

TECHNICAL REPORT 88-1

SEISMIC ACTIVITY NEAR THE V.C. SUMMER NUCLEAR STATION

For the Period
January - March 1988

by

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Contract No. N482355

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INTRODUCTION

Analysis of the seismic activity near the V.C. Summer Nuclear Station in South Carolina between January 1 and March 31, 1988 is presented in this report. During this period a total of sixteen events were recorded. All events were located. The largest shock was of magnitude 1.4 (February 23 - 1350 UTC). Fifty percent (8) of the earthquakes were of magnitudes greater than zero. Five shocks were of B quality and were located at depths of 1.0 to 1.5 km.

SEISMIC NETWORK

Earthquakes recorded during this period were located using stations of the SCE&G and USC networks. The configuration of the stations utilized to locate the events in this report is shown in Figure 1 and station coordinates are listed in Appendix I.

DATA ANALYSIS

Hypocentral locations of the events were determined using the computer program HYP071 (Lee and Lahr, 1972) and the velocity model listed in Appendix II. The event magnitude (M_L) was determined from the 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 was determined using a simplified magnitude (M_L) energy (E) relation by Gutenberg and Richter (1956):

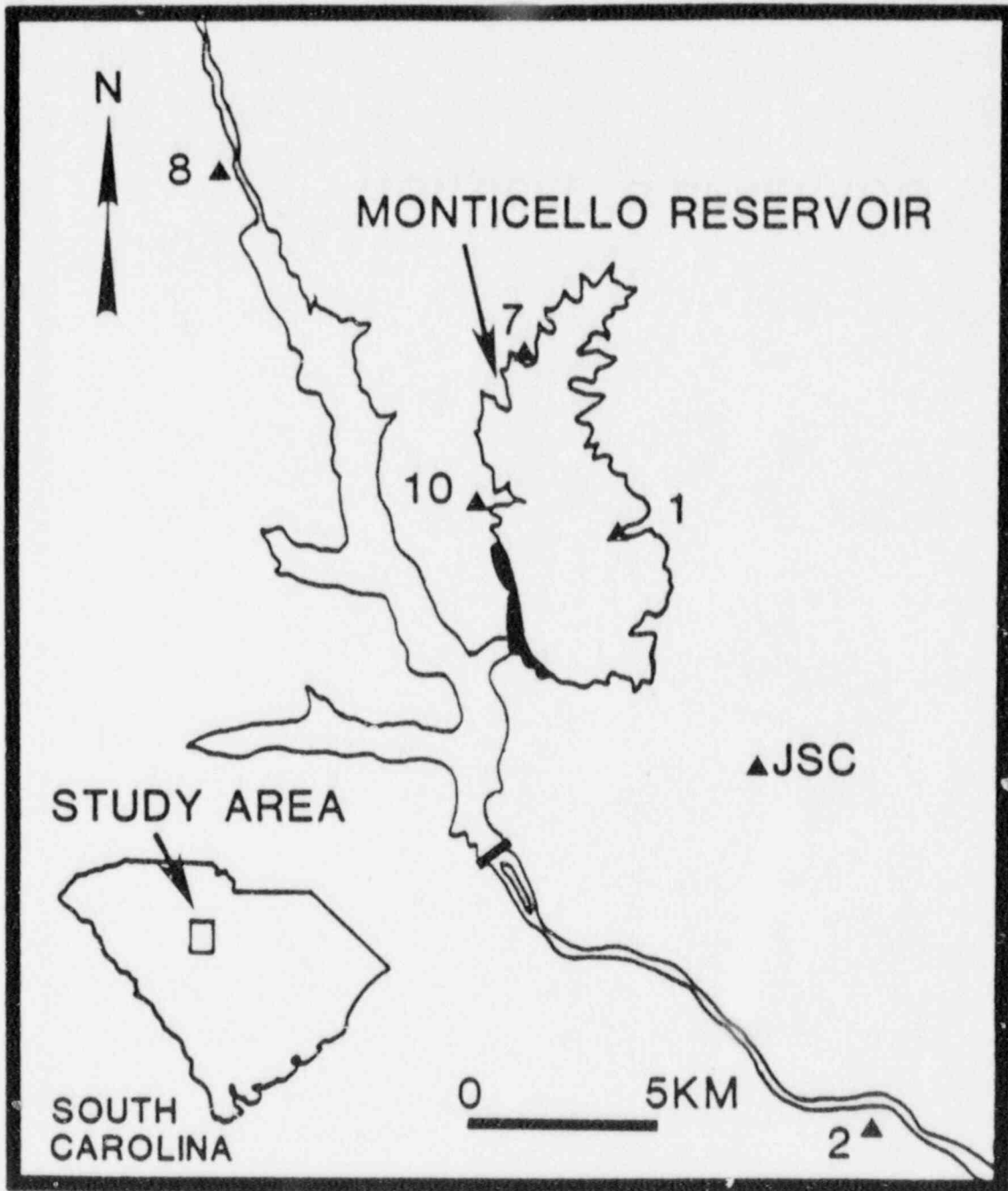


Figure 1. Seismic stations utilized to locate earthquakes near Monticello Reservoir during January-March 1988.

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

OBSERVED SEISMICITY FOR THE PERIOD JANUARY-MARCH 1988

During this period sixteen events were recorded and located (see Appendix III). This level of activity was similar to that observed during the previous reporting period, and the long-term decline in seismicity is continuing (Figure 2). The largest event of this quarter ($M_L=1.4$) occurred on February 23 at 1350 UTC. Eight shocks (50%) were of magnitudes greater than zero.

The epicenters of earthquakes located during this quarter and during each month are presented in Figure 3 - 6. The majority of the earthquakes during this period were clustered on the western shore of the reservoir. Five earthquake locations were of quality B or better. These events were located between depths of 1.0 km and 1.9 km.

CORRELATION OF RESERVOIR WATER LEVEL 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 normal variations up to approximately five feet per day between the maximum and minimum water level. We have been monitoring the water level to see if there is any correlation between the daily or seasonal changes in the reservoir level and the local seismicity. Water level was compared with seismicity in Figure 7. The top two plots show the median water level and the change in water level each day. The number of events per day

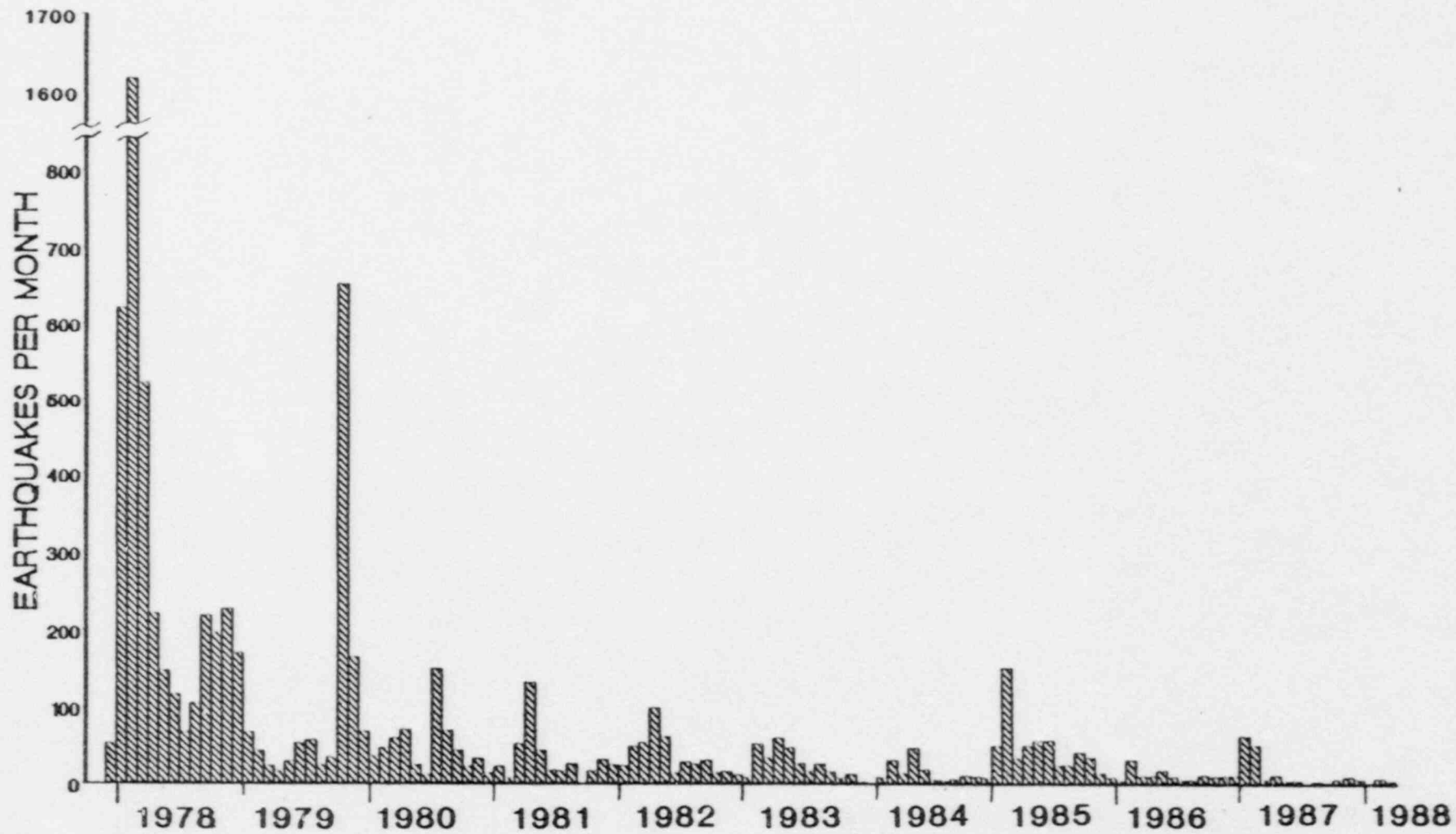


Figure 2. Earthquakes per month between reservoir impoundment and March 1988.

MONTICELLO EARTHQUAKES JANUARY - MARCH 1988

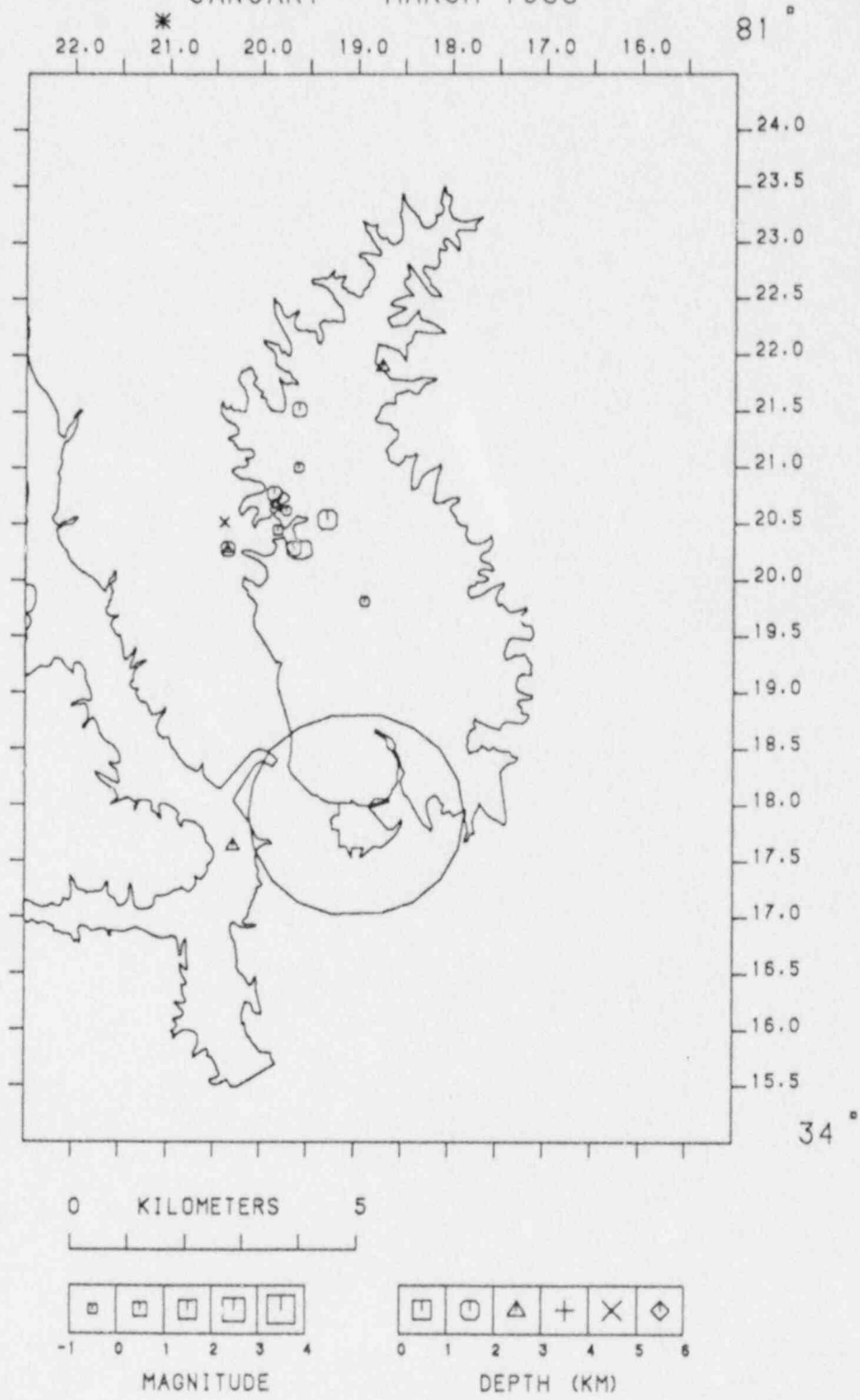


Figure 3. Seismic activity at Monticello Reservoir during January-March 1988.

MONTICELLO EARTHQUAKES JANUARY 1988

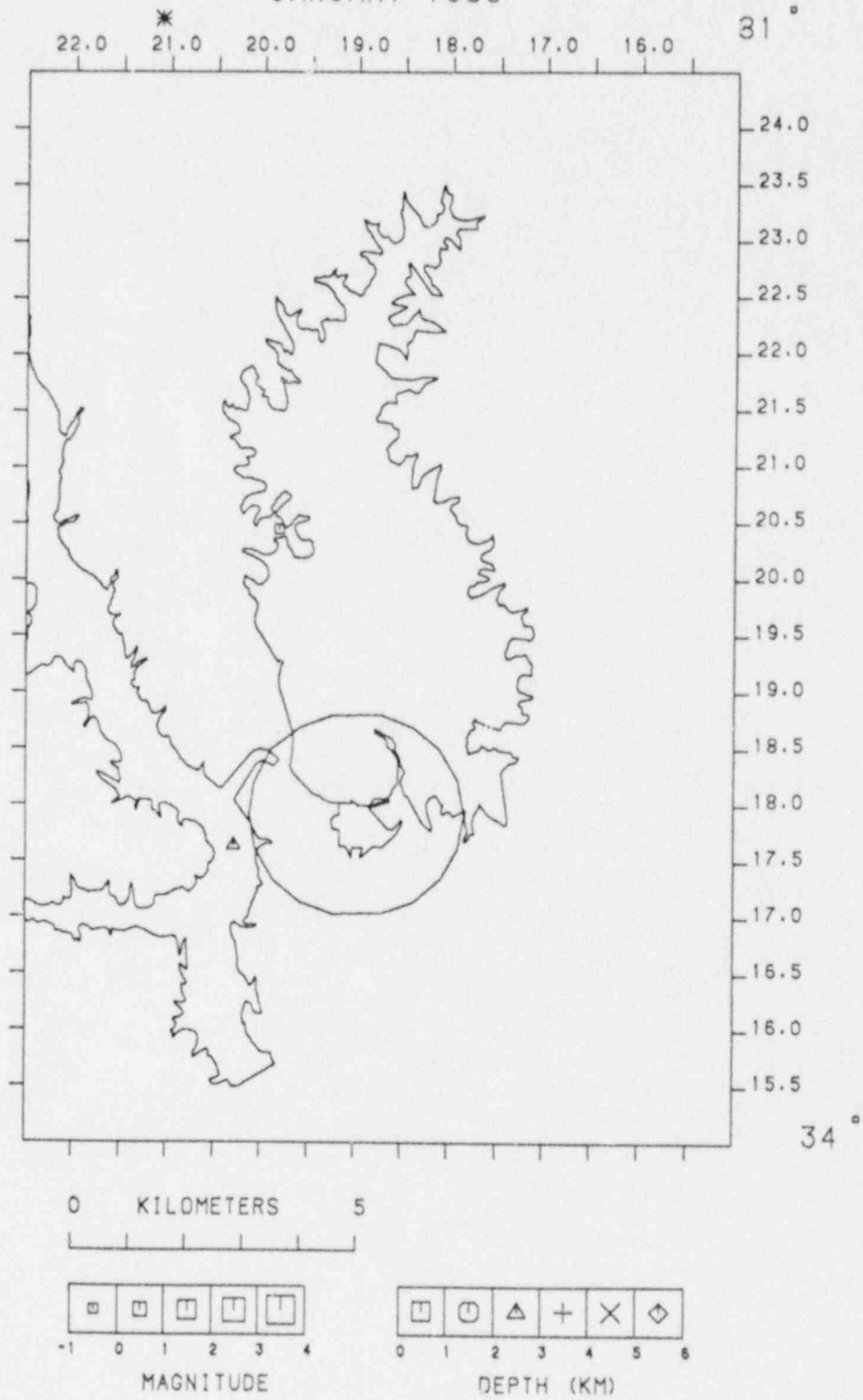


Figure 4. Seismic activity at Monticello Reservoir during January 1988.

MONTICELLO EARTHQUAKES FEBRUARY 1988

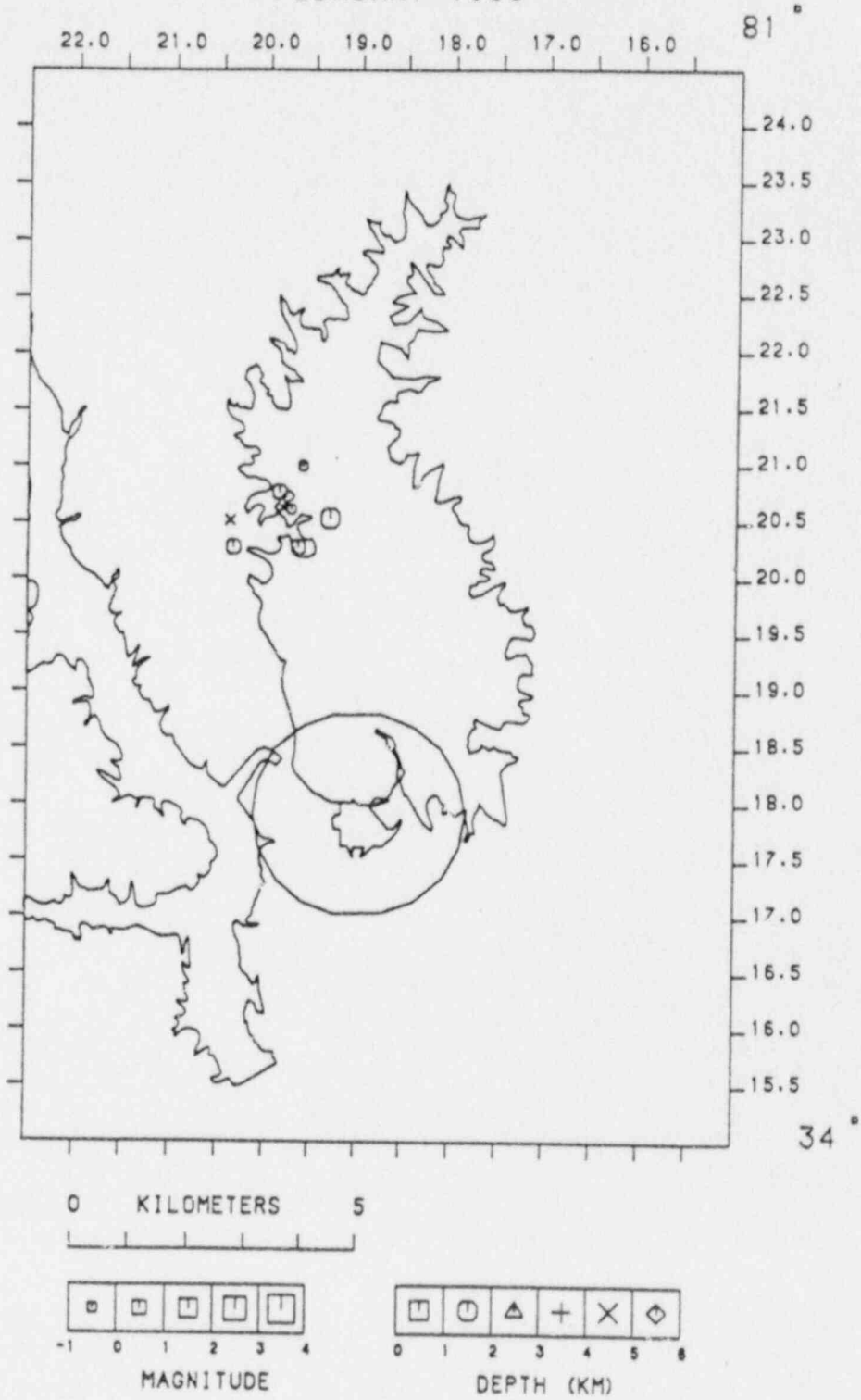


Figure 5. Seismic activity at Monticello Reservoir during February 1988.

MONTICELLO EARTHQUAKES MARCH 1988

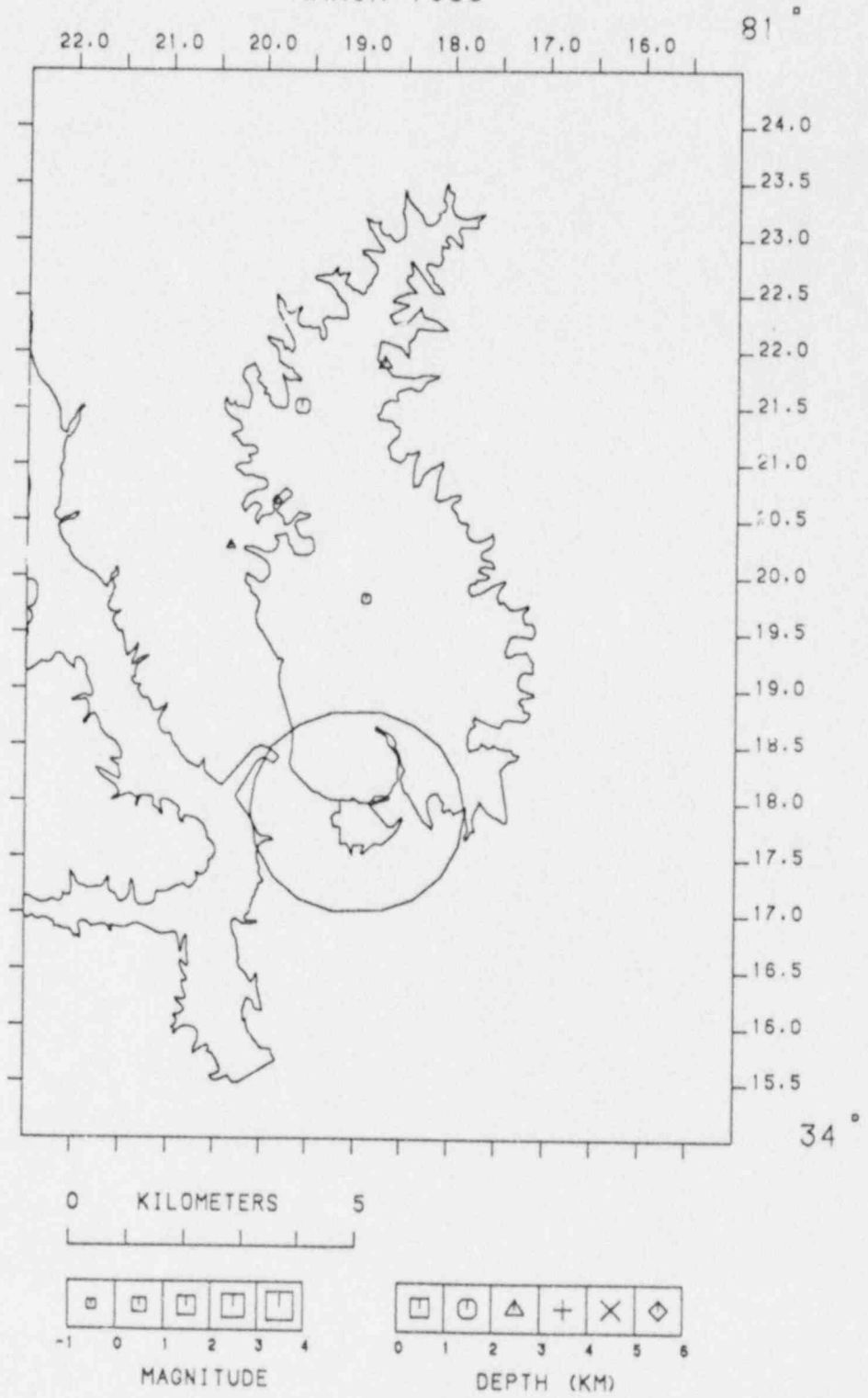


Figure 6. Seismic activity at Monticello Reservoir during March 1988.

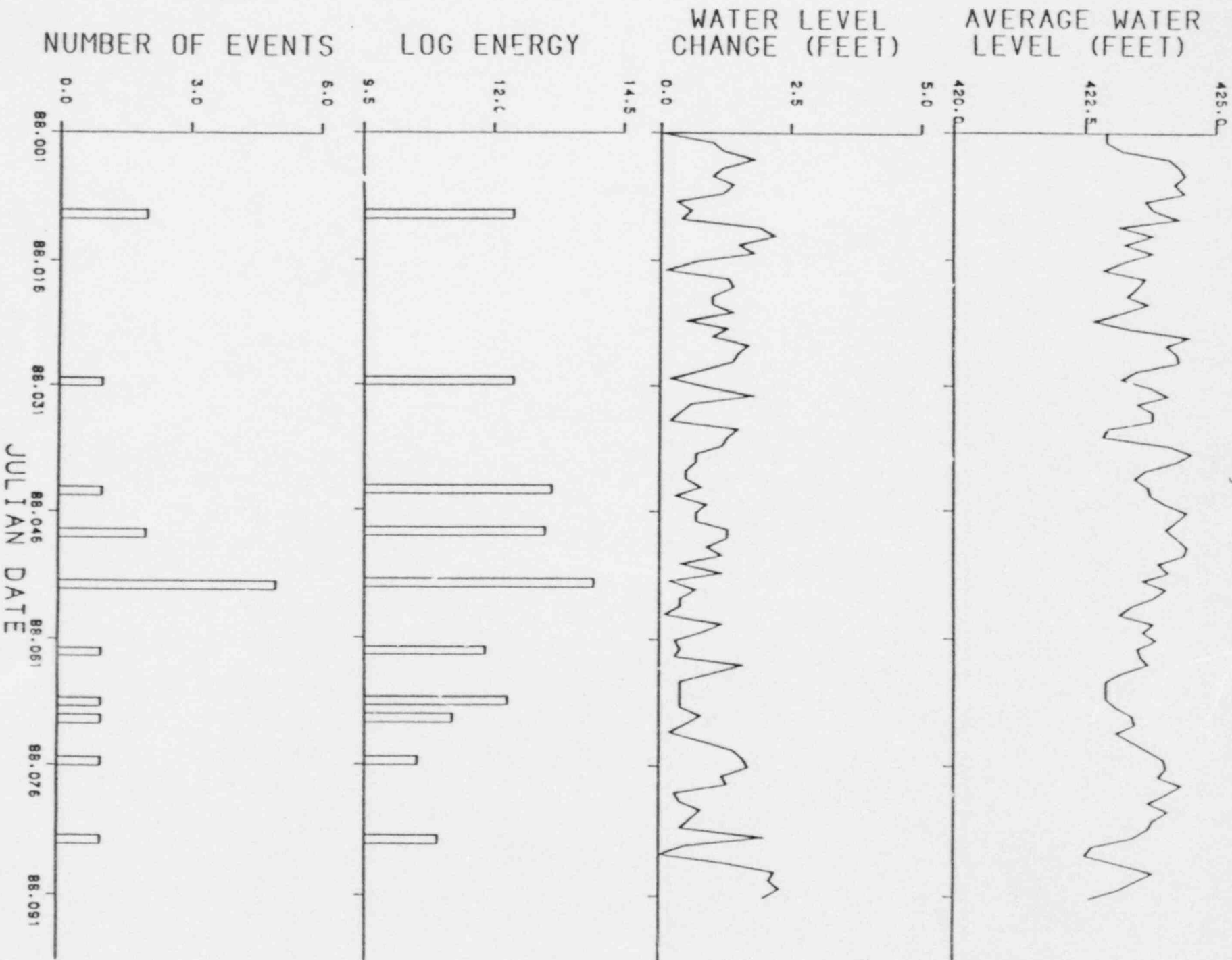


Figure 7. Comparison of the median daily lake level and daily change in water level with the number of earthquakes per day and the log of the energy released.

and the log of the energy released per day are shown in the lower two histograms. There is no apparent correlation between the change in median water level or daily water level fluctuations and seismicity.

CONCLUSIONS

The level of activity observed during the first quarter of 1988 was not significantly different from that observed during the fourth quarter of 1987. The largest event was of magnitude 1.4. Eight of the sixteen earthquakes were of magnitudes greater than 0.0. The five quality B earthquake locations range in depth from 1.0 to 1.9 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 HYPO71, U.S. Geological Survey, *Open-File Report*, 100 pp.

APPENDIX I

STATION LOCATIONS

NO.	STN.	LAT.°N	LONG.°W
1	J3C	34° 16.80'	81° 15.60'
2	001	34° 19.91'	81° 17.74'
3	002	34° 11.58'	81° 13.81'
4	007	34° 22.23'	81° 19.50'
5	008	34° 24.53'	81° 24.55'
6	010	34° 20.18'	81° 20.25'

APPENDIX II

MONTICELLO RESERVOIR

VELOCITY MODEL

Velocity km/sec	Depth to top 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-MARCH 1988

HYPO71 FORMAT

Column 1	Date.
Column 2	Origin time (UTC) h.m.sec.
Column 3	Latitude (N) degrees, min.
Column 4	Longitude (W) degrees, min.
Column 5	Depth (km).
Column 6	Local duration magnitude.
Column 7	No. of station readings used to locate event. P and S arrivals from same stations are regarded as 2 readings.
Column 8	Largest azimuthal separation in degrees between stations.
Column 9	Epicentral distance in km to nearest station.
Column 10	Root mean square error of time residuals in sec. $RMS = \sqrt{R_i^2 / NO}$, where R_i is the time residual for the i th station.
Column 11	Standard error of the epicenter in km*.
Column 12	Standard error of the focal depth in km*.

*Statistical interpretation of standard errors involves assumptions which may not be met in earthquake locations. Therefore standard errors may not represent actual error limits.

If ERH or ERZ is blank, this means that it cannot be computed, because of insufficient data.

**MONTICELLO EARTHQUAKES
JANUARY-MARCH 1988**

DATE	ORIGIN	LAT N	LONG W	DEPTH	MAG	NO	GAP	DMIN	RMS	ERH	ERZ	QM
880110	216	17.46	34-17.64	81-20.29	2.91	0.37	9 222	4.7	0.08	0.7	1.6	C1
880110	353	38.12	34-20.45	81-19.82	0.41	-0.86	4 232	3.3	0.05			C1
880130	7 0	19.04	34-24.97	81-21.10	7.80	0.37	5 339	5.6	0.09	3.9	1.9	D1
880212	1235	58.45	34-20.28	81-20.35	1.00	0.87	7 232	0.2	0.08	1.2	1.0	C1
880217	0 7	36.29	34-20.77	81-19.86	1.28	0.78	8 163	1.2	0.01	0.1	0.2	B1
880217	018	44.20	34-21.00	81-19.60	1.95	-1.22	4 150	1.8	0.02			C1
880223	1350	16.22	34-20.52	81-20.39	4.60	-0.60	5 222	0.7	0.02	0.4	0.5	C1
880223	1350	30.05	34-20.54	81-19.30	1.00	1.39	6 121	1.6	0.08	0.9	3.0	B1
880223	1354	7.72	34-20.65	81-19.80	3.92	-0.86	4 151	1.1	0.00			C1
880223	14 6	24.00	34-20.62	81-19.73	1.79	-0.60	6 143	1.1	0.05	0.5	1.0	B1
880223	1423	30.22	34-20.28	81-19.65	1.63	0.21	6 123	0.9	0.08	0.7	1.2	B1
880302	2146	43.04	34-21.52	81-19.60	1.89	0.01	8 165	1.3	0.09	0.8	1.0	B1
880308	6 5	41.96	34-21.90	81-18.73	2.67	0.29	6 216	1.3	0.05	0.7	0.8	C1
880310	659	43.93	34-20.68	81-19.86	5.13	-0.40	5 158	1.1	0.00	0.1	0.1	C1
880315	631	1.77	34-20.28	81-20.35	2.78	-0.86	5 130	0.2	0.09	2.2	1.1	C1
880324	1251	37.15	34-19.81	81-18.91	1.00	-0.60	6 204	1.8	0.03	0.4	1.0	C1