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MAWSON GEOPHYSICAL OBSERVATORY,

ANNUAL REPORT 1974

by

P.J. Cameron

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SUMMARY

Continuous magnetic and seismic recording was maintained at Mawson, Antarctica, during 1974 with the two La Cour magnetographs and the Benioff seismograph giving trouble-free service. Earthquake arrival times were sent regularly via Melbourne to the U.S. Geological Survey, and monthly magnetic data were sent to the Toolangi Observatory Group, Melbourne. During the year new wiring was installed to all scale-value and orientation coils and these coils were realigned in the meridian. Third-order magnetic observations were taken at Knuckey Peaks and Mt King (Enderby Land) during January 1975.

1. INTRODUCTION

Mawson was established as a scientific research station on the Antarctic continent in February 1954 by the Australian National Antarctic Research Expedition (ANARE). In 1955 magnetic recording began with the installation of a La Cour magnetograph (Oldham, 1957); a seismograph was added by McGregor in 1956.

In 1961 a second magnetograph and a new seismograph were installed (Hollingsworth, 1962) so that in 1974 recording equipment consisted of a normal-run magnetograph, a sensitive run magnetograph and a three-component Benioff seismograph.

The geophysical observatory is operated and maintained by the Bureau of Mineral Resources, Geology and Geophysics (BMR) as part of ANARE and derives logistic support from the Antarctic Division, Department of Science. Station data are given in Table 1.

The author arrived at Mawson in December 1973 to relieve Richard Almond and was relieved in December 1974 by Peter Hill. The author accompanied a tractor train traverse to Enderby Land in January 1975 to take third-order magnetic observations when possible.

2. CONTROL EQUIPMENT

No changes were made to the power and timing equipment which is adequately described by Robertson (1972). The equipment worked satisfactorily for the year and there were only few occasions when standby power was required.

The rate of the EMI clock varied slightly with room temperature but time-signal reception from VNG or WWV was always good enough to provide adequate control. No need was found for the Eddystone receiver. The TMU timing unit occasionally incremented by a spurious second but caused no great problem. Standby timing was provided by a Mercer chronometer, the rate of which was checked daily against time signals.

3. MAGNETIC OBSERVATORY

Apart from minor record losses, continuous recording was maintained on both the normal and sensitive La Cour magnetographs. There were only three hours when neither magnetograph was recording. This occurred when the lights were on in the variometer room to check wiring and align coils. The clutch disengaged on the drum drive, once on the sensitive recorder and several times on the normal recorder, with consequent record loss. Also one day's normal record was lost owing to fogging.

Elsec proton-precession magnetometer

Continuous recording of total intensity (F) using the magnetometer was continued from 1973 on the Moseley strip-chart recorder. The magnetometer was also used for absolute observations.

By the end of May, however, the magnetometer was behaving erratically. Initially spurious internal pulses were causing inconsistent readouts, and the electronics engineer spent considerable time on the problem. The pulses were eliminated by a modification in the reset line to the decade counters, but further problems arose in the relay, re-amp and do-timer units. Although these units were repaired, reliable service was not assured and the instrument was not used for absolute measurements for the remainder of the year. It was replaced at the end of the year.

Absolute observations

Absolute observations of D, H, and Z were made on average seven times per month. The instruments used were:

D	Askania Declinometer 332
H	QHMs 300, 301, 302
Z	BMZ 62
	PPM 340 (until end of May)

The following comparisons with instruments brought from Australia were made in December 1974:

D	Askania Declinometer 332	:	Askania Declinometer 812
H	QHM 300	:	HTM 704, QHM 492
F	PPM 340	:	PPM 339

Comparison of QHM 300, 301, and 302 results during the year indicates that a correction of -1 nT should be applied to 301 and 302 relative to 300. Corrections were not applied to individual QHM results for the adoption of the H baseline.

Adopted baseline values are given in Table 2. The Z baseline value is adopted from PPM 340 observations until May 23 and from BMZ observations thereafter. This latter part is yet to be adjusted by the BMZ correction, which will be determined when more PPM/BMZ comparisons are available.

Temperature scale values and baseline values obtained from the normal and sensitive Z thermographs are given in Table 3. The H thermographs were not used because they were too insensitive.

Scale values

Scale-value determinations on the normal magnetograph were made on average seven times per month and on the sensitive magnetograph once per month. Adopted scale values are given in Table 14.

At the end of June new wiring, in the form of independent twisted pairs, was installed from the MCO 3 control panel to all the normal magnetograph scale-value and orientation coils. This meant the coils were no longer connected in series and eliminated the possibility of interaction of fields between variometers during simultaneous scale-value determinations. Also, scale-value currents could be adjusted independently for similar deflections of approximately 50 mm on the magnetogram. After the rewiring scale values altered slightly as indicated below:

	H(nt/mm)	D('/mm)	Z(nT/mm)
Mean Jan - Jun	21.22	2.42	22.65
Mean Jul - Dec	21.41	2.45	22.71

Scale values were adopted by taking the July to December results as being the more reliable.

The sensitive magnetograph was rewired similarly on 30 October.

The limited amount of wire available for the rewiring necessitated some change in the colour code from that given in Robertson (1970). The present wiring to the coils is as follows:

Independent twisted pairs with black common.

Z s.v.	white	
H s.v.	red	
H or.	grey	
D s.v.	brown	
D or.	green	
Lamp power	blue pair (NORMAL)	red pair (SENSITIVE)
Time Mark power	blue pair (")	brown pair(")

Orientation

In order to reconcile orientation test data from 1973 with that of previous years an instruction was received from HQ to conduct H and D orientation tests and to check the alignment of the orientation coils. It was suspected that the coils could have vibrated out of the direction of 64°W and caused errors in the calculated orientation angles. On checking the coil alignments it was found (in fact) that this was so and the actual alignment of the coils is given at the end of Table 4. The coils were realigned and plastered in position along the direction

$64^{o}W$ on 14 October. Orientation tests were conducted both before and after the realignment of coils.

Table 5 presents a list of all exorientation angles measured in 1973 and 1974, and calculated assuming the coil alignments were as measured in 1974. Using these coil alignments, consistent values of exorientation angles are obtained. As the table indicates, the sensitive D magnet is in need of re-orientation.

Data

Monthly data, consisting of K-indices, preliminary baseline values, scale values, and mean geomagnetic values were transmitted regularly to the Toolangi Observatory Group, Melbourne. Table 6 gives the preliminary monthly mean geomagnetic values and K-indices for 1974. Annual mean values from 1964 to 1974, together with the annual mean change, are given in Table 7.

4. SEISMOLOGICAL OBSERVATORY

The three-component Benioff seismograph provided continuous recording for the year. No problems arose with the seismograph and the annual maintenance was carried out in August.

The major cause of record loss was damage to the Z signal line between the geophysics office and the seismic hut. The Z signal from the seismometer in the cosmic ray vault travels via pyrotenax cable to the geophysics office and then via a PVC shielded cable to the seismic hut. This PVC cable was laid on trayways above the ground from the office, over the diesel workshop and power house, then on the ground to the seismic hut. During periods of high wind or blizzard the cable on the trayway was prone to wear (causing interference) and breakage. After numerous breakages and repair the troublesome section was replaced and fastened more securely to the trayway.

Calibration

Weight-lift and frequency-response tests were conducted on the Z seismometer in February (at 20 dB attenuation) and November (at 6 dB, 10 dB, and 14 dB). The period/magnification curves are given in

Plate 1. The seismograph parameters are given in Table 8.

Calibration pulses were applied to the horizontal seismometers twice a day during the record changes and to the vertical seismometer once a day. The calibration control for the vertical seisometer is installed at the top of the cosmic ray shaft and pulses were applied by the cosmic ray physicist.

Attenuation

Table 9 provides the seismometer attenuation settings for the year. Since the vertical seismometer was installed in the cosmic ray vault in 1973 (Almond, in prep.) attenuation of the Z signal could be kept at 4 dB for much of the time. Although microseisms due to wind were still evident on the Z trace the effect was far less than experienced by the horizontal seismometers on the surface.

Data

Arrival times were sent daily to Melbourne for transmission to the United States. They were also sent, about once a week, to other Antarctic stations on an exchange arrangement.

Final analysis completed on the author's return to Canberra, indicated that about 620 events had been recorded. Several events considered to be real but not listed in the USGS Earthquake Data Reports were retained in the bulletin.

5. REGIONAL MAGNETIC MEASUREMENTS

In January 1975 the author accompanied a tractor train to Knuckey Peaks, the base camp for the Enderby Land summer operations. It was hoped that third-order magnetic observations could be taken regularly on this traverse, but owing to the requirement for the train to reach Knuckey Peaks in the minimum of time only three observations of Z were obtained.

While in Enderby Land only two stations were occupied, viz. on Mount King and on Knuckey Peaks. As Petkovic (1971) reported, 'field observations were greatly handicapped by weather conditions', notably wind, making a QHM impossible to damp on many occasions. An observation tent similar to that used by the surveyors is again recommended for field use. Results of field observations are given below.

STATION	D	H(nT)	Z(nT)	Position	
Knuckey Peaks [1]	43°49'W	20988	50242	-67°54.3'S	53°32.4'E
Mount King	53°00'W	18502		-67°00.9'S	52°49.7'E
E 003 [2]			47423		
E 153			50146		
E 052			46672		

Note 1. Knuckey Peaks have a high magnetite content and hence these values do not represent the regional field.

2. E 003, E 153, and E 052 refer to route markers on the Enderby Land traverse and their position is not accurately known at the time of writing.

6. BUILDING MAINTENANCE

The exterior of the geophysics office was painted early in the year. During the year carpet was laid on the main office area, two desks were restored with new tops and the oil heater and flue were painted.

7. ACKNOWLEDGEMENTS

The author wishes to express his gratitude for the ready assistance given him by all members of the 1974 expedition and Enderby Land summer party. In particular, the author wishes to thank: Graham Hinch, Wade Butler, and Jerry Walter for changing the records and scaling while the author was away from the station; Graham Henstridge for his help and perseverance with the PPM and 'things electronic'; and Werner Hayman for his help with repairing pyrotenax cable.

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TABLE 1

STATION DATA

	Magnetic	Seismological
Name	Mawson	Mawson
Code	MW	MAW
Latitude geographic	67° 36' S	67° 36.2'S
geomagnetic	-73.1°	
Longitude geographic	62° 53' E	62° 52.5'E
geomagnetic	102.9°	
Elevation (m)	10	9 (N, E) 0 (Z)
Foundation	Precambrian granite	Precambrian granite

TABLE 2

OBSERVED MEAN BASELINE VALUES, NORMAL MAGNETOGRAPH

DATE 1974	UT h m	Baseline	Remarks
Horizontal Intensity		BHs nT	
Jan. 01	00 00	17350	
Feb. 01	00 00	17343	Change of S.V.& observer
May. 24	10 35	17123	Variometer knocked
Declination		BD(w) ° '	
Jan.01	00 00	60 37.9	
Feb.01	00 00	60 38.1	Adopted
Mar. 01	00 00	60 39.2	Unknown
Apr. 01	00 00	60 39.0	Adopted
June 01	00 00	60 38.8	Adopted
July 01	00 00	60 38.6	Adopted
Oct. 14	11 00	60 37.5	S.V/Or. Coils adjusted.
Oct. 29	08 40	60 38.6	S.V/Or. Coils plastered.
Dec. 04	08 15	60 37.9	Checked alignment of coils.
Vertical Intensity		BZs nT	
Jan. 01	00 00	47156	
Feb. 01	00 00	47163	Change of S.V.& observer
May. 23	03 00	47154*	Variometer knocked

* This value derived from BMZ readings and still to be adjusted to PPM value.

TABLE 3

THERMOGRAPH PARAMETERS, 1974

FROM	TO	OBSERVED St	ADOPTED St	ADOPTED Bt
		°C/mm	°C/mm	°C
Z Thermograph(Normal)				
01-02-74	31.12.74	1.85	1.85	-105.7
Z Thermograph (Sensitive)				
01-02-74	31.12.74	1.10	1.10	-59.4
H Thermographs not used.				

TABLE 4

MAGNETOGRAPH PARAMETERS

COMPONENT	MEAN OBSERVED SCALE VALUE	ADOPTED SCALE VALUE	STANDARD DEVIATION Scale Value	STANDARD DEVIATION Baseline	TEMP. COEFF. nT/°C
Normal					
H	21.31	21.40	0.10	2.4 nT	0.0
D	2.43	2.44	0.02	0°.3'	
Z	22.68	22.70	0.12	3.7 nT	2.0

TABLE 5

ORIENTATIONS OF VARIOMETER MAGNETS 1973-1974

Date	Normal			Sensitive		REMARKS
	H	D	Z	H	D	
15-16 FEB.1973	E 0.4°N	N 0.8°E		E1.0°S	N2.4° W	
18/12/73	E 0.6°N			E1.0°S		
26/12/73	E 0.5°N	N 0.3°W		E1.0°S	N2.9° W	
4/12/74			N1.4°Down			
29/5/74	E 1.1°N				N2.7° W	
30/5/74		N0.8°W		E2.3°S		Sensitive H Trace Active
30/10/74	E 0.7°N	N 0.01°W				
1/11/74	E 0.5°N	N 0.03°W		E1.1°S	N2.8°W	

REFERENCE FIELDS

1973	H	18391 nT		1974	H	18390 nT
	D	62.29°			D	62.41°
	P.V.	27.71°			P.V.	27.59°
					Z	47380 nT

ORIENTATION OF S.V./OR.COILS PRIOR TO 14/10/74

COIL	NORMAL	SENSITIVE
H	63.79° W	60.91° W
D	63.54° W	62.49° W

All coils adjusted to 64.0° W 14/10/74.

TABLE 6

PRELIMINARY MONTHLY MEAN GEOMAGNETIC VALUES AND K-INDEX 1974

M o n t h	D(West)	H , nT	Z , nT	K
January	62° 20.5'	18 399	47 414	3.9
February	21.3	393	412	3.5
March	24.1	386	419	4.3
April	24.0	383	410	4.0
May	25.6	392	387	3.9
June	24.7	386	374	4.1
July	26.0	387	375	4.3
August	26.9	381	372	4.2
September	26.6	389	360	4.0
October	26.3	387	363	4.3
November	26.8	404	346	3.8
December	25.4	411	326	4.0
MEAN	62° 24.9	18 392	47 380	4.0

T A B L E 7

GEOMAGNETIC ANNUAL MEAN VALUES 1964-1974

Year	D	I	H	X	Y	Z	F
	° ′	° ′	nT	nT	nT	nT	nT
1964	-60 59.2	-69 15.4	18353	8901	-16049	-48460	51819
1965	-61 12.6	-69 13.1	18356	8840	-16086	-48368	51734
1966	-61 24.0	-69 9.6	18362	8790	-16121	-48235	51612
1967	-61 34.4	-69 7.2	18374	8747	-16158	-48168	51553
1968	-61 43.8	-69 5.2	18365	8698	-16174	-48060	51449
1969	-61 53.0	-69 3.4	18353	8649	-16186	-47954	51346
1970	-62 00.5	-69 0.4	18358	8616	-16209	-47840	51241
1971	-62 5.3	-68 56.4	18375	8602	-16236	-47719	51135
1972	-62 11.4	-68 53.1	18381	8575	-16257	-47600	51026
1973	-62 17.6	-68 49.7	18391	8551	-16281	-47486	50923
1974	-62 24.9	-68 49.7	18392	8516	-16298	-47380	50824
MEAN ANNUAL CHANGE	-8.57	+2.57	+3.9	-38.5	-24.9	+108.0	-99.5

TABLE 8

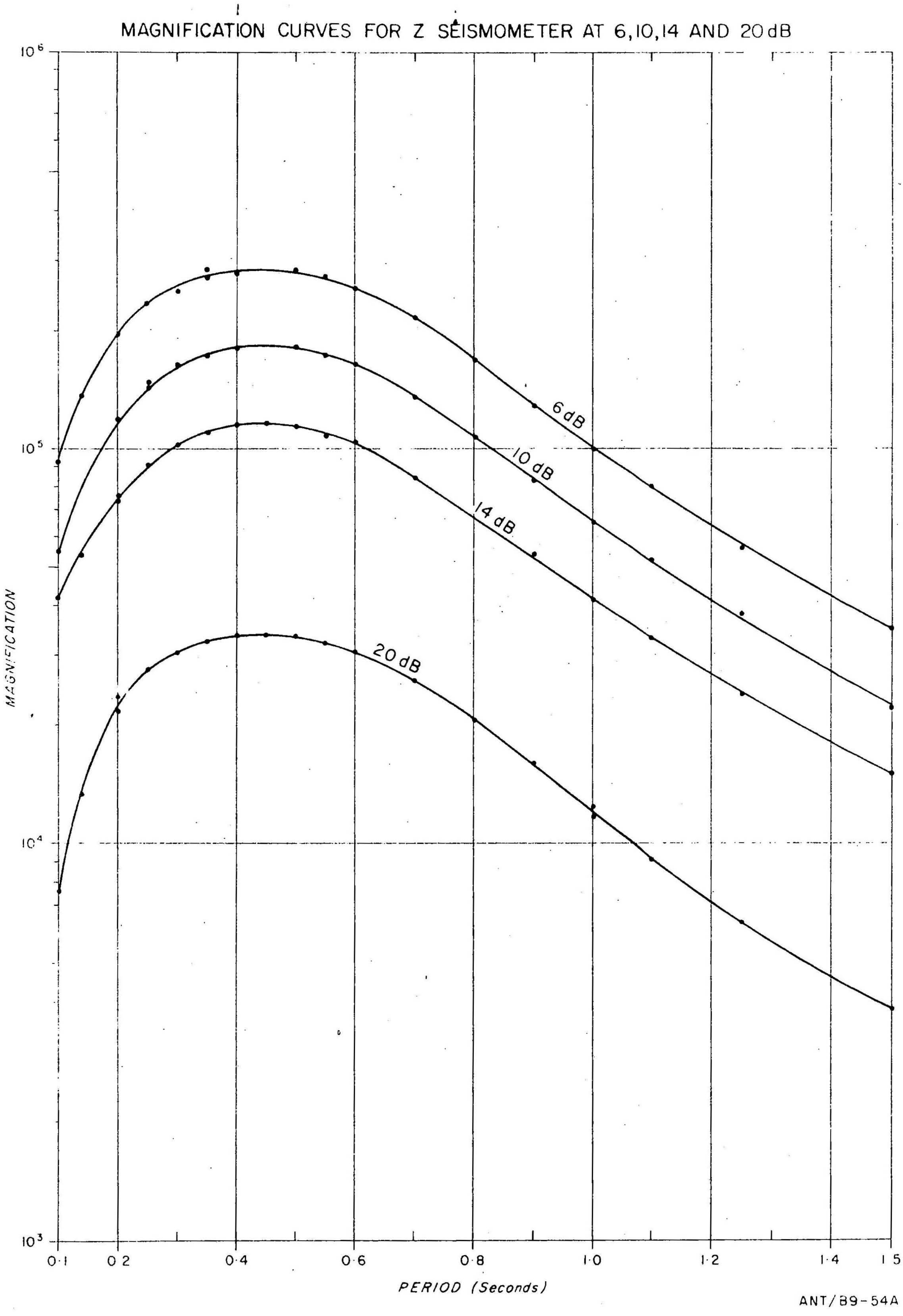
SEISMOGRAPH PARAMETERS

Component	Z	N	E
Seismometer			
Type	Benioff	Benioff	Benioff
Free period (s)	1.0	1.0	1.0
Coil Rs (ohms)	146	438	438
Damping	not measured	not measured	not measured
Galvanometer			
Type	Geotech	Geotech	Geotech
Free period (s)	0.2	0.2	0.2
Coil Rg (ohms)	-	-	-
Damping	not measured	not measured	not measured
Calibrator			
Motor constant (N/A)	1.52	1.49	1.30
Recorder			
Type	Benioff	Benioff	Benioff
Chart rate	60mm/min	60mm/min	60mm/min
System			
Damping	17:1	17:1	17:1
Mag/1 S	42 K	37 K	34 K
Mag Peak/period	120K/0.45	-	-
Attenuator	14 dB	8 dB	8 dB
Polarity	Up	Up	Up

TABLE 9

SEISMOMETER ATTENUATION SETTINGS 1974

MONTH	DAY	TIME(UT)	ATTENUATOR		MONTH	DAY	TIME(UT)	ATTENUATOR	
			Vertical	Horizontals				Vertical	Horizontal
Jan.	1	0000	8	6	AUG	6	0807	8	8
	27	0024	12	8		7	0323	4	6
Feb.	3	0753	16	10	Oct.	6	0333	6	6
	9	0013	16	9		7	0246	4	6
	11	0017	20	9	Nov.	1	0249	6	8
Mar.	10	0332	18	9		2	0424	4	6
	13	0315	16	9		4	0248	8	8
	21	0352	12	9		5	0249	4	6
Apr.	29	0326	10	8		11	1130	8	8
May.	6	0314	8	6		13	0312	10	8
	14	0423	6	6		15	0315	8	8
Jun.	10	0340	4	6			1138	6	8
	18	0315	6	8		16	0314	8	8
	20	0312	4	6		17	0433	6	8
Jul.	19	0324	6	8		19	0250	6	6
	21	0341	4	6		30	0309	8	6
Aug.	5	0321	6	8	Dec.	8	1210	10	8


MAGNIFICATION CURVES FOR Z SEISMOMETER AT 6,10,14 AND 20 dB
10⁶
10⁵
10⁴
10³
MAGNIFICATION
6 dB
10 dB
14 dB
20 dB
0·1
0·2
0·4
0·6
0·8
1·0
1·2
1·4
1·5
PERIOD (Seconds)
ANT/B9-54A