7	2.1		F	EXPLOSION
129	10	19	730	22.4	46	15.5	118	17.3	2.5		D	
130	10	20	2329	3.2	46	41.8	117	48.5	1.9		E	EXPLOSION

Table 1. (continued)

1969
1970

Sequence A

NUM	MO	DY	HRMN	SEC	LAT N ° '	LONG W ° '	MAG	DEPTH	QUAL	REMARKS
131	10	21	2048	16.1	47 38.5	118 14.1	2.6		F	PROBABLE EXPLOSI
132	10	21	2235	38.7	46 31.6	118 6.3	2.0		E	EXPLOSION
133	10	23	1741	10.1	46 52.5	120 32.1	2.4		F	EXPLOSION
134	10	23	2348	43.5	46 49.4	120 29.7	2.3		D	EXPLOSION
135	10	24	447	5.2	46 41.1	119 14.0	1.0	<10	C	
136	10	28	039	46.4	46 50.3	120 30.0	2.5		E	EXPLOSION
137	10	28	416	57.3	46 44.1	119 19.3	0.9	<10	D	
138	10	28	513	3.2	46 44.3	119 19.9	1.6	<10	C	
139	10	29	034	36.4	46 50.1	120 31.4	2.6		E	EXPLOSION
140	10	30	1616	35.8	46 48.7	120 31.8	2.5		E	EXPLOSION
141	11	1	0 0	23.5	46 51.1	120 29.1	2.5		D	EXPLOSION
142	11	1	112	46.8	46 51.9	120 30.6	2.8		E	EXPLOSION
143	11	3	2246	23.5	46 43.5	119 15.7	1.1		D	
144	11	5	041	27.2	47 5.9	118 3.4	3.1		F	PROBABLE EXPLOSI
145	11	5	1940	44.8	46 50.2	120 29.8	2.4		D	EXPLOSION
146	11	6	021	30.0	46 48.6	120 29.9	2.4		D	EXPLOSION
147	11	8	1140	20.7	46 43.2	119 6.3	1.9	<10	C	
148	11	8	12 2	0.6	46 43.5	119 6.8	1.2	<10	C	
149	11	10	056	15.4	46 33.2	119 39.0	1.6	5-15	C	
150	11	10	814	16.5	46 46.2	119 3.9	1.5		D	
151	11	10	852	18.5	46 43.5	119 6.8	1.4	<10	C	
152	11	10	1859	8.1	46 43.6	119 7.1	2.0	<10	C	
153	11	10	19 3	27.0	46 43.9	119 7.0	1.6	<10	C	
154	11	18	1817	38.0	46 36.7	119 38.2	1.0		D	
155	11	21	423	57.9	46 30.4	119 37.4	0.8		D	
156	11	21	1631	56.0	46 37.3	118 53.1	3.0		D	EXPLOSION
157	11	23	5 8	31.7	46 42.4	119 22.4	1.9	<10	C	
158	11	26	1216	26.0	46 32.3	119 38.7	0.7		D	
159	11	26	2231	8.7	46 25.6	119 15.6	1.3	<10	B	
160	11	30	240	41.8	46 38.0	118 43.2	1.9		D	PROBABLE EXPLOSI
161	12	1	23 1	44.8	46 8.9	118 35.3	2.0		E	PROBABLE EXPLOSI
162	12	3	2018	48.7	46 46.4	119 45.7	2.2		D	POSSIBLE EXPLOSI
163	12	13	1755	57.0	46 40.6	119 13.3	1.3	<10	D	
164	12	18	2137	60.0	46 41.0	119 13.8	1.1		D	
165	12	18	2257	39.7	46 41.1	119 13.2	1.6	<10	B	
166	12	30	141	57.0	46 40.6	119 12.8	1.2	<10	C	
167	1	1	616	7.6	46 14.6	118 15.1	2.3		E	
168	1	1	644	26.7	46 16.2	118 17.8	2.6		E	
169	1	2	858	51.5	46 44.9	119 22.1	1.3	<10	B	
170	1	10	117	19.7	46 56.2	118 9.4	2.4		E	PROBABLE EXPLOSI
171	1	15	1326	59.1	46 26.0	119 15.8	1.1	<10	B	
172	1	19	1133	1.2	46 58.7	119 43.5	1.8		D	
173	1	19	1510	45.1	46 52.6	119 24.1	0.9		D	
174	1	20	154	58.1	46 25.8	119 17.6	1.8	<10	B	
175	1	24	1358	32.6	46 25.8	119 18.0	1.7	<10	B	
176	1	30	035	30.7	46 50.7	118 14.4	2.6		E	PROBABLE EXPLOSI
177	1	30	557	49.4	46 26.3	119 15.5	1.6	<10	B	
178	1	31	1122	17.5	46 26.0	119 14.6	1.4	<10	B	
179	2	1	1751	50.6	46 25.8	119 16.5	1.4	<10	B	
180	2	3	552	3.1	46 25.7	119 18.0	1.2	<10	B	

Table 1. (continued)

Sequence A

1970

NUM	MO	DY	HRMN	SEC	LAT N ° '	LONG W ° '	MAG	DEPTH	QUAL	REMARKS
181	2	5	118	18.9	46 25.7	119 17.5	1.9	<10	B	
182	2	7	747	45.7	46 25.7	119 17.9	1.6	<10	B	
183	2	7	2249	57.6	46 52.9	119 26.8	1.5		D	
184	2	8	2013	17.5	46 26.0	119 14.9	1.7	<10	B	
185	2	9	053	28.1	46 52.5	119 25.0	1.3		D	
186	2	9	619	34.9	47 42.3	120 17.7	2.7		E	PROBABLE EXPLOSION
187	2	9	950	48.4	46 54.5	119 42.9	1.1		D	
188	2	9	1618	54.9	46 52.3	119 24.9	1.6	<10	C	
189	2	10	929	15.6	46 51.7	119 25.5	1.2		D	
190	2	10	935	29.7	46 51.3	119 24.9	1.1		D	
191	2	11	1037	15.9	46 53.1	119 24.8	1.5	<10	C	
192	2	11	1047	11.4	46 26.2	119 14.8	2.1	<10	B	
193	2	12	319	33.8	46 26.3	119 17.7	1.0	<10	B	
194	2	13	247	35.9	46 44.8	119 22.0	0.9		D	
195	2	13	959	52.6	46 51.9	119 25.2	1.3		D	
196	2	14	1337	23.4	46 50.4	119 24.7	1.2		D	
197	2	14	1349	51.0	46 53.3	119 24.5	1.8	<5	B	
198	2	15	617	1.5	46 53.4	119 24.5	1.9	<10	C	
199	2	15	1836	20.3	46 52.9	119 24.2	1.5	<10	C	
200	2	17	221	57.9	46 25.5	119 17.0	1.7	<10	B	
201	2	18	719	8.8	46 52.3	119 26.4	1.4		D	
202	2	21	1228	13.3	46 52.3	119 24.7	1.0		D	
203	2	21	1232	10.2	46 51.7	119 24.7	1.1		D	
204	2	21	1232	19.8	46 52.8	119 24.1	1.6		D	
205	2	21	13 5	31.9	46 52.7	119 24.5	1.4	<10	C	
206	2	22	045	25.5	46 52.1	119 25.1	1.7		D	
207	2	25	6 2	11.2	46 23.4	118 55.6	1.0		D	
208	2	26	1820	44.0	46 24.4	119 0.2	1.1		D	
209	3	1	1051	11.5	46 53.4	119 25.1	2.3	<10	C	
210	3	2	1233	40.7	46 52.0	119 25.6	1.1		D	
211	3	3	158	40.1	46 25.9	119 15.2	1.5	<10	B	
212	3	3	846	3.4	46 52.8	119 26.5	1.5		D	
213	3	3	851	4.6	46 52.9	119 26.9	1.4	<10	C	
214	3	3	1728	7.8	46 53.7	119 25.1	2.3	<10	C	
215	3	3	1736	23.8	46 43.6	119 5.2	2.1	<10	C	
216	3	4	023	36.8	46 38.1	119 16.6	1.6	14-18	A	
217	3	4	047	59.0	46 53.4	119 25.2	1.8	<10	C	
218	3	6	920	50.7	46 49.7	119 3.3	1.5		D	
219	3	6	2147	49.7	46 40.6	119 16.8	1.8	<10	C	
220	3	6	2151	41.6	46 40.5	119 16.8	1.4		D	
221	3	8	1810	54.4	46 40.9	119 17.6	0.9	<10	C	
222	3	10	233	5.7	46 53.3	119 25.2	1.6	<10	C	
223	3	10	1440	34.5	46 51.9	119 26.3	1.5		D	
224	3	12	029	37.2	46 17.5	119 32.6	1.9		E	POSSIBLE EXPLOSION
225	3	12	948	7.0	46 53.5	119 25.0	1.9	<10	C	
226	3	12	1056	59.2	46 24.6	118 59.9	1.0		D	
227	3	13	042	40.2	46 51.5	119 24.9	1.4		D	
228	3	16	1548	21.2	46 31.6	119 33.1	1.9	20-24	A	
229	3	19	13 3	50.7	46 38.3	118 43.8	2.5		D	PROBABLE EXPLOSION
230	3	21	2043	13.7	47 16.6	118 59.8	2.3		D	PROBABLE EXPLOSION

Table 1. (continued)

Sequence A

1970

NUM	MO	DY	HRMN	SEC	LAT N ° ′	LONG W ° ′	MAG	DEPTH	QUAL	REMARKS
231	3	25	023	34.8	46 40.5	118 14.6	2.4		D	PROBABLE EXPLOSION
232	3	29	1527	46.5	46 53.1	119 25.0	1.5	<10	C	
233	3	29	1542	50.4	46 52.9	119 25.3	1.7		D	
234	3	31	434	43.2	46 25.6	119 16.9	1.6	<10	B	
235	4	4	240	13.8	46 12.9	120 5.5	2.8		E	EXPLOSION
236	4	4	1043	27.6	46 25.6	119 16.3	1.7	<10	B	
237	4	11	154	31.2	46 53.0	119 25.7	1.7	<10	C	
238	4	11	252	47.0	46 53.6	119 26.8	1.6	<10	C	
239	4	15	1718	51.8	47 27.7	119 46.9	2.3		E	PROBABLE EXPLOSION
240	4	22	342	38.4	46 53.5	119 26.2	1.5	<10	D	
241	4	22	22 2	58.9	46 16.0	120 14.5	2.7		E	EXPLOSION
242	4	25	220	36.3	46 25.5	119 16.9	1.7	<10	B	
243	4	26	14 5	31.1	46 54.0	119 26.1	1.7	<10	C	
244	4	29	228	55.5	46 15.1	120 16.2	2.6		E	EXPLOSION
245	5	3	1031	26.3	46 25.6	119 15.2	1.0		B	
246	5	6	050	17.8	46 48.8	119 19.3	1.5	<10	D	
247	5	6	1715	38.0	46 53.8	119 27.3	2.5		D	
248	5	8	848	29.2	46 25.8	119 17.3	1.5	<10	B	
249	5	8	18 9	10.6	46 20.4	120 10.5	2.1		E	EXPLOSION
250	5	12	1159	51.1	46 6.6	119 31.2	1.4		D	
251	5	12	2152	37.8	46 22.3	118 20.0	2.2		D	PROBABLE EXPLOSION
252	5	13	2030	8.7	47 28.4	118 43.6	2.3		E	PROBABLE EXPLOSION
253	5	18	622	37.3	46 25.2	119 14.9	1.6	<10	B	
254	5	19	2322	42.8	46 35.2	119 4.8	1.1		D	
255	5	20	1228	5.1	46 37.9	119 16.3	1.7	14-18	A	
256	5	20	23 6	59.4	46 21.5	120 10.7	1.9		F	EXPLOSION
257	5	23	19 2	32.3	46 19.3	119 23.6	1.2		D	
258	5	24	1948	40.5	46 25.8	119 18.0	2.0	<10	B	
259	5	28	1234	17.4	46 49.0	119 22.1	1.6	<10	C	
260	5	29	1159	29.7	46 25.9	119 18.2	1.8	<10	B	
261	6	2	858	53.6	46 35.2	119 4.9	1.2		D	
262	6	3	1248	59.5	46 48.5	119 22.0	1.1	<10	D	
263	6	3	1730	27.5	46 48.0	119 22.2	1.1		D	
264	6	3	1949	13.4	46 48.7	119 21.9	1.3		D	
265	6	4	2155	57.1	46 44.8	119 24.4	0.9		D	
266	6	5	217	8.6	46 48.4	119 22.3	1.6	<10	C	
267	6	8	936	30.3	46 44.3	119 24.2	0.9		D	
268	6	11	1043	26.3	46 48.3	119 18.5	1.0		D	
269	6	12	15 1	56.0	46 17.6	119 32.1	1.3		D	POSSIBLE EXPLOSION
270	6	16	1529	17.5	46 59.0	119 34.1	1.5		D	POSSIBLE EXPLOSION
271	6	17	2040	52.4	47 1.0	119 27.4	1.5		D	POSSIBLE EXPLOSION
272	6	19	1941	8.9	46 38.2	118 43.4	1.9		D	PROBABLE EXPLOSION
273	6	19	2118	14.1	46 17.4	120 0.6	2.1		E	EXPLOSION
274	6	22	053	57.1	46 25.8	120 9.2	2.8		E	EXPLOSION
275	6	22	226	25.0	46 37.4	118 42.4	1.8		E	PROBABLE EXPLOSION
276	6	24	2134	2.7	46 12.7	119 4.3	2.3		D	
277	6	25	222	48.8	46 49.0	119 20.0	1.2		D	
278	6	26	010	49.9	46 12.0	119 4.2	1.7		D	
279	6	26	1329	29.8	46 25.3	119 13.5	1.4	<10	B	

Table 1. (continued)

Sequence B

1970

NUM	MO	DY	HRMN	SEC	LAT N °	'	LONG W °	'	MAG	DEPTH	QUAL	REMARKS
1	7	12	1023	34.3	46	49.9	119	22.2	0.9	<10	D	
2	7	14	241	59.8	46	19.2	117	39.4	2.9		F	PROBABLE EXPLOSION
3	7	15	1357	57.5	47	8.6	119	13.9	1.5	20-25	B	
4	7	17	1324	35.0	46	48.6	119	22.6	0.8	<10	D	
5	7	18	021	24.4	46	48.5	119	23.3	0.6	<10	D	
6	7	18	316	25.7	46	48.5	119	23.1	1.1	<10	C	
7	7	27	035	49.5	46	49.7	119	20.2	0.9	<10	D	
8	7	27	2159	42.4	46	48.6	119	22.7	1.0	<5	B	
9	7	29	1320	52.8	46	48.6	119	23.5	0.8	<10	D	
10	7	29	2042	29.3	48	17.0	119	18.7	2.6		F	POSSIBLE EXPLOSION
11	7	29	2310	45.1	46	49.5	119	27.5	1.2	<10	C	
12	7	30	1743	20.4	46	49.2	119	22.7	1.0	<5	B	
13	7	31	618	29.5	46	42.7	119	54.3	1.1	<10	D	
14	8	2	1519	5.5	46	38.8	119	5.5	0.5	<15	D	
15	8	3	1611	38.5	46	29.1	119	38.2	0.8	<15	C	
16	8	5	152	28.2	46	52.2	119	25.4	0.9	<10	B	
17	8	10	2121	27.0	46	49.7	119	19.6	0.7	<10	D	
18	8	14	330	45.3	45	52.3	119	4.0	1.8		E	POSSIBLE EXPLOSION
19	8	16	9 0	52.9	46	33.1	117	59.1	2.0		F	POSSIBLE EXPLOSION
20	8	23	1111	40.8	46	44.7	119	20.5	3.0	<5	B	MAG MAY BE REVISED
21	8	23	1216	55.6	46	44.8	119	20.6	1.1	<5	B	
22	8	24	1157	21.4	46	44.8	119	21.2	0.9	<5	C	
23	8	24	1238	57.8	46	49.8	119	18.7	1.2	<10	C	
24	8	24	21 7	29.2	46	44.6	119	20.9	1.0	<5	C	
25	8	27	1126	12.1	46	39.6	119	35.6	1.3	<5	B	
26	8	28	16 9	9.8	46	50.0	119	18.6	1.3	<5	C	
27	9	1	1348	43.0	46	43.4	118	14.8	2.2		E	POSSIBLE EXPLOSION
28	9	3	2242	50.9	46	44.9	119	21.2	0.8	<10	C	
29	9	4	557	31.2	46	41.1	119	35.6	1.3	<10	C	
30	9	5	1417	40.5	46	54.2	119	33.2	0.9		D	
31	9	7	17 7	46.8	46	44.8	119	21.3	0.9	<10	B	
32	9	11	220	52.6	46	37.5	120	31.4	3.0		E	POSSIBLE EXPLOSION
33	9	12	1326	52.1	47	11.3	119	27.7	1.5		D	POSSIBLE EXPLOSION
34	9	14	1526	28.9	46	45.1	119	22.9	0.8	<10	B	
35	9	14	1856	37.8	46	18.6	119	27.6	1.1		D	
36	9	17	527	41.1	46	49.1	119	21.5	1.4	<10	D	
37	9	19	250	5.9	46	25.5	119	15.7	1.1	<5	B	
38	9	19	1125	26.3	46	36.3	119	6.6	0.8		C	
39	9	20	17 2	5.7	46	17.0	119	30.7	1.5	5-10	C	
40	9	22	224	51.5	46	49.3	119	32.6	1.0	<10	C	
41	9	25	537	39.9	46	42.7	119	21.1	0.5	<10	C	
42	9	25	1215	35.9	46	49.9	119	32.2	0.9	<10	D	
43	9	29	322	36.8	46	45.0	119	22.7	1.5	<10	B	
44	9	29	1750	12.7	45	44.9	119	6.2	2.2		D	POSSIBLE EXPLOSION
45	9	29	1851	19.4	46	45.1	119	22.8	1.8	<5	B	
46	9	29	2247	52.1	46	59.4	119	49.0	2.0	25-29	B	
47	9	30	2112	26.6	46	21.3	119	4.3	0.6		D	POSSIBLE EXPLOSION
48	10	1	7 4	41.0	46	49.8	119	32.7	1.7	<5	B	
49	10	1	1045	25.5	46	49.4	119	32.8	0.8	<10	C	
50	10	1	11 7	6.7	46	49.3	119	32.9	0.9	<10	C	

Table 1. (continued)

Sequence B

1970

NUM	MO	DY	HRMN	SEC	LAT N °	'	LONG W °	'	MAG	DEPTH	QUAL	REMARKS
51	10	1	1146	52.7	46	45.2	119	22.6	2.3	<5	B	MAG MAY BE REVISED
52	10	1	13 7	1.7	46	49.9	119	32.2	1.2	<10	C	
53	10	2	118	18.0	45	40.2	120	38.2	2.5		E	POSSIBLE EXPLOSION
54	10	2	1556	24.7	46	45.1	119	22.4	3.0	<10	B	MAG MAY BE REVISED
55	10	2	16 8	23.5	46	45.3	119	22.4	1.2	<10	B	
56	10	3	11 7	18.1	46	45.0	119	22.6	1.3	<5	B	
57	10	4	1922	26.1	46	45.2	119	23.1	1.0	<10	C	
58	10	7	656	14.7	46	9.8	119	38.7	1.6		D	
59	10	9	825	21.7	46	45.2	119	22.9	1.2	<10	B	
60	10	12	435	25.0	46	45.2	119	21.1	0.8	<10	C	
61	10	13	822	10.4	46	38.1	119	4.1	1.3	<10	C	
62	10	14	1016	1.2	46	44.8	119	23.8	1.0	<10	C	
63	10	15	21 2	24.8	46	38.1	119	5.7	1.3	<10	C	
64	10	15	21 4	35.1	46	37.9	119	6.3	1.1		D	
65	10	15	2130	23.2	46	38.3	119	5.8	1.2	<10	C	
66	10	15	2135	42.3	46	38.3	119	5.4	1.3	<10	C	
67	10	17	1623	13.0	47	15.6	119	37.3	1.7		F	POSSIBLE EXPLOSION
68	10	17	1651	47.3	47	13.6	119	40.0	1.8		E	POSSIBLE EXPLOSION
69	10	19	715	6.6	46	54.6	117	36.2	2.7		F	POSSIBLE EXPLOSION
70	10	20	0 7	32.4	46	38.3	119	5.7	1.2	<10	C	
71	10	21	652	44.5	46	37.9	119	6.1	1.2		D	
72	10	24	21 1	12.5	46	44.9	119	22.4	1.4	<10	B	
73	10	30	533	41.0	46	37.8	119	5.7	1.1		D	
74	11	1	333	38.6	46	45.0	119	21.2	0.9	<10	C	
75	11	1	454	44.6	46	49.3	119	32.7	1.1	<10	C	
76	11	5	8 5	49.0	46	34.9	119	4.6	1.2	<10	C	
77	11	6	14 2	54.5	46	40.9	118	50.1	1.0		D	
78	11	6	1417	42.5	46	50.9	119	22.1	1.0	<10	D	
79	11	6	1815	16.4	46	41.3	118	51.0	2.2	<10	C	
80	11	7	719	38.3	46	25.5	119	17.6	1.3	<5	B	
81	11	7	719	44.2	46	25.5	119	17.3	1.9	<5	B	
82	11	8	051	41.8	46	24.5	118	59.8	1.6		D	
83	11	10	1139	6.1	46	45.3	119	22.3	1.0	<10	C	
84	11	11	536	11.3	46	43.2	119	21.2	0.7	<10	C	
85	11	11	16 3	36.7	46	41.1	118	50.6	1.8	<10	C	
86	11	11	16 4	36.9	46	41.1	118	51.8	1.2		D	
87	11	12	139	38.5	46	38.3	119	4.0	0.9		D	
88	11	14	1540	46.0	46	25.8	119	17.5	1.7	<3	A	
89	11	19	2040	25.7	46	38.1	119	5.4	1.2	<10	C	
90	11	21	1910	57.8	46	43.8	117	46.4	2.5		E	PROBABLE EXPLOSION
91	11	22	045	2.6	46	51.3	120	27.9	2.5		D	EXPLOSION
92	11	22	1059	25.2	46	38.4	119	4.7	1.0		D	
93	11	22	1215	50.4	46	38.1	119	3.4	1.2		C	
94	11	22	1219	19.8	46	25.7	119	17.4	1.0	<3	B	
95	11	24	1118	25.0	46	54.6	119	26.6	1.1	<10	C	
96	11	25	728	7.3	46	39.9	119	35.1	0.3		C	
97	11	25	915	45.3	46	34.6	119	4.4	0.8		D	
98	11	25	1239	15.2	46	55.5	119	18.1	1.3	<10	C	
99	11	26	450	58.9	46	39.7	119	35.5	1.2	<10	B	
100	11	26	626	31.1	46	39.7	119	35.1	0.5		C	

Table 1. (continued)

Sequence B

1970

NUM	MO	DY	HRMN	SEC	LAT N ° '	LONG W ° '	MAG	DEPTH.	QUAL	REMARKS
101	11	26	727	20.7	46 39.5	119 35.6	1.3	<5	B	
102	11	27	551	49.5	46 26.5	119 15.8	1.1	<5	B	
103	11	27	613	10.2	46 26.1	119 15.2	1.3	<5	B	
104	11	27	739	28.0	46 25.9	119 15.2	1.3	<10	B	
105	11	27	8 3	10.4	46 26.0	119 15.3	0.9	<10	B	
106	11	27	912	51.9	46 54.7	119 39.3	1.2	<10	C	
107	11	27	1127	30.3	46 34.3	119 6.1	0.4		D	
108	11	27	12 2	30.4	46 48.6	119 24.2	0.7	<10	C	
109	11	28	16 1	52.1	46 48.7	119 24.1	0.3	<10	D	
110	11	29	1019	27.5	46 41.3	118 50.7	1.7	<10	C	
111	11	29	1021	1.5	46 34.7	119 6.3	1.0		C	
112	11	29	1040	24.7	46 41.3	118 51.1	1.5	<10	C	
113	11	29	11 9	36.3	46 49.0	119 24.0	1.1	<10	C	
114	11	29	1132	13.2	46 41.3	118 50.9	1.6		D	
115	11	29	17 9	49.3	46 49.1	119 21.1	0.9	<10	C	
116	11	29	1721	25.6	46 48.6	119 23.9	0.8	<10	C	
117	11	29	1824	1.2	46 39.5	118 54.0	0.7		D	
118	11	29	2315	52.3	46 7.7	120 8.3	2.4		E	PROBABLE EXPLOSION
119	11	30	1035	16.4	46 48.7	119 23.7	0.8	<10	C	
120	11	30	1117	7.1	46 48.6	119 23.8	0.6	<10	C	
121	11	30	1248	54.0	47 7.6	119 36.9	1.8		D	POSSIBLE EXPLOSION
122	11	30	1847	53.3	46 48.7	119 23.8	0.7	<10	C	
123	11	30	20 1	56.3	46 41.4	118 51.5	1.6	<10	C	
124	12	1	7 6	39.1	46 41.3	118 52.6	2.2		D	
125	12	1	942	25.4	46 34.8	119 5.3	1.2		C	
126	12	1	23 4	2.1	47 8.8	119 38.3	2.0		D	POSSIBLE EXPLOSION
127	12	2	411	50.3	46 48.6	119 23.8	0.4	<10	D	
128	12	2	430	28.6	46 48.7	119 23.8	0.4	<10	D	
129	12	2	436	1.6	46 48.7	119 24.0	0.4	<10	D	
130	12	2	11 1	46.7	46 34.6	119 4.4	0.7		D	
131	12	3	351	49.6	46 34.7	119 4.2	1.4	<10	C	
132	12	3	358	27.4	46 34.7	119 4.5	1.4		C	
133	12	4	1846	21.4	46 39.0	119 6.3	0.9		D	
134	12	4	2253	56.1	46 38.0	119 5.5	0.8		C	
135	12	9	1710	24.1	46 54.1	120 54.6	3.1		D	PROBABLE EXPLOSION
136	12	9	2319	44.8	46 14.5	119 59.2	2.5		D	EXPLOSION
137	12	10	1151	6.9	46 38.2	119 5.4	0.8		D	
138	12	11	053	20.1	46 34.8	119 4.6	1.6	<10	B	
139	12	11	054	8.6	46 34.6	119 4.2	1.2		C	
140	12	11	6 2	31.3	46 48.7	119 24.2	0.9	<10	D	
141	12	11	1910	35.3	46 48.7	119 24.1	1.3	<5	C	
142	12	11	1939	55.9	46 48.8	119 23.9	1.7	<5	C	
143	12	11	2027	11.7	46 48.6	119 24.0	1.2	<10	C	
144	12	12	913	27.9	46 49.1	119 24.6	0.4	<10	D	
145	12	12	1344	32.5	46 48.7	119 23.9	1.5	<10	C	
146	12	12	1745	23.0	46 48.9	119 23.8	0.6	<10	D	
147	12	12	1810	7.9	46 57.4	119 3.6	2.2		C	EXPLOSION
148	12	13	140	7.3	46 48.7	119 23.9	1.0	<10	D	
149	12	13	6 8	34.4	46 48.8	119 23.7	1.2	<5	C	
150	12	13	717	31.6	46 48.8	119 23.7	1.5	<5	B	

Table 1. (continued)

1970
1971

Sequence B

NUM	MO	DY	HRMN	SEC	LAT N °	'	LONG W °	'	MAG	DEPTH	QUAL	REMARKS
151	12	13	725	36.6	46	48.9	119	23.8	0.9	<10	C	
152	12	13	754	3.0	46	49.0	119	24.3	0.4	<10	D	
153	12	13	8 5	38.6	46	48.8	119	23.7	1.4	<5	B	
154	12	13	1647	56.1	46	48.9	119	23.8	0.7	<10	D	
155	12	13	1827	28.3	46	48.8	119	23.7	1.2	<10	C	
156	12	13	1853	40.2	46	48.7	119	23.6	0.8	<10	C	
157	12	13	1930	38.5	46	49.0	119	23.7	1.6	<3	B	
158	12	13	1944	44.5	46	38.0	119	1.2	1.4		C	
159	12	14	014	2.5	46	49.0	119	23.8	2.0	<3	B	
160	12	14	120	19.6	46	39.2	119	6.8	0.8		D	
161	12	15	521	44.2	46	41.1	118	51.6	1.6	<10	C	
162	12	19	5 9	33.9	46	41.2	118	51.1	2.0	<10	C	
163	12	19	531	52.2	46	40.7	118	50.2	1.6		D	
164	12	19	621	42.5	46	40.1	118	54.3	1.2		D	
165	12	19	2050	9.0	46	38.0	119	4.8	1.3		D	
166	12	21	1031	0.3	46	5.7	119	29.1	1.2		E	
167	12	21	1347	37.1	46	6.2	119	28.7	1.5		D	
168	12	21	1538	18.6	46	44.5	119	24.5	0.8		D	
169	12	21	2112	28.7	46	37.1	119	9.7	0.8		C	
170	12	22	013	31.3	46	6.7	119	27.7	1.4		E	
171	12	22	014	12.4	46	7.4	119	26.8	1.3		E	
172	12	22	021	21.4	46	9.1	119	27.8	1.4		D	
173	12	23	854	14.2	47	3.0	119	26.2	2.1	<10	C	
174	12	24	1029	24.3	46	53.7	119	32.5	1.3	<10	C	
175	12	24	2044	24.2	46	48.7	119	23.5	0.8	<10	D	
176	12	24	21 1	34.3	46	53.9	119	32.2	1.2		D	
177	12	24	21 7	40.8	46	54.4	119	32.5	1.1		D	
178	12	25	1436	4.9	46	49.0	119	32.6	1.3	<10	C	
179	12	25	2049	13.2	47	2.7	119	25.9	1.6		D	POSSIBLE EXPLOSION
180	12	26	038	32.6	46	48.8	119	32.6	0.5	<10	C	
181	12	26	123	11.5	46	49.0	119	32.8	1.3	<5	B	
182	12	26	8 1	47.3	46	48.9	119	32.5	1.4	<10	C	
183	12	26	946	57.1	46	52.9	119	28.8	1.4	<10	B	
184	12	26	14 7	7.6	46	44.6	119	24.4	1.1	<10	C	
185	12	26	1936	28.0	46	53.6	119	31.9	1.3	<10	C	
186	12	26	2029	18.4	46	49.3	119	32.6	1.5	<10	B	
187	12	27	7 1	45.9	46	49.0	119	33.0	0.3		D	
188	12	27	719	30.7	46	37.9	119	5.9	0.9		C	
189	12	27	15 1	16.6	46	38.6	119	4.1	1.9	<5	B	
190	12	27	1025	12.8	46	37.7	119	5.9	0.7		C	
191	12	28	5 4	11.2	46	37.7	119	6.2	0.8		C	
192	12	28	1526	35.0	46	37.6	119	6.2	0.8		C	
193	1	1	1243	29.2	46	24.9	119	3.1	0.6		D	
194	1	2	2022	26.3	46	48.4	119	23.5	0.8		D	
195	1	2	2324	32.6	46	48.9	119	23.5	0.5	<10	D	
196	1	2	2356	2.4	46	48.5	119	22.9	0.6		D	
197	1	3	2047	3.6	46	48.7	119	23.6	0.5		D	
198	1	4	119	30.7	46	48.8	119	23.8	1.8	<5	B	
199	1	4	123	33.5	46	49.1	119	23.4	1.9	<5	C	
200	1	4	438	28.9	46	48.8	119	23.8	0.7	<10	C	

Table 1. (continued)

Sequence B

NUM	1971 MO	DY	HRMN	SEC	LAT N °	'	LONG W °	'	MAG	DEPTH	QUAL	REMARKS
201	1	4	744	19.0	46	49.0	119	23.6	0.8	<10	D	
202	1	4	1610	33.5	46	12.3	119	21.8	2.6		C	EXPLOSION
203	1	4	1837	58.5	46	48.9	119	23.4	1.3	<10	C	
204	1	4	1842	36.7	46	49.0	119	23.6	1.4	<5	B	
205	1	4	2034	54.4	46	48.8	119	24.0	1.2	<10	D	
206	1	5	030	35.1	46	49.0	119	23.8	1.6	<5	B	
207	1	5	136	44.5	46	49.2	119	23.8	1.9	<5	B	
208	1	5	138	16.4	46	49.1	119	23.7	1.5	<5	B	
209	1	5	258	52.2	46	49.0	119	23.8	1.3	<5	B	
210	1	5	314	40.5	46	49.0	119	23.5	1.9	<5	B	
211	1	5	319	31.1	46	49.0	119	23.8	1.1	<10	C	
212	1	5	327	54.3	46	49.0	119	23.9	1.2	<10	C	
213	1	5	331	58.8	46	49.2	119	23.2	1.4	<10	B	
214	1	5	334	11.0	46	48.8	119	23.5	0.8	<10	C	
215	1	5	357	19.7	46	49.2	119	23.3	1.7	<5	B	
216	1	5	423	30.8	46	48.8	119	23.2	1.7	<10	B	
217	1	5	456	46.9	46	48.8	119	23.8	0.7	<10	C	
218	1	5	1254	21.9	46	48.8	119	23.3	1.2	<10	C	
219	1	5	1951	52.2	46	48.9	119	23.3	1.4	<10	C	
220	1	6	841	49.1	46	49.3	119	23.2	0.9		D	
221	1	6	1010	32.5	46	49.2	119	23.7	0.9	<10	D	
222	1	6	1339	11.6	46	44.6	119	25.6	0.7		C	
223	1	7	12 4	55.6	46	44.3	119	21.7	1.7	<10	B	
224	1	8	112	13.2	46	51.8	119	23.9	0.9		D	
225	1	8	8 0	49.7	46	39.7	119	34.7	0.8	<10	C	
226	1	8	11 8	15.2	46	53.5	119	18.0	0.9		D	
227	1	9	2023	15.6	46	38.0	119	6.5	1.4	<10	C	
228	1	9	2045	13.6	46	37.8	119	6.4	1.2		C	
229	1	11	3 5	33.1	46	38.5	119	4.7	1.2	<10	B	
230	1	11	14 5	26.5	46	41.1	118	50.9	1.9	<10	C	
231	1	14	1539	45.4	46	39.6	119	34.9	0.7		C	
232	1	15	17 5	22.7	46	38.6	119	4.1	1.1		C	
233	1	16	2050	2.4	46	54.6	119	33.3	1.5	<10	C	
234	1	18	1821	31.5	46	38.6	119	3.8	1.7	<10	C	
235	1	19	623	18.2	46	41.1	118	52.3	1.2		D	
236	1	19	937	49.7	46	38.4	119	4.7	1.2		C	
237	1	20	1725	51.5	46	39.6	119	34.4	0.6		C	
238	1	20	2025	53.9	46	38.0	119	6.5	0.9		D	
239	1	20	2058	46.4	46	38.2	119	6.4	1.9	<10	C	
240	1	21	18 2	48.0	46	40.5	118	51.5	1.7		D	
241	1	21	1848	32.3	46	38.0	119	7.1	1.1		D	
242	1	21	2244	50.8	46	38.2	119	6.8	1.8	<10	C	
243	1	22	413	52.4	46	38.1	119	7.1	1.5	<10	B	
244	1	22	1225	44.4	46	54.3	119	32.2	2.3	<10	B	
245	1	22	15 7	17.9	46	53.6	119	32.5	2.5	<10	B	
246	1	22	16 5	40.2	46	37.9	119	7.4	1.2	<10	C	
247	1	22	18 7	35.7	46	37.3	119	10.5	1.6		C	
248	1	22	2159	58.7	46	17.6	120	20.1	2.9		E	EXPLOSION
249	1	23	228	44.2	46	37.5	119	9.8	1.7	<10	C	
250	1	23	243	22.2	46	37.3	119	10.1	0.8		C	

Table 1. (continued)

Sequence B

1971

NUM	MO	DY	HRMN	SEC	LAT N ° '	LONG W ° '	MAG	DEPTH	QUAL	REMARKS
251	1	23	2329	55.5	46 37.2	119 9.8	1.2		C	
252	1	23	2332	37.5	46 37.1	119 9.7	1.0		C	
253	1	24	025	2.2	46 48.7	119 23.5	0.5		D	
254	1	24	21 4	41.6	46 37.6	119 9.0	1.3		D	
255	1	24	21 5	48.1	46 37.5	119 10.0	2.5	<10	C	
256	1	24	2110	13.6	46 37.2	119 10.4	1.2		D	
257	1	25	053	41.4	46 37.4	119 10.3	1.0		C	
258	1	25	927	0.5	46 37.3	119 11.0	1.1		C	
259	1	25	1745	16.0	46 49.6	118 44.3	2.3		C	EXPLOSION
260	1	26	413	38.7	46 54.1	119 33.1	1.3		D	
261	1	26	841	5.2	46 54.9	119 33.0	1.9	<10	C	
262	1	26	1017	5.4	46 54.5	119 34.0	3.0	<10	C	MAG MAY BE REVISED
263	1	26	1335	27.1	46 53.0	119 32.3	1.4	<10	C	
264	1	26	1857	4.7	46 53.9	119 32.8	1.4	<10	C	
265	1	27	649	30.0	46 54.0	119 33.0	1.3	<10	C	
266	1	27	914	21.0	46 54.6	119 33.0	1.0		D	
267	1	27	1344	39.3	46 54.3	119 33.3	1.2	<10	D	
268	1	27	1347	27.5	46 54.6	119 33.0	1.6	<10	C	
269	1	27	1441	6.9	46 54.8	119 32.6	1.2		D	
270	1	27	19 9	59.5	46 47.1	120 35.1	2.3		E	EXPLOSION
271	1	27	20 8	5.7	46 49.7	118 43.8	2.1		D	EXPLOSION
272	1	27	2322	45.5	46 41.1	118 50.7	2.0	<10	C	
273	1	28	015	0.8	46 53.9	119 33.0	1.3		D	
274	1	28	148	9.5	46 49.8	118 43.4	1.7		D	PROBABLE EXPLOSION
275	1	28	1639	25.2	46 54.6	119 32.4	2.1	<10	C	
276	1	29	1049	1.9	46 37.4	119 9.4	0.8		C	
277	1	30	19 8	5.4	46 53.8	119 32.5	1.5	<10	C	
278	1	30	2224	50.5	47 50.9	119 40.4	2.6		E	EXPLOSION
279	1	31	1129	39.8	46 53.9	119 32.0	1.3	<10	C	
280	2	1	1318	9.9	46 49.3	119 5.7	0.7		D	
281	2	1	1615	22.2	46 41.0	118 51.9	2.0	<10	C	
282	2	1	1638	10.8	46 54.0	119 32.2	1.6	<10	C	
283	2	3	2218	8.7	46 39.0	119 7.2	1.4	<10	B	
284	2	4	1754	39.8	46 21.9	119 4.8	1.5	<10	D	POSSIBLE EXPLOSION
285	2	4	1915	28.2	46 47.3	120 32.3	2.2		E	EXPLOSION
286	2	5	035	49.5	46 54.0	119 31.9	1.5	<10	C	
287	2	6	130	42.9	46 21.7	119 4.5	1.1	<10	D	POSSIBLE EXPLOSION
288	2	7	1545	44.7	46 38.5	119 4.4	1.0		C	
289	2	9	452	56.0	46 21.7	119 4.8	0.5	<10	D	POSSIBLE EXPLOSION
290	2	10	425	48.1	46 54.5	119 31.9	2.2	<5	B	
291	2	11	327	12.5	46 44.6	119 25.1	0.6		C	
292	2	12	2225	10.1	46 13.4	120 27.5	2.5		D	EXPLOSION
293	2	13	8 5	50.3	46 54.6	119 33.8	1.4	<10	C	
294	2	15	149	2.1	46 38.6	119 4.1	1.0		C	
295	2	15	3 9	43.8	46 55.5	119 33.2	1.3	<10	C	
296	2	15	16 7	13.1	46 38.7	119 3.8	1.1		D	
297	2	16	2136	27.9	46 49.6	118 24.8	2.2		E	EXPLOSION
298	2	17	1446	37.1	46 49.8	119 25.3	1.3	<10	C	
299	2	17	20 2	9.5	47 3.0	119 25.8	1.7		D	
300	2	18	3 3	9.9	46 23.9	119 0.8	0.9		D	

Table 1. (continued)

Sequence B

NUM	1971 MO	DY	HRMN	SEC	LAT N °	'	LONG W °	'	MAG	DEPTH	QUAL	REMARKS
301	2	18	2234	1.3	46	22.4	118	20.1	2.3		D	EXPLOSION
302	2	19	1 2	13.5	46	49.6	118	26.1	2.2		D	EXPLOSION
303	2	19	2023	5.3	46	42.4	117	50.9	2.4		E	EXPLOSION
304	2	19	2250	1.0	46	42.5	120	29.2	2.6		E	EXPLOSION
305	2	20	413	41.9	46	41.2	118	52.0	1.8	<10	C	
306	2	20	1226	12.3	46	39.7	119	34.6	0.7		C	
307	2	20	2222	27.4	46	36.3	119	5.3	0.8		C	
308	2	20	2238	54.8	46	36.3	119	5.4	0.7		C	
309	2	20	2256	19.3	46	36.3	119	5.2	0.8		C	
310	2	21	043	16.4	46	36.1	119	5.3	0.7		C	
311	2	21	045	47.0	46	36.3	119	5.3	1.0		C	
312	2	21	046	28.6	46	36.2	119	5.3	1.1		C	
313	2	26	529	13.7	46	39.5	119	34.5	0.9	<10	C	
314	2	26	1059	46.3	46	39.6	119	34.6	1.3	<5	B	
315	2	26	2254	59.9	46	43.3	120	33.4	2.8		E	EXPLOSION
316	3	1	133	30.1	47	42.4	120	9.3	2.6		E	POSSIBLE EXPLOSION
317	3	1	1829	26.4	46	34.4	119	3.8	0.6		D	
318	3	2	845	27.0	46	41.1	119	11.8	1.3	<5	B	
319	3	4	256	36.1	46	40.7	118	51.6	1.1		D	
320	3	5	1419	57.4	46	24.3	119	24.2	1.0		C	
321	3	5	2058	47.1	46	42.8	120	36.5	2.8		E	EXPLOSION
322	3	6	21 3	48.3	46	34.5	119	37.4	1.3		D	
323	3	6	21 4	7.3	46	34.5	119	37.7	1.0		D	
324	3	6	2113	16.3	46	34.4	119	37.6	0.6		D	
325	3	9	816	23.6	46	40.8	117	48.6	2.5		E	POSSIBLE EXPLOSION
326	3	9	951	19.6	46	48.0	119	32.9	1.2	14-18	C	
327	3	9	14 0	8.0	46	39.3	119	9.9	0.8	<10	C	
328	3	10	2321	52.7	47	2.5	119	25.3	1.5		D	POSSIBLE EXPLOSION
329	3	13	828	28.8	46	41.0	118	52.1	1.1		D	
330	3	17	957	2.0	46	41.3	118	52.3	2.5	<10	C	
331	3	17	2019	27.3	46	50.6	119	21.8	1.0	<10	C	
332	3	19	1258	27.1	46	52.4	120	2.2	1.4		E	
333	3	19	20 6	50.7	46	41.0	118	52.1	1.8	<10	C	
334	3	20	1 3	56.4	47	43.3	120	11.9	2.6		E	POSSIBLE EXPLOSION
335	3	20	649	25.8	46	40.9	118	51.0	1.8	<10	C	
336	3	20	7 0	24.1	46	41.2	118	52.2	1.9	<10	C	
337	3	20	8 2	57.4	46	41.1	118	51.2	2.0	<10	C	
338	3	21	650	26.9	46	2.3	118	23.9	2.4		E	POSSIBLE EXPLOSION
339	3	21	655	36.4	46	1.1	118	24.0	2.4		E	POSSIBLE EXPLOSION
340	3	22	256	28.2	46	31.4	119	41.5	0.4		D	
341	3	23	238	6.0	46	41.3	118	51.8	1.7	<10	C	
342	3	23	11 6	25.0	46	35.8	119	4.4	0.7		C	
343	3	24	2045	40.3	46	41.0	118	51.2	1.4		D	
344	3	24	2222	32.1	46	38.3	119	5.2	1.2	<10	C	
345	3	24	2259	2.0	46	50.4	120	2.5	1.7		E	
346	3	27	1522	48.9	46	49.6	119	27.3	0.7	<10	C	
347	4	2	15 7	29.9	46	54.8	119	26.6	1.2		D	
348	4	3	2346	28.3	46	49.5	119	30.4	1.6	<10	C	
349	4	5	1 0	9.4	46	50.1	119	20.6	1.3	<5	B	
350	4	5	8 1	50.9	46	40.8	121	9.8	2.6		E	POSSIBLE EXPLOSION

Table 1. (continued)

Sequence B

1971

NUM	MO	DY	HRMN	SEC	LAT N ° '	LONG W ° '	MAG	DEPTH	QUAL	REMARKS
351	4	5	1117	34.4	46 48.8	119 32.8	1.3	<10	C	
352	4	5	2228	48.5	46 49.1	119 22.2	1.7	<10	C	
353	4	11	2212	57.0	46 40.9	118 52.4	1.8	<10	C	
354	4	12	525	12.7	46 41.2	118 52.9	2.1	<10	C	
355	4	12	527	54.4	46 40.7	118 52.0	1.8		D	
356	4	12	540	56.5	46 41.4	118 51.9	1.6		D	
357	4	12	556	11.8	46 41.3	118 52.0	1.3		C	
358	4	13	623	58.8	46 52.9	119 15.6	1.3	12-20	C	
359	4	13	1056	50.9	46 41.1	118 51.5	1.7		D	
360	4	13	1057	41.0	46 40.8	118 51.8	1.7	<10	C	
361	4	14	723	22.5	46 39.0	119 37.4	0.6		C	
362	4	14	1136	35.8	46 41.2	118 50.7	1.5		D	
363	4	23	548	56.7	47 2.2	119 25.9	1.3		D	
364	4	24	1252	14.8	46 53.5	119 22.4	1.6	<10	C	
365	4	26	438	17.7	47 40.2	120 3.6	2.6		D	
366	4	28	1434	39.3	46 41.2	118 51.8	1.9		D	
367	4	29	10 7	45.9	46 11.1	119 33.7	1.6		C	
368	5	3	1935	52.9	46 39.3	119 37.5	1.4	3-8	B	
369	5	4	16 9	54.1	46 52.8	119 22.1	1.2	<10	C	
370	5	9	1319	10.2	46 49.6	119 25.3	0.9	<10	D	
371	5	9	1348	57.0	46 49.8	119 25.9	1.2	<10	C	
372	5	9	16 9	36.3	46 49.6	119 25.3	1.0	<10	C	
373	5	11	1051	31.9	46 21.8	119 5.1	1.4	<10	C	
374	5	11	1148	0.1	46 22.2	119 5.3	1.5	<10	C	
375	5	11	1428	36.8	46 21.9	119 4.9	0.9		D	
376	5	12	1156	21.4	46 49.9	119 25.0	0.9	<10	C	
377	5	18	4 9	9.9	46 55.5	119 18.1	1.4		D	
378	5	22	1557	10.0	47 49.9	118 55.4	3.3		F	
379	5	26	1913	1.2	46 21.2	119 3.9	1.0		D	
380	6	4	446	27.2	46 46.2	120 1.0	1.2		D	
381	6	5	625	9.5	46 40.4	118 53.1	1.8	<10	C	
382	6	5	19 1	52.6	46 39.3	119 4.5	1.1		C	
383	6	10	938	4.6	46 35.1	119 38.2	1.1		B	
384	6	10	1053	10.6	46 34.8	119 37.9	1.2		B	
385	6	13	1146	14.6	46 18.1	119 23.2	1.1	<10	D	
386	6	18	1727	5.8	46 34.2	119 46.1	1.3		D	
387	6	20	747	42.0	46 17.9	119 22.8	1.4		D	
388	6	20	748	6.5	46 18.1	119 23.2	1.7	<10	B	
389	6	25	19 9	0.1	46 51.4	119 41.7	1.4		D	POSSIBLE EXPLOSIO
390	6	27	247	57.4	46 26.9	119 19.5	0.4		C	EXPLOSION
391	6	29	1937	49.9	46 25.4	119 22.5	0.8		C	EXPLOSION
392	6	29	2115	44.9	46 25.4	119 22.5	1.0		C	EXPLOSION
393	6	30	059	21.2	46 50.6	119 40.9	1.2		D	

in a series of limited areas, each only a few km across. A much smaller number of earthquakes occurred elsewhere on or near the Hanford Reservation (Figures 2 and 3).

The region around the seismograph stations has been arbitrarily divided into zones (Figures 2 and 3) to show variations in total detected earthquake activity. The outer boundary of each zone (except the small zone around station I) is the approximate locus of earthquakes with an S-P interval of 3.0 sec at the station at the center of the zone. Figure 4 shows the level of earthquake activity in the zones on a weekly basis. "C local" refers to the small cluster of earthquakes approximately 5 km northeast of station C (Figure 3). Several features are evident on Figure 4. There is considerable variation in the level of activity within a given zone, and a zone may be inactive for a period of several months. There is no obvious correlation from one zone to another, i.e., the whole region does not appear to become active at the same time. The "C" zone is generally the most active.

Most of the earthquakes in the Hanford region appear to have focal depths of less than 10 km. Some of the better recorded events appear to have occurred at depths of less than 5 km. However, the seismograph network is generally not sufficiently dense to determine precisely the focal depth of such shallow earthquakes. Ten events, however, had focal depths greater than 10 km, with 4 of them being over 20 km deep.

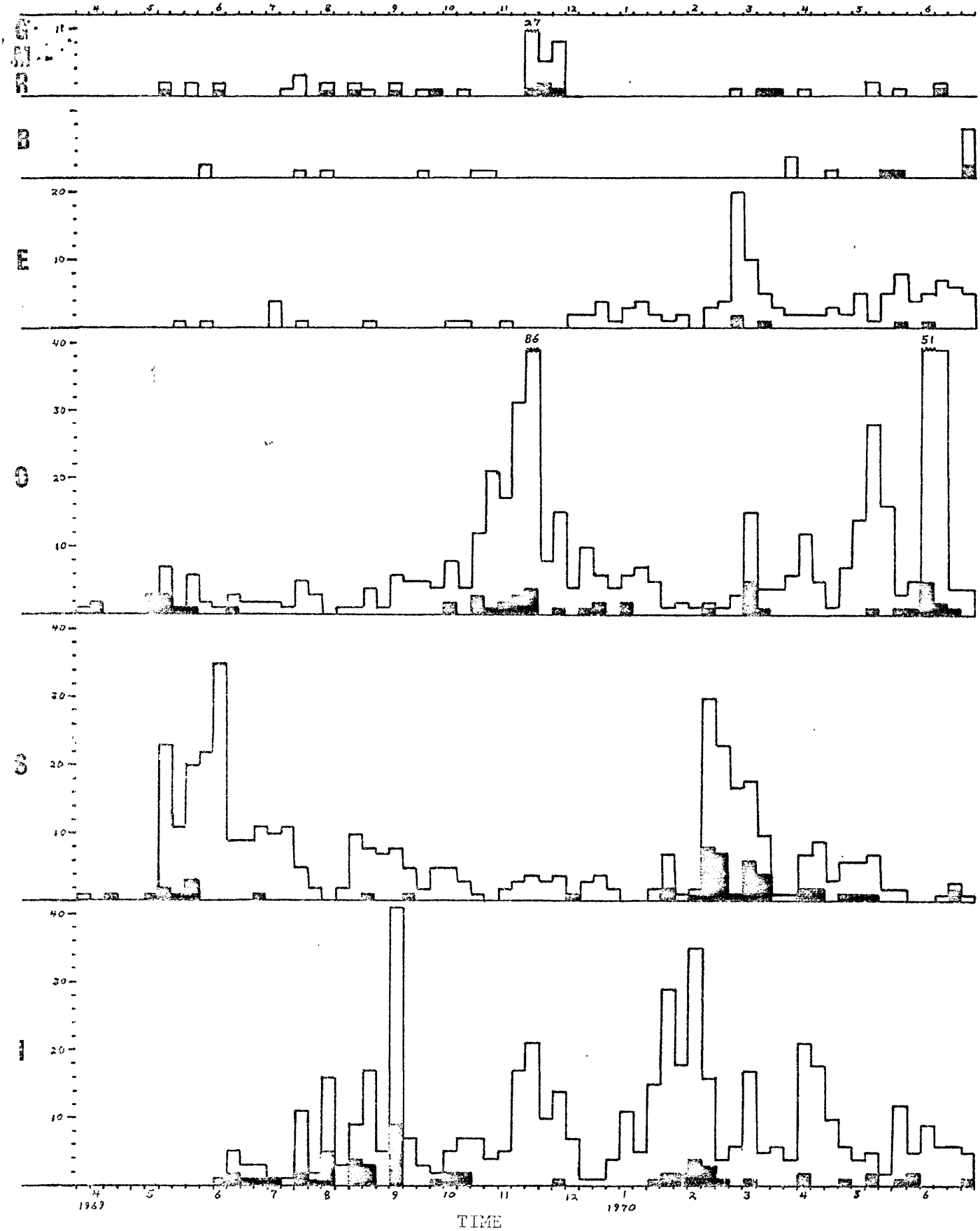

Figure 4. Level of earthquake activity in the zones outlined in Figures 2 and 3; time division is by week with the numbers indicating the month beginning in that week. Open bars indicate events detected and solid bars indicate events for which epicenters could be determined.

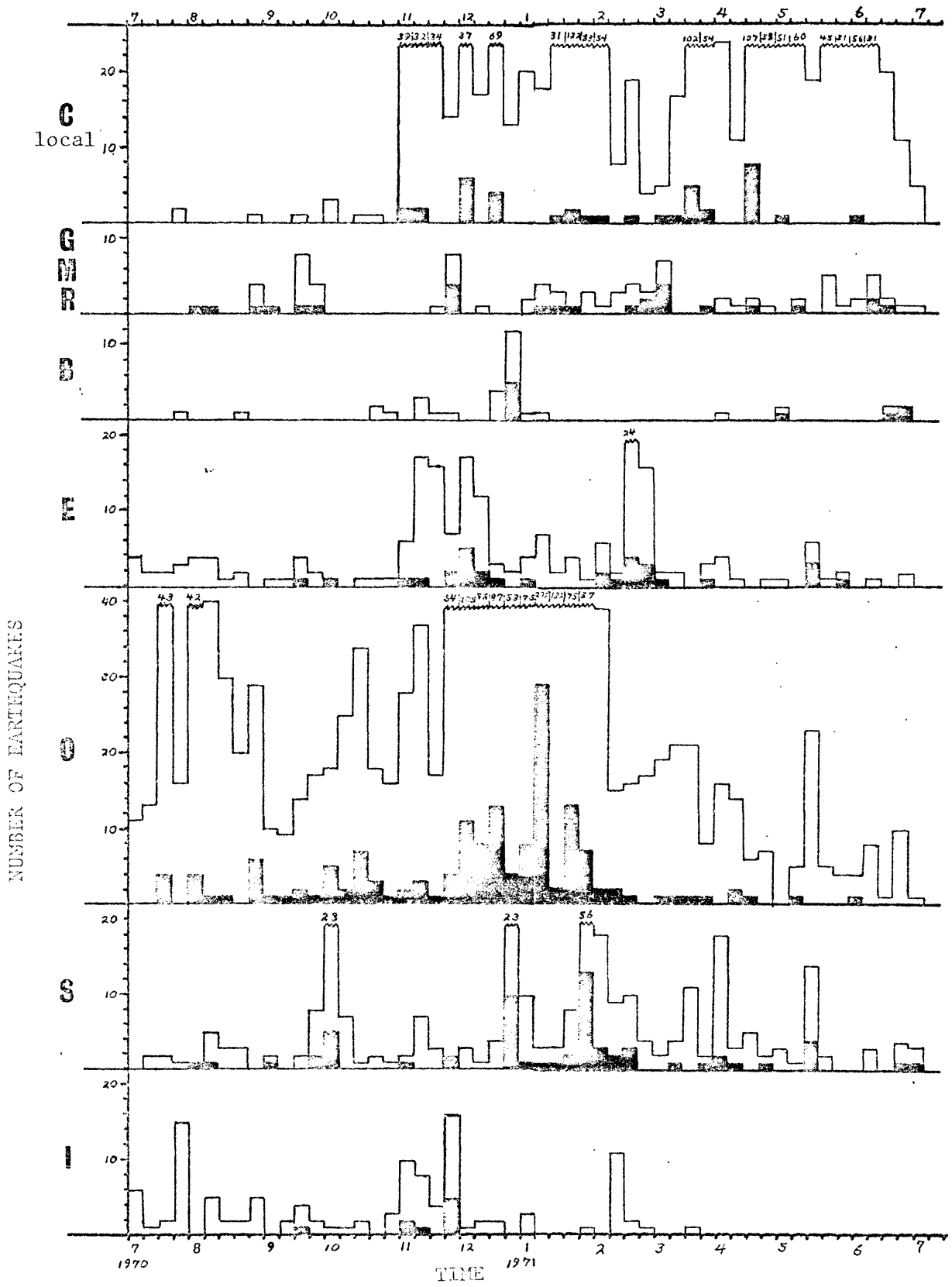

Figure 4. (continued)

The number of these anomalously deep events is still too small to establish any significant trends.

Forty-nine of the 549 earthquakes occurring within 75 km of Gable mountain had Richter magnitudes of 2 or greater (Footnote 2); the largest of these were 2 events of about magnitude 3. The events of magnitude 2 or greater have a distribution similar to that of the smaller events in the region.

A magnitude distribution (plot of the logarithm of the number of earthquakes above magnitude M against M) has been made for the Wooded Island seismic zone (Pitt, 1971) and will be made for the entire Hanford region as the data are re-analyzed.

No single event recorded on the Hanford network had a sufficient number of clear first motion readings to be used for a focal mechanism analysis. A composite focal mechanism analysis was attempted for the Wooded Island earthquake zone but no consistent pattern could be determined. With extremely shallow earthquakes, as occur in the Hanford region, errors in the near surface velocity model can greatly affect the projected positions of the first motions on the focal sphere and lead to unreliable focal mechanism solutions.

Footnote 2:
Previously reported magnitudes for events occurring through June 1970 have been revised upward by 0.7. Magnitudes for events occurring after June 1970 are unchanged. Eaton and others, 1970, contains a detailed discussion on the determination of magnitudes of small earthquakes using high-gain seismic instruments similar to those used in the Hanford network.

Summary

With the present dimensions and sensitivity, the Hanford seismograph network is capable of detecting earthquakes as small as Richter magnitude 1 out to a distance of at least 75 km from Cable mountain. Within the region monitored by the network, seismic activity appears to be concentrated in certain limited areas with much of the region appearing to be aseismic during the current, rather short, period of recording. There is as yet insufficient evidence to indicate whether the various limited areas of seismic activity are part of a regional tectonic process. The earthquakes do not precisely correlate with any of the surface tectonic features proposed in the Hanford region (Figure 1). However, the broad, northwest trending zone containing most of the seismic activity is sub-parallel to the Saddle Mountains anticline and fault zones. Only a small number of earthquakes have occurred near the Wallula-Rattlesnake lineament south of the reservation, but this does not necessarily signify that the structure is aseismic. Some sections of the San Andreas fault that have produced major earthquakes in historic times are currently not producing any earthquakes.

While the conclusions from the data covered in this report are tentative, additional analysis of these data combined with the data currently being recorded on the 24 station network should provide a basis for definite conclusions. A number of large quarry explosions occurring in the Hanford region are being used to obtain more precise information on the complex crustal structure of the region. A more accurate crustal model will improve the accuracy of earthquake location and the reliability of focal mechanism solutions.

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