TECHNICAL REPORT 86-1

SEISMIC ACTIVITY NEAR THE V.C. SUMMER NUCLEAR STATION

For the Period January — March 1986

by

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Contract No. N418202

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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, 1986 is presented in this report. During this period a total of 48 events were recorded of which 32 were located. The largest snock was of magnitude 1.3 (860207 2304 UTC). The remaining earthquakes were of magnitudes less than 1.0. Seventy eight percent of the B-quality events located at depths not exceeding 2 km below the surface. This level of activity represents a decline from that observed during January-March 1985.

SEISMIC NETWORK

This report is based primarily on data recorded by the four-station network operated by S.C.E.&G. and the USGS/USC stations JSC, 6A and 7. The locations of the stations are shown in Figure 1 and their coordinates are listed in Appendix I.

DATA ANALYSIS

Hypocentral locations of the events are determined by using the HYPO71 program (Lee and Lahr, 1972) and the velocity model listed 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).

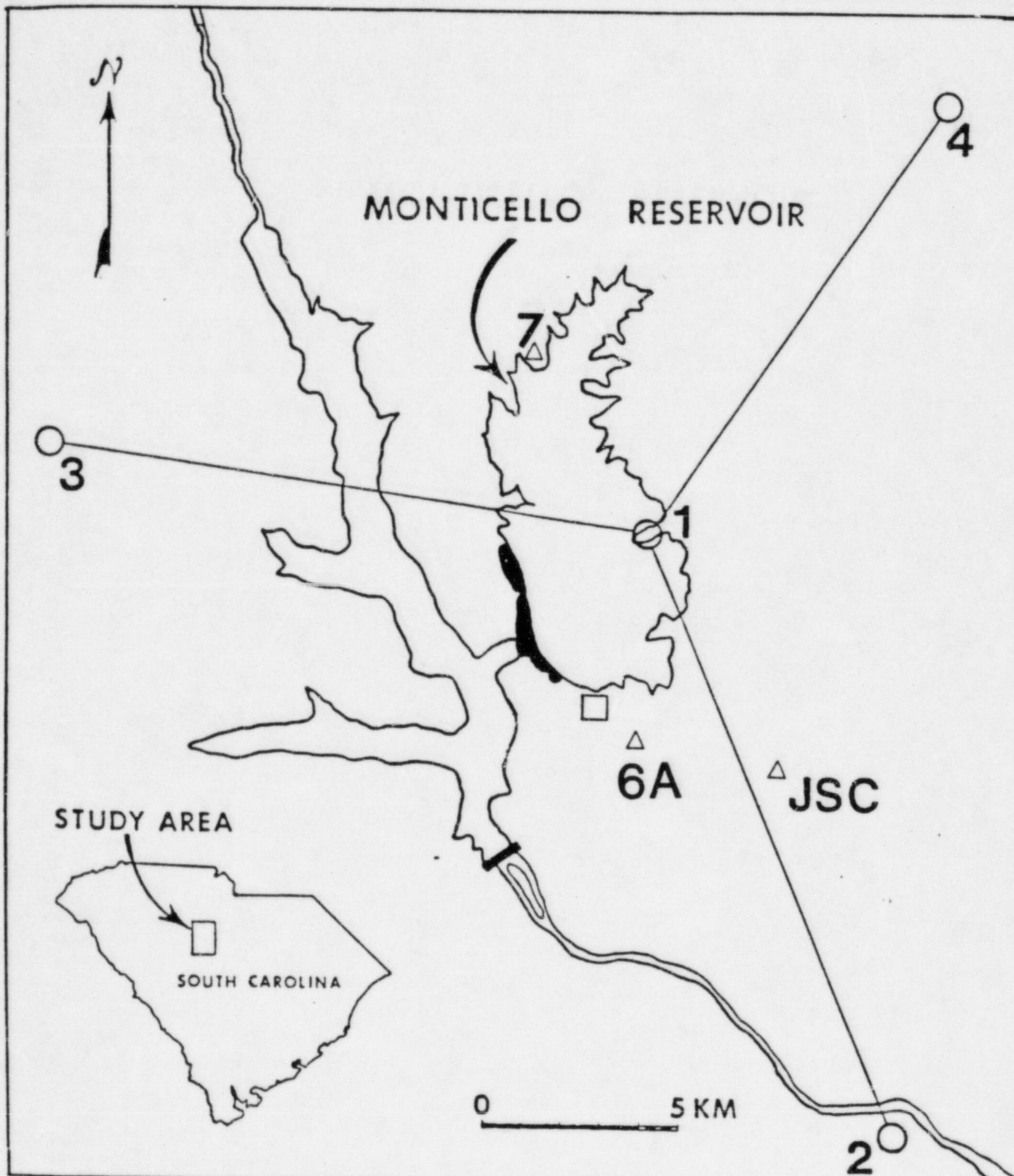

N
MONTICELLO RESERVOIR
7
3
1
4
6A
JSC
2
STUDY AREA
SOUTH CAROLINA
0
5 KM

Figure 1

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

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

OBSERVED SEISMICITY FOR THE PERIOD JANUARY-MARCH, 1986

During this period, 48 events were recorded of which 32 were located (see Appendix III). Instrument down time was a major factor in the relatively poor ratio of located to recorded events. Sixty-five percent of the recorded activity occurred in February. Fifteen of these events were recorded in a single swarm (February 7-9). The largest event of this quarter (M_L=1.3) occurred on February 7, 1986 and was the only event with a magnitude of 1.0 or greater. The seismic activity decreased substantially from the level observed during the same period in 1985 in which 216 events were recorded. The current level of activity is concordant with the decline observed between 1978 and 1984. The increased seismicity recorded in 1985 was anomalous (Figure 2).

During this quarter the majority of the earthquakes located in an east-west trending band beneath the west-central portion of the reservoir and the western shore. A cumulative plot of epicenters of all the events located during this period is shown in Figure 3. Separation of all epicentral locations by month are shown in Figures 4-6.

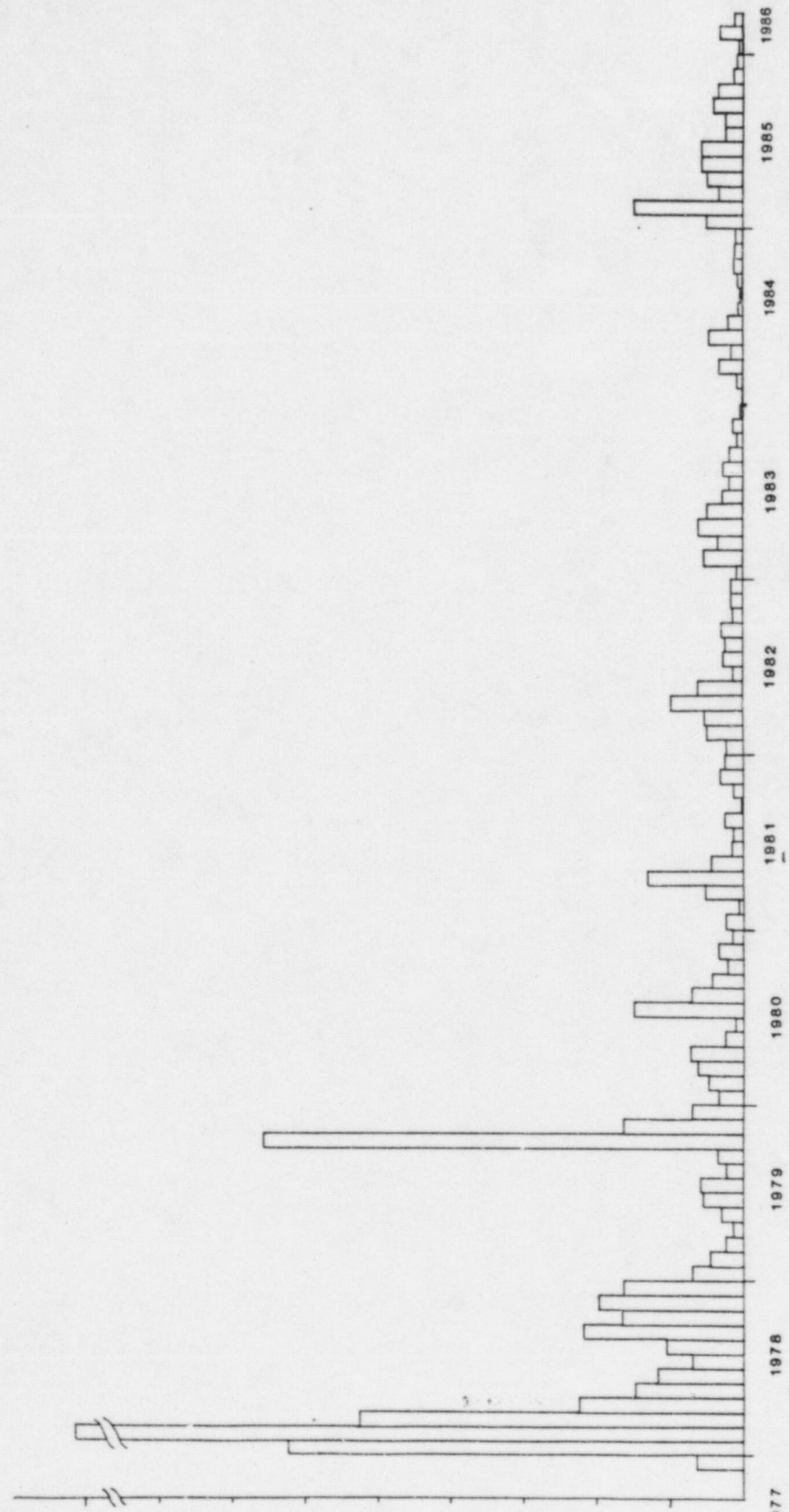

No. of Events
1600
800
700
600
500
400
300
200
100
1977
1978
1979
1980
1981
1982
1983
1984
1985
1986

Figure 2

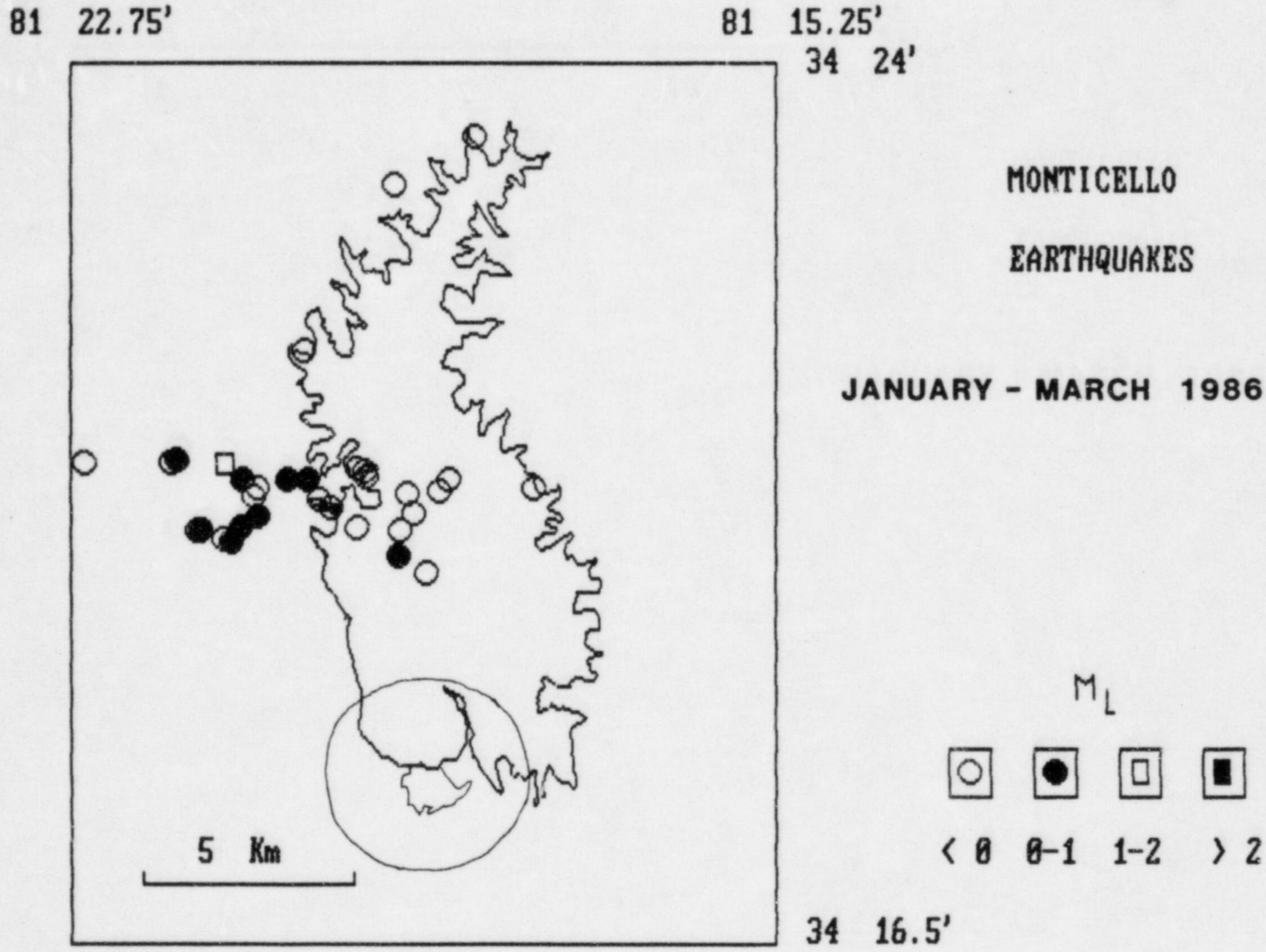

81 22.75'
81 15.25'
34 24'
MONTICELLO
EARTHQUAKES
JANUARY - MARCH 1986
5 Km
M_L
< 0 0-1 1-2 > 2.
34 16.5'

Figure 3

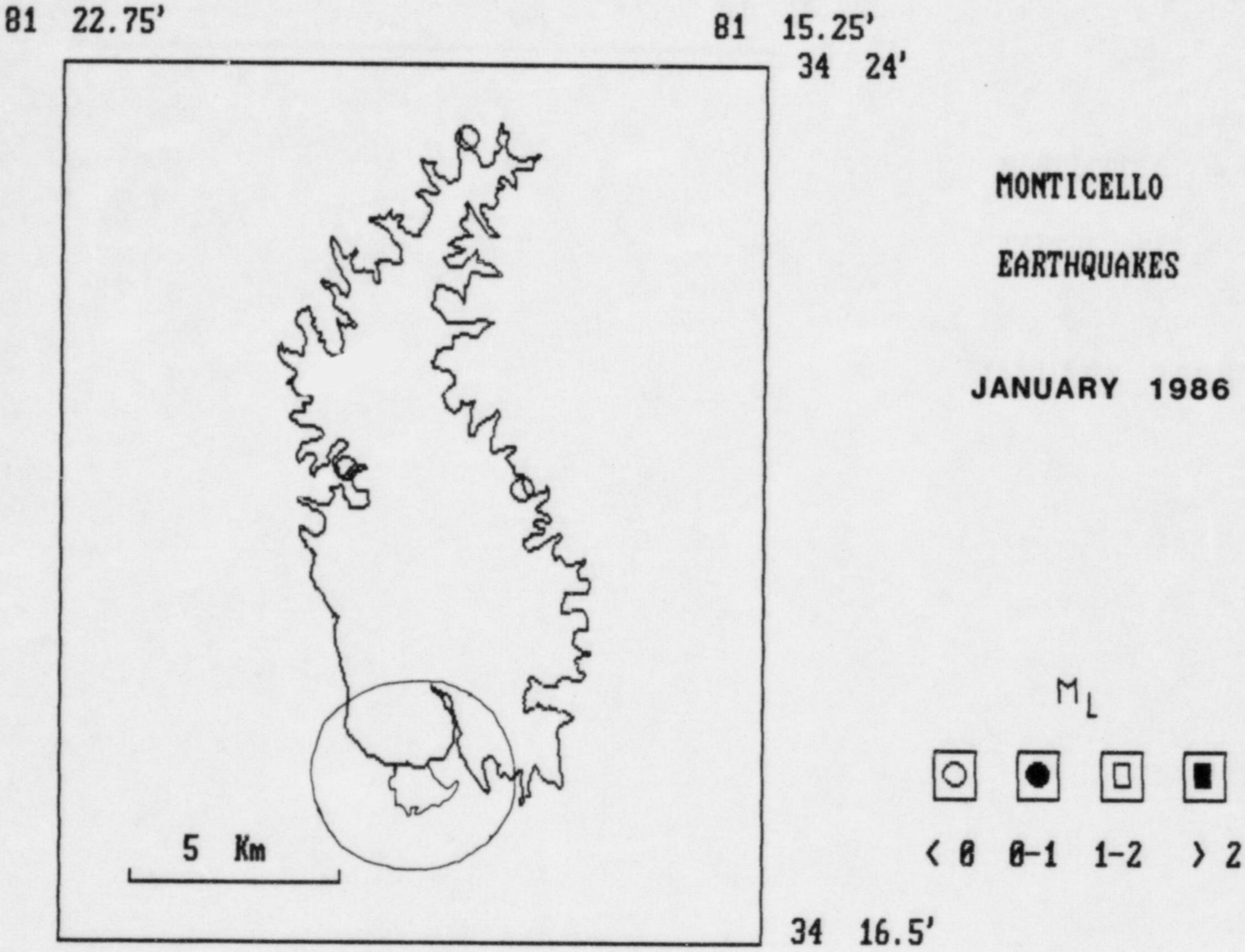

81 22.75'
81 15.25'
34 24'
5 Km
34 16.5'
MONTICELLO
EARTHQUAKES
JANUARY 1986
M_L
< 0 0-1 1-2 > 2

Figure 4

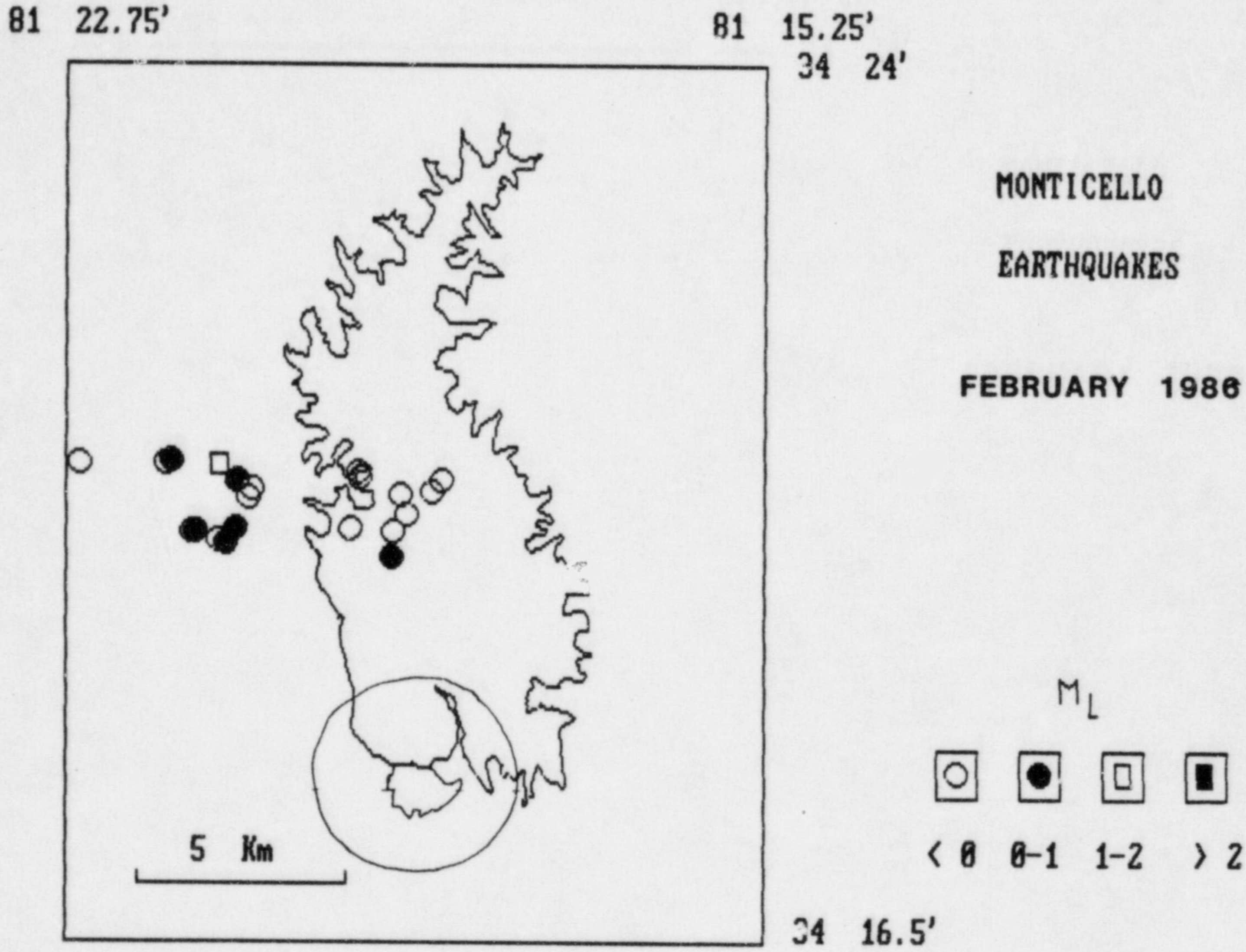
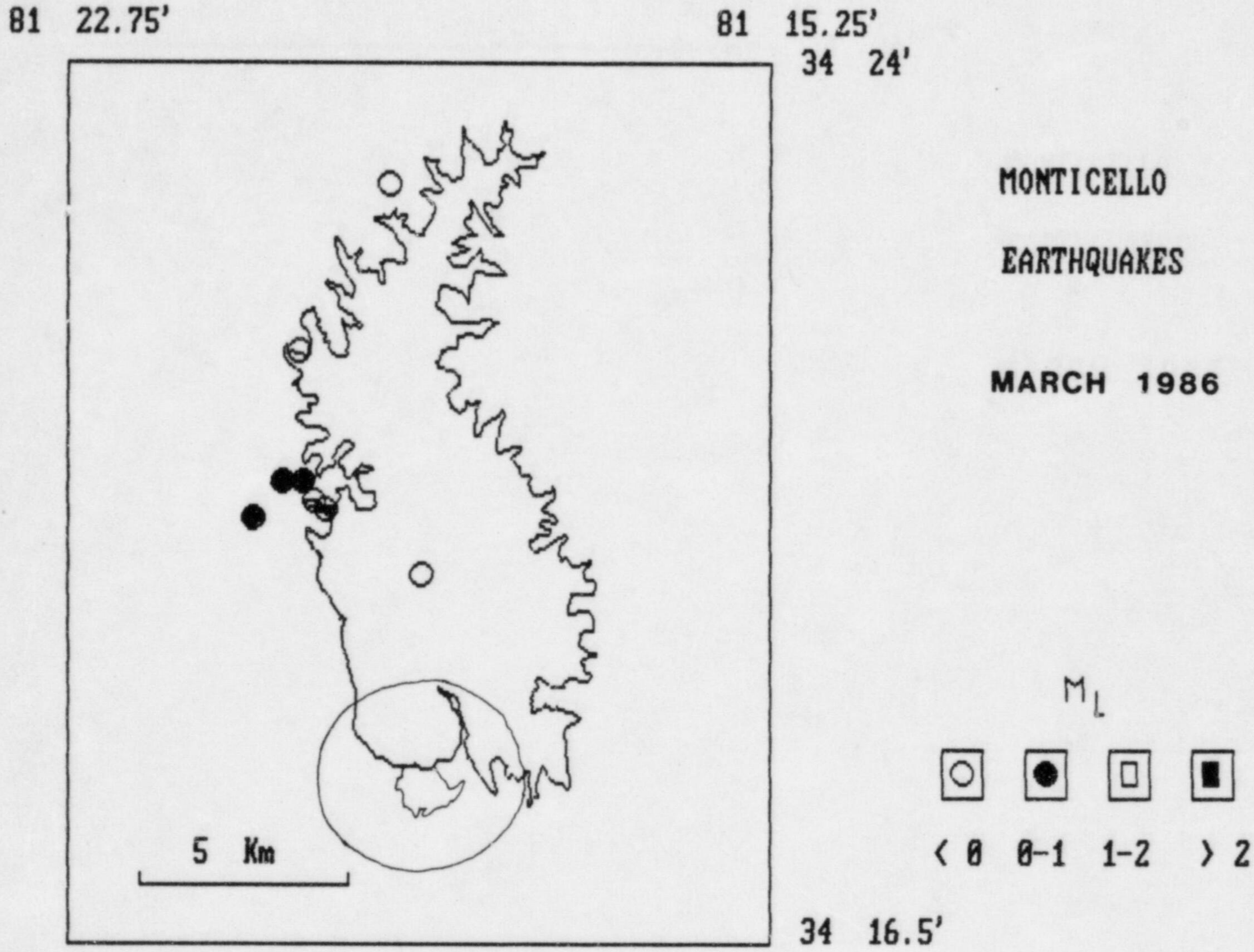

81 22.75'
81 15.25'
34 24'
MONTICELLO
EARTHQUAKES
FEBRUARY 1986
5 Km
M_L
< 0 0-1 1-2 > 2
34 16.5'

Figure 5



81 22.75'
81 15.25'
34 24'
MONTICELLO
EARTHQUAKES
MARCH 1986
M_L
< 0
0-1
1-2
> 2
5 Km
34 16.5'

Figure 6

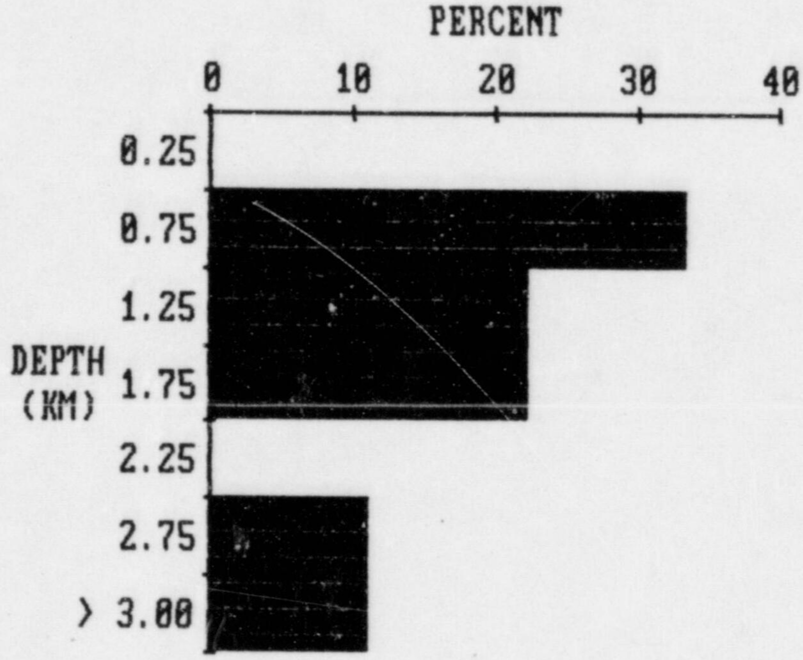
Nine events were located with a quality of B. Of these, seven (~ 78%) located within 2 km of the surface. The remaining events (~ 22%) located within the top 3.5 km (Figure 7).

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 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 to seismicity in Figure 8. The top two plots show the average water level and the change in water level per day. The number of events per day and the log of the energy released per day are shown in the lower two histograms. These charts include both located and unlocated events around the reservoir. No correlation between seismicity and lake level is readily apparent.

CONCLUSIONS

Activity during the first quarter of 1986 was low in comparison to that experienced during the same period in 1985 but is comparable to the levels of 1983-1984. The majority of the earthquakes (98%) were of magnitudes less than 1.0 and 78% of the accurately located shocks located within the upper 2 km of the



N = 9

Figure 7

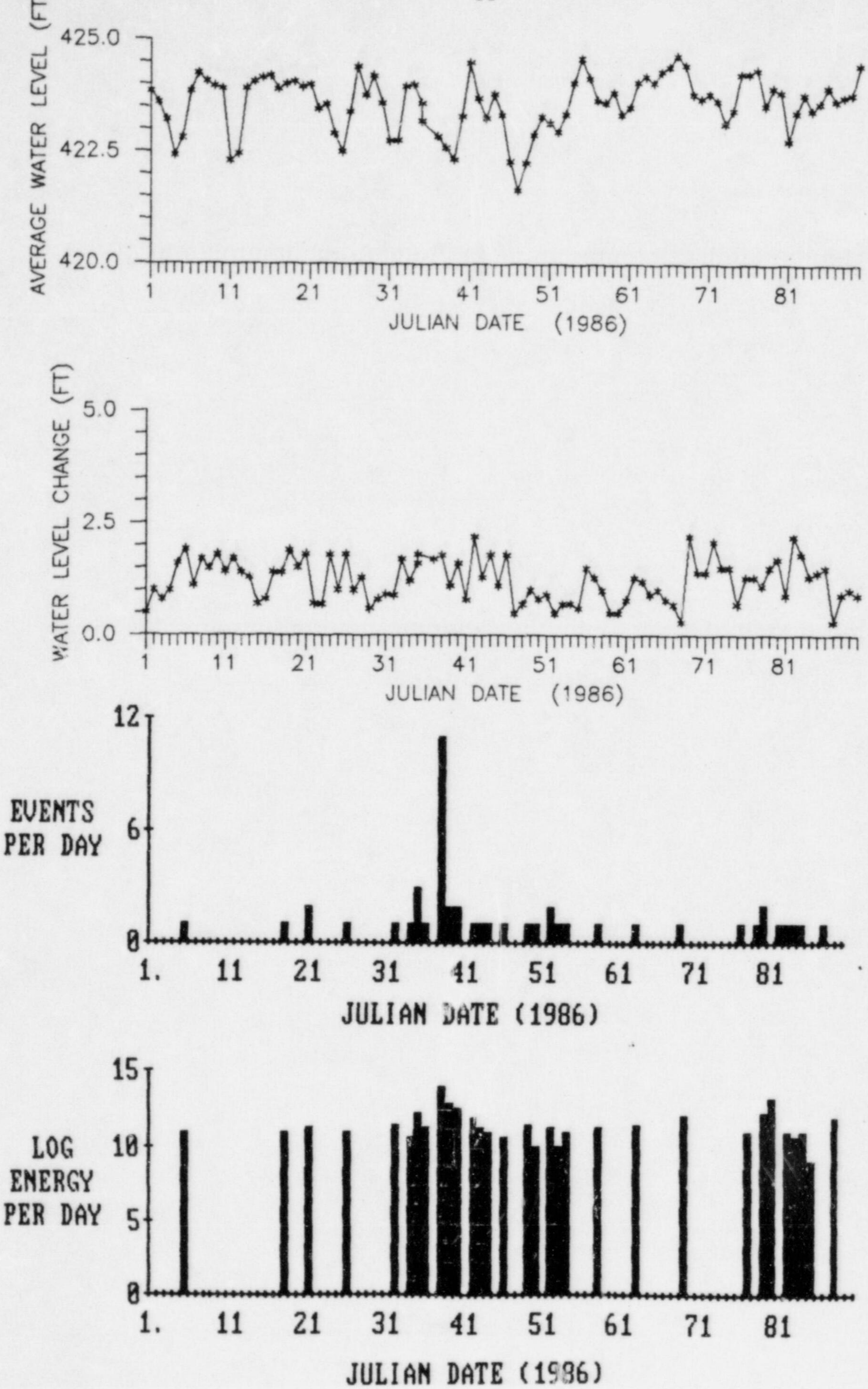

AVERAGE WATER LEVEL (FT)
425.0
422.5
420.0
1 11 21 31 41 51 61 71 81
JULIAN DATE (1986)
WATER LEVEL CHANGE (FT)
5.0
2.5
0.0
1 11 21 31 41 51 61 71 81
JULIAN DATE (1986)
EVENTS PER DAY
12
6
0
1. 11 21 31 41 51 61 71 81
JULIAN DATE (1986)
LOG ENERGY PER DAY
15
10
5
0
1. 11 21 31 41 51 61 71 81
JULIAN DATE (1986)

Figure 8

crust. The epicenters clustered mainly in a broad east-west trending band beneath the west-central portion of the reservoir and the western shore.

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

APPENDIX I

STATION LOCATIONS

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	06A	34° 17.32'	81° 18.15'
7	007	34° 22.23'	81° 19.50'

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 1986

860105	312	35.67	34-23.37	81-18.45	2.75	-0.86	5	170	6.5	0.01	0.1	0.3	C1
860118	1558	5.12	34-20.36	81-17.84	1.00	-0.60	6	227	0.8	0.06	1.3	0.7	C1
860126	2359	51.43	34-20.53	81-19.72	2.97	-0.60	4	132	11.8	0.09			C1
860201	9 4	56.71	34-20.03	81-19.72	1.44	-0.24	10	125	3.1	0.06	0.2	0.9	B1
860204	19 8	47.39	34-20.02	81-20.96	1.97	0.01	6	155	10.1	0.09	0.7	7.3	C1
860204	2324	53.78	34-19.91	81-21.04	6.97	0.12	5	158	10.0	0.01	0.2	0.4	C1
860207	936	55.05	34-20.44	81-18.73	0.87	-0.11	6	131	8.3	0.09	0.6	160.8	C1
860207	1543	11.22	34-20.58	81-22.61	0.99	-0.40	5	154	7.4	0.09	2.1	98.2	D1
860207	1543	34.58	34-20.36	81-20.77	0.89	-0.60	4	148	10.3	0.05			C1
860207	1547	44.91	34-20.01	81-21.38	0.87	0.51	6	158	9.5	0.04	0.3	73.2	C1
860207	16 6	48.51	34-20.61	81-21.64	0.82	0.78	5	148	8.9	0.05	0.5	108.9	D1
860207	17 7	34.08	34-20.44	81-20.93	3.51	0.21	6	147	10.0	0.01	0.1	0.5	B1
860207	1948	0.20	34-20.01	81-21.42	0.89	0.87	6	159	9.4	0.05	0.4	85.5	C1
860207	23 4	6.81	34-20.57	81-21.12	1.93	1.29	5	146	9.7	0.02	0.3	2.9	C1
860209	1325	37.13	34-19.80	81-19.26	4.22	0.01	5	146	7.9	0.01	0.1	0.4	C1
860211	742	29.08	34-20.52	81-19.62	1.95	0.12	10	132	3.1	0.08	0.3	0.8	B1
860212	019	25.63	34-20.30	81-20.82	0.90	-0.40	9	132	4.8	0.08	0.4	11.0	C1
860215	027	5.05	34-20.33	81-19.17	1.95	-0.86	5	212	2.3	0.06	0.7	0.9	C1
860218	830	34.89	34-19.93	81-21.14	1.95	-0.24	7	247	4.9	0.08	0.8	2.1	C1
860221	428	43.06	34-20.59	81-21.68	0.11	-1.22	5	281	4.5	0.06	0.1	0.2	C1
860221	524	9.07	34-20.46	81-19.60	1.75	-0.40	6	211	3.0	0.07	0.8	1.2	C1
860222	1 4	49.55	34-20.34	81-18.84	0.30	-1.22	5	201	1.9	0.00	0.0	0.1	C1
860223	657	12.35	34-20.01	81-19.25	2.79	-0.60	8	203	2.3	0.05	0.4	0.4	C1
860227	3 1	13.63	34-20.14	81-19.11	1.56	-0.40	10	198	2.1	0.05	0.3	0.4	C1
860304	940	5.56	34-22.95	81-19.32	1.48	-0.24	8	168	1.4	0.03	0.1	0.2	B1
860310	1837	5.73	34-20.12	81-20.77	2.73	0.12	11	134	4.4	0.07	0.2	0.6	B1
860318	747	53.22	34-21.55	81-20.26	3.28	-0.60	4	262	1.7	0.00			C1
860320	2130	29.57	34-20.44	81-20.23	0.63	0.21	11	132	3.9	0.08	0.3	1.2	B1
860321	2 1	1.20	34-20.19	81-20.00	1.68	0.12	11	128	3.5	0.08	0.3	1.1	B1
860321	211	34.16	34-20.28	81-20.11	0.69	0.91	12	130	3.7	0.05	0.2	0.5	B1
860323	943	39.88	34-19.64	81-18.98	5.86	-0.60	6	247	2.0	0.09	1.5	0.9	C1
860326	3 0	20.41	34-20.44	81-20.45	0.77	0.68	10	133	4.3	0.08	0.3	1.9	B1