TECHNICAL REPORT 82-3

SEISMIC ACTIVITY NEAR THE V.C. SUMMER NUCLEAR STATION

For the Period July - September 1982

by

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University of South Carolina
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Contract No. N301315

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INTRODUCTION

This report presents a summary of seismic activity near the V. C. Summer Nuclear Power Station in South Carolina for the three month period between July 1 and September 30, 1982. During this reporting period a total of 63 locatable events were recorded. The largest events were of magnitudes between 1.0 and 2.0 and are listed in Table 1.

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

The 63 locatable events recorded during this reporting period (July 1 - September 30, 1982) are listed in Appendix III. Five events had

TABLE 1

Date	Magnitude
July 29	1.42
July 29	1.12
July 30	1.15
August 27	1.32
September 18	1.44

magnitudes between 1.0 and 2.0 and the rest were small ($M_L \leq 1.0$). Their depth estimates indicate that 35% of the activity during this period occurred below 2.0 km depth, the deepest event being 4.7 km deep. However, in the past, relocation of these events with magnetic tape data suggests that these may be shallower than the true depths.

A sequence of 14 events occurred near Newberry, S.C., about 25 km west of the V. C. Summer station, in July and August. The main event (M_L = 2.3) occurred July 16 and was followed by eight smaller shocks between July 16 and July 22, and five on August 12 and 13. (See also Robinson et al., 1982.)

A cumulative plot of the epicenters of the events located during this reporting period is shown in Figure 2. A cross section along the line AA' (Fig. 2) 48^{o} NW including events within 0.5 km of the line is shown in Figure 3. The hypocentral locations are shallower below the Monticello Reservoir than outside it. The clusters of activity do not appear to define any fault plane. A monthly breakup of their locations is shown in Figures 4-6.

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 7 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. The histograms showing events per day and log of energy release, include the unlocated events around the reservoir.

CONCLUSIONS

This reporting period, July 1 through September 30, 1982, is characterized by a low level of seismic activity. Figure 8 shows a histogram of the number of events per month from December, 1977 through September, 1982, which suggests a long term seismic trend at Monticello Reservoir of discrete earthquake swarms separated by relatively quiet periods. The low level of seismicity for this three month period is in agreement with the long term trend in that it follows the large swarm that occurred during the previous reporting period.

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.

Robinson, A. W., Rawlins, J. and Talwani, P. (1982). The Newberry County, S.C., earthquakes of July and August, 1982, Earthquake Notes, v. 53, no. 3, p. 33.

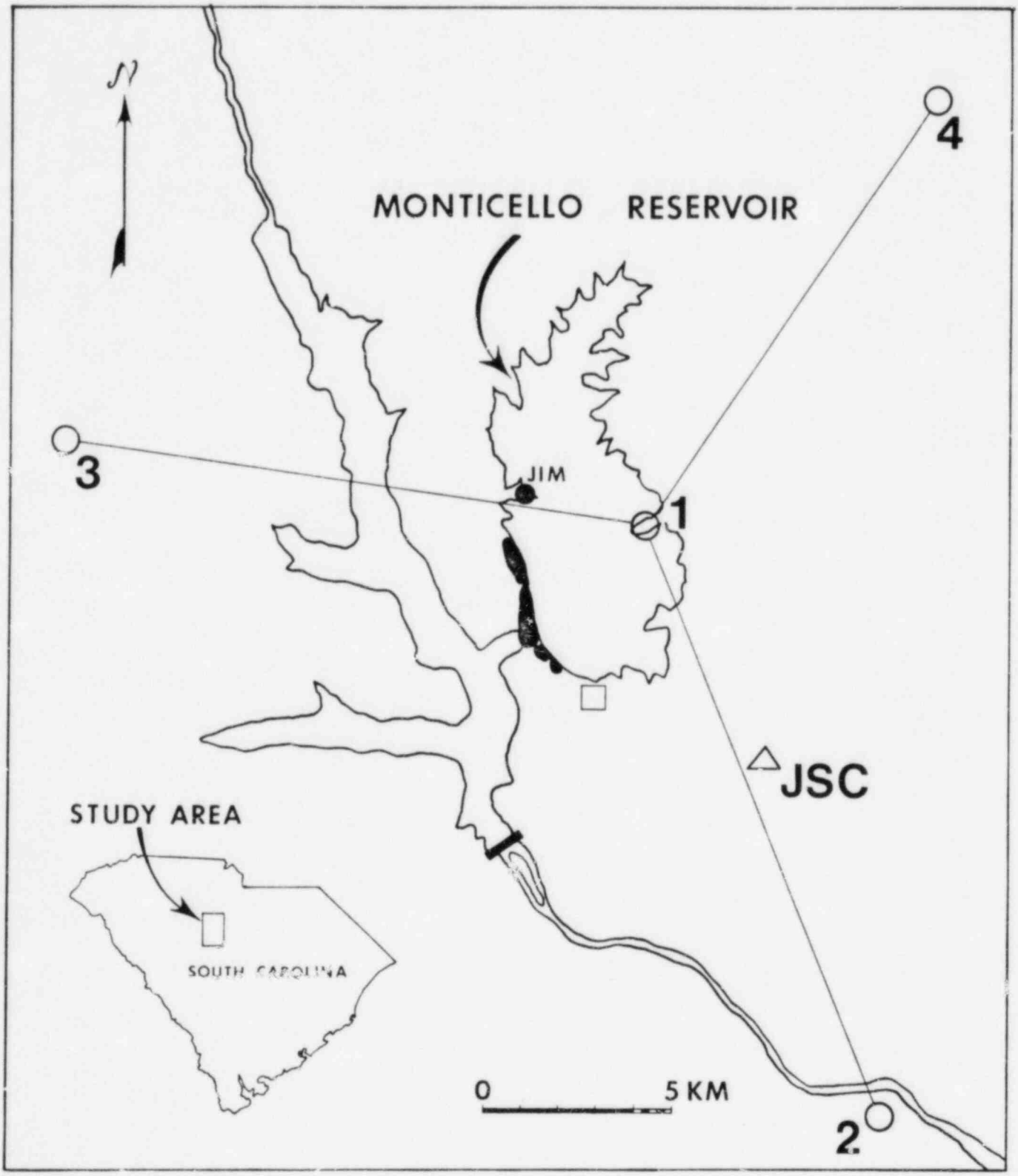
N
MONTICELLO RESERVOIR
JIM
1
2
3
4
JSC
STUDY AREA
SOUTH CAROLINA
0
5 KM

Figure 1

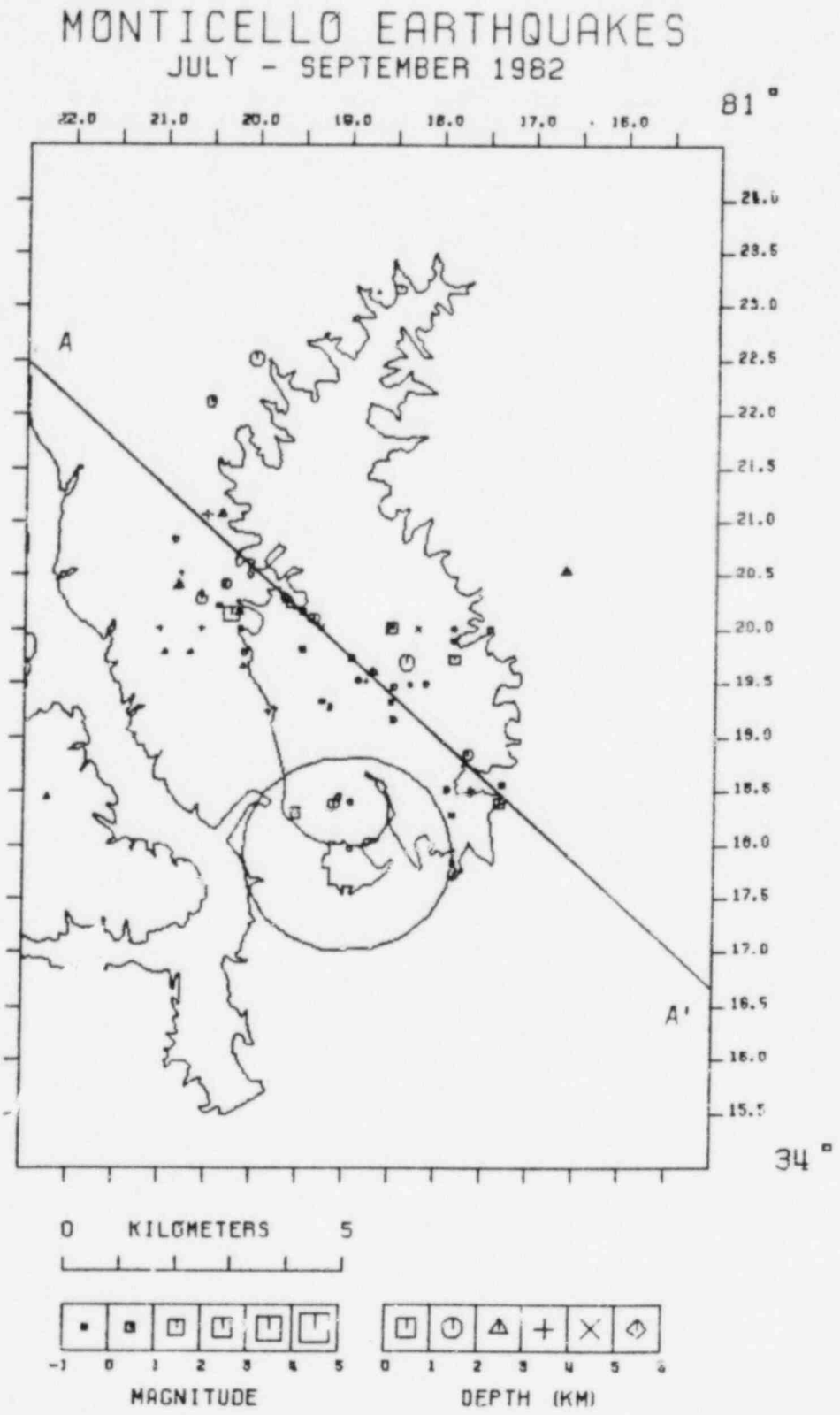
MONTICELLO EARTHQUAKES
JULY - SEPTEMBER 1982
81°
34°
A
A'
0 KILOMETERS 5
MAGNITUDE
DEPTH (KM)

Figure 2

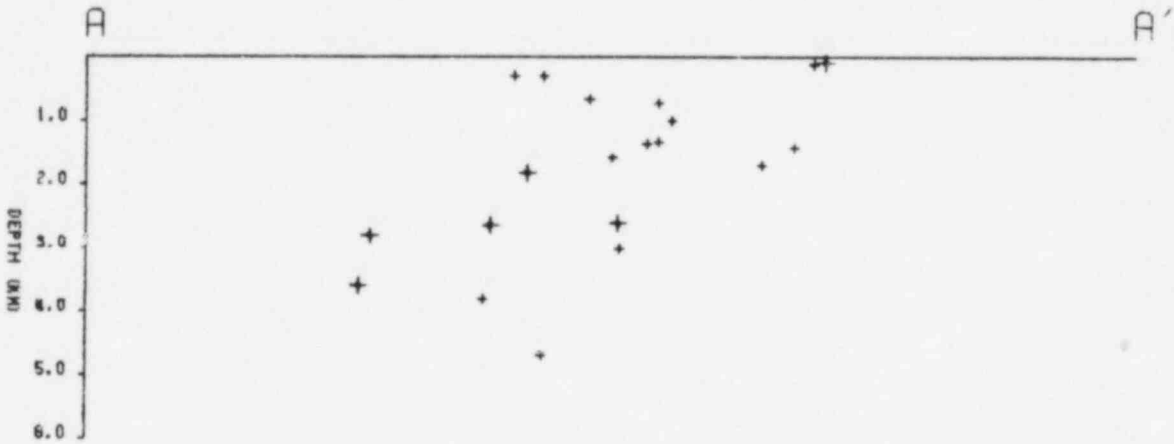

Figure 3

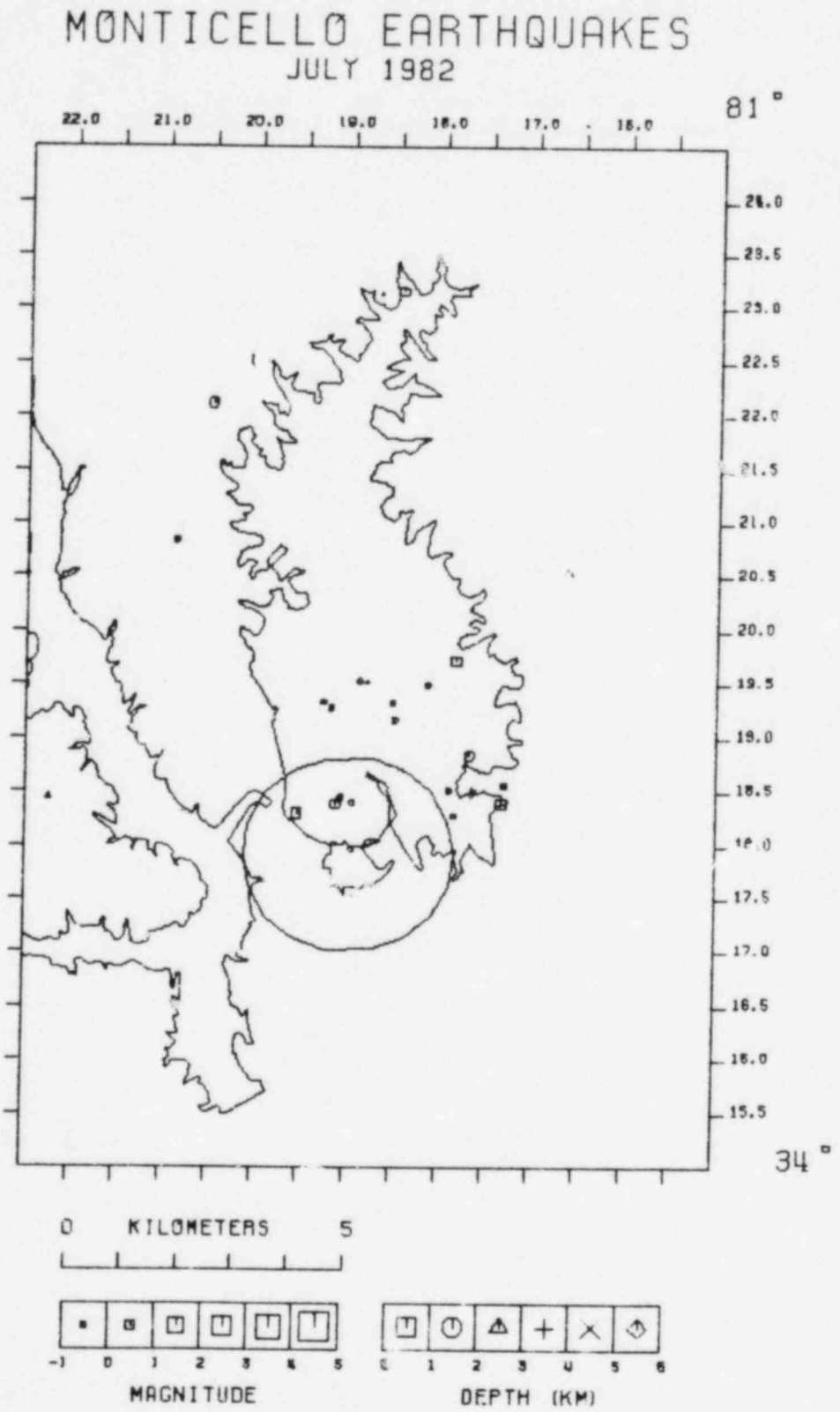
MONTICELLO EARTHQUAKES
JULY 1982
81°
22.0
21.0
20.0
19.0
18.0
17.0
16.0
34°
0 KILOMETERS 5
MAGNITUDE
DEPTH (KM)

Figure 4

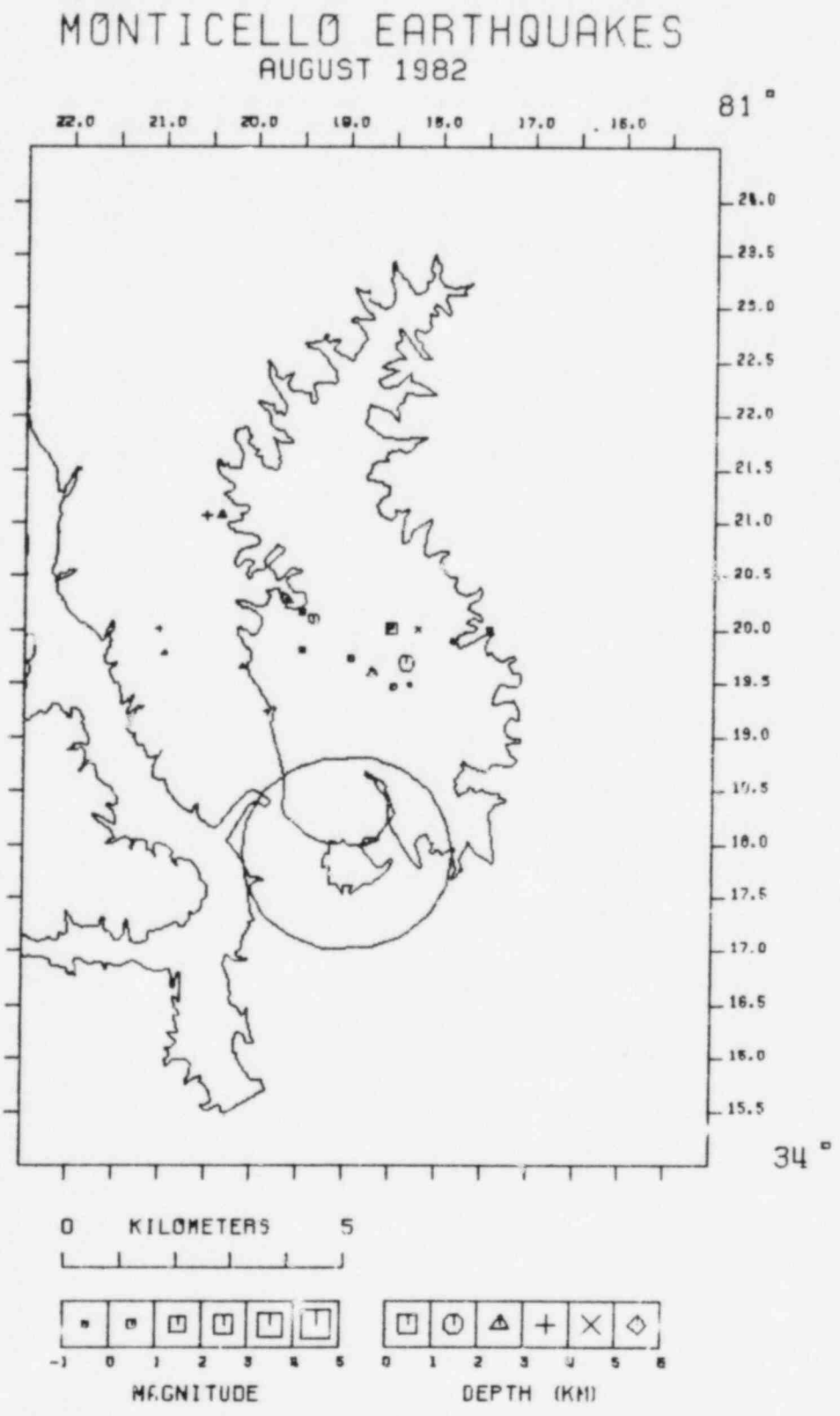
MONTICELLO EARTHQUAKES
AUGUST 1982
81°
34°
22.0
21.0
20.0
19.0
18.0
17.0
16.0
29.0
28.5
25.0
22.5
22.0
21.5
21.0
20.5
20.0
19.5
19.0
18.5
18.0
17.5
17.0
16.5
16.0
15.5
0 KILOMETERS 5
-1 0 1 2 3 4 5
MAGNITUDE
0 1 2 3 4 5 6
DEPTH (KM)

Figure 5

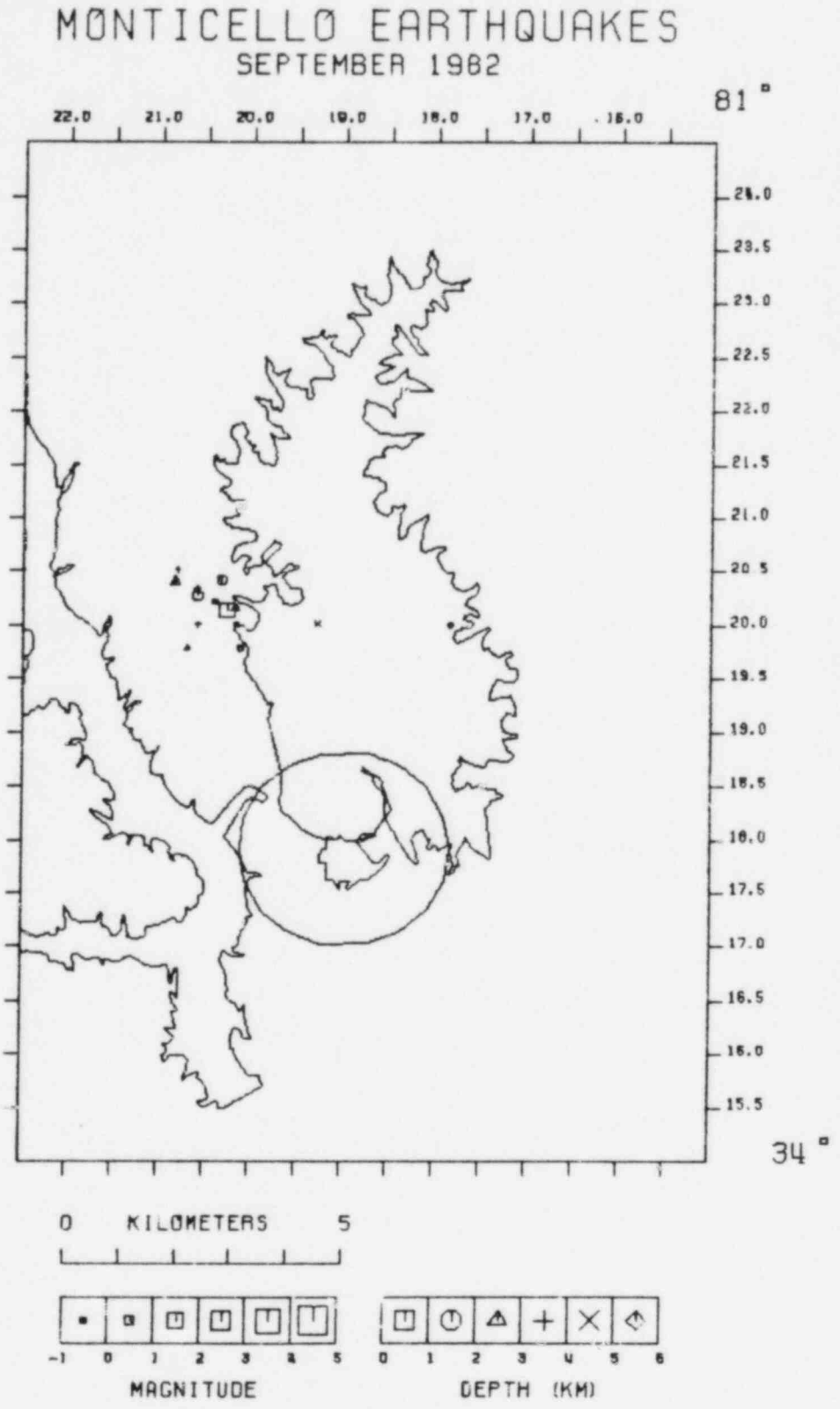
MONTICELLO EARTHQUAKES
SEPTEMBER 1982
81°
34°
0 KILOMETERS 5
MAGNITUDE
DEPTH (KM)

Figure 6

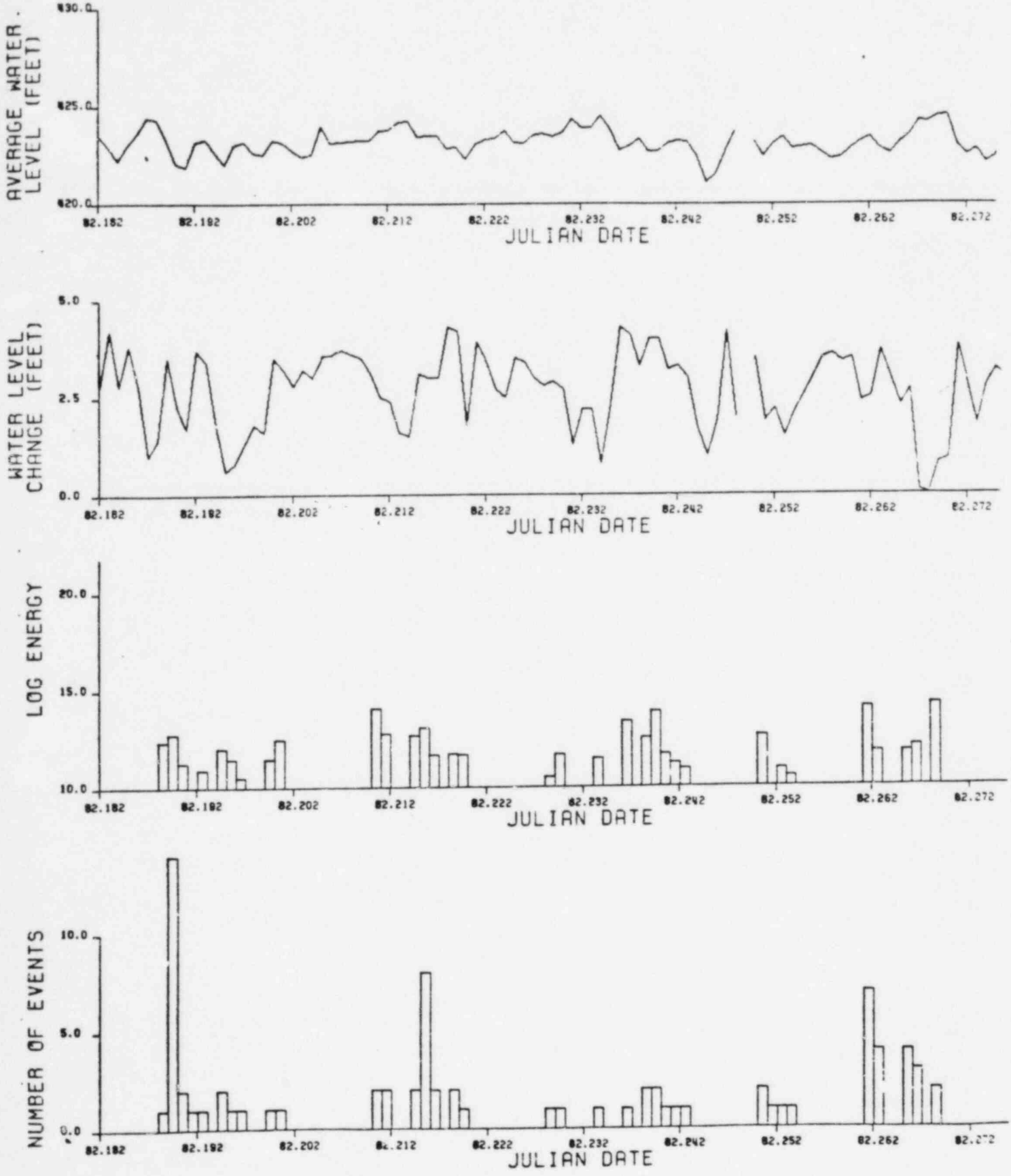
AVERAGE WATER LEVEL (FEET)
630.0
625.0
620.0
82.182
82.192
82.202
82.212
82.222
82.232
82.242
82.252
82.262
82.272
JULIAN DATE
WATER LEVEL CHANGE (FEET)
5.0
2.5
0.0
JULIAN DATE
LOG ENERGY
20.0
15.0
10.0
JULIAN DATE
NUMBER OF EVENTS
10.0
5.0
0.0
JULIAN DATE

Figure 7

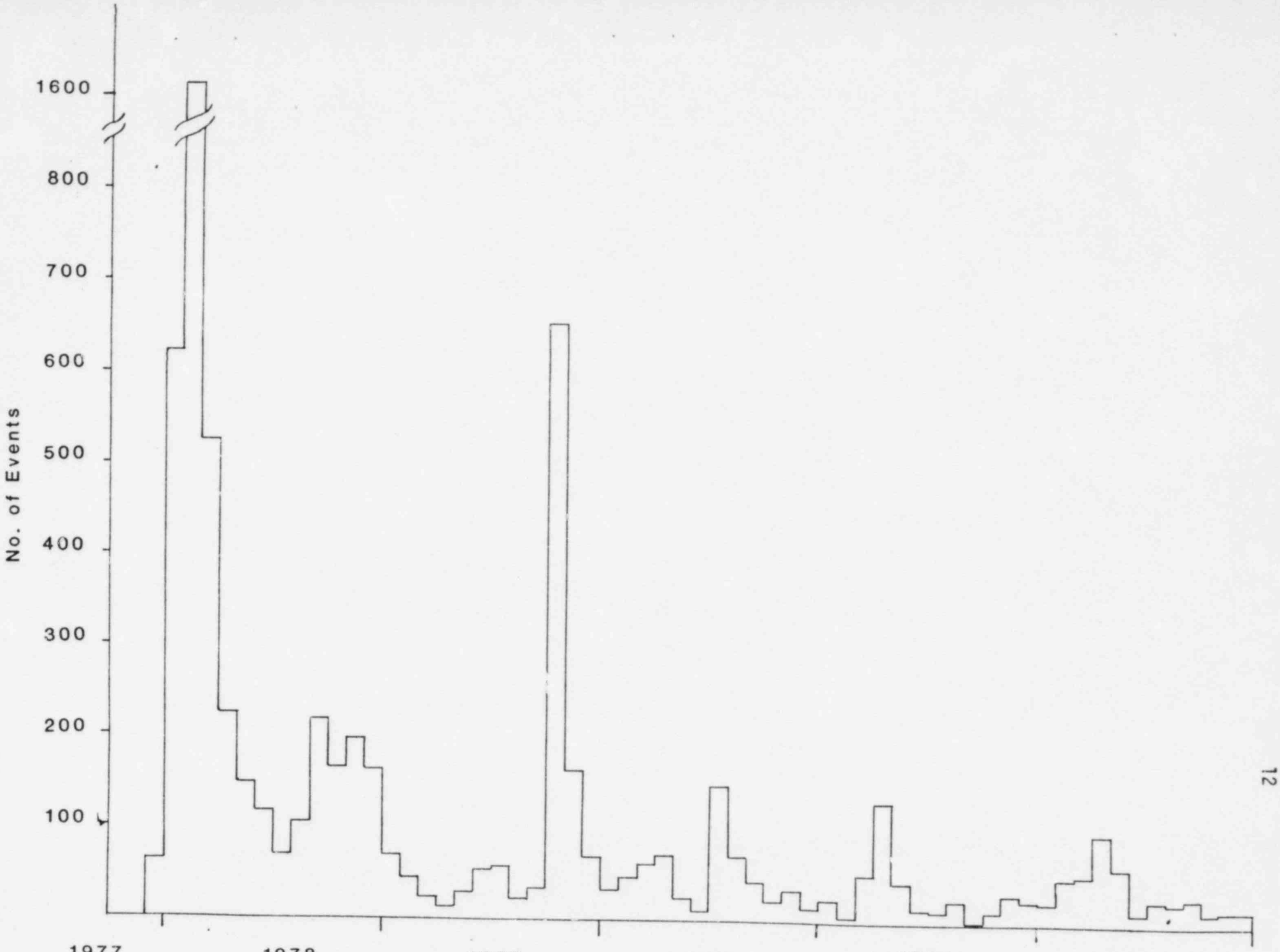
1600
800
700
600
500
400
300
200
100
No. of Events
1977
1978
1979
1980
1981
1982

Figure 8

APPENDICES

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'
6	008	34°24.53'	81°24.55'

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
JULY - SEPTEMBER 1982

DATE	ORIGIN	LAT N	LONG W	DEPTH	MAG	NO	GAP	DMIN	RMS	ERH	ERZ	QM
820708	033 55.82	34-19.52	81-18.80	3.03	-0.24	6	202	1.8	0.04	0.7	1.5	C
820708	548 35.64	34-18.40	81-18.95	1.34	-0.24	7	203	3.4	0.09	0.7	1.5	C
820708	651 1.69	34-17.97	81-18.95	1.85	-0.60	7	212	4.0	0.08	0.7	1.6	C
820708	656 22.43	34-19.33	81-19.28	1.85	-0.86	7	190	2.6	0.07	0.4	1.5	C
820708	848 16.07	34-18.45	81-19.08	1.90	-0.60	7	204	3.4	0.08	0.6	1.5	C
820708	848 35.39	34-18.51	81-17.91	1.55	-0.86	7	234	3.6	0.07	0.6	1.5	C
820708	849 3.29	34-18.38	81-19.14	1.99	0.01	7	208	3.4	0.07	0.6	1.5	C
820708	853 38.35	34-18.30	81-19.55	0.56	0.29	8	212	2.7	0.08	0.4	1.5	C
820708	854 19.08	34-18.48	81-17.46	1.43	-0.86	6	223	2.7	0.08	0.6	1.5	C
820708	856 17.17	34-18.56	81-17.31	0.12	-0.60	5	204	2.6	0.08	0.6	1.5	C
820708	1523 35.82	34-18.39	81-17.34	0.09	0.01	8	178	2.9	0.08	0.5	1.5	C
820708	1720 7.36	34-19.32	81-18.52	1.34	-0.40	9	130	1.9	0.03	0.4	1.5	C
820708	1917 12.66	34-19.53	81-18.89	1.60	-0.60	5	240	2.1	0.05	0.6	1.5	C
820708	20 2 44.87	34-20.55	81-16.63	2.17	0.21	9	224	3.0	0.05	0.6	1.6	C
820709	239 46.11	34-18.84	81-17.68	1.71	-1.22	7	146	3.0	0.06	0.6	1.5	C
820709	1522 32.36	34-18.28	81-17.84	0.55	-0.40	6	234	1.8	0.01	0.4	1.5	C
820710	334 12.13	34-19.16	81-18.50	1.00	-1.83	3	355	7.4	0.04	0.7	1.6	C
820711	547 2.98	34-18.44	81-22.25	2.65	-0.60	6	236	2.4	0.06	0.6	1.5	C
820713	10 6 57.69	34-19.72	81-17.84	0.07	0.07	7	183	2.4	0.02	0.5	1.5	C
820713	1023 3.95	34-19.50	81-18.15	1.00	-0.75	3	355	1.8	0.05	0.6	1.5	C
820714	449 54.03	34-23.13	81-18.71	2.69	-0.20	7	167	6.1	0.05	0.6	1.6	C
820715	1712 53.56	34-19.28	81-19.19	0.37	-0.86	5	249	2.5	0.06	0.6	1.5	C
820718	127 12.92	34-20.84	81-20.89	1.38	-0.24	10	173	5.1	0.06	0.6	1.6	C
820719	2014 8.67	34-23.16	81-18.47	1.80	0.73	10	135	6.1	0.06	0.6	1.6	C
820729	1528 5.84	34-19.59	81-33.54	1.97	1.42	9	300	7.5	0.05	0.6	1.6	C
820729	2020 38.56	34-19.93	81-32.08	1.98	1.12	9	295	7.5	0.06	0.6	1.6	C
820730	548 58.72	34-22.51	81-20.02	1.90	1.15	8	164	5.9	0.08	0.6	1.6	C
820730	2332 10.43	34-22.12	81-20.51	1.94	0.21	8	154	5.6	0.05	0.6	1.6	C
820802	6 8 4.88	34-21.07	81-20.38	2.82	0.57	8	143	5.4	0.07	0.6	1.6	C
820802	1518 32.81	34-19.81	81-19.49	0.30	-0.40	4	209	2.7	0.04	0.6	1.5	C
820803	845 29.76	34-21.06	81-20.54	3.60	0.01	9	143	4.4	0.06	0.6	1.6	C
820803	10 9 48.64	34-20.01	81-18.52	0.86	0.57	8	248	1.8	0.08	0.6	1.5	C
820803	1010 57.89	34-20.01	81-18.23	4.60	-0.24	10	122	2.8	0.04	0.6	1.5	C
820803	1014 50.47	34-19.74	81-18.95	0.67	-0.60	7	247	2.9	0.04	0.6	1.5	C
820803	1152 1.33	34-20.01	81-18.51	0.67	0.01	10	123	2.9	0.06	0.6	1.5	C
820803	13 3 34.80	34-20.16	81-19.49	0.31	-0.40	4	268	2.5	0.04	0.6	1.5	C
820803	1840 24.73	34-20.10	81-19.37	1.83	0.37	10	127	3.5	0.04	0.6	1.5	C
820803	2153 4.98	34-19.23	81-19.86	3.92	-0.24	8	162	3.5	0.04	0.6	1.5	C
820804	1754 24.22	34-19.49	81-18.32	0.72	-0.40	8	127	2.5	0.06	0.6	1.5	C
820804	2019 34.91	34-20.01	81-21.05	3.65	-0.24	7	156	5.1	0.04	0.6	1.6	C
820806	1159 8.56	34-19.79	81-20.99	2.40	-0.11	9	140	5.0	0.02	0.4	1.5	C
820817	836 18.10	34-20.01	81-17.45	0.10	-0.11	7	145	5.2	0.04	0.6	1.5	C
820821	311 24.78	34-19.90	81-17.84	1.94	0.24	6	237	1.6	0.03	0.6	1.5	C
820824	2030 33.54	34-19.61	81-18.72	2.62	0.82	9	129	1.6	0.09	0.6	1.5	C
820826	227 51.57	34-20.28	81-19.65	2.66	0.37	10	128	3.0	0.09	0.4	1.8	B

820827	113	19.76	34-19.69	81-18.36	1.80	1.32	9	128	1.0	0.04	0.2	0.5	B1
820827	222	39.19	34-19.66	81-20.14	2.45	-0.40	6	257	3.7	0.01	0.2	0.4	C1
820828	1556	12.68	34-19.47	81-16.50	1.36	-0.11	8	129	1.4	0.08	0.4	0.8	B1
820829	1019	0.08	34-20.33	81-19.70	3.80	-0.40	9	129	3.1	0.07	0.3	0.6	B1
820907	1154	54.33	34-20.01	81-17.88	1.88	-0.40	8	237	0.2	0.07	1.0	0.5	C1
820910	2258	49.96	34-20.52	81-20.82	3.19	-0.86	7	135	4.9	0.04	0.2	0.7	B1
820918	1819	42.72	34-20.41	81-20.84	2.60	0.01	8	147	4.8	0.06	0.4	1.0	B1
820918	1820	9.36	34-20.14	81-20.27	0.44	1.44	8	131	3.9	0.05	0.2	1.0	B1
820918	19 1	10.27	34-20.02	81-19.29	4.71	-0.60	6	251	2.4	0.06	1.1	0.7	C1
820918	2021	32.27	34-20.42	81-20.33	1.94	0.91	10	132	4.1	0.08	0.3	1.2	B1
820918	2338	34.58	34-20.35	81-20.60	2.87	-0.24	6	177	4.5	0.02	0.3	0.6	B1
820919	354	48.61	34-19.78	81-20.71	2.35	-0.11	8	138	4.6	0.05	0.3	0.9	B1
820922	2226	22.89	34-20.22	81-20.41	1.94	-0.24	9	131	4.1	0.08	0.3	1.2	B1
820922	2251	35.76	34-20.01	81-20.17	4.22	-0.60	8	132	3.7	0.05	0.3	0.5	B1
820922	2337	51.35	34-19.79	81-20.12	1.94	-0.60	4	154	8.9	0.04	0.0	0.0	C1
820923	012	42.25	34-20.16	81-20.15	2.98	0.01	10	130	3.8	0.05	0.2	0.4	B1
820923	4 1	8.04	34-20.01	81-20.59	3.45	-0.11	9	135	4.4	0.08	0.3	0.8	B1
820925	2220	48.87	34-20.28	81-20.60	1.67	0.21	10	131	4.4	0.09	0.3	2.1	B1