TECHNICAL REPORT 84-1

SEISMIC ACTIVITY NEAR THE V.C. SUMMER NUCLEAR STATION

For the Period January - March 1984

by
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Contract No. N355486

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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 January 1 and March 31, 1984. During this reporting period, a total of 31 locatable events were recorded. The largest event was of magnitude 2.0 on March 7, four events had magnitudes between 1.0 and 2.0, and the remaining events were small (M_L < 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 31 located events recorded during this period are listed in Appendix III. One event was of magnitude 2.0 (March 7, 1984), four

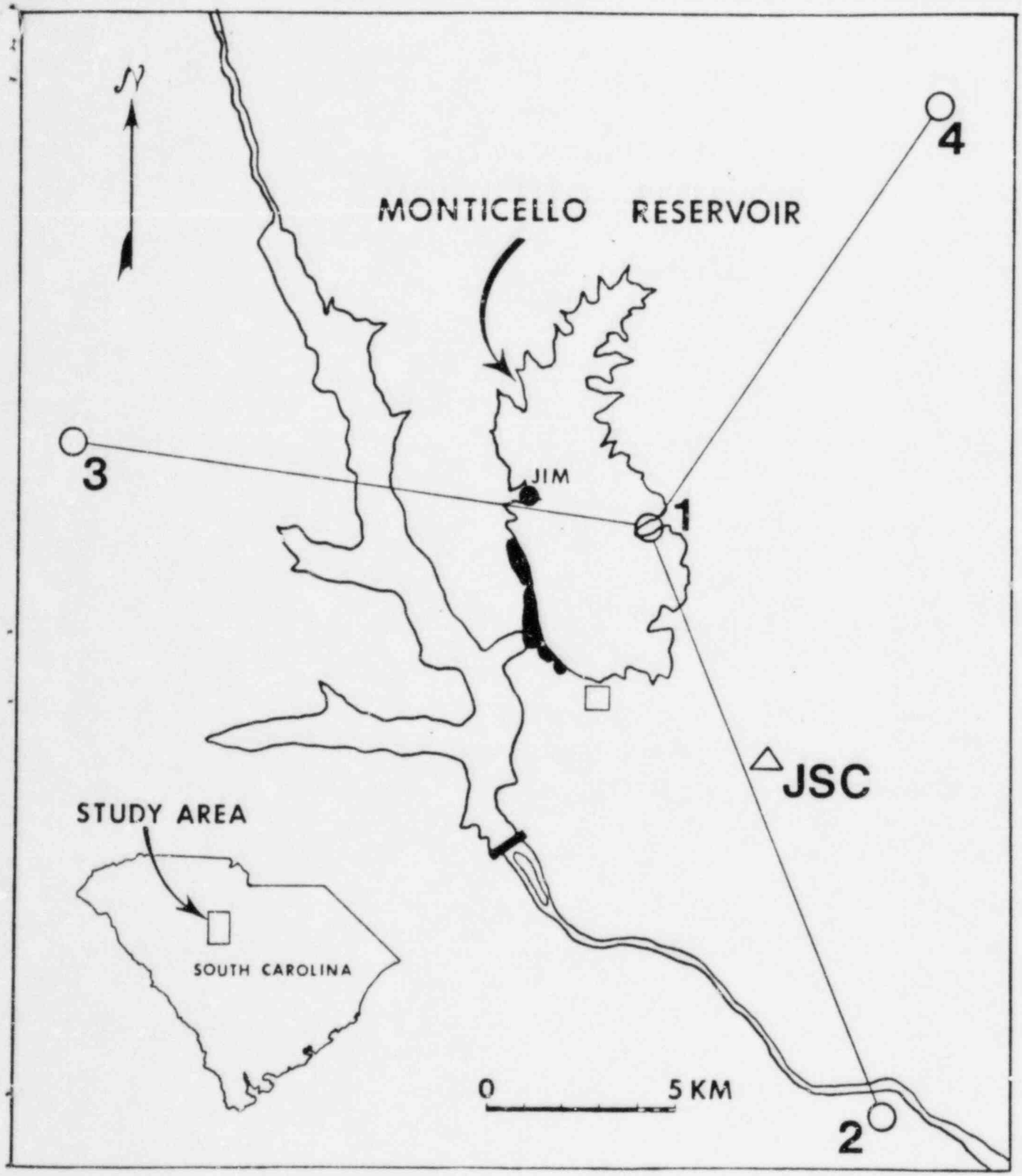
N
MONTICELLO RESERVOIR
JIM
1
2
3
4
JSC
STUDY AREA
SOUTH CAROLINA
0
5 KM

Figure 1

had magitudes greater than 1.0 (Table 1), and the rest were small.

TABLE 1

Date	Magnitude
March 7	1.09
March 7	2.00
March 18	1.02
March 18	1.18
March 20	1.32

Depth analyses for this reporting period were not divided into 0.5 km increments as in the past year's reports due to the low number of events. However, 87% of all the events located during this period occurred within the top two kilometers and the deepest event occurred at 2.53 km.

A cumulative plot of epicenters of events located during this period is shown in Figure 2 and a cross section in Figure 3, which appears to show a southwest dipping plane defined by the events within 1.0 km of the cross section. A monthly breakdown of epicentral locations is shown in Figures 4-6. Most of the activity occurred in mid-March in a broad east-west band across the center of the reservoir.

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

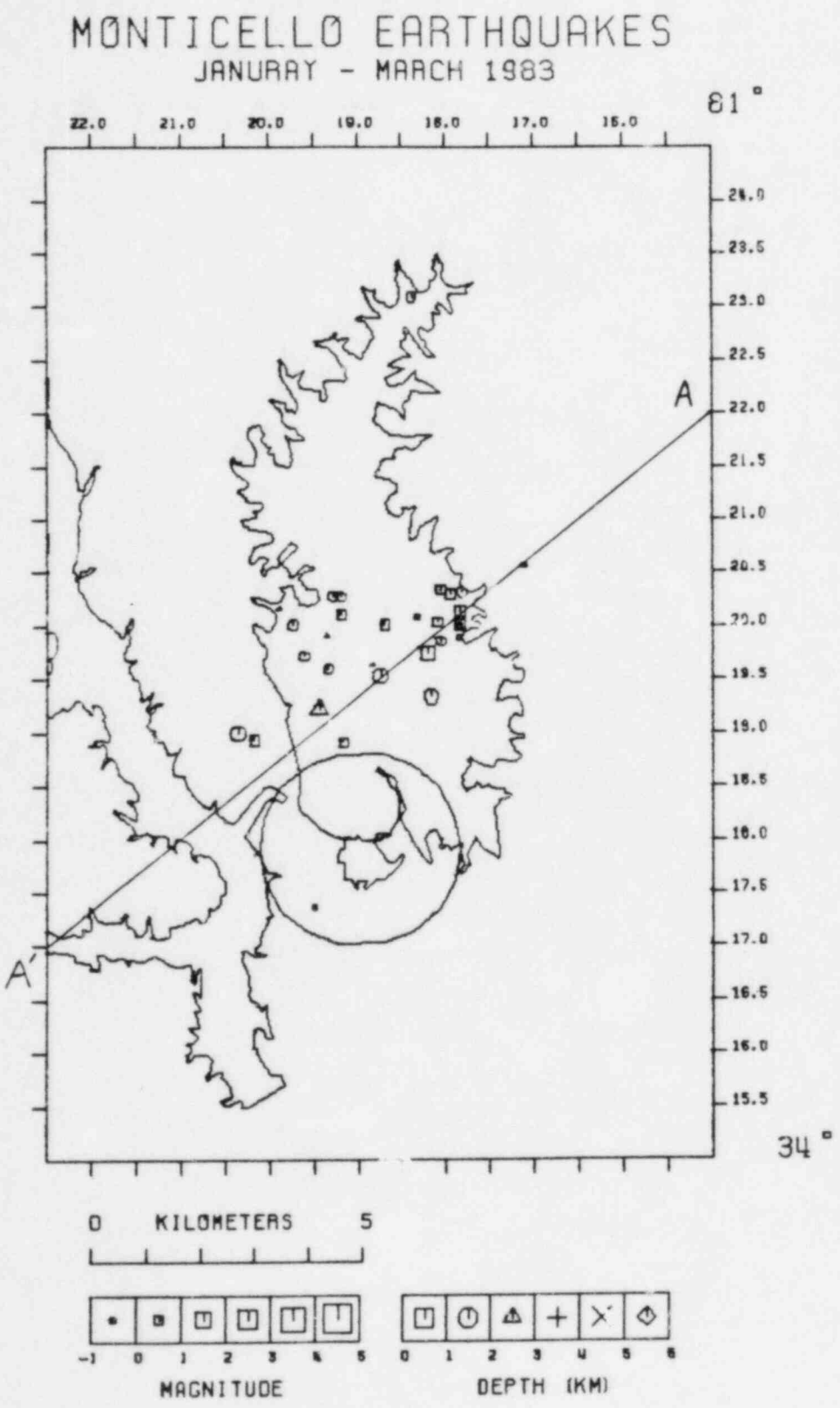
MONTICELLO EARTHQUAKES
JANURAY - MARCH 1983
81°
34°
A
A'
0 KILOMETERS 5
MAGNITUDE
DEPTH (KM)

Figure 2

Figure 3

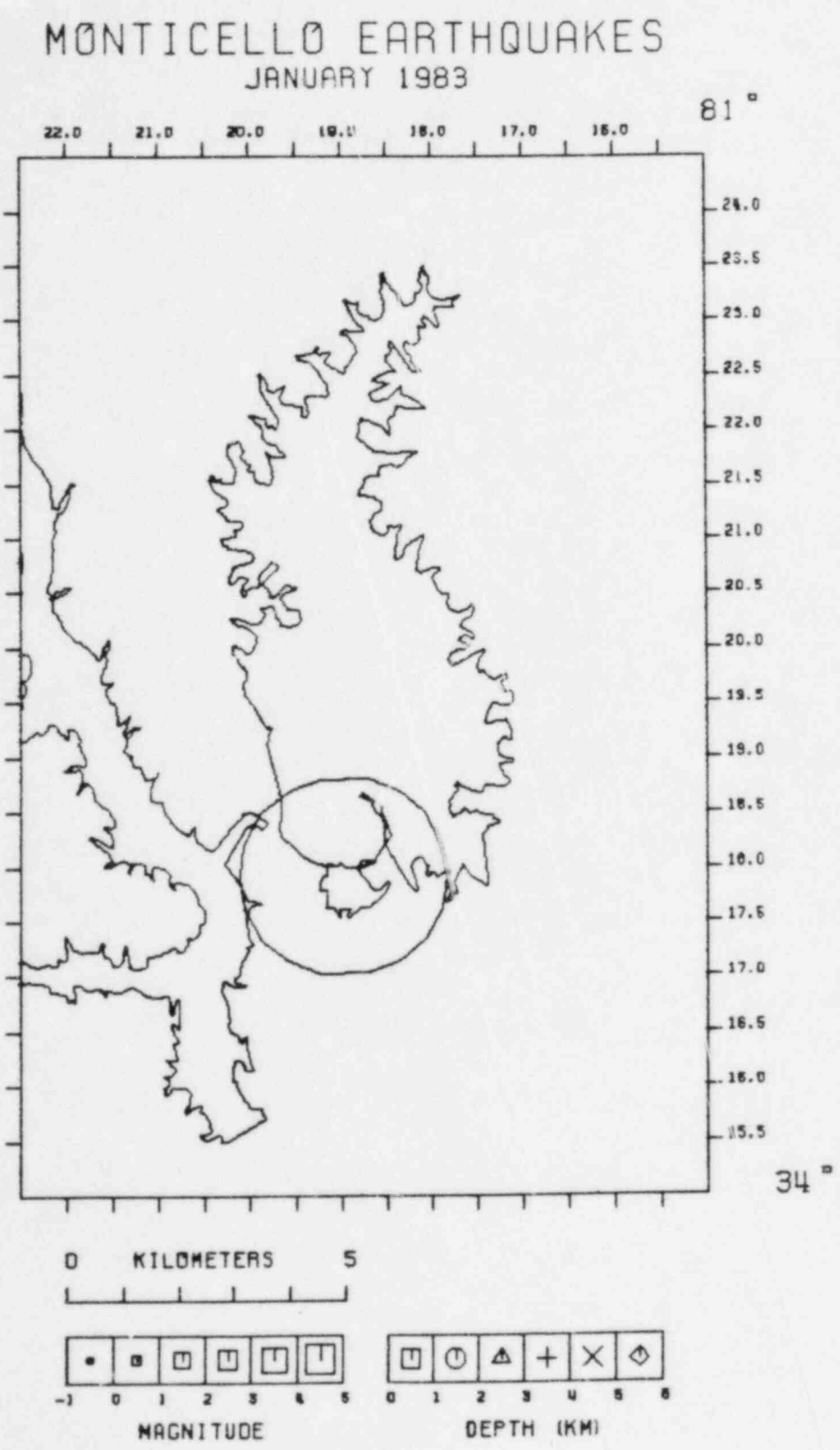
MONTICELLO EARTHQUAKES
JANUARY 1983
81°
34°
22.0
21.0
20.0
19.0
18.0
17.0
16.0
24.0
23.5
23.0
22.5
22.0
21.5
21.0
20.5
20.0
19.5
19.0
18.5
18.0
17.5
17.0
16.5
16.0
15.5
0 KILOMETERS 5
-1 0 1 2 3 4 5
MAGNITUDE
0 1 2 3 4 5 6
DEPTH (KM)

Figure 4

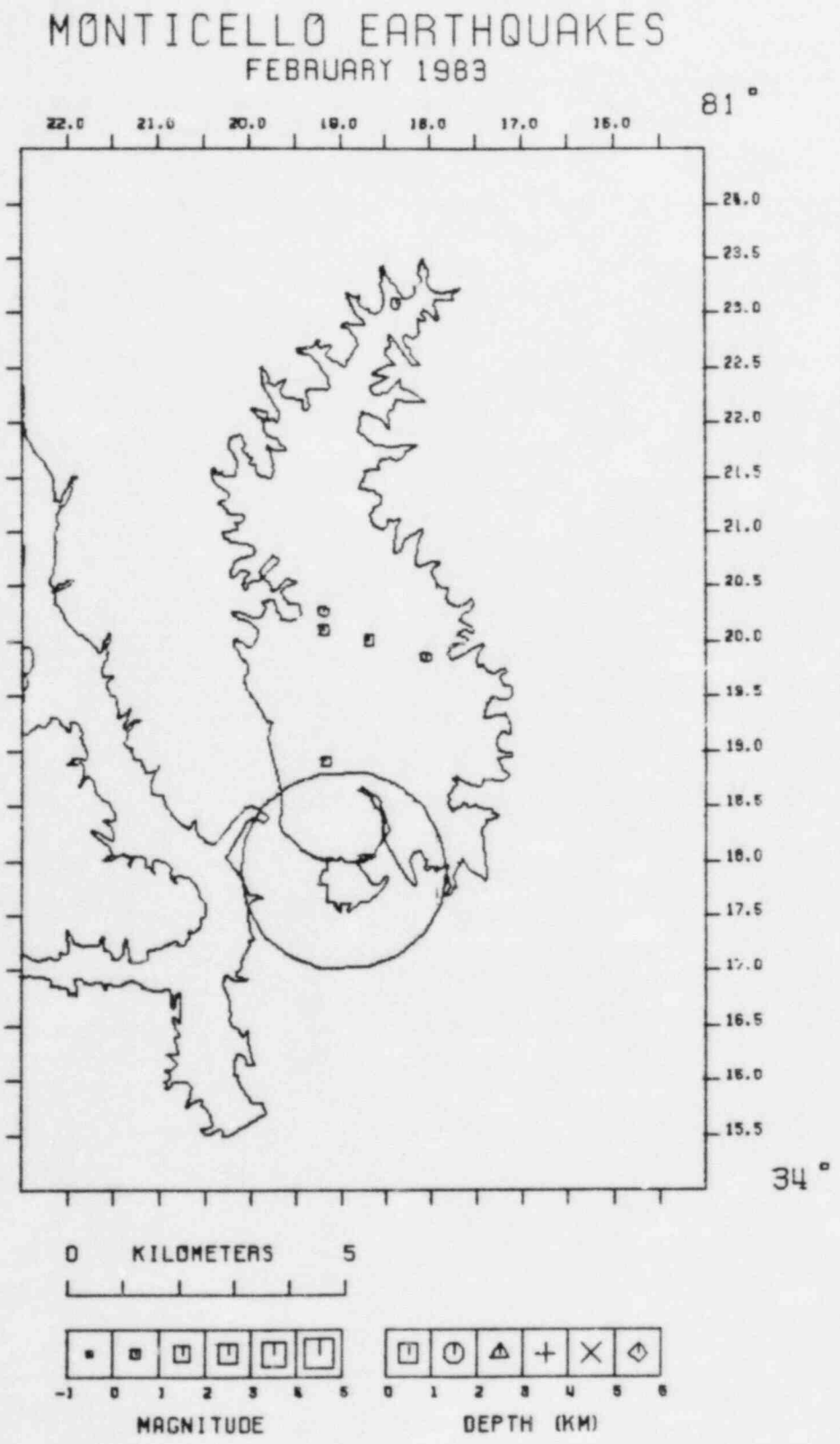
MONTICELLO EARTHQUAKES
FEBRUARY 1983
81°
34°
0 KILOMETERS 5
MAGNITUDE
DEPTH (KM)

Figure 5

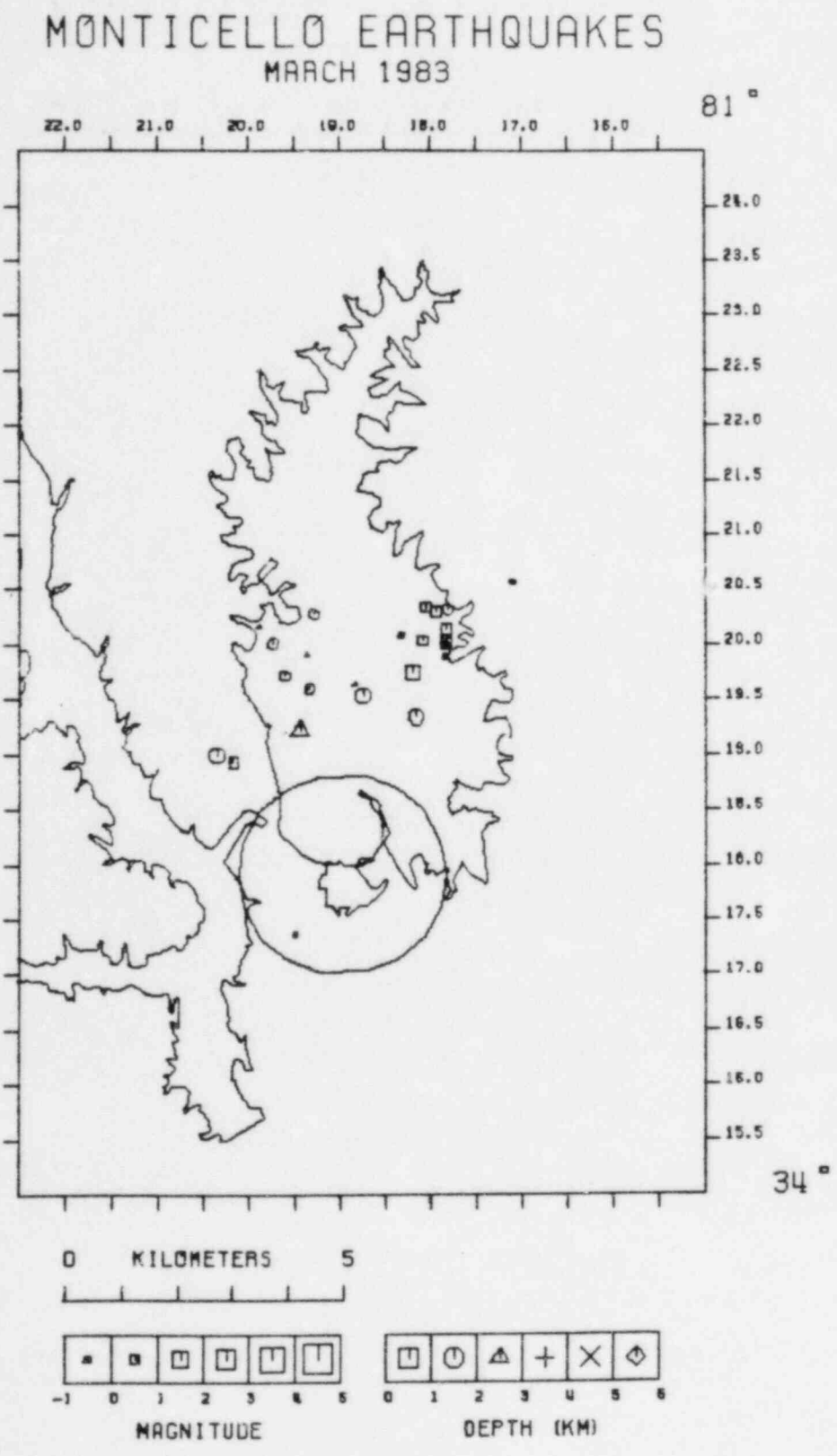
MONTICELLO EARTHQUAKES
MARCH 1983
81°
34°
22.0
21.0
20.0
19.0
18.0
17.0
16.0
24.0
23.5
23.0
22.5
22.0
21.5
21.0
20.5
20.0
19.5
19.0
18.5
18.0
17.5
17.0
16.5
16.0
15.5
0 KILOMETERS 5
-1 0 1 2 3 4 5
MAGNITUDE
0 1 2 3 4 5 6
DEPTH (KM)

Figure 6

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

Monticello Reservoir experienced a low level of seismic activity for the January 1 through March 31, 1984 reporting period, with increased seismicity in the middle of March. A trend of discrete swarms separated by relatively quiet periods has been apparent for approximately five years (Figure 8) and the seismicity level for this period continues to agree with the trend, including a general decline in activity. Depth of seismicity for this reporting period was primarily within the uppermost two kilometers.

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.

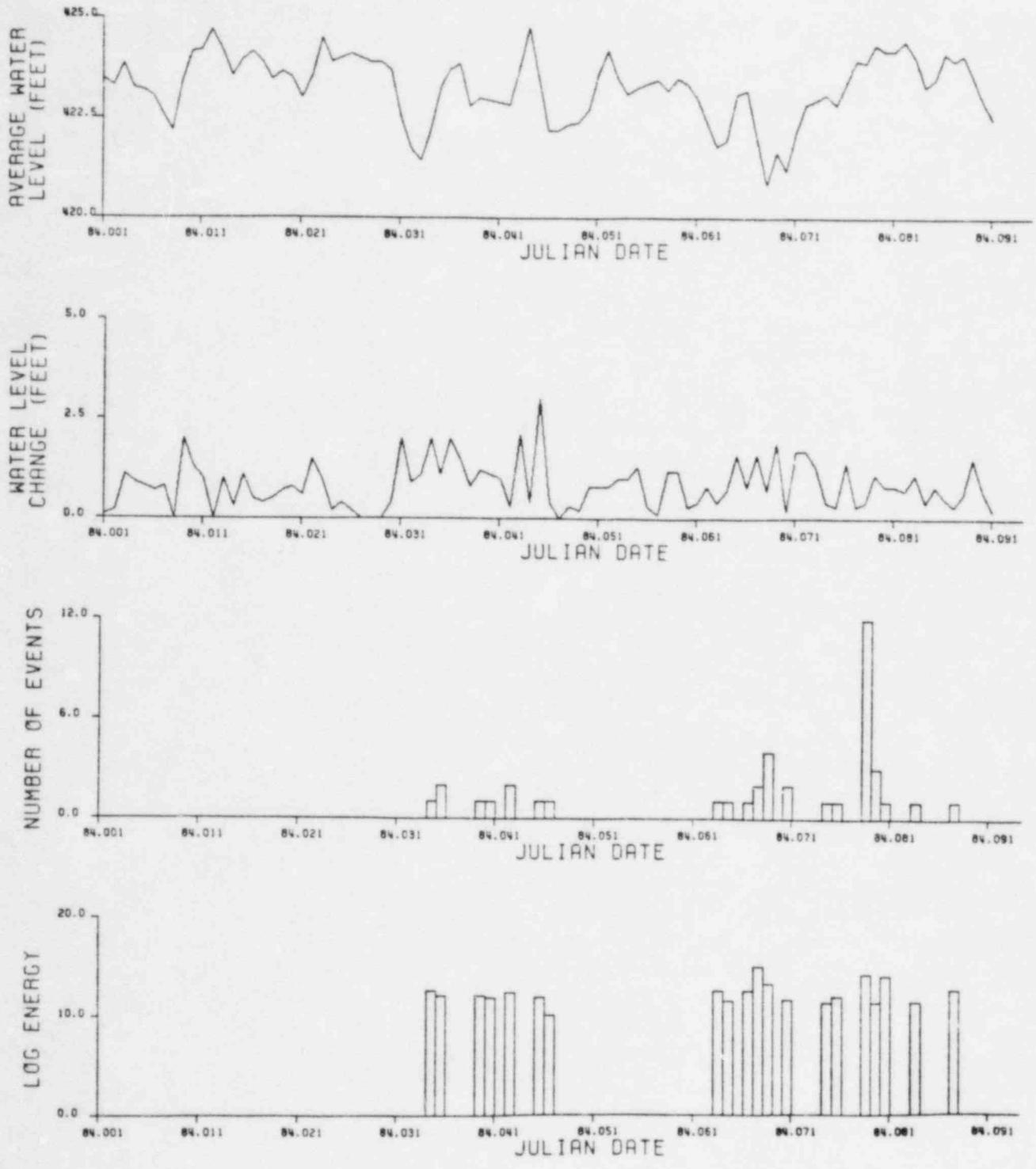
AVERAGE WATER LEVEL (FEET)
425.0
422.5
420.0
84.001
84.011
84.021
84.031
84.041
84.051
84.061
84.071
84.081
84.091
JULIAN DATE
WATER LEVEL CHANGE (FEET)
5.0
2.5
0.0
JULIAN DATE
NUMBER OF EVENTS
12.0
6.0
0.0
JULIAN DATE
LOG ENERGY
20.0
10.0
0.0
JULIAN DATE

Figure 7

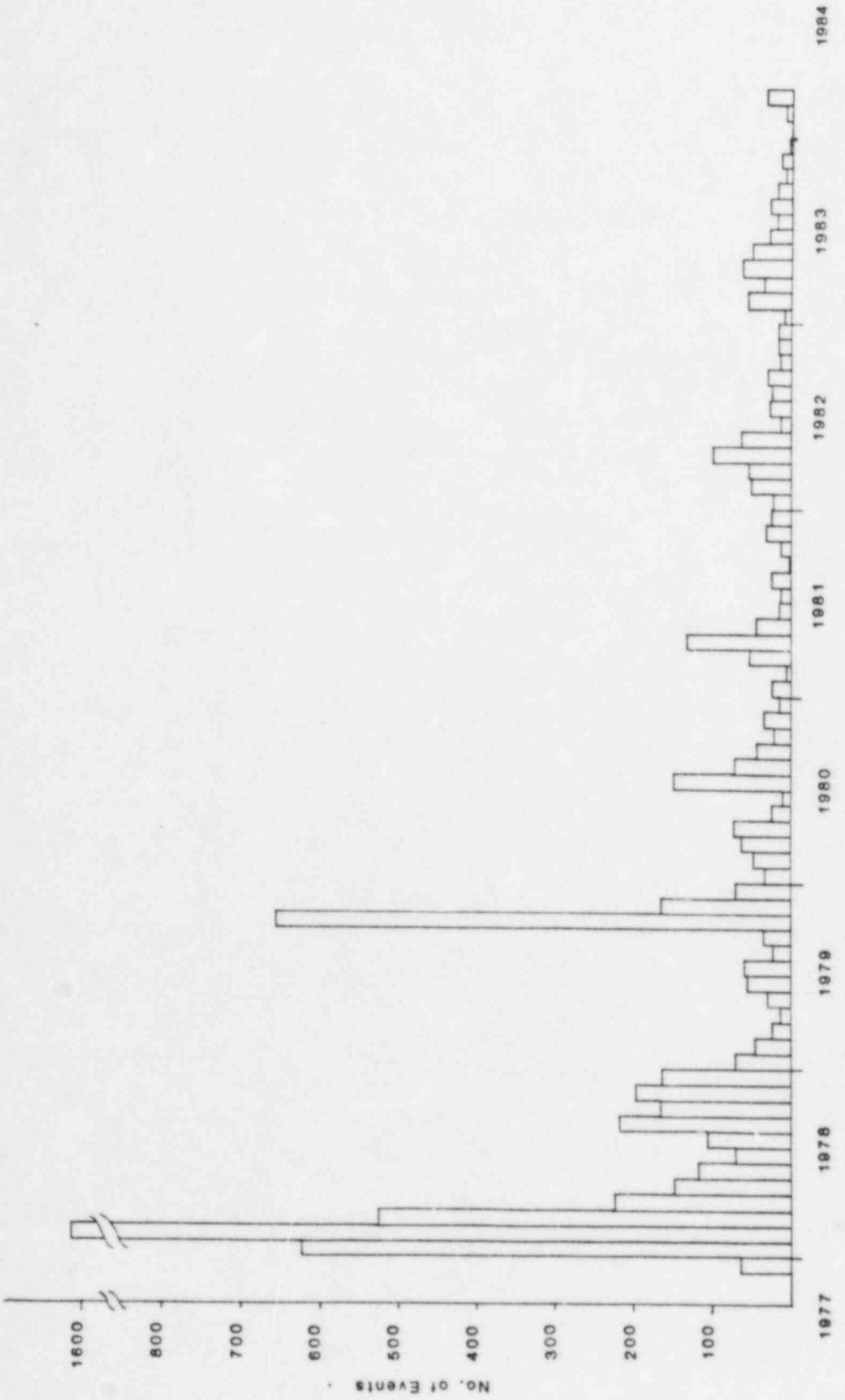
No. of Events
1600
800
700
600
500
400
300
200
100
1977
1978
1979
1980
1981
1982
1983
1984

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'

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	ORIGIN	LAT N	LONG W	DEPTH	MAG	NO	GAP	DMIN	RMS	ERH	ERZ	GM
840203	945 11.10	34-18.91	81-19.18	0.80	0.44	6	248	2.2	0.04	0.0	1.0	C
840208	350 39.42	34-20.28	81-19.21	1.92	0.12	9	127	1.6	0.04	0.0	1.0	B
840209	142 14.69	34-20.01	81-18.70	0.29	0.01	9	124	1.6	0.04	0.0	1.0	B
840211	11 2 11.28	34-23.09	81-18.38	1.98	0.21	9	125	1.6	0.04	0.0	1.0	B
840211	1151 13.46	34-19.86	81-18.06	1.00	0.14	9	125	1.6	0.04	0.0	1.0	B
840214	18 7 6.67	34-20.11	81-19.20	0.26	0.00	9	125	1.6	0.04	0.0	1.0	B
840303	830 5.49	34-20.14	81-17.84	0.21	0.57	9	125	1.6	0.04	0.0	1.0	B
840304	1213 0.56	34-19.90	81-17.84	0.50	0.34	8	125	1.6	0.04	0.0	1.0	B
840306	1755 27.35	34-19.72	81-19.65	1.78	0.79	8	125	1.6	0.04	0.0	1.0	B
840307	633 16.23	34-19.34	81-18.15	1.66	0.37	8	125	1.6	0.04	0.0	1.0	B
840307	2047 9.70	34-19.22	81-19.45	2.53	0.79	8	125	1.6	0.04	0.0	1.0	B
840308	11 7 9.40	34-20.01	81-19.74	1.66	0.02	8	125	1.6	0.04	0.0	1.0	B
840308	1113 7.44	34-19.64	81-18.84	2.09	0.47	8	125	1.6	0.04	0.0	1.0	B
840308	1455 5.27	34-18.93	81-20.18	0.28	0.40	8	125	1.6	0.04	0.0	1.0	B
840310	1019 53.90	34-19.91	81-19.37	2.52	0.19	8	125	1.6	0.04	0.0	1.0	B
840315	1940 40.99	34-19.60	81-19.35	1.96	0.86	8	125	1.6	0.04	0.0	1.0	B
840318	556 2.62	34-20.04	81-18.09	0.83	0.02	8	125	1.6	0.04	0.0	1.0	B
840318	557 11.84	34-20.57	81-17.11	1.26	0.40	8	125	1.6	0.04	0.0	1.0	B
840318	6 0 23.32	34-19.74	81-18.21	0.40	0.86	8	125	1.6	0.04	0.0	1.0	B
840318	927 58.28	34-20.01	81-17.84	0.87	0.86	8	125	1.6	0.04	0.0	1.0	B
840318	928 50.40	34-20.32	81-17.82	1.97	0.51	8	125	1.6	0.04	0.0	1.0	B
840318	1117 10.16	34-20.01	81-17.84	0.32	0.86	8	125	1.6	0.04	0.0	1.0	B
840318	1117 53.36	34-20.01	81-17.84	0.56	0.57	8	125	1.6	0.04	0.0	1.0	B
840318	1133 47.67	34-20.30	81-17.95	0.16	0.01	8	125	1.6	0.04	0.0	1.0	B
840318	1143 29.47	34-19.00	81-20.36	1.79	0.18	8	125	1.6	0.04	0.0	1.0	B
840318	1241 34.24	34-20.09	81-18.33	0.25	0.60	8	242	1.6	0.04	0.0	1.0	B
840318	18 6 27.70	34-20.34	81-18.06	0.15	0.37	8	125	1.6	0.04	0.0	1.0	B
840318	2131 30.33	34-20.17	81-19.90	2.04	0.40	8	145	1.6	0.04	0.0	1.0	B
840320	146 45.78	34-19.54	81-18.75	1.51	1.32	10	129	1.7	0.06	0.0	1.0	B
840323	1037 57.95	34-17.37	81-19.50	1.78	0.40	7	159	5.4	0.04	0.0	1.0	B
840327	1450 35.63	34-20.28	81-19.30	1.73	0.37	10	127	2.5	0.05	0.2	0.6	B