TECHNICAL REPORT 83-3

SEISMIC ACTIVITY NEAR THE V.C. SUMMER NUCLEAR STATION

For the Period July - September 1983

by
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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 a three-month period from July 1 through September 30, 1983. During this period a total of 26 locatable events were recorded of which only one was of magnitude greater than 1.0 (September 14, M_L = 1.09). The remaining events were of magnitudes less than 1.0.

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 are 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 26 events located during this reporting period are listed in Appendix III. The largest event was of magnitude 1.09 on September 14, 1983.

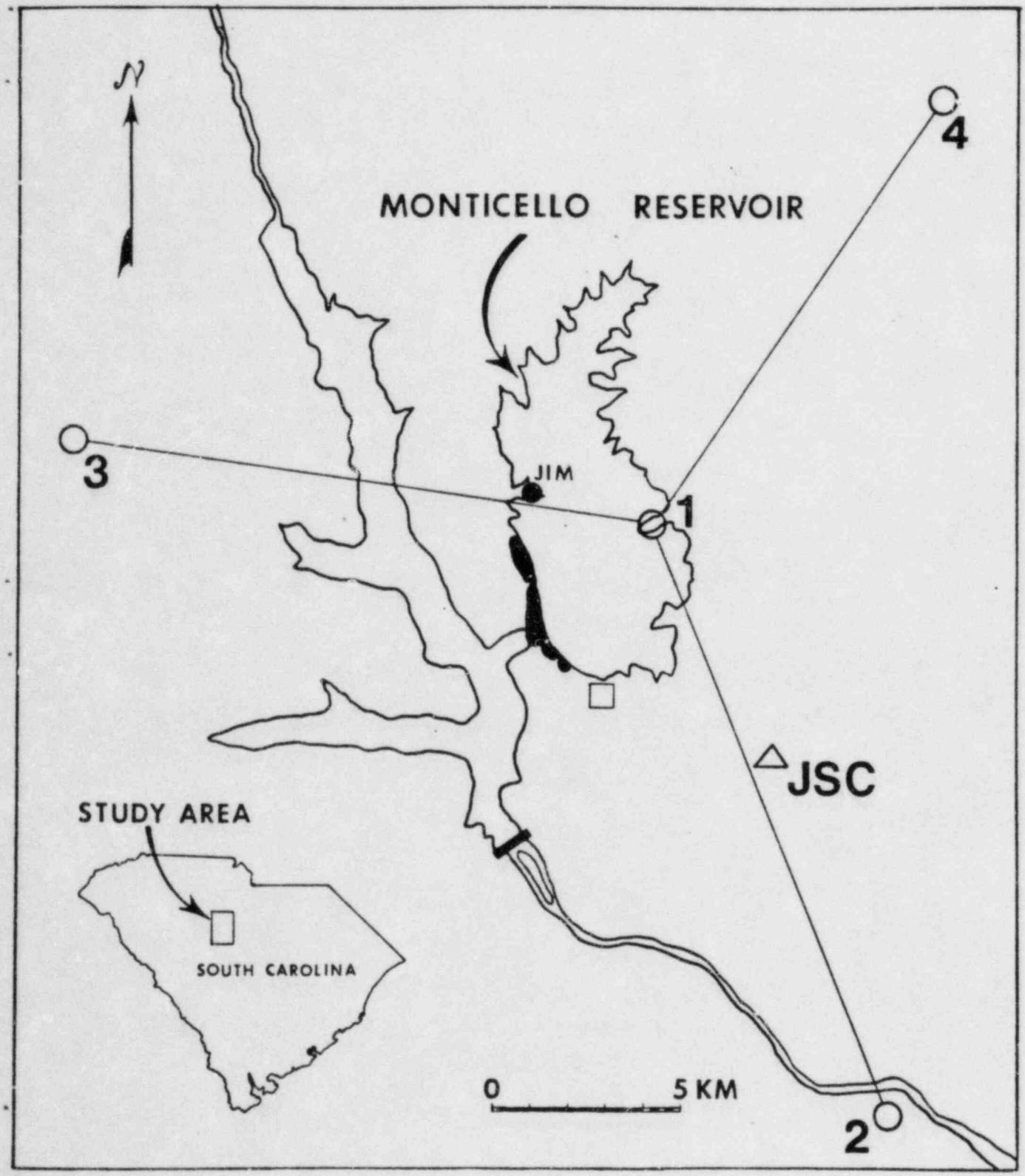
N
MONTICELLO RESERVOIR
4
3
JIM
1
JSC
STUDY AREA
SOUTH CAROLINA
0
5 KM
2

Figure 1

The remaining events were small (M_L < 1.0). Depth estimates for the seismic activity indicate that approximately 73% occurred within 2.0 km of the surface, 19% between 2.0 and 3.0 km depth, and 8% at depths greater than 3.0 km. Depth comparisons of A and B quality events for the previous five years and for the first nine months of 1983 are given in 0.5 km increments in Figure 2. The trend continues whereby more events fall into the 1.5 to 2.0 km increment than any other grouping and a significant percentage occurs at depths greater than 3.0 km.

A cumulative plot of epicenters of events located around Monticello Reservoir during this period is shown in Figure 3, and a monthly breakdown of epicentral locations 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 five 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.

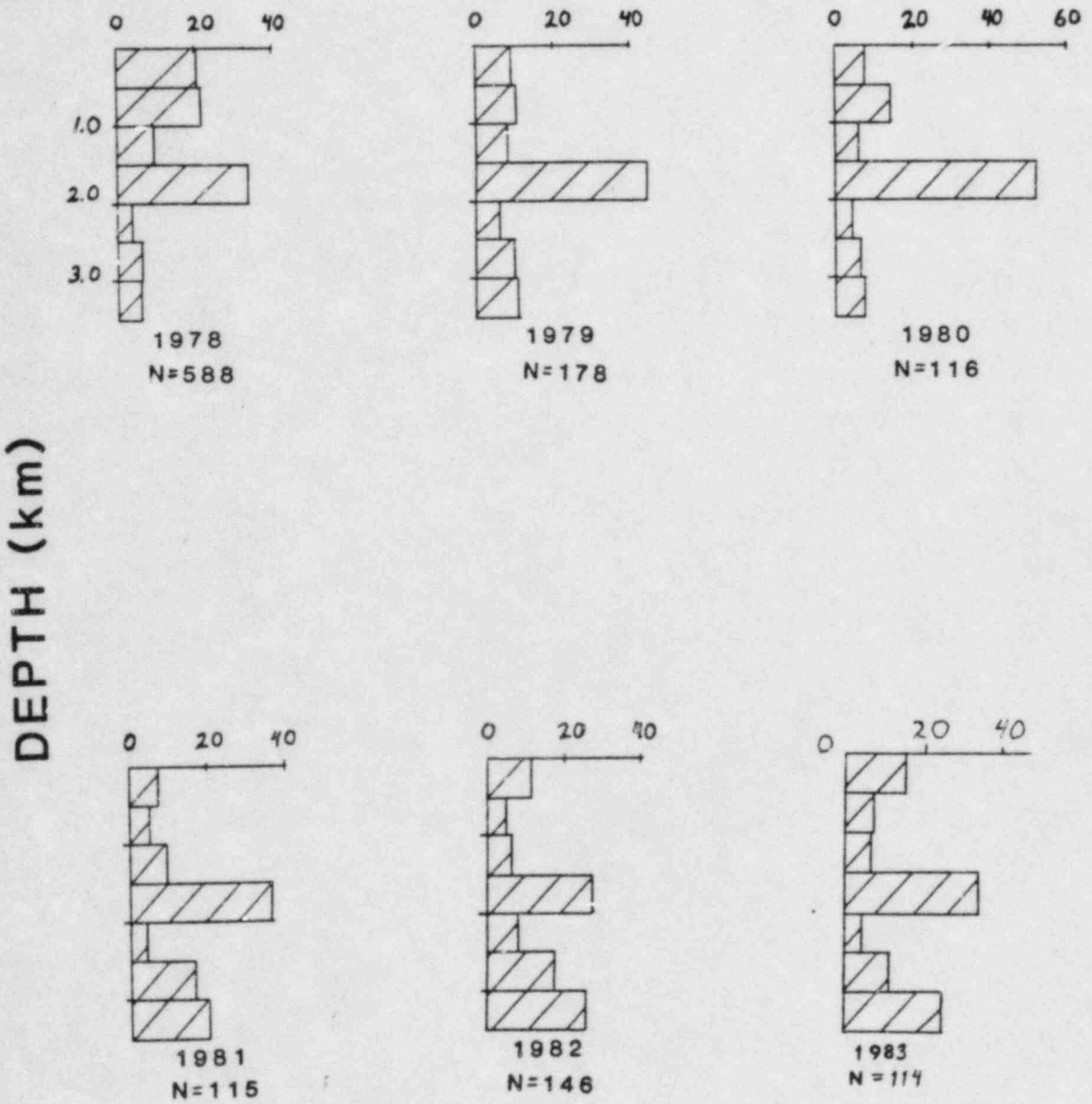
PERCENT
DEPTH (km)
0
20
40
60
1.0
2.0
3.0
1978
N=588
1979
N=178
1980
N=116
1981
N=115
1982
N=146
1983
N=114

Figure 2

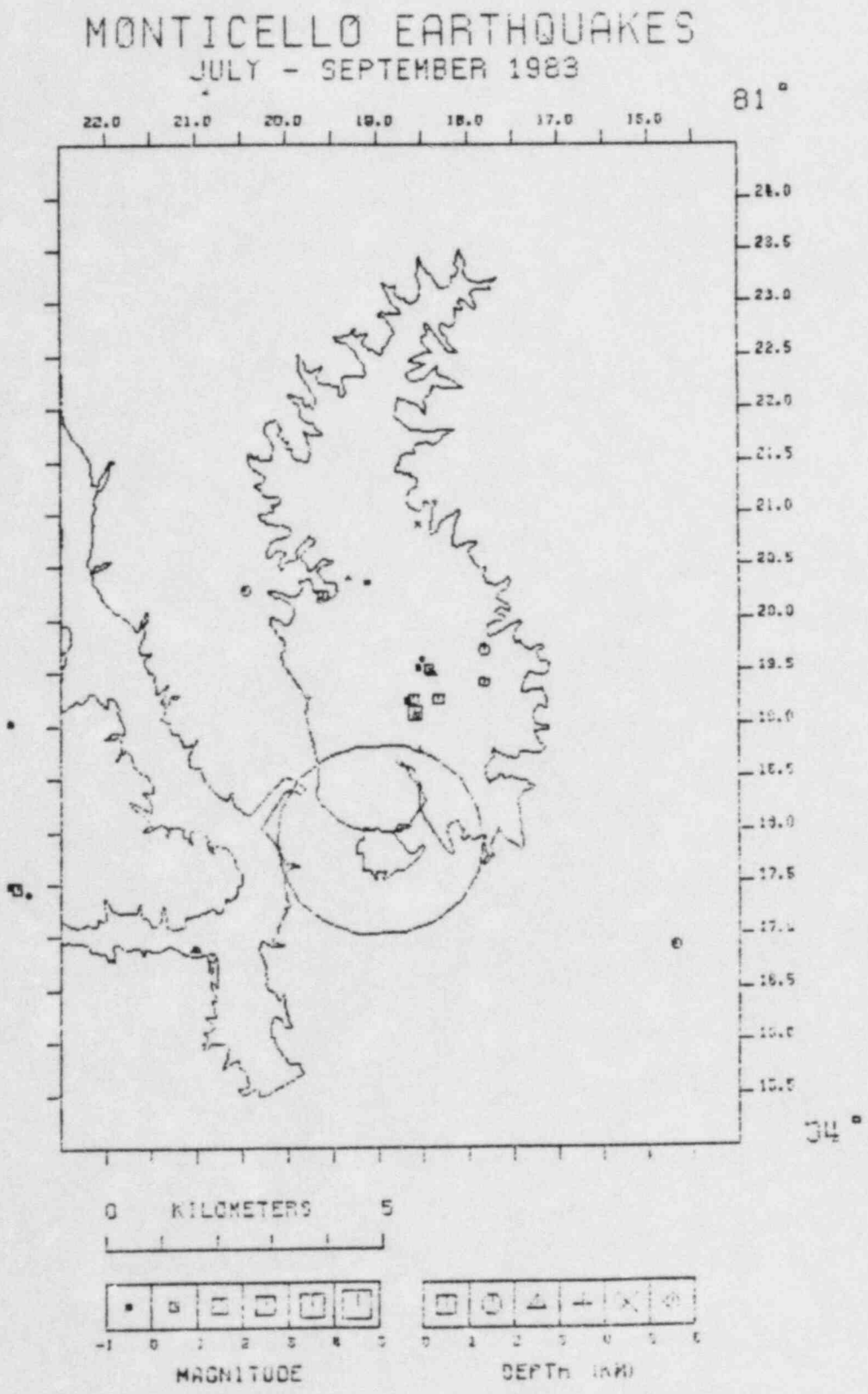
MONTICELLO EARTHQUAKES
JULY - SEPTEMBER 1983
81°
34°
22.0
21.0
20.0
19.0
18.0
17.0
16.0
0 KILOMETERS 5
MAGNITUDE
DEPTH (KM)

Figure 3

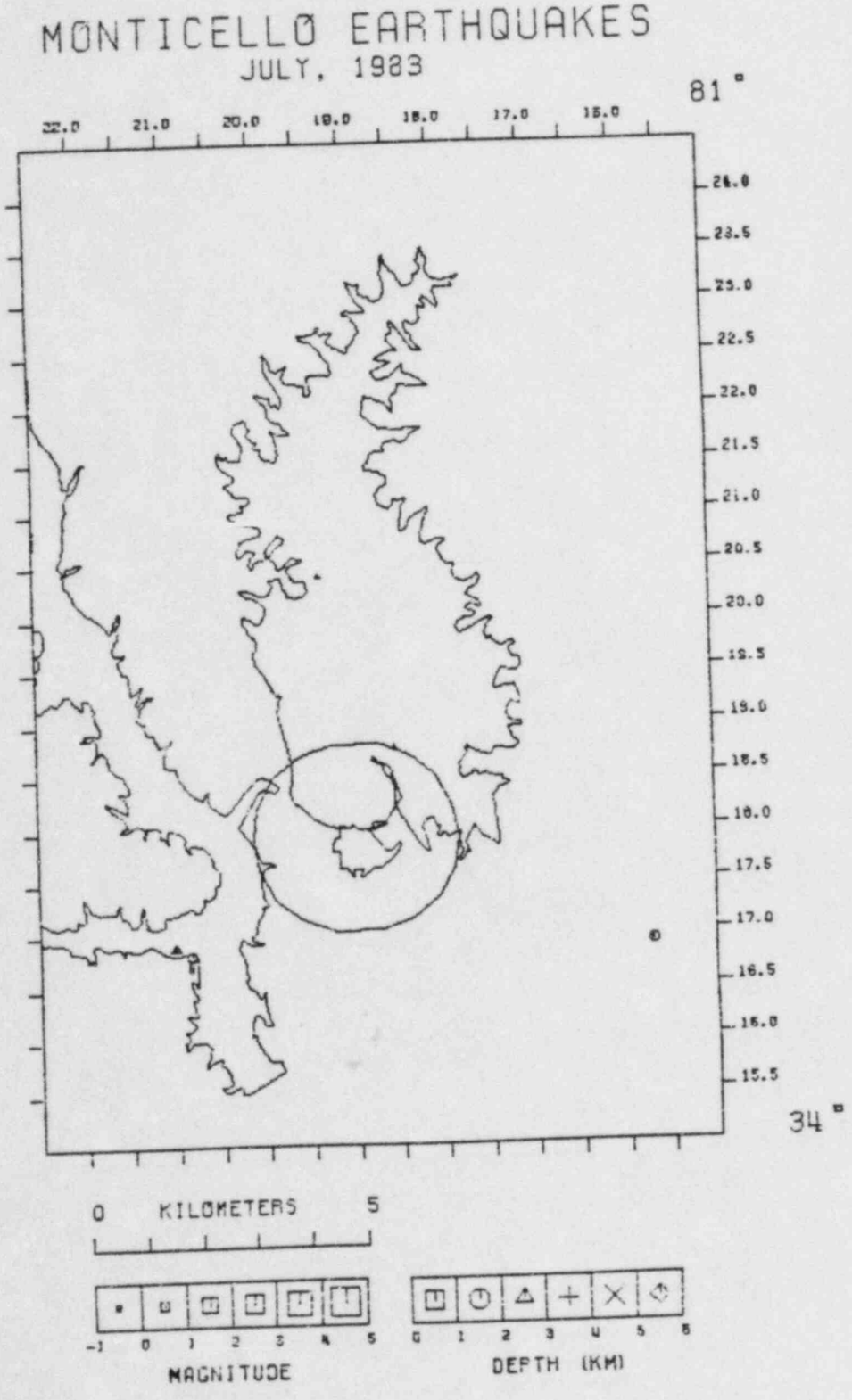
MONTICELLO EARTHQUAKES
JULY, 1983
81°
34°
0 KILOMETERS 5
MAGNITUDE
DEPTH (KM)

Figure 4

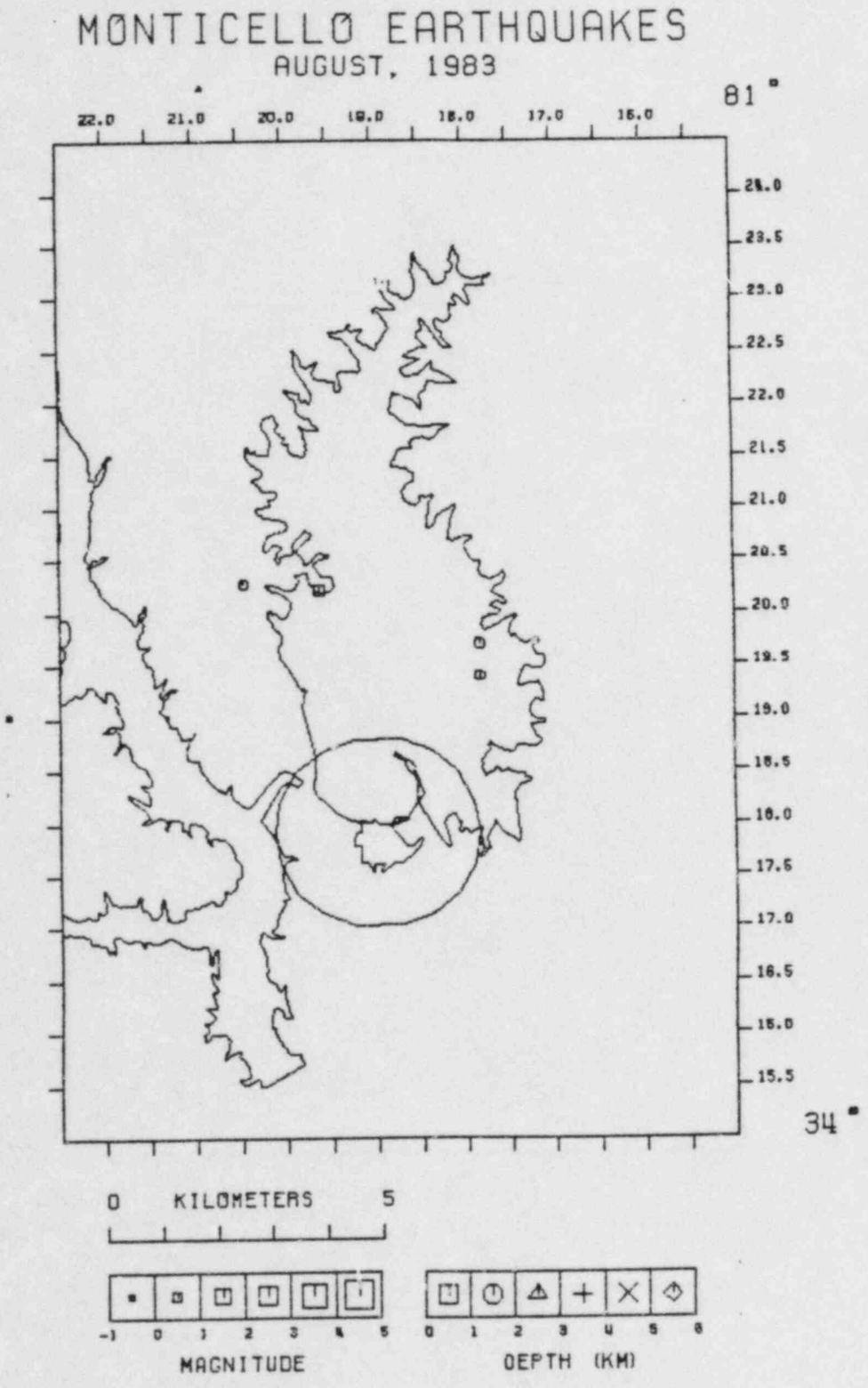
MONTICELLO EARTHQUAKES
AUGUST, 1983
81°
34°
22.0
21.0
20.0
19.0
18.0
17.0
16.0
24.0
23.5
23.0
22.5
22.0
21.5
21.0
20.5
20.0
19.5
19.0
18.5
18.0
17.5
17.0
16.5
16.0
15.5
0 KILOMETERS 5
-1 0 1 2 3 4 5
MAGNITUDE
0 1 2 3 4 5 6
DEPTH (KM)

Figure 5

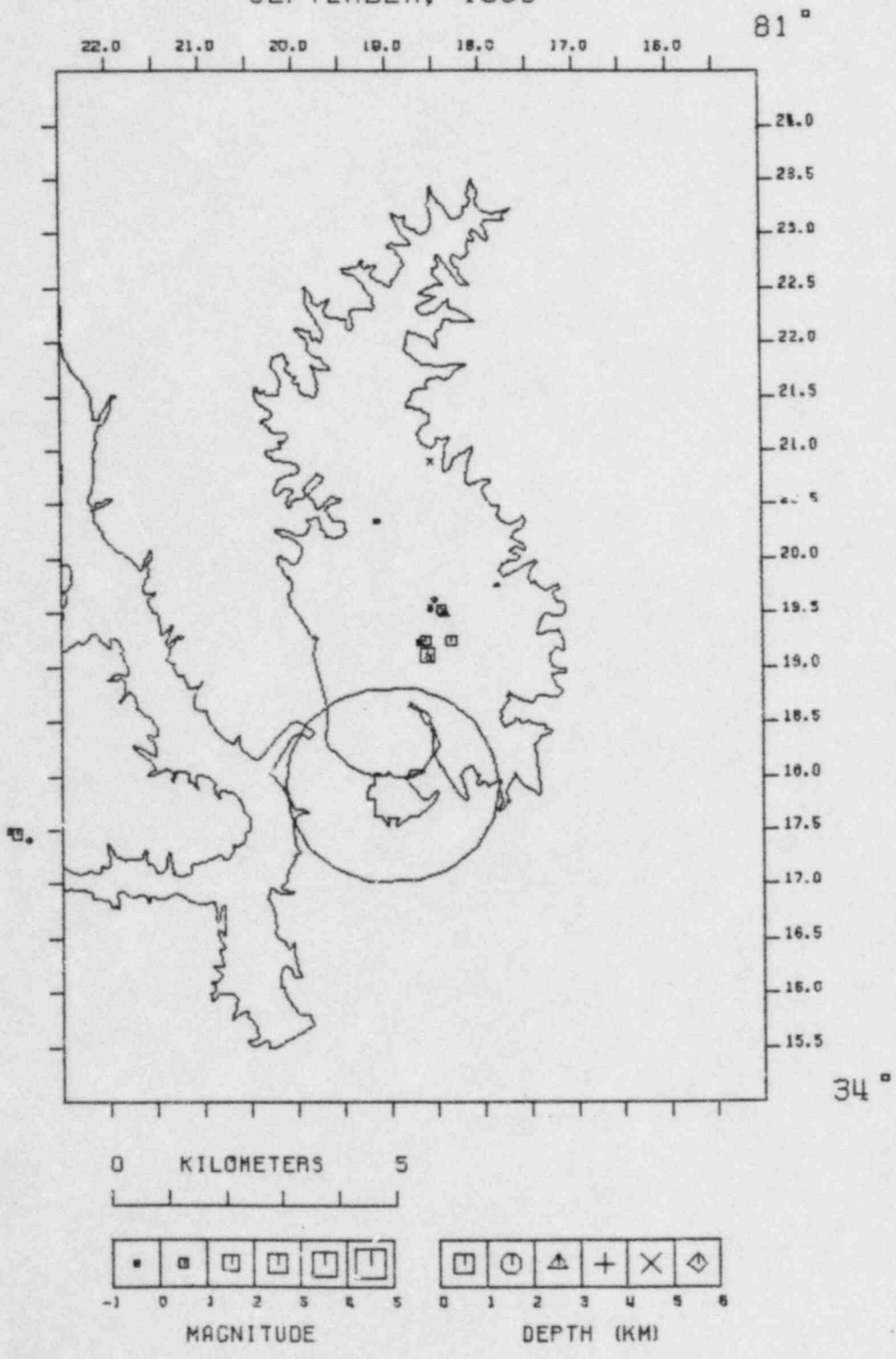
MONTICELLO EARTHQUAKES
SEPTEMBER, 1983
81°
34°
22.0
21.0
20.0
19.0
18.0
17.0
16.0
23.5
23.0
22.5
22.0
21.5
21.0
20.0
19.5
19.0
18.5
18.0
17.5
17.0
16.5
16.0
15.5
0 KILOMETERS 5
-1 0 1 2 3 4 5
MAGNITUDE
0 1 2 3 4 5 6
DEPTH (KM)

Figure 6

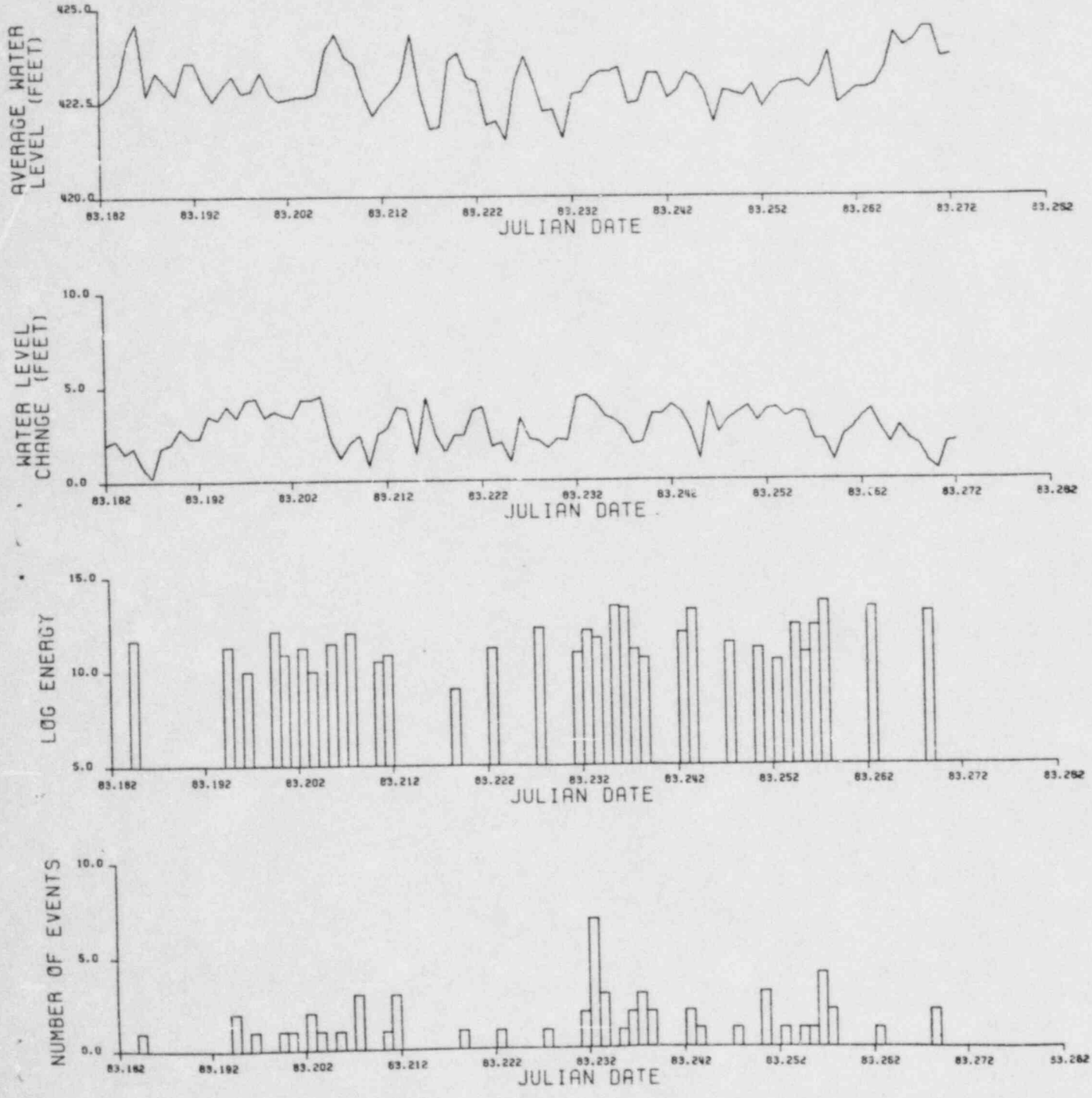
AVERAGE WATER LEVEL (FEET)
425.0
422.5
420.0
83.182
83.192
83.202
83.212
83.222
83.232
83.242
83.252
83.262
83.272
83.282
JULIAN DATE
WATER LEVEL CHANGE (FEET)
10.0
5.0
0.0
JULIAN DATE
LOG ENERGY
15.0
10.0
5.0
JULIAN DATE
NUMBER OF EVENTS
10.0
5.0
0.0
JULIAN DATE

Figure 7

CONCLUSIONS

Seismic activity in the Monticello Reservoir area generally occurs in a long-term trend of discrete swarms separated by relatively quiet periods. Figure 8 is a histogram of the number of events per month from December, 1977, through September, 1983. The swarm occurring in early 1983 is not as discrete nor as high a peak as in previous years, suggesting a tapering off of activity. The low level of seismicity during the July through September, 1983, reporting period reinforces the observation of decreasing activity. The 1.5 to 2.0 km increment continues to be the predominating depth range and a small percentage continues to occur at depths greater than 3.0 km.

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 HYP071, U.S.G.S. Open-File Report, 100 pp.

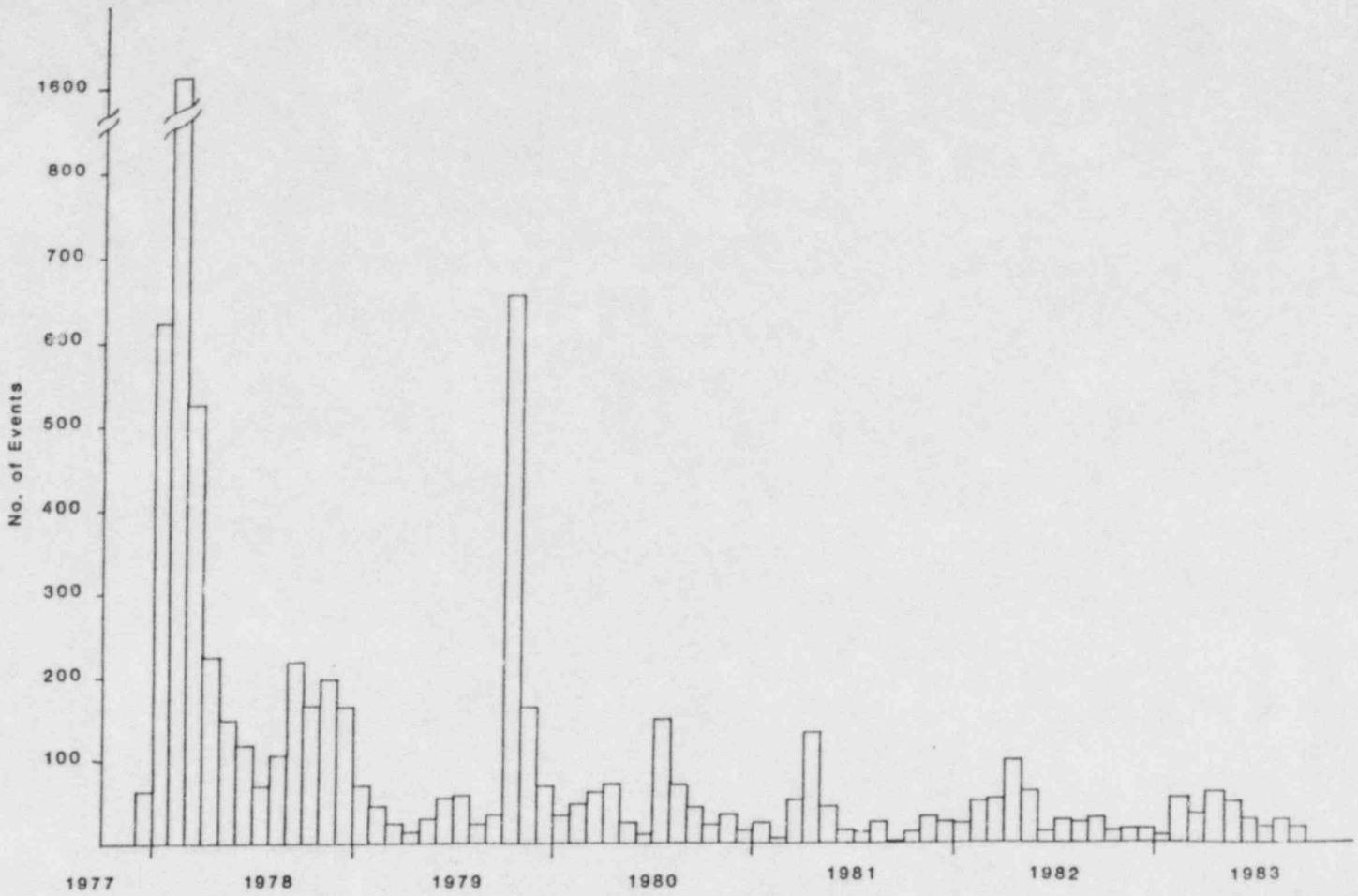
No. of Events
1600
800
700
600
500
400
300
200
100
1977
1978
1979
1980
1981
1982
1983

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

DATE	ORTGIN	LAT N	LONG W	DEPTH	MAG	NO	GAP	DMIN	RMS	ERH	ERZ	QM
830703	1512 12.81	34-18.76	81-18.54	3.87	-0.11	7	120	2.4	0.01	0.1	0.1	B1
830715	1835 25.89	34-16.90	81-15.70	1.00	-1.22	3	190	0.2	0.06			C1
830718	911 30.50	34-16.88	81-21.02	2.79	0.21	10	177	7.5	0.05	0.2	1.0	B1
830724	358 36.84	34-20.39	81-19.33	2.64	-0.24	8	137	2.6	0.06	0.3	0.6	B1
830726	833 53.49	34-16.81	81-20.84	1.93	0.12	9	176	7.5	0.04	0.2	1.3	B1
830810	19588 25.36	34-25.00	81-20.88	2.85	-0.40	8	287	10.6	0.09	1.2	3.5	C1
830824	650 21.83	34-19.71	81-17.84	1.00	0.99	6	224	0.4	0.05	1.0	0.9	C1
830824	10144 22.12	34-19.40	81-17.84	1.66	0.01	7	212	1.0	0.07	0.9	1.0	C1
830826	8533 59.68	34-19.03	81-23.07	1.02	-0.86	4	305	1.3	0.04			C1
830830	4533 41.62	34-20.22	81-19.61	0.93	0.12	6	254	2.9	0.04	0.8	3.2	C1
830831	22000 22.48	34-20.28	81-20.46	1.92	0.95	10	131	4.2	0.04	0.2	0.7	B1
830905	438 44.12	34-19.54	81-18.56	0.66	-0.24	8	243	1.4	0.05	0.2	0.5	C1
830907	105 33.05	34-19.76	81-17.84	2.14	-0.86	10	122	0.3	0.06	0.2	0.3	B1
830907	128 23.65	34-19.62	81-18.51	1.54	-0.60	10	127	1.3	0.06	0.2	0.4	B1
830907	7533 38.35	34-20.90	81-18.55	4.08	-0.86	10	132	2.2	0.06	0.2	0.4	B1
830909	5222 39.64	34-20.35	81-19.13	1.61	-0.86	10	127	2.3	0.03	0.1	0.3	B1
830911	200 0.86	34-19.24	81-18.62	0.63	0.37	8	132	1.8	0.07	0.3	0.8	B1
830912	659 12.36	34-17.49	81-23.06	0.85	-0.60	6	187	9.3	0.09	0.6	1.3	D1
830913	404 48.56	34-19.22	81-18.68	0.15	-0.24	8	132	1.9	0.05	0.1	0.4	B1
830913	432 39.35	34-19.24	81-18.34	0.34	0.01	8	130	1.5	0.07	0.3	0.8	B1
830913	1137 7.86	34-19.53	81-18.44	0.29	0.01	8	128	1.3	0.09	0.3	1.1	B1
830913	1221 3.99	34-19.08	81-18.58	1.82	-0.11	8	133	2.0	0.08	0.4	0.7	B1
830914	1113 5.41	34-19.49	81-18.41	2.68	0.82	8	128	1.3	0.07	0.3	0.5	B1
830914	1418 1.91	34-19.11	81-18.59	0.32	1.09	8	133	2.0	0.09	0.3	0.7	B1
830925	809 40.54	34-17.41	81-22.86	1.97	-0.40	7	186	9.1	0.09	0.6	4.0	C1
830925	857 23.46	34-17.47	81-22.99	0.14	0.82	8	187	9.2	0.05	0.3	0.7	C1