TECHNICAL REPORT 82-1

SEISMIC ACTIVITY NEAR THE V.C. SUMMER NUCLEAR STATION

For the Period January - March 1982

by

Pradeep Talwani
Principal Investigator
Geology Department
University of South Carolina
Columbia, S.C. 29208

Contract No. N301315

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INTRODUCTION

This report presents a summary on seismic activity near the V. C. Summer Nuclear Power Station in South Carolina for a three-month period between January 1 and March 31, 1982. During this reporting period a total of 76 locatable events were recorded, two of which exceeded magnitude 2.0.

SEISMIC NETWORK

The report is based on the data recorded by a four-station network operated by S.C.E. and G. In addition, data from a permanent station (JSC) of the South Carolina seismographic network is also used. Location of all these stations is shown in Figure 1, and their coordinates are listed in Appendix I.

DATA ANALYSIS

Location of the events is determined using HYPO71 program (Lee and Lahr, 1972) and the velocity model given in Appendix II. The event magnitude (M_L) is determined from signal duration at Station JSC, using the following relation:

$$M_L = -1.83 + 2.04 \text{ Log } D$$

where D is the signal duration (seconds).

An estimate of daily energy release is determined using a simplified magnitude (M_L) energy (E) relation by Gutenberg and Richter, 1956.

$$\log_{10} E = 11.8 + 1.5\, M_L$$

RESULTS

Seventy-six events recorded during this reporting period (January 1 - March 31, 1982) are listed in Appendix III. Two events were of magnitudes greater than or equal to 2.0 (March 2, 1982, M_L = 2.69; March 31, 1982, M_L = 2.00). Thirteen events were of magnitudes between 1.0 and 2.0, and the remaining events were of magnitudes less than 1.0. Their depth estimates indicate that 34% of the activity during this period occurred at depths between 1.0 and 2.0 km and 54% occurred below 2.0 km, the deepest event being 5.31 km.

A cumulative plot of the epicenters of the events located during this reporting period is shown in Figure 2. A monthly breakup of their locations is shown in Figures 3-5.

RESERVOIR WATER LEVEL AND ITS COMPARISON WITH SEISMICITY

Monticello Reservoir is a pumped storage facility. Any decrease in reservoir level associated with power generation is recovered when water is pumped back into the reservoir. There can be variations up to about 4 feet per day between the maximum and minimum water level. We have been monitoring this water level to see if there is any correlation between the daily or seasonal changes in the reservoir level and the local seismicity. Figure 6 shows the comparison of water level to seismicity. The top two graphs show the water level and the change of water level per day. The number of events per day and log of energy released per day are shown on the lower two graphs. Histogram showing events per day and log of energy release, includes also the unlocated events around the reservoir.

CONCLUDING REMARKS

Relative to the two previous reporting periods (July - September, 1981 and October - December, 1981), seismic activity during this three-month period has significantly increased. Figure 7 shows a plot of the number of events per month from December, 1977 through March, 1982, which suggests that seismicity at Monticello Reservoir occurs in discreet swarms, separated by relatively quiet periods. The low level of activity during the previous two reporting periods is associated with the quiet period preceding the swarm occurring in February and March of this period. However, as is shown in Figure 7, the general level of seismic activity at Monticello appears to be progressively decreasing.

REFERENCES

Gutenberg, B. and Richter, C. F. (1956). Magnitude and energy of earthquakes, Ann. Geof. 9, p. 1-15.

Lee, W. H. K. and Lahr, J. C. (1972). A computer program for determining hypocenter, magnitude and first motion pattern of local earthquakes, Revisions of HYPO 71, U.S.G.S. Open-file report, 100 pp.

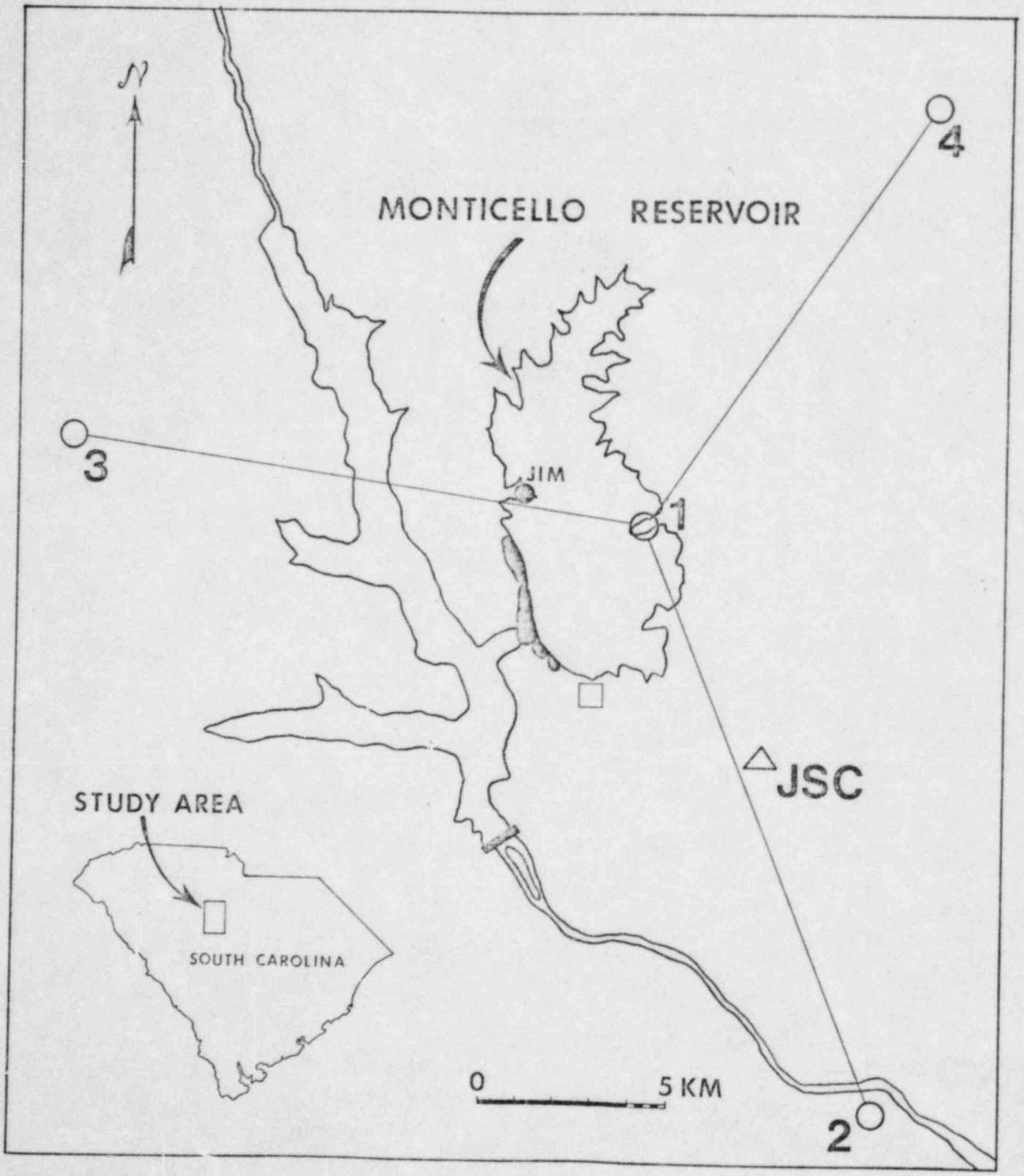
N
MONTICELLO RESERVOIR
JIM
1
2
3
4
JSC
STUDY AREA
SOUTH CAROLINA
0
5 KM

Figure 1

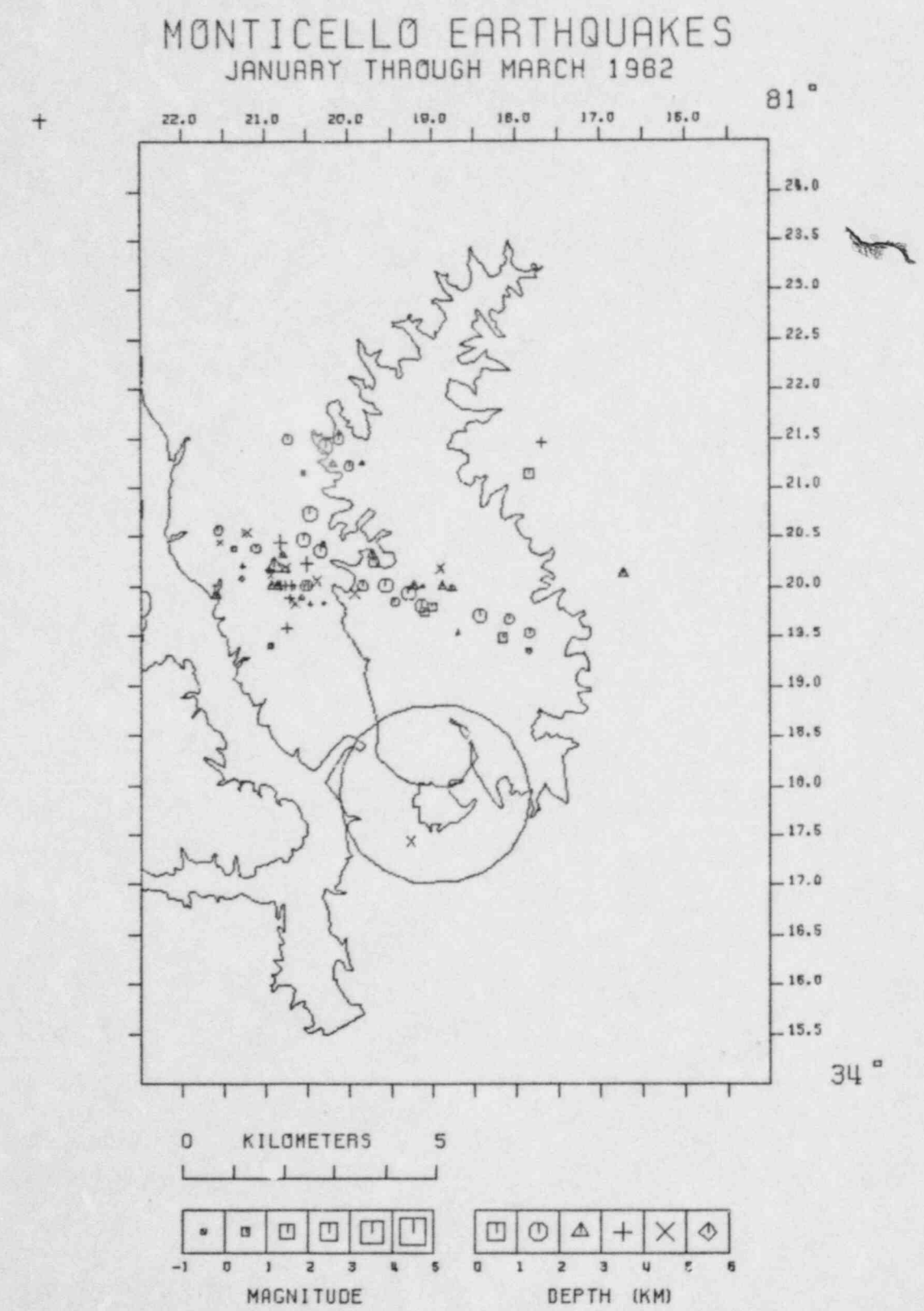
MONTICELLO EARTHQUAKES
JANUARY THROUGH MARCH 1982
81°
34°
22.0
21.0
20.0
19.0
18.0
17.0
16.0
24.0
23.5
23.0
22.5
22.0
21.5
21.0
20.5
20.0
19.5
19.0
18.5
18.0
17.5
17.0
16.5
16.0
15.5
0 KILOMETERS 5
-1 0 1 2 3 4 5
MAGNITUDE
0 1 2 3 4 5 6
DEPTH (KM)

Figure 2

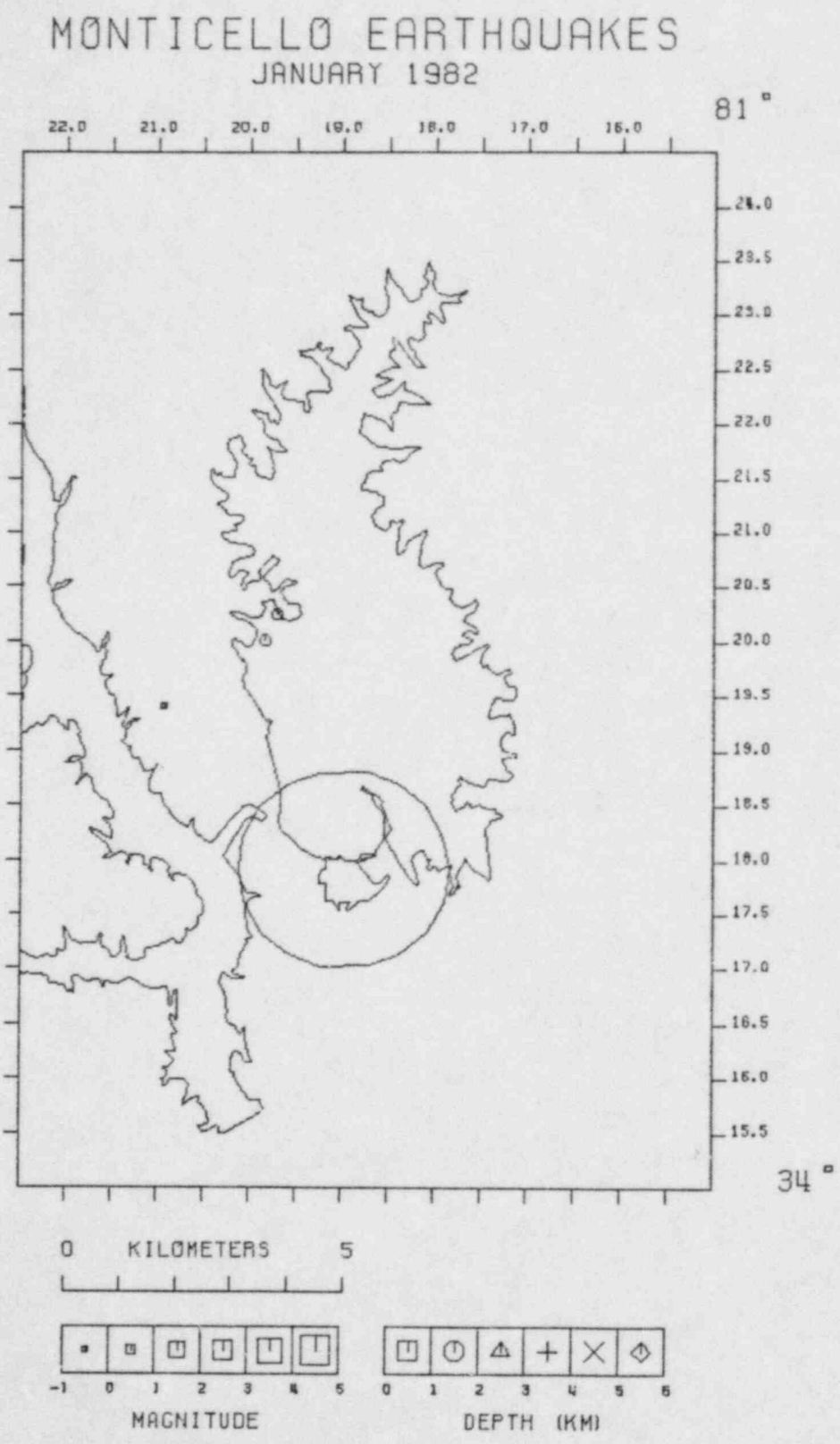
MONTICELLO EARTHQUAKES
JANUARY 1982
81°
22.0
21.0
20.0
19.0
18.0
17.0
16.0
24.0
23.5
23.0
22.5
22.0
21.5
21.0
20.5
20.0
19.5
19.0
18.5
18.0
17.5
17.0
16.5
16.0
15.5
34°
0 KILOMETERS 5
-1 0 1 2 3 4 5
MAGNITUDE
0 1 2 3 4 5 6
DEPTH (KM)

Figure 3

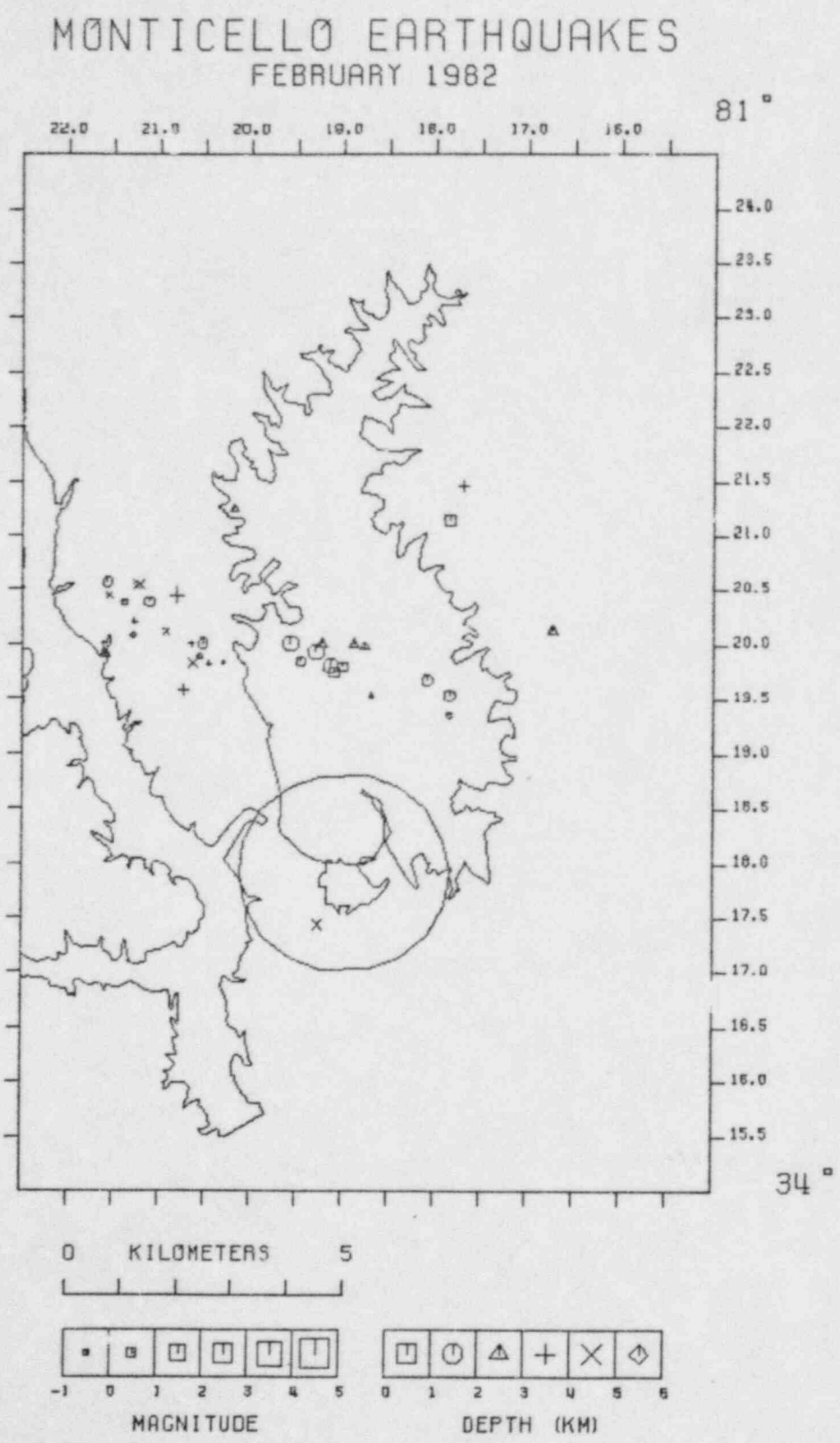
MONTICELLO EARTHQUAKES
FEBRUARY 1982
81°
22.0
21.0
20.0
19.0
18.0
17.0
16.0
24.0
23.5
23.0
22.5
22.0
21.5
21.0
20.5
20.0
19.5
19.0
18.5
18.0
17.5
17.0
16.5
16.0
15.5
34°
0 KILOMETERS 5
-1 0 1 2 3 4 5
MAGNITUDE
0 1 2 3 4 5 6
DEPTH (KM)

Figure 4

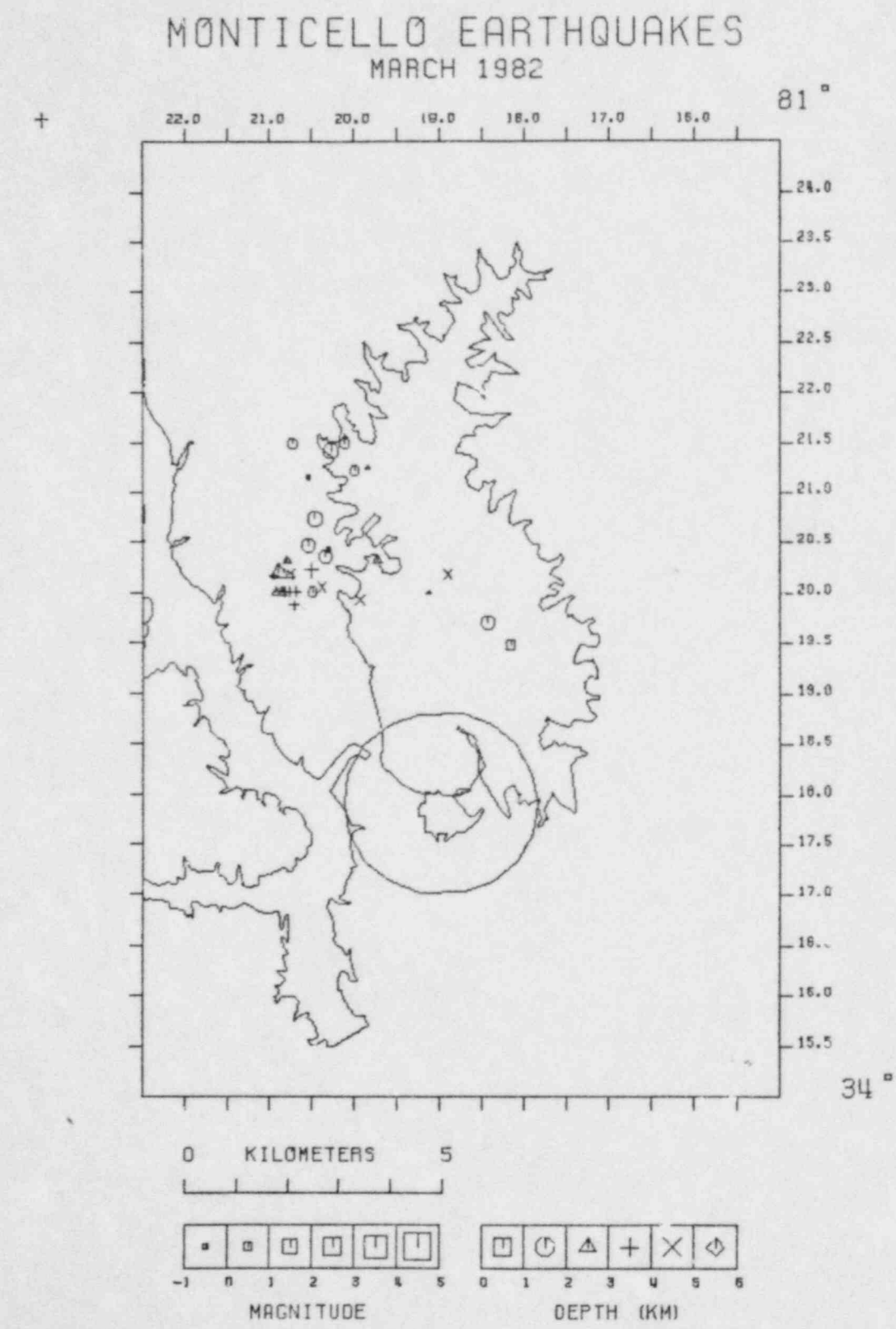
MONTICELLO EARTHQUAKES
MARCH 1982
81°
34°
22.0
21.0
20.0
19.0
18.0
17.0
16.0
24.0
23.5
23.0
22.5
22.0
21.5
21.0
20.5
20.0
19.5
19.0
18.5
18.0
17.5
17.0
16.5
16.0
15.5
0 KILOMETERS 5
-1 0 1 2 3 4 5
MAGNITUDE
0 1 2 3 4 5 6
DEPTH (KM)

Figure 5

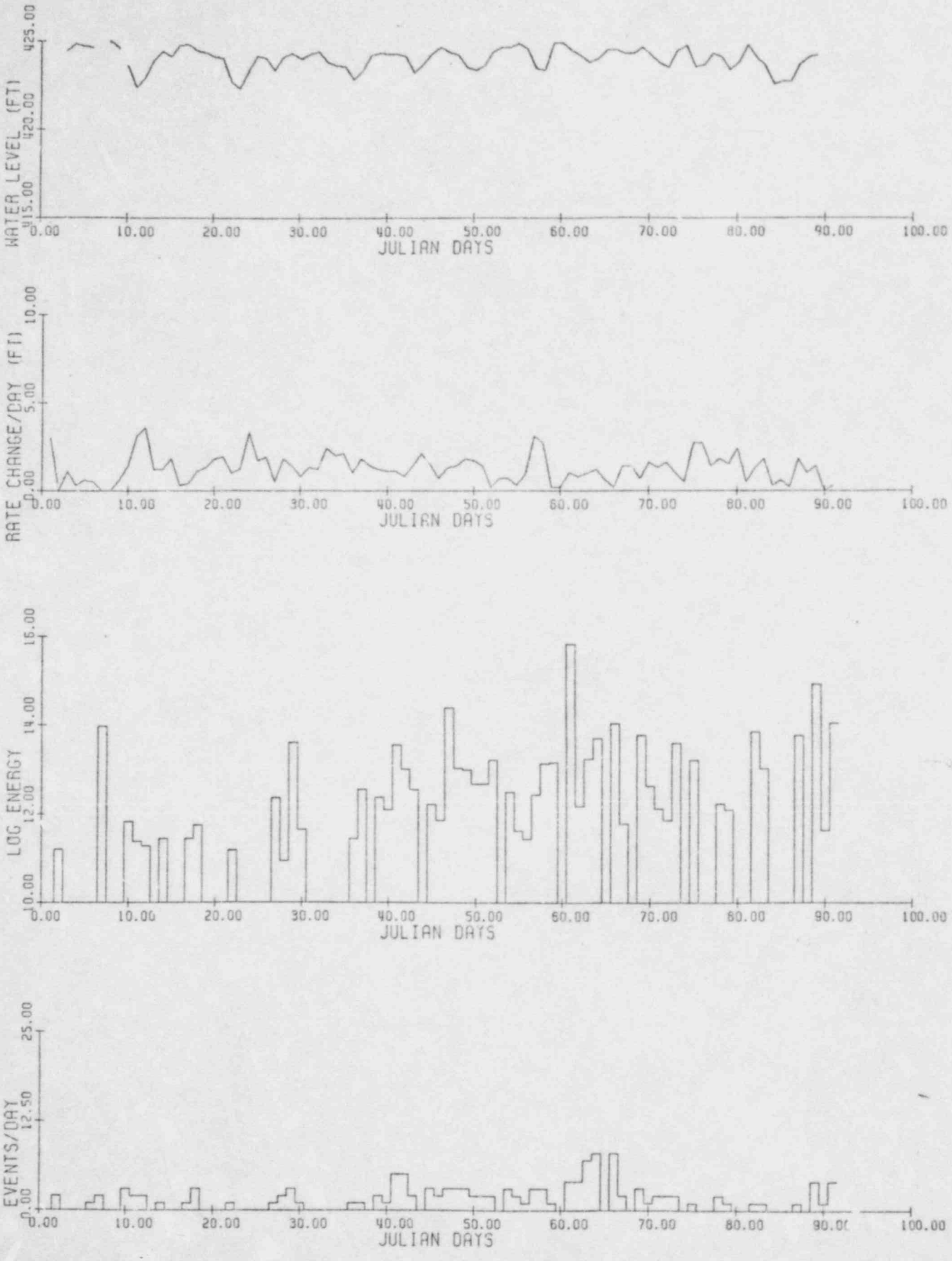
WATER LEVEL (FT)
425.00
420.00
415.00
0.00
10.00
20.00
30.00
40.00
50.00
60.00
70.00
80.00
90.00
100.00
JULIAN DAYS
RATE CHANGE/DAY (FT)
10.00
5.00
0.00
JULIAN DAYS
LOG ENERGY
15.00
14.00
12.00
10.00
JULIAN DAYS
EVENTS/DAY
25.00
12.50
0.00
JULIAN DAYS

Figure 6

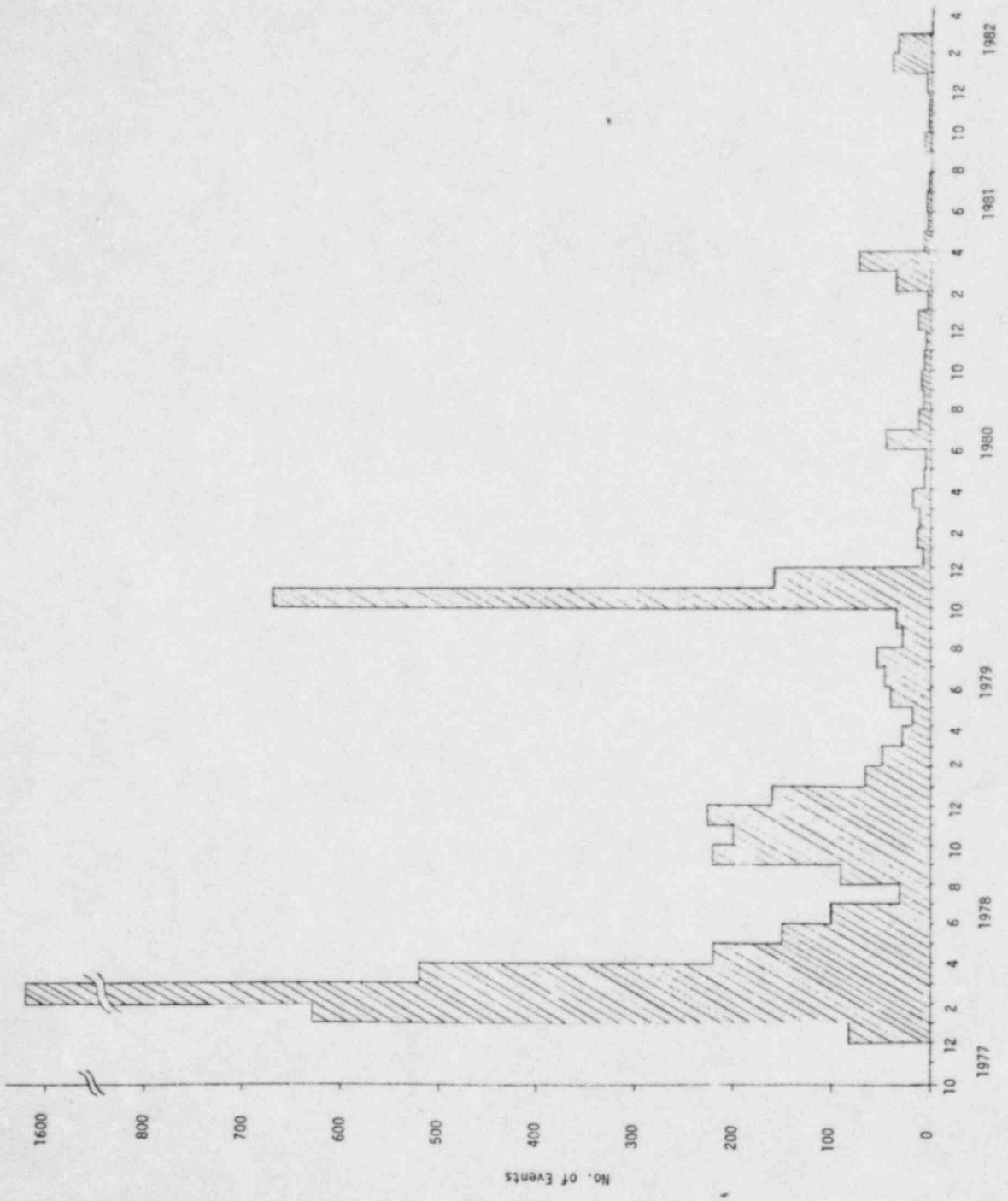
No. of Events
1600
800
700
600
500
400
300
200
100
0
10 12 2 4 6 8 10 12 2 4 6 8 10 12 2 4 6 8 10 12 2 4 6 8 10 12 2 4
1977
1978
1979
1980
1981
1982

Figure 7

APPENDICE :

APPENDIX I

STATION LOCATION

NO.	STN.	LAT. N.	LONG. W.
1	001	34°19.91'	81°17.74'
2	002	34°11.58'	81°13.81'
3	003	34°21.09'	81°27.41'
4	004	34°25.72'	81°12.99'
5	JSC	34°16.80'	81°15.60'

APPENDIX II

MONTICELLO RESERVOIR

VELOCITY MODEL

Velocity km/sec	Depth km
1.00	0.00
5.40	0.03
5.90	0.18
6.10	0.46
6.30	0.82
8.10	30.00

APPENDIX III

MONTICELLO EARTHQUAKES
JANUARY THROUGH MARCH 1982

DATE	ORIGIN	LAT N	LONG W	DEPTH	MAG	NO	GAP	DMIN	RMS	ERH	ERZ	QM
820117	1527 39.27	34-19.40	81-20.93	0.02	-0.86	6	145	5.0	0.08	0.5	0.1	B1
820121	1924 40.75	34- 7.93	81- 9.65	0.95	1.50	7	321	9.3	0.08	1.2	125.4	D1
820129	221 18.30	34-20.25	81-19.71	1.93	0.73	8	128	3.1	0.08	0.4	1.2	B1
820129	4 6 25.40	34-20.01	81-19.84	1.78	0.68	8	130	3.2	0.08	0.4	1.2	B1
820206	2341 31.06	34-20.01	81-19.23	2.54	0.51	8	127	2.3	0.09	0.4	0.7	B1
820208	123 22.93	34-21.14	81-17.84	0.28	0.37	6	132	2.3	0.05	0.2	0.5	B1
820210	10 1 14.40	34-19.81	81-19.14	1.77	1.02	7	129	2.2	0.02	0.1	0.4	B1
820210	1014 36.46	34-20.01	81-20.53	1.77	0.29	4	261	4.3	0.08	0.0	0.0	C1
820210	11 9 21.60	34-20.01	81-18.88	2.69	0.12	5	247	1.8	0.07	1.8	0.7	C1
820210	1112 26.17	34-19.80	81-19.00	0.68	0.82	7	128	1.9	0.06	0.3	0.9	B1
820211	410 32.72	34-19.36	81-17.84	1.63	-0.40	4	212	1.0	0.05	0.0	0.0	C1
820211	716 2.18	34-21.46	81-17.69	3.25	0.73	6	221	2.9	0.01	0.1	0.1	C1
820212	254 33.38	34-20.01	81-19.57	1.74	1.87	6	129	2.8	0.08	0.6	2.5	B1
820212	228 50.93	34-19.99	81-18.76	2.75	0.01	5	125	1.6	0.02	0.1	0.2	C1
820213	1651 38.20	34-19.54	81-18.69	2.17	-0.11	5	244	1.6	0.02	0.5	0.2	C1
820216	610 26.74	34-19.58	81-20.74	3.41	0.21	4	262	4.6	0.00	0.0	0.0	C1
820216	1533 22.23	34-19.93	81-19.29	1.08	1.72	7	128	2.4	0.04	0.2	1.8	B1
820218	150 23.08	34-19.75	81-19.09	0.48	0.78	7	129	2.1	0.03	0.2	0.5	B1
820218	912 3.93	34-19.68	81-18.08	1.70	0.01	5	239	0.7	0.02	0.8	0.3	C1
820219	1023 7.67	34-19.85	81-19.48	1.89	0.57	7	130	2.7	0.08	0.4	0.9	B1
820220	17 0 48.82	34-21.25	81-20.18	2.59	0.21	6	145	4.5	0.07	0.4	1.3	B1
820221	1615 33.42	34-17.44	81-19.27	4.08	0.95	6	156	5.1	0.03	0.2	0.5	B1
820222	15 1 8.41	34-19.89	81-20.57	1.84	-0.40	6	136	4.3	0.06	0.4	2.4	C1
820222	1840 50.61	34-19.83	81-20.64	4.34	0.01	5	137	4.5	0.01	0.1	0.5	C1
820222	2333 37.61	34-20.01	81-20.66	3.59	-0.24	7	135	4.5	0.09	0.5	1.2	B1
820223	635 23.45	34-19.54	81-17.84	1.91	0.44	7	124	0.7	0.07	0.4	0.5	B1
820224	1649 18.16	34-20.14	81-16.73	2.67	0.82	6	135	1.6	0.07	1.4	1.7	C1
820224	1653 4.80	34-20.45	81-20.82	3.25	1.75	5	134	4.8	0.03	0.4	1.4	C1
820226	2340 9.14	34-20.57	81-21.57	1.85	0.37	8	138	6.0	0.09	0.5	2.4	C1
820227	037 18.37	34-20.09	81-21.29	1.89	-0.11	6	137	5.5	0.04	0.3	2.0	C1
820227	054 10.30	34-20.21	81-21.27	3.15	-0.86	5	135	5.5	0.00	0.0	0.0	C1
820227	1 0 29.35	34-20.01	81-21.61	3.93	-0.11	6	140	5.9	0.07	0.6	1.3	B1
820227	1 5 54.84	34-20.39	81-21.39	0.59	-0.60	5	135	5.7	0.02	0.2	1.9	C1
820227	148 29.70	34-20.53	81-21.25	4.04	-0.24	5	137	5.5	0.05	0.4	1.1	C1
820227	639 45.34	34-23.24	81-17.77	1.96	-0.86	4	238	6.2	0.00	0.0	0.0	C1

Appendix III (cont.)

820227	935	40.96	34-20.39	81-21.11	1.89	0.87	6	266	5.2	0.09	1.6	3.5 C1
820227	936	49.63	34-20.55	81-21.22	4.77	0.01	4	267	5.5	0.00	0.0	0.0 C1
820227	943	10.03	34-20.45	81-21.55	4.18	-0.60	4	269	5.9	0.00	0.0	0.0 C1
820227	1035	26.01	34-20.12	81-20.93	4.48	-0.40	4	264	4.9	0.00	0.0	0.0 C1
820227	1054	27.24	34-19.84	81-20.30	5.31	-0.60	4	259	3.9	0.00	0.0	0.0 C1
820228	337	48.18	34-19.83	81-20.46	3.39	-0.86	6	136	4.2	0.09	0.6	1.6 B1
820228	613	8.46	34-19.91	81-21.60	2.76	0.91	8	142	5.9	0.09	0.4	1.4 B1
820302	8 1	57.41	34-20.33	81-19.73	2.31	0.21	6	129	3.2	0.04	0.3	0.6 B1
820302	1648	8.60	34-20.21	81-20.89	2.28	2.69	4	133	4.9	0.00	0.0	0.0 C1
820302	2349	24.74	34-20.01	81-20.68	3.20	0.12	5	135	4.5	0.02	0.2	0.5 C1
820303	13 5	6.77	34-20.06	81-20.38	4.61	0.01	5	133	4.1	0.01	0.1	0.2 C1
820304	3 0	24.46	34-20.01	81-20.76	3.33	0.68	8	135	4.6	0.05	0.3	0.6 B1
820304	320	52.86	34-20.19	81-18.90	4.82	0.57	6	248	1.9	0.05	1.0	0.5 C1
820304	450	36.92	34-19.93	81-19.93	4.87	0.21	4	256	3.4	0.00	0.0	0.0 C1
820304	521	31.76	34-20.01	81-20.49	1.98	0.57	5	261	4.2	0.07	1.6	2.1 C1
820305	1135	21.24	34-21.22	81-19.99	1.83	0.21	6	143	4.2	0.03	0.2	0.7 B1
820305	13 3	44.13	34-21.49	81-20.11	1.81	0.82	6	148	4.7	0.06	0.6	2.9 C1
820305	1330	20.99	34-21.25	81-19.84	2.53	-0.11	5	143	4.1	0.02	0.2	0.5 C1
820305	1355	44.76	34-21.42	81-20.27	1.90	1.18	8	148	4.8	0.07	0.4	1.9 B1
820305	1356	0.17	34-21.57	81-20.11	2.62	-0.60	4	149	4.8	0.08	0.0	0.0 C1
820307	152	33.35	34-20.01	81-20.92	2.56	0.68	8	136	4.9	0.06	0.4	0.9 B1
820307	2 6	4.84	34-20.16	81-20.73	3.48	-0.11	7	133	4.6	0.07	0.4	1.0 B1
820307	3 4	9.76	34-20.18	81-20.95	3.29	0.57	7	134	5.0	0.09	0.5	1.2 B1
820307	258	12.52	34-20.48	81-20.54	1.88	1.32	7	134	4.4	0.09	0.5	4.0 B1
820307	322	2.06	34-20.01	81-20.85	2.81	0.57	7	136	4.8	0.08	0.6	1.4 B1
820307	1311	25.64	34-19.88	81-20.70	3.68	0.21	7	137	4.5	0.05	0.3	0.7 B1
820310	1011	30.74	34-21.49	81-20.73	1.77	0.29	6	151	5.4	0.07	0.4	2.3 C1
820310	2111	12.92	34-19.71	81-18.43	1.85	1.32	7	126	1.1	0.04	0.2	0.4 B1
820314	254	57.42	34-20.23	81-20.50	3.48	1.13	7	131	4.3	0.08	0.4	0.9 B1
820316	828	47.62	34-19.49	81-18.16	0.66	0.95	7	126	1.0	0.01	0.1	0.1 B1
820318	1625	6.66	34-20.32	81-20.79	2.63	0.21	7	132	4.7	0.09	0.6	1.6 B1
820320	2242	20.94	34-20.01	81-20.82	3.46	0.21	7	136	4.7	0.09	0.5	1.1 B1
820323	5 0	47.45	34-24.72	81-23.68	3.16	1.37	7	223	8.8	0.08	0.6	2.8 C1
820324	030	18.32	34-20.20	81-20.76	4.50	0.82	6	133	4.7	0.04	0.3	0.7 B1
820328	1713	1.78	34-20.74	81-20.46	1.88	1.60	7	138	4.4	0.05	0.3	2.1 C1
820328	1716	6.20	34-20.43	81-20.30	1.84	-0.24	6	133	4.0	0.05	0.3	1.4 B1
820330	049	41.06	34-20.36	81-20.34	1.20	1.42	7	132	4.1	0.04	0.3	1.9 B1
820330	133	43.63	34-21.15	81-20.54	0.01	-0.40	7	144	4.9	0.04	0.2	0.1 B1
820330	1055	4.81	34-20.01	81-19.12	2.36	-0.40	5	184	2.1	0.09	2.6	3.6 D1
820330	1824	45.41	34- 6.84	81- 7.45	1.02	2.00	7	324	13.1	0.06	1.0	94.5 D1
820330	2110	29.52	34-26.59	81-24.04	2.00	1.64	7	249	11.4	0.08	0.9	7.9 D1

ATTACHMENT