

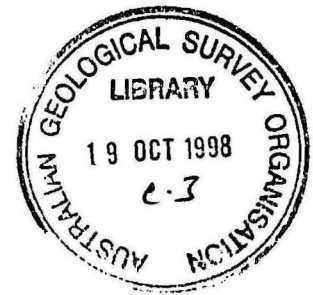
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G E O L O G I C A L S U R V E Y
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Department of Primary Industries and Energy

AUSTRALIAN GEOLOGICAL SURVEY ORGANISATION

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P.I. Roberts

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Geohazards, Land and Water Resources Division, AGSO

Canberra 1998

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ABBREVIATIONS

AGSO	Australian Geological Survey Organisation
ANARE	Australian National Antarctic Research Expeditions
ASC	Australian Seismological Centre
ASP	Atmospheric and Space Physics group at the Australian Antarctic Division (formerly Upper Atmosphere Physics group)
BMR	Bureau of Mineral Resources, Geology and Geophysics (now AGSO)
DOS	Disk Operating System
DEC	Declinometer
DIM	Declination and Inclination Magnetometer
DPIE	Department of Primary Industries and Energy
GED	Brand name of master clock
GPS	Global Positioning System
LPZ	Long Period vertical seismometer
NIPR	National Institute of Polar Research of Japan
PPM	Proton Precession Magnetometer
QHM	Quartz Horizontal Magnetometer
SPZ	Short Period vertical seismometer
PC	Personal Computer
RCF	Ring Core Fluxgate magnetic variometer
RTA	Return to Australia
PEM	Photo Electronic Magnetometer
QNX	Brand name of a computer operating system
SPS	Standby Power Supply.
UPS	Uninterruptable Power Supply
UTC	Universal Time Coordinated

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SUMMARY

The Australian Geological Survey Organisation (AGSO) operated Geomagnetic, Seismological, and Tidal Gravity Observatories at Mawson during 1997.

The author arrived at the Mawson on the 22nd December 1996 to replace the previous observer, Adrian Giffen, who departed Mawson 25th December 1996. The following summer, the replacement observer for 1998, Maria De Deuge, arrived at Mawson on the 26th December 1997. After an extended changeover the author departed Mawson on the 11th February 1998 for the return voyage to Hobart.

As part of the Geomagnetic Observatory operations absolute observations of the geomagnetic field (using DIM, QHM, and DEC instruments) were carried out regularly (8 times per month) on Pier A of the Mawson Absolute Hut to calibrate the magnetic variometer. Temperature calibrations were performed at the start of the absolute observation. The absolute instruments performed generally well during 1997. However on 25/01/97 the fibre of the Declinometer broke while hanging the tension weight on the fibre at the end of that days observation set. The fibre was replaced and the instrument zeroed and on the 04/02/97 the Declinometer was fully operational.

In the variometer building a Ringcore Fluxgate Variometer (RCF) was used to measure geomagnetic variation (1 second sample interval) and proton precession magnetometer (PPM) used to measure total field strength (10 second sample interval). The RCF system performed well throughout the year with no faults with the sensor or electronics. Some data losses resulted from down time due to faults with the acquisition PC, the PPM, or installation of new acquisition software. The PPM system however did not perform well during 1997. A continuing noise problem, resulting in a "spiky" output, with the PPM sensor existed for much of the year resulting in PPM data of limited use.

To develop a model for the years variometer data multi-linear regression of the year's absolute measurements of the field (X, Y, Z) with time and the corresponding digital variometer and temperature data were performed and compared with those determined in 1996 and 1995. Based on these comparisons and the reliability of the regression results for 1997 it was decided that the 1997 results could be adopted for the 1997 baseline model. Baseline values and drifts were applied to the variometer model such that the variometer residual data produced was flat and zero centred.

Seismic activity is monitored and continuously recorded by two separate systems consisting of short (SPZ) and long period (LPZ) analogue seismometers and wide band Guralp seismometers whose data is transmitted to AGSO's Australian Seismological Centre in Canberra. Both SPZ and LPZ records were intermittently affected by high frequency interference and chart noise during windy made it necessary to increase the AR320 amplifier attenuation on those days. At various times throughout the year the clutch mechanism of the LPZ Helicorder would "stick" causing as corruption of chart traces. Several problems with the timing system caused timing pulses on chart and digital data to either drift or be missing entirely. These occurred due to faults with the GED clock or the GPS 1pps from Aeronomy. Annual Calibrations of the analogue system were performed in November of 1997. Note that only SPZ calibrations were performed as LPZ calibrations were considered unnecessary due to the long term stability of the LPZ seismometers.

Variation of the gravitational field was measured using the LaCoste and Romberg gravity meter and a PC using acquisition software similar to the software used for the geomagnetic observatory. The system performed well during 1997 with very little maintenance or servicing required. On the 11th January 1998 the Tidal Gravity project at Mawson was discontinued upon instructions from head office. All equipment relating to the project was packed up and RTA'd on Voyage 5 of the 1997/98 season.

A number of non-routine tasks were completed as part of the overall AGSO program. These included a wireless ethernet bridge in the Variometer Building to enable local and wide area networking, the installation of a QNX operating system with network capabilities on two Pentium PC's (intended for a new QNX based acquisition system), a sign post to define the 100m limit of the magnetic quiet zone, the upgrading of the Office PC with a second hard drive, development of improved software routines for data processing, and the re-writing 1997 Instructions Manual.

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1.0 INTRODUCTION

The Australian Geological Survey Organisation (AGSO) operates geomagnetic and seismological observatories at Mawson and Macquarie Island and a seismological observatory at Casey. It also assists in the operation and calibration of the Australian Antarctic Division geomagnetic monitoring programs at Casey and Davis as part of its contribution to the Australian National Antarctic Research Expeditions (ANARE). Logistic support is provided by the Australian Antarctic Division.

The observatory commenced operation in 1955 with the installation of a three component La Cour magnetograph from Heard Island. The first seismological data was collected in 1956. The history of instrumentation changes at the observatory from 1955 until 1997 are listed in APPENDIX A. Station details are shown in Table 1 below.

The author arrived at the Mawson on the 22nd December 1996. The previous observer, Adrian Giffen, departed Mawson 25th December 1996 ([1] Giffen, A., 1997). The following summer, the replacement observer for 1998, Maria De Deuge, arrived at Mawson on the 26th December 1997. After an extended changeover the author departed Mawson on the 11th February 1998 for the return voyage to Hobart.

This report provides information on the AGSO operations of the Mawson Geophysical Observatory during 1997. The Mawson Geophysical Observatory consists of a Geomagnetic Observatory (discussed in Section 2), a Seismological Observatory (discussed in Section 3), and a Tidal Gravity Observatory (discussed in Section 4). Each of these sections provides details of events that are relevant to observatory operations and summarises information and results appropriate to data collected. Section 5 discusses general operations that are common to all the observatories. Geomagnetic data relevant to Casey and Davis are contained in Section 6. Section 7 briefly outlines the non observatory related duties performed during the year. Acknowledgments, References, and Appendices are provided at the end of the report.

Table 1: Mawson Station Data for 1997

Magnetic Absolute Hut - Pier A (instrument level) ([2] Hutchinson, R., 1989)	
Geographic Coordinates (WGS-72) ¹	67° 36' 14.1" S and 62° 52' 45.2" E
Geomagnetic Coordinates	73.194° S 107.5466° E (IGRF 1990.0)
Elevation	12 m
Foundation	Mawson Charnockite
Magnetic Variometer Building - Mark N1 ([2] Hutchinson, R., 1989)	
Geographic Coordinates	67° 36' 11.4" S and 62° 52' 44.5" E
Elevation	9 m
Foundation	Concrete on Mawson Charnockite
Cosray Vault - Seismometer Platform ([3] Crosthwaite, P., 1986)	
Geographic Coordinates	67° 36' 16.6" S and 62° 52' 16.6" E
Elevation	17 m
Foundation	Concrete on Mawson Charnockite

¹Trevor Forgan (AUSLIG, Adelaide, pers. comm. June 1997) indicated the co-ordinates were originally calculated for Hutchinson using WGS-72. Updated co-ordinates for reference stations at Mawson using WGS-84 give the geographic co-ordinates of Pier A as: (WGS-84) 67° 36' 14.01" S 62° 52' 45.79" E

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2.0 GEOMAGNETIC OBSERVATORY

2.1 Non Routine Tasks

2.1.1 Wireless Ethernet Bridge

During the summer of 1997/98 a wireless ethernet bridge was installed in the Variometer Building to enable local and wide area networking for the new QNX based PC acquisition system which is currently under development (see Section 2.1.2). The ethernet bridge in the Variometer Building consists of a ARLAN 640 spread spectrum ethernet transceiver and a Yagi antenna. The PC's network card connects to the transceiver using RG58 coaxial cable with BNC connectors at both ends. For the network to function each end of the cable must be terminated with a 50 ohm load. The RF port of the transceiver connects to the Yagi antenna which is installed outside on the eastern wall of the Variometer Building. The antenna and support brackets are made of aluminium. The ARLAN unit is attached to the eastern wall of the recorder room. The ethernet bridge links to the Mawson LAN by networking wirelessly to a second ethernet bridge located in the Green Store which uses an omni directional antenna installed on the roof of the Green Store (approximately 600m from the Variometer Building).

Before installation the various ARLAN components were tested for any potential magnetic interference using the PPM and DIM in the Magnetic Absolute Hut. At distances over 0.5m (between instrument and ARLAN) no significant magnetic component was measurable hence no magnetic interference to the sensors in the Variometer Building is anticipated.

To test the link, the QNX based PC (Charnockite) with network capabilities, was installed in the Variometer Building along side the existing Acquisition PC. The wireless link was tested using Telnet and Ftp sessions to Charnockite. The link became fully operational on the 9/2/98.

2.1.2 QNX System

During 1997 two Pentium PC's, intended for a new QNX based acquisition system, were installed with the QNX operating system with network capabilities. One PC is currently (as of February 1998) located in the Variometer Building (remote login address is agso1.mawson.antdiv.gov.au). The second Pentium is situated in Wombat. However due to a fault (discovered February 1998) with its KNE2000LC network card the second PC cannot currently be accessed via the network. Attempts to use a DEC network adaptor were unsuccessful due to memory addressing problems. The installation of a new KNE2000LC card is all that is required for the network to function correctly - the necessary drivers and protocols are already installed and successfully tested. The configuration of the PC's network hardware and software is shown in APPENDIX F.

2.1.3 Magnetic Quiet Zone Boundary Sign

The eastern magnetic quiet zone is a 100m region surrounding both the Variometer Building and the Magnetic Absolute Hut. The standard AGSO policy for activity within the zone is no vehicles or other large structures within a 100m and no persons within 50m of either quiet zone buildings. To define the 100m limit of the zone a post was erected (during January of 1998) at the entrance to the magnetic quiet zone. All the necessary environmental preliminary assessments have been completed and approved by the Australian Antarctic Division. A suitably labelled sign is yet to be fitted to the post. A map showing the location of the sign relative to magnetic quiet zone buildings is shown in APPENDIX G.

2.1.4 1997 Instructions Manual

During 1997 the Mawson Geophysical Observatory Instructions Manual ([6] Roberts, P., 1997) was simplified and updated to reflect the changes in observatory procedures that had taken place over the last couple of seasons. The 1996 manual ([7] Giffen, A., 1996) contains information that while no longer directly relevant to current procedures forms a valuable reference.

2.1.5 Computer Access System

On the changeover voyage of the 1996/97 season two credit card sized password decoders (one is a spare) arrived from DPIE. It is intended these cards be used in conjunction with appropriate software to allow access to firewall protected AGSO computers by outside users, such as the Geophysicist at Mawson. However the software to support the system was never sent and the password system could not be installed.

2.2 Absolute Observations and Reductions

Absolute observations of the geomagnetic field were carried out regularly on Pier A of the Mawson Absolute Hut to calibrate the magnetic variometer. An average of 16 observations of F, D, I and H were carried out every month using the absolute instruments. Absolute observations were made in both quiet and disturbed field conditions. The routine absolute observations were reduced using software programs developed by Peter Crosthwaite ([4] Crosthwaite, P., 1994). The first absolute observation by the author was carried out on 27/12/96 and the last on 26/12/97. A typical monthly observation schedule comprised of:

- 6 X PPM, DEC, QHM 300, DIM, PPM
- 1 X PPM, DEC, QHM 301, DIM, PPM
- 1 X PPM, DEC, QHM 302, DIM, PPM

All DIM, QHM, and DEC observations used azimuth sightings to marks BMR 89/2 or SOH (when mark 89/2 was buried under snow) taken before and after, so both H and D could be determined from the QHM observations. A flood light was used to illuminate the mark BMR 89/2 over winter. All QHMs were used as 2π instruments at Mawson. The PPM observations were made with the PPM sensor head in the standard bolts down orientation. The declinometer was left on the pier with the weight hanging between sets of absolute observations.

Secondary instruments were included in the observation schedule about 2 times per month to ensure they remained calibrated with the primary instruments. Two secondary QHMs were used following the standard routine for determining H and D.

Temperature calibrations were performed at the start of the absolute observation. This was done by manually recording the temperature of the recorder room as displayed on the Doric Trendicator.

2.3 Absolute Instruments

2.3.1 Background

The primary absolute instruments used at Mawson in 1997 were:

- | | |
|---|-------------|
| • DIM Elsec 810/213, Theodolite 352229 | for D and I |
| • PPM Elsec 770/199 in bolts down orientation | for F |

The secondary instruments were:

- | | |
|--|-------------|
| • Declinometer 630332, Askania glass circle 611665 | for D |
| • QHM 300, Thermometer 1650, Askania glass circle 611665 | for H and D |
| • QHM 301, Thermometer 1416, Askania glass circle 611665 | for H and D |
| • QHM 302, Thermometer 1401, Askania glass circle 611665 | for H and D |
| • PPM Elsec 770/206 in bolts down orientation | for F |

The QHM reduction formula is as follows:

$$H = \frac{Kn}{(1 - k_1 T)(1 + k_2 H \cos \phi) \sin \phi \cos(\frac{1}{2}(\phi_+ - \phi_-) + \alpha)}$$

Where:	H	=	magnitude of horizontal component of the magnetic field;
	K	=	main constant of the QHM;
	n	=	rotational torsion applied during QHM measurement (multiple of π);
	k1	=	QHM temperature coefficient;

T	=	ambient temperature of QHM;
k2	=	QHM induction coefficient;
ϕ	=	$\frac{1}{2}(\phi+ + \phi-) =$ mean deflection angle;
$\phi+$	=	positive torsion deflection angle;
$\phi-$	=	negative torsion deflection angle;
and α	=	residual torsion in QHM fibre.

Table 2 to Table 4 details the QHM constants and parameters.

2.3.2 Performance During 1997

The absolute instruments performed generally well during 1997. It should be noted though that observations performed with QHM 301 are significantly more difficult to perform than with QHM 300 or 302. The instrument is difficult to stabilise and its thermometer difficult to read. Baselines residuals also seem to be higher scatter than those produced using instruments 300 or 302.

On 25/01/97 the fibre of the Declinometer broke while hanging the tension weight on the fibre at the end of that days observation set. The fibre was replaced and the instrument zeroed and on the 04/02/97 the Declinometer was fully operational.

2.4 Standard Instrument Comparisons and Corrections

The only travelling standard taken to Mawson during the summer of 1997/98 was Elsec PPM 770/210 and comparisons between it and 770/199 were performed by the Maria De Deuge on 28/12/97 and 30/12/97. Pre and post Mawson comparisons between PPM 770/210 and the Australian F standard (MNS-2.3) were performed at the Canberra Observatory and results of all comparisons are given in Table 5. The instrument corrections in this table have been compared against previous years corrections to obtain the adopted corrections for 1997 as shown below. These corrections (rounded to the nearest 0.1 nT) have been incorporated into the mean field values in this report:

I:	0.0 '	D:	0.0 '	F:	+4.5 nT
----	-------	----	-------	----	---------

In terms of X, Y, Z and H this corresponds to:

X:	0.7 nT	Y:	-1.5 nT	Z:	-4.2 nT	H:	1.7 nT
----	--------	----	---------	----	---------	----	--------

2.5 Variometer Instruments and Data

2.5.1 Introduction

A Ringcore Fluxgate Variometer (RCF) was used to measure geomagnetic variation (1 second sample interval) during 1997. The variometer system was housed in the sensor room of the Magnetic Variometer Building, on the eastern outskirts of the station about 90 metres from the Absolute Hut. A proton precession magnetometer (PPM) was located in the recorder room of the Variometer building and was used to measure total field strength (10 second sample interval). The Narod RCF system was installed in the Variometer Building on 11/12/92 ([5] Rada, A., 1994).

2.5.2 Performance of the Variometer during 1997

The RCF system performed well throughout the year with no faults with the sensor or electronics. Some data losses resulted from down time due to faults with the acquisition PC (see Section 2.6.3), the PPM, or installation of new acquisition software.

The PPM system however did not perform well during 1997. A continuing noise problem, resulting in a "spiky" output, with the PPM sensor existed for much of the year. Figure 7 illustrates the poor performance of the PPM during 1997. It is believed this problem contributed to a another fault which caused the COM2 port of the acquisition PC to become "clogged" on two separate occasions. The clogging of this port meant PPM data was not being logged by the PC. This fault caused significant loss of PPM data. A new sensor that arrived on the first voyage for 1997/98 was installed on 20/10/97. However tests revealed this sensor to be open circuit. Later this sensor was repaired and tested by the author and was left at Mawson as a backup sensor for the 1998 season.

Ultimately the original sensor was reinstalled. Another sensor arrived with Maria De Deuge on the changeover voyage for 1997/98. This sensor was installed and tested on 31/12/97.

2.5.3 Baseline Model

2.5.3.1 Background

The magnetic field can be derived from the variometer output by applying the following matrix equation:

$$\begin{pmatrix} X \\ Y \\ Z \end{pmatrix} = \begin{pmatrix} b_x \\ b_y \\ b_z \end{pmatrix} + \begin{pmatrix} d_x \\ d_y \\ d_z \end{pmatrix} * (Time - Time_0) + \begin{pmatrix} S_{xx} & S_{xy} & S_{xz} \\ S_{yx} & S_{yy} & S_{yz} \\ S_{zx} & S_{zy} & S_{zz} \end{pmatrix} * \begin{pmatrix} x \\ y \\ z \end{pmatrix} + \begin{pmatrix} q_x \\ q_y \\ q_z \end{pmatrix} * t_h + \begin{pmatrix} Q_x \\ Q_y \\ Q_z \end{pmatrix} * t_e$$

where X, Y and Z are the components of the geomagnetic field in nano tesla

b_x, b_y, b_z are baselines for each of the components at standard temperature and reference time

d_x, d_y, d_z are baseline drift rates for each of the elements

$Time_0$ is a reference time

s_{ij} is the scale value matrix

x, y, z are the digital ordinates from the variometer (also designated by a, b, c)

q_x, q_y, q_z are temperature coefficients for the variometer sensor head

Q_x, Q_y, Q_z are temperature coefficients for the variometer electronics

t_h is the digital temperature ordinate for the variometer sensor

t_e is the digital temperature ordinate for the variometer electronics

The variometer sensor temperature is derived using the equation:

$$T_h = B_t + S_t * (t_h)$$

where T_h is the variometer sensor temperature in degrees Celsius

B_t is the temperature baseline

S_t is the temperature scale value

t_h is the digital temperature ordinate for the variometer sensor

2.5.3.2 Temperature Model

Calibration of the variometer temperature channel T_h was achieved using a Doric Trendicator Model 410A at the start of each absolute observation. The Doric readings (averages of 6 x 10s samples over an UTC minute) were regressed against the variometer temperature counts (also averages of 6 x 10s samples). Ninety eight calibrations were used in the regression; covering the period 01/01/97 to 31/12/97. The resulting temperature model is:

$$T_h = (11.74 \pm 0.15) + (0.10 \pm 0.009)(t_h) \text{ deg C}$$

For 1996 the temperature model was:

$$T_h = (11.79 \pm 0.06) + (0.079 \pm 0.005)(t_h) \text{ deg C}$$

Note: the numbers after the '±' are one standard error in each case. The model adopted for 1997, shown below, is the same as the model used in previous years (the origin of this model is not known to the author). In 1997 the temperature coefficients q and Q were both adopted as zero.

$$T_h = (11.81) + (0.137)(t_h) \text{ deg C}$$

2.5.3.3 Magnetic Field Model

The scale value parameters used in the model matrix equation (see APPENDIX C for the 1997 adopted scale values) were derived through multi-linear regression of the year's absolute measurements of the field (X, Y, Z) with time and the corresponding digital variometer and temperature data, using an Excel spreadsheet package. The resulting parameters were then used to calculate values of the field from the variometer digital data, which were compared with field values obtained from the absolutes. The residuals from the two sets of values were minimised by calculating baseline values and drift rates and applying them to the variometer model. Following is the procedure used for determining the baseline model for the 1997 variometer data.

Data Continuity Check

A baseline file, TRIAL.CON, was produced, using a fixed set of baselines and scale values taken from the last period of the 1996blv.maw (1996 baseline model file). Drift rates were set to zero.

To ensure baseline continuity a file (.OBS file) was produced containing all 1997 observations data plus two months of data either side of the 1997 data (ie. data for 1/11/96 to 31/2/98 inclusive). This file was then processed for DIM and QHM 300 data using REDUCE, COMPARE and MACQCSV (vout option) to produce a .CSV file containing the necessary baseline residual information.

The residual X, Y, and Z data from the .CSV file was imported into Excel and plotted against time. Separate plots for DIM and QHM data were produced. These plots were then used to confirm that at day zero (ie. the start of 1997 data) there were no large steps in the baselines from the end of 1996 to the beginning of 1997 data.

Scale Value Check using Multiple Linear Regression

Using the plots from above, periods of approximately linear data, suitable for performing regressions were identified. These were Period 1 (days 001 to 149), Period 2 (days 150 to 280), and Period 3 (days 281 to 365).

Again TRIAL.CON, REDUCE, COMPARE and MACQCSV (this time using the aout option) were used to process the 1997 absolutes file (the .OBS without 1996 or 1998 data) to produce linearised X, Y, Z, a, b, c, t_h , t_e , and date data. This data was imported into Excel and multiple linear regressions (using the function LINEST) were performed on each of X versus (a, b, c, t_h , t_e , date), Y versus (a, b, c, t_h , t_e , date), and Z versus (a, b, c, t_h , t_e , date), for days 001 to 365 as well as the periods 1, 2, and 3. This was done separately for DIM, QHM 300, and DIM/QHM 300 data combined.

The results of these regressions are presented in APPENDIX C. The scale values resulting from the regressions were compared with those determined in 1996 and 1995. Based on these comparisons and the reliability of the regression results for 1997, as determined from the standard error for each scale value, it was decided that the 1997 results could be adopted for the 1997 baseline model as opposed to using 1996 scale values.

Baseline Step Check using Fcheck

To identify possible steps in the baseline of Variometer data, EXAMINE (using FCHECK) was used on the 1997 Variometer data. The output of FCHECK was imported into Excel and plotted against time to produce the plot shown in Figure 7. The high degree of spread in the data (particularly from day 200 onwards) is a result of the noise produced by the PPM sensor's poor internal connections. The spread is so high in this data that it could not be used as a check for baseline steps. Consequently no additional baseline steps were applied to the Variometer data for 1997.

Producing a Baseline File (1997blv.maw)

The file TRIAL.CON was modified to contain the newly adopted scale values. The fixed baseline (taken from the last baseline values of 1996blv.maw) and zero drift rates were retained. It should be noted that changing the scale values will change the ordinates and hence the baseline values between the end of 1996 and the start of 1997. The magnitude of this unavoidable change would be apparent in the daily means.

TRIAL.CON, REDUCE, COMPARE and MACQCSV (using the vout option) were used to process the 1997 absolutes file.

The residual X, Y, and Z data from the .CSV file was imported into Excel and plotted against time. Separate plots for DIM and QHM data were produced. Using these plots, periods of approximately linear data were identified, for the X (3 periods), Y (2 periods), and Z (6 periods) components.

Again TRIAL.CON, REDUCE, COMPARE, and MACQCSV (this time using the aout option) were used to process the 1997 absolutes file to produce linearised X, Y, Z, a, b, c, t_h , t_e , and date data.

The .CSV file was imported into an Excel spreadsheet. The parameters were then used to calculate values of the X, Y, and Z for each of the 6 periods from the variometer digital data, which were compared with field values obtained from the absolutes. The residuals from the two sets of values were minimised by determining baseline values and drift rates and applying them to the variometer model. From the .CSV data annual mean values of X, Y, and Z were also calculated.

The results from above were typed into 1997blv.maw which is a standard format suitable for use with the program MAGOBS.EXE and ABSLOB.EXE which is used to further process the data. The output of ABSLOB.EXE produces a baseline file similar to TRIAL.CON (actually called 1997mac.maw as shown in APPENDIX D). This file was used to produce residual data which was plotted (Figure 8 to Figure 10) and checked to ensure the data was flat and zero centred. The contents of 1997blv.maw is also shown in APPENDIX D.

2.5.4 Processing the 1997 Variometer Data

2.5.4.1 Day and Month Files

The batch program GPROC was run (from /geomag2/obs/maw/1997/) to process the low resolution data files into day files (eg. 1997d001.maw). GPROC also produces a cron job, on lodestone, to process the day files into month files (eg. 1997jan.maw). These month files form the basis for further data processing. It should be noted that where multiple raw data files exist for a single day GPROC should be run from a DOS shell. This requires the appropriate raw data files to be copied across to the local hard disk. If multiple days data are processed from the geomag2 only the first file encountered will be processed.

2.5.4.2 World Data Centre (WDC) Data

For each day of variometer data the month files have a header which contains default spike filter settings used by the program MAGOBS to filter out noisy data. These spike filters are set to zero so unfiltered data can be produced. From lodestone and using the on line unix editor each spike filter string was modified (by using the replace utility) as follows:

- Default spike filter setting: t 100 75 2
- Modified spike filter setting: t 0 0 0

MAGOBS is run (from /geomag/bin/) using the command xm.sh. The Minute data option (type m) and then the NGIC option (type n) were chosen to produce output files suitable for viewing (eg. 1997m01.maw for the month of January, 1997m02.maw for February, etc). These files are then renamed (eg. maw97jan.bin) and copied to the directory /geomag2/mag1997/maw/. This file name and directory structure is necessary in order to view the files using the INTERMAGNET software which can be executed from /geomag2/intermag/ using the command im01. The years variometer data was viewed to check for data gaps, noise spikes, and overall quality.

To produce data suitable for the WDC, again MAGOBS was run using the Minute data option, and then the w option to produce 400 char X, Y, Z, and F data. Files produced (one for each month) are the same name as above (eg 1997m01.maw). These were renamed to a standard form (eg maw97jan.wdc). A second format (120 char IAGA format for H, D, Z, F, I, X, and Y data) was also produced using MAGOBS but using the MHV file option (type h). This produces a single file (1997iaga.maw) which was renamed to maw97mhv.wdc. All the .wdc files were then zipped (file name maw97wdc.zip), using PKZIP V2.04g, and sent to WDC by anonymous ftp (ftp.ngdc.noaa.gov) with a covering email (to lmorris@ngdc.noaa.gov).

2.5.4.3 Data Loss

Table 8 details the loss of Variometer data for 1997. The dates and times apply to high (h) and low (v) resolution files. In addition part of the high resolution data file for the 30/01/97 has been lost for reasons unknown. The low resolution data file for that day, however, is complete.

2.5.5.4 K Indices

Preliminary magnetic data reports were sent monthly to the Geomagnetism section in Canberra, including K indices and mean monthly quiet field values. K indices were derived as range indices from the digital data using software written by ([4] Crosthwaite, P., 1994). The five days of lowest K index sum each month were used to derive the mean monthly quiet field values. A summary of the final monthly K index distribution is given in Table 9 and summarised as the yearly K index distribution in Figure 11. Full final K indices and daily sums are presented in the Australian Geomagnetism Report 1997 (in preparation).

2.5.5.5 Monthly Mean Field Values

Monthly mean values (see Table 10) were calculated for January to December 1997 using the variometer parameters presented in APPENDIX D. To produce this data MAGOBS is run from DOS (from directory /geomag/bin/dos/) using the command xm.sh. MAGOBS produced a 'Hour-Value Special' file, named 1997hvs.maw, and a MS-Word formatted annual summary file, named mhvals01.doc. By appropriate editing and reformatting of mhvals01.doc the data shown in Table 10 can be extracted. For each month mean field values were derived for all days of the month, 5 international quiet days, 5 international disturbed days. Final corrections given in Section 2.4 have been applied.

2.5.5.6 Hourly Mean Values

The hourly mean values shown in APPENDIX H are also extracted from the file mhvals01.doc. The monthly averages of hourly mean values have been derived using the variometer model and corrections presented in this report. The UT time given at the head of each column indicates the start of the hour over which the values below have been averaged. Values have been calculated for all days, international quiet days (Q) and international disturbed days (D). The plots at the end of APPENDIX H are produced by choosing option p when MAGOBS is run. These files are in encapsulated postscript format.

2.6 Acquisition System

2.6.1 Introduction

The Ring Core Fluxgate measured the three-components X (positive north), Y (positive east) and Z (positive down) of the field. The total field strength, F, was also logged with an Elsec 820 proton precession magnetometer (PPM).

The temperature of both the sensor housing, T_h , and the electronics, T_e , were monitored by sensors inside the perspex RCF sensor cover, and the electronics box, respectively. Temperature in the variometer room was regulated by a fast-cycle heater, nominally set at 10⁰ C. Seasonal adjustment of the thermostat during 1997 was necessary to maintain the RCF head temperature to the set point.

The digital X, Y, Z, T_h , T_e and PPM data were recorded on an NEC IBM-AT compatible Powermate 1 Personal Computer located in the recorder room of the Variometer Building. The six channels of digital data were recorded every second and as one minute averaged values onto hard disk for all of 1997.

The timing for the digital recording system was taken from the computer DOS clock with a correction factor applied in the acquisition software. The minute pulses were registered as fiducial marks by the acquisition software, which allowed accurate time comparisons to be made between the PC time and the GED clock. The real time CMOS clock in the acquisition PC has a drift rate of approximately 1 second per day and was synchronised to the DOS clock every 2-3 days when data was copied from the PC onto floppy disk to transfer it to the office PC.

2.6.2 Fiducial Recording

It is possible to record the time and corresponding variometer data for each individual field reading by using the three fiducial buttons located as follows:

- On the wall adjacent to the acquisition PC in the variometer building (for temperature calibrations)
- On the bench in the absolute hut (for PPM readings)
- Hanging from Pier A in the absolute hut (for declinometer, QHM and DIM readings)

However fiducial recordings were not used during 1997 as the cable that allows the recordings to be performed has not been functional since 10 May 1996. Repair or replacement of the cable was not practical.

2.6.3 Performance During 1997

Several problems occurred with the acquisition PC during the year. On 20/10/97 the PC failed to respond to any keystrokes. A system re-boot was required to fix the problem. On 16/3/97 data files failed to write to the hard drive despite there being ample drive space. It is possible that the disk had become badly fragmented so all unwanted files were removed from the hard disk. No further problems of this nature occurred. On 8/5/97 it was discovered that the COM2 port of the acquisition PC to become “clogged”. The clogging of this port meant PPM data was not being logged by the PC. The problem had existed since 9/4/97. A system re-boot appeared to fix the problem however it occurred again on the 8/8/97 but was not detected until the 11/8/97. On 20/5/97 new acquisition software was installed and tested on the acquisition PC.

2.7 Data Tables and Figures

Table 2: Mawson QHM Constants

Note that collimation is the angle between the normal of the magnet's mirror and its magnetic axis. In some expressions for calculating H the value of n is taken as the number of multiples of 2π. The software used to calculate H uses values of n as multiples of π. Consequently the value of K, in this table, is half the value of K that is often quoted for the instruments.

<i>QH M</i>	<i>K nT</i>	<i>k1 10⁻⁵ °C⁻¹</i>	<i>k2 10⁻¹⁰ nT⁻¹</i>	<i>α.H 10⁵ 'nT</i>	<i>Odd π mis- alignment</i>	<i>Collimation</i>
300	7828.0	39.4	69.0	2.22	0.0'	22.5'
301	8230.5	39.7	90.0	0.00	0.0'	72.5'
302	7690.1	42.0	90.0	0.00	0.0'	27.0'
172	7938.5	39.1	46.1	0.00	0.0'	0.0'
704	6025.8	26.0	0.0	0.00	0.0'	27.0'

Table 3: Mawson Thermometer Correction Factors

<i>Thermometer</i>	<i>-10°C</i>	<i>0°C</i>	<i>+10°C</i>	<i>+20°C</i>	<i>+30°C</i>	<i>+40°C</i>
1650	-0.10	0.00	+0.05	+0.20	+0.10	+0.15
1401	+0.10	+0.10	+0.05	0.00	-0.50	-
1416	-0.10	-0.10	-0.10	-0.05	-0.10	-0.10
619	-	-0.05	0.00	-0.05	-0.10	-0.10
704	0.00	-	-	-	-	0.00

Table 4: Mawson QHM α Angles

To calculate QHM α angles a value of $H=18500$ nT is used to allow a direct comparison with previous years. A value of αH is taken from each QHM absolute observation set to enable calculation of α angles. For QHM 301 there were actually 16 absolute observations done but 2 results were rejected from the α angle average and standard deviation calculation.

<i>Instrument</i>	<i>1997 Mean α Angle</i>	<i>1997 Samples</i>	<i>1996 Average</i>
QHM 300	12.7' $\pm$ 0.5	70	13.0' $\pm$ 0.5
QHM 301	-11.8' $\pm$ 0.3	14	-12.2' $\pm$ 0.5
QHM 302	-0.4' $\pm$ 0.5	12	-0.9' $\pm$ 0.4

Table 5: PPM Comparisons for 1997/98

Date	Place	Instrument Difference (nT) MNS-2.3 - E770/210	Instrument Difference (nT) E770/210 - E770/199
22/10/97	Canberra	Ave = 0.9, 95% = 0.33	na
28/12/97	Mawson	na	Ave = 4.1, 95% = 0.4
30/12/97	Mawson	na	Ave = 3.7, 95% = 0.3
27/05/98	Canberra	Ave = 0.6, 95% = 0.20	na

Table 6: Mawson Instrument Differences Through Baselines

The secondary instruments were included in the observation routine and comparison with the standard instruments produced the instrument differences shown.

Instrument A	Instrument B	Field Component	1997 Instrument Difference A-B	Samples A/B	1996 Instrument Difference A-B
Decl 630332	QHM 300	D	-2.3' $\pm$ 0.4	95/70	-2.0' $\pm$ 0.7
Decl 630332	QHM 301	D	0.0' $\pm$ 0.9	95/13	-0.1' $\pm$ 0.5
Decl 630332	QHM 302	D	-0.8' $\pm$ 1.4	95/11	-0.8' $\pm$ 0.3
Decl 630332	DIM 213	D	-0.9' $\pm$ 0.0	95/99	-1.0' $\pm$ 0.5
DIM 213, PPM 199	QHM 300, PPM 199	I	-0.1' $\pm$ 1.5	70/99	-0.1' $\pm$ 0.1
DIM 213, PPM 199	QHM 300	H	-1.1' $\pm$ 0.4	98/69	-0.9' $\pm$ 1.3
DIM 213, PPM 199	QHM 301	H	3.3 nT $\pm$ 1.9	98/15	5.2 nT $\pm$ 0.9
DIM 213, PPM 199	QHM 302	H	-2.2 nT $\pm$ 0.4	98/10	-3.1 nT $\pm$ 1.6

Table 7: Mawson Instrument Corrections for QHM 300

These values are derived from plots (see Figure 4 to Figure 6) of the baseline residual difference between DIM and QHM 300 for the X, Y and Z components.

Days of 1997	X correction (nT)	Y correction (nT)	Z correction (nT)
1 - 365	+4	+4	0

Table 8: Mawson Variometer Data Loss for 1997

Date/Time (UT)	DOY	Channel	Cause
20/02/97(0844) to 20/02/97 (0849)	051	All	PC failed to respond to keystrokes. Re-booted PC.
16/03/97 (1203) to 17/03/97 (0852)	075 - 076	PPM	PC hard drive failed to write.
17/03/97 (1059) to 17/03/97 (1113)	076	All	Diagnosing hard drive fault. Re-booted PC
09/04/97 (2041) to 08/05/97 (0959)	099 - 128	PPM	Noisy PPM sensor causing COM2 on PC to fail.
08/05/97 (0943) to 08/05/97 (0959)	128	All	Diagnosing COM2 fault. Re-booted PC.
20/05/97 (0827) to 20/05/97 (0828)	140	All	Installing new versions of acquisition software.
08/08/97 (0054) to 11/08/97 (0720)	220 - 223	PPM	Noisy PPM sensor causing COM2 on PC to fail.
20/10/97 (0857) to 20/10/97 (0924)	293	PPM	Testing new Elsec sensor head.
20/10/97 (0908) to 20/10/97 (0924)	293	All	Testing new Elsec sensor head. Rebooted PC.

Table 9: Mawson Monthly Average K Index for 1997

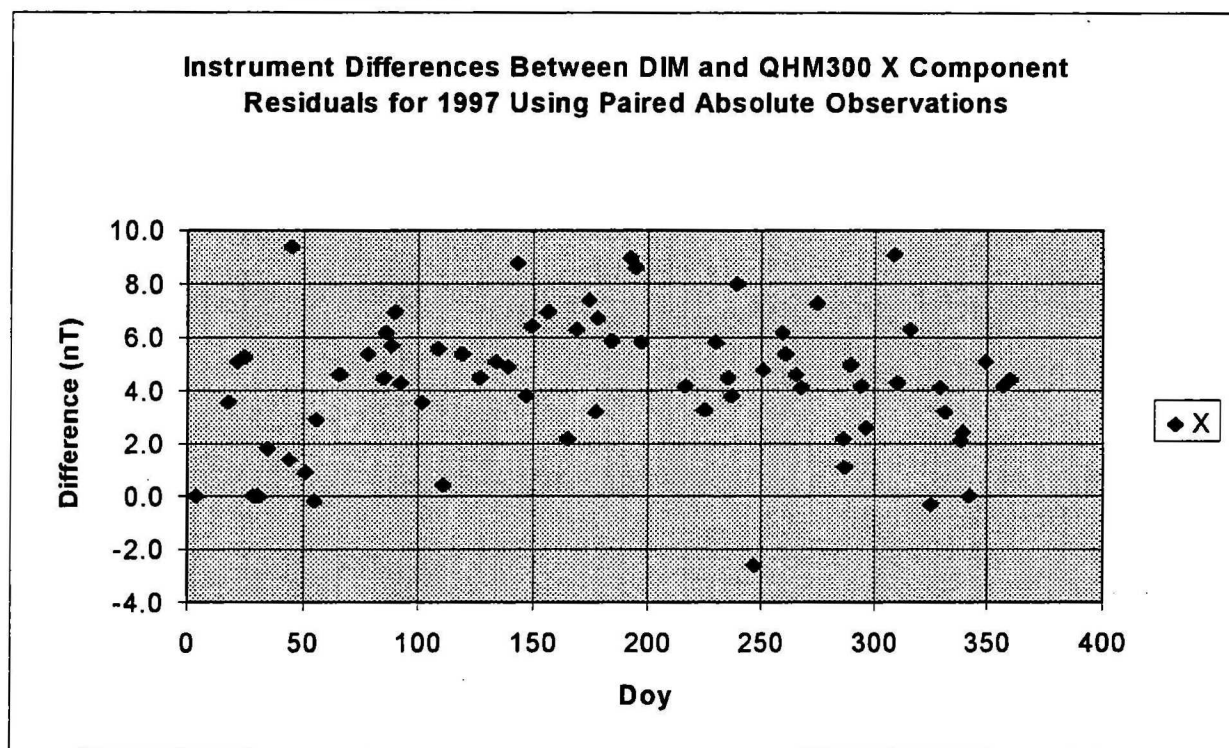
Month	Mean K Index	K0 %	K1 %	K2 %	K3 %	K4 %	K5 %	K6 %	K7 %	K8 %	K9 %
Jan	3.21	0.4	7.8	25.8	25.4	23.8	12.1	3.1	1.6	0.0	0.0
Feb	3.25	1.3	11.6	22.4	25.9	14.2	15.1	8.2	1.3	0.0	0.0
Mar	3.03	3.9	14.8	22.3	21.1	19.1	10.9	5.9	2.0	0.0	0.0
Apr	3.18	4.6	14.2	20.0	21.3	13.8	14.6	9.2	2.5	0.0	0.0
May	2.64	14.0	17.0	17.0	20.8	14.0	9.8	5.3	1.9	0.0	0.0
Jun	2.72	9.2	14.6	21.7	25.8	11.3	13.8	3.3	0.4	0.0	0.0
Jul	2.53	3.6	22.2	28.2	22.6	13.7	7.7	1.2	0.4	0.4	0.0
Aug	2.79	6.6	14.8	21.1	27.7	15.2	9.8	3.5	1.2	0.0	0.0
Sep	3.17	2.1	12.1	19.6	27.9	17.5	14.2	5.4	1.3	0.0	0.0
Oct	3.02	3.5	13.7	22.3	26.2	15.6	12.1	4.7	2.0	0.0	0.0
Nov	3.29	0.0	10.4	22.9	25.8	20.0	10.8	9.2	0.8	0.0	0.0
Dec	2.62	2.8	15.3	31.0	29.4	12.9	6.5	2.0	0.0	0.0	0.0
Annual	2.95	4.3	14.0	22.9	25.0	15.9	11.5	5.1	1.3	0.0	0.0

Table 10: Mawson Monthly Mean Field Data

Month	Days	X (nT)	Y (nT)	Z (nT)	F (nT)	H (nT)	D (deg)	I (deg)
January	All	7778.3	-16857.2	-45678.2	49307.0	18565.3	-65° 13.8'	-67° 52.9'
	Q	7782.0	-16861.8	-45673.8	49305.0	18571.0	-65° 13.6'	-67° 52.4'
	D	7767.8	-16841.5	-45682.8	49304.3	18546.7	-65° 14.4'	-67° 54.2'
February	All	7764.3	-16850.1	-45686.8	49310.3	18552.9	-65° 15.6'	-67° 53.9'
	Q	7769.7	-16860.5	-45678.5	49306.9	18564.7	-65° 15.5'	-67° 52.9'
	D	7736.5	-16812.9	-45703.0	49308.4	18507.7	-65° 17.4'	-67° 57.3'
March	All	7757.0	-16851.6	-45683.3	49306.4	18551.2	-65° 17.0'	-67° 53.9'
	Q	7770.2	-16867.8	-45669.6	49301.3	18571.5	-65° 16.0'	-67° 52.3'
	D	7743.7	-16828.5	-45698.5	49310.6	18524.7	-65° 17.4'	-67° 56.0'
April	All	7747.3	-16849.4	-45690.7	49311.0	18545.2	-65° 18.4'	-67° 54.5'
	Q	7761.6	-16863.9	-45667.1	49296.3	18564.3	-65° 17.1'	-67° 52.7'
	D	7728.5	-16834.0	-45719.8	49329.9	18523.5	-65° 20.4'	-67° 56.7'
May	All	7747.0	-16857.6	-45674.6	49298.8	18552.6	-65° 19.1'	-67° 53.6'
	Q	7761.8	-16873.2	-45666.3	49298.8	18572.9	-65° 17.8'	-67° 52.1'
	D	7717.9	-16832.3	-45698.0	49307.3	18517.4	-65° 22.1'	-67° 56.5'
June	All	7747.2	-16863.4	-45663.7	49290.7	18557.9	-65° 19.5'	-67° 53.0'
	Q	7756.9	-16872.8	-45664.8	49296.4	18570.4	-65° 18.6'	-67° 52.2'
	D	7734.3	-16851.4	-45667.8	49288.4	18541.6	-65° 20.8'	-67° 54.1'
July	All	7752.6	-16875.8	-45651.2	49284.2	18571.4	-65° 19.6'	-67° 51.8'
	Q	7754.5	-16880.8	-45653.4	49288.2	18576.7	-65° 19.7'	-67° 51.5'
	D	7742.5	-16860.8	-45641.4	49268.5	18553.6	-65° 20.1'	-67° 52.7'
August	All	7744.3	-16870.1	-45654.7	49284.2	18562.7	-65° 20.5'	-67° 52.4'
	Q	7748.2	-16876.9	-45655.8	49288.1	18570.5	-65° 20.4'	-67° 52.0'
	D	7728.4	-16845.3	-45660.2	49278.3	18533.6	-65° 21.3'	-67° 54.5'
September	All	7734.1	-16864.9	-45664.0	49289.5	18553.8	-65° 21.9'	-67° 53.3'
	Q	7746.2	-16880.9	-45653.8	49287.3	18573.3	-65° 21.1'	-67° 51.7'
	D	7719.4	-16843.4	-45678.7	49293.6	18528.2	-65° 22.7'	-67° 55.3'
October	All	7731.6	-16867.0	-45671.2	49296.5	18554.7	-65° 22.5'	-67° 53.4'
	Q	7742.9	-16881.8	-45658.1	49291.1	18572.8	-65° 21.7'	-67° 51.9'
	D	7708.5	-16835.3	-45690.4	49300.0	18516.4	-65° 23.9'	-67° 56.4'
November	All	7738.9	-16883.0	-45670.2	49302.2	18572.3	-65° 22.5'	-67° 52.2'
	Q	7737.5	-16884.9	-45662.2	49295.2	18573.4	-65° 22.8'	-67° 51.9'
	D	7732.0	-16865.6	-45689.1	49312.8	18553.7	-65° 22.3'	-67° 53.9'
December	All	7744.6	-16890.7	-45651.0	49287.9	18581.6	-65° 22.1'	-67° 51.1'
	Q	7747.9	-16894.9	-45649.4	49288.2	18586.7	-65° 21.9'	-67° 50.7'
	D	7738.4	-16876.3	-45653.6	49284.6	18566.1	-65° 22.0'	-67° 52.2'
Annual	All	7748.9	-16865.1	-45670.0	49297.4	18560.1	-65° 19.4'	-67° 53.0'
	Q	7756.6	-16875.0	-45662.8	49295.2	18572.4	-65° 18.8'	-67° 52.0'
	D	7733.2	-16843.9	-45681.9	49298.9	18534.4	-65° 20.4'	-67° 55.0'

Figure 1: Mawson DIM 810/213 and QHM 300 X Component Instrument Difference

This figure shows the difference between the X component measured by DIM 810/213 and QHM 300 for all paired observations done with these instruments.

**Figure 2: Mawson DIM 810/213 and QHM 300 Y Component Instrument Difference**

This figure shows the difference between the Y component measured by DIM 810/213 and QHM 300 for all paired observations done with these instruments.

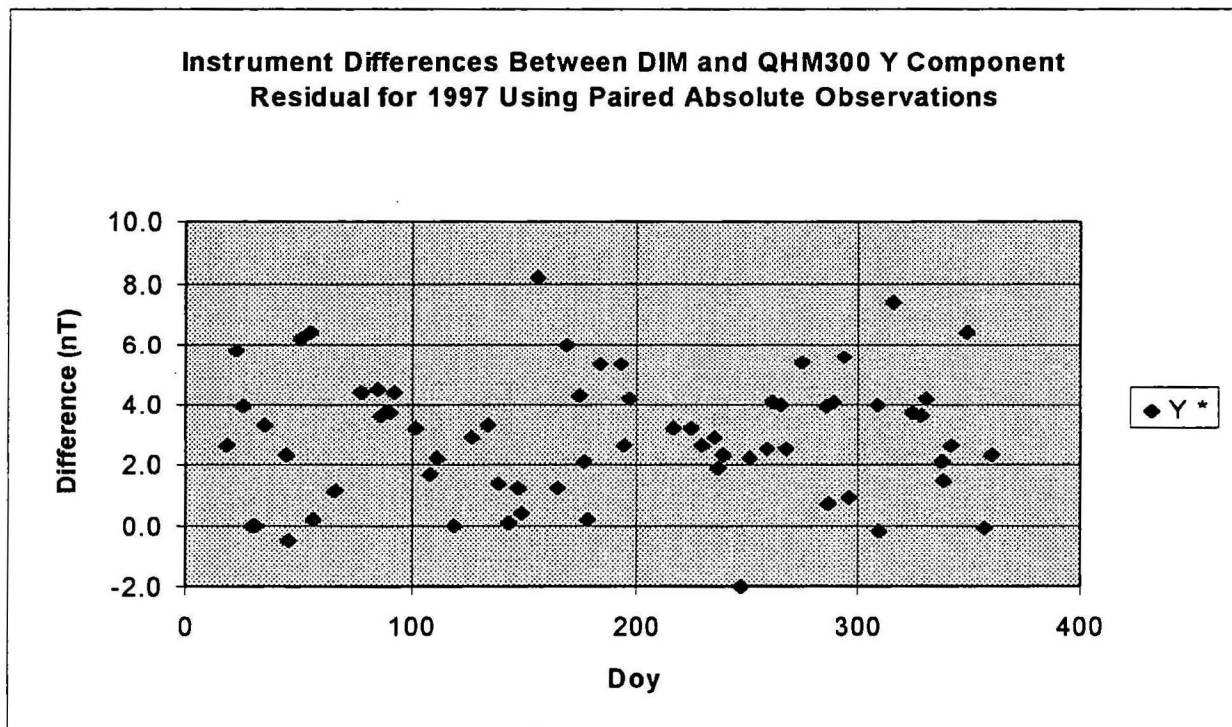


Figure 3: Mawson DIM 810/213 and QHM 300 Z Component Instrument Difference

This figure shows the difference between the Z component measured by DIM 810/213 and QHM 300 for all paired observations done with these instruments.

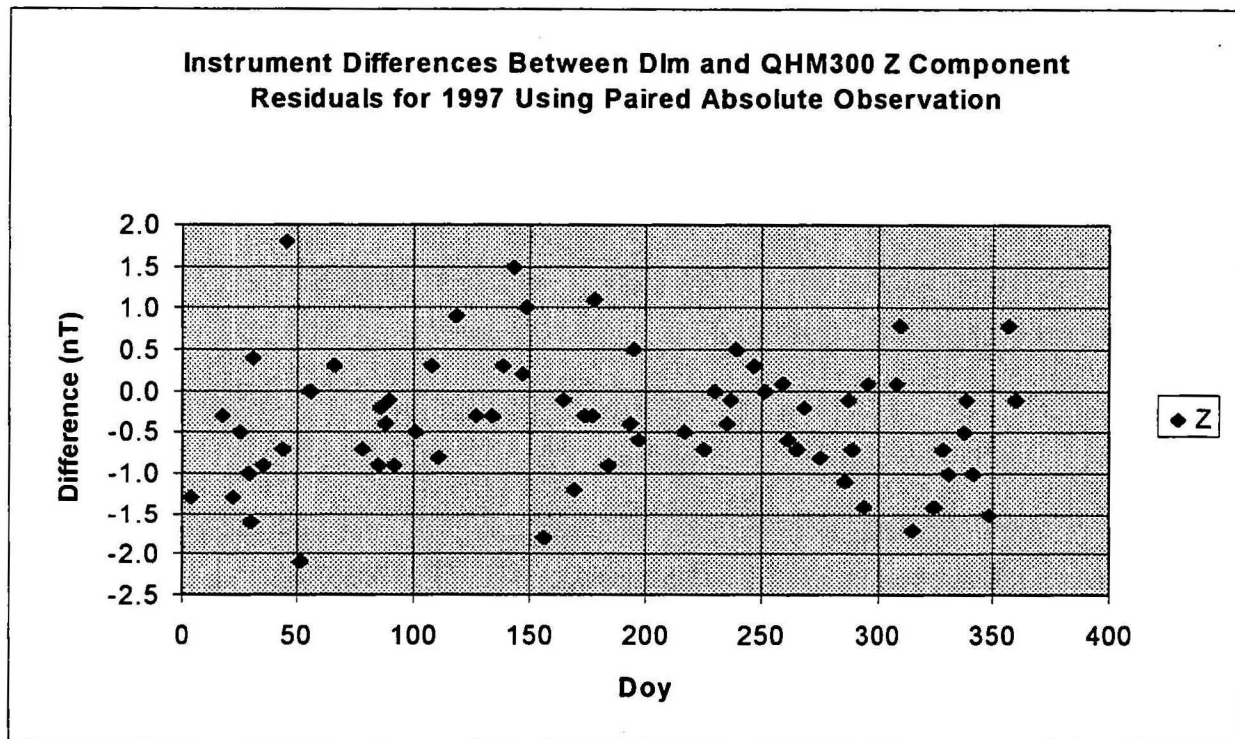
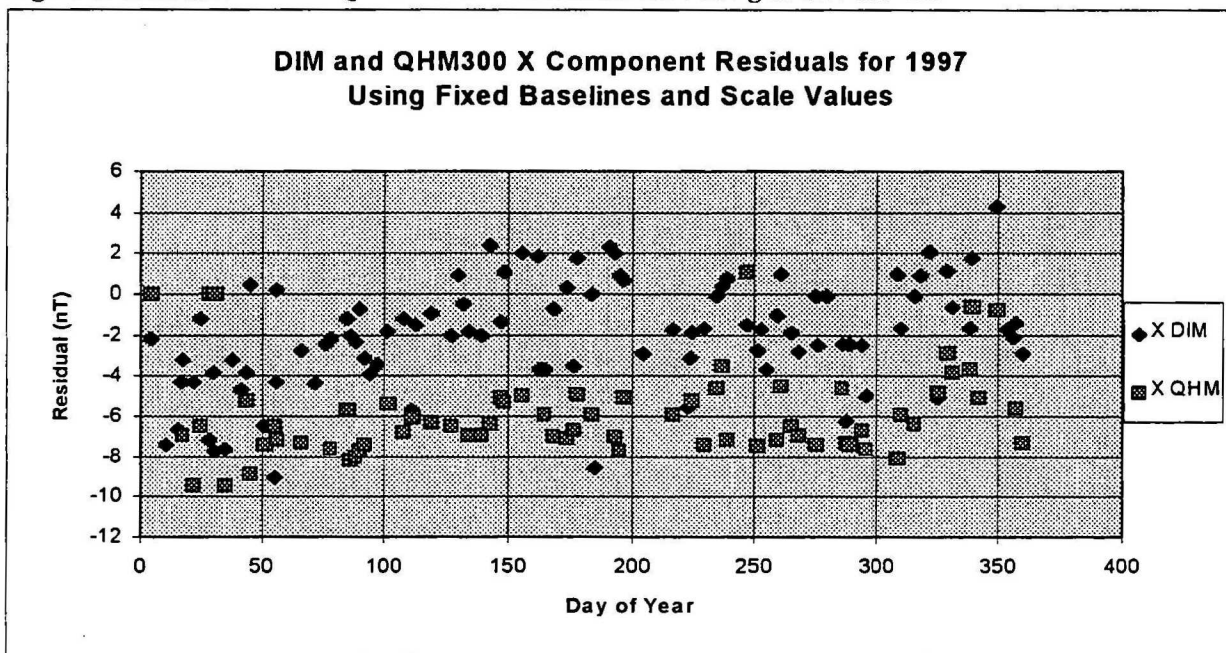
**Figure 4: Mawson DIM and QHM 300 X Residuals for 1997 using Fixed Baselines**

Figure 5: Mawson DIM and QHM 300 Y Residuals for 1997 using Fixed Baselines

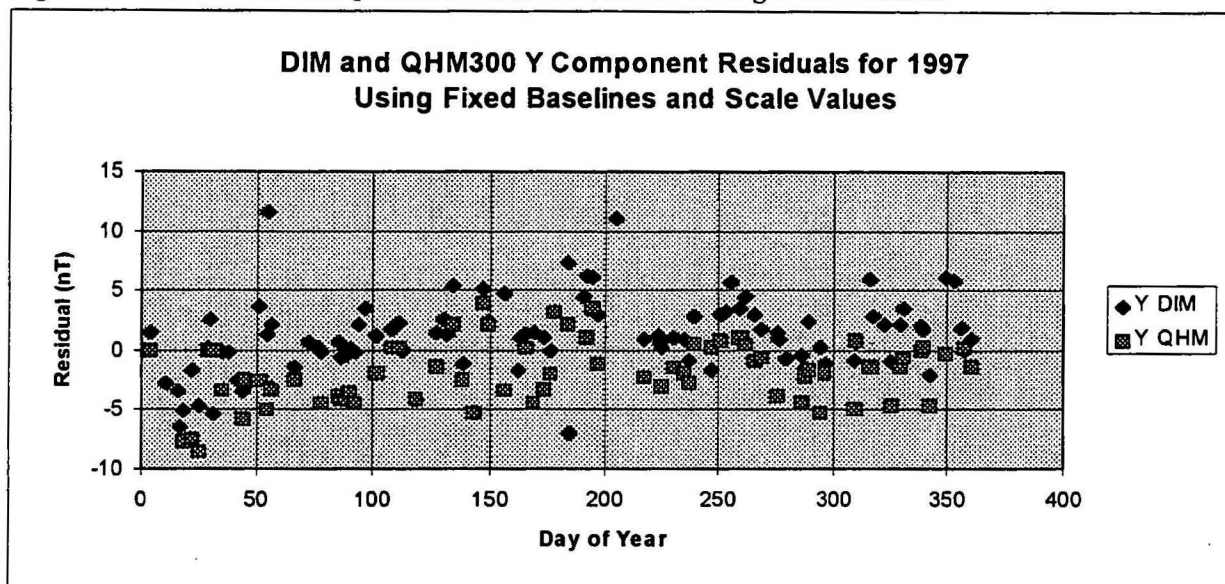


Figure 6: Mawson DIM and QHM 300 Z Residuals for 1997 using Fixed Baselines

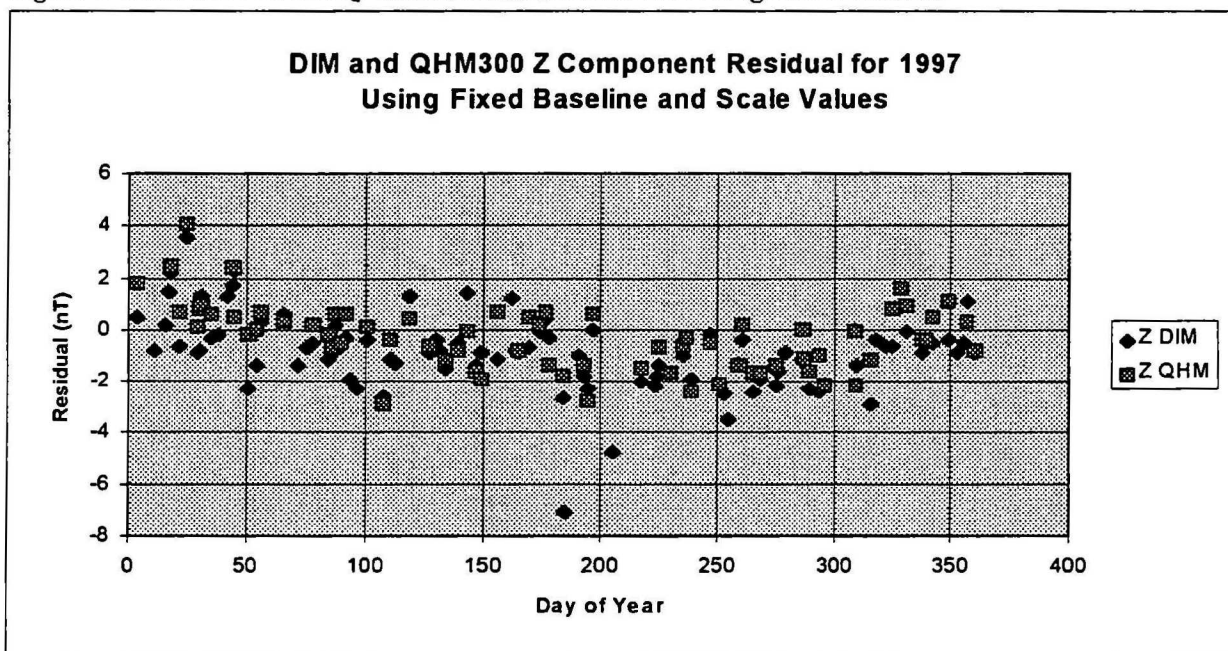


Figure 7: Mawson Fcheck Variometer Data for 1997

This figure was produced by processing the 1997 Variometer data with EXAMINE (using FCHECK). The high degree of spread in the data (particularly from day 200 onwards) is a result of the noise produced by the PPM sensor's poor internal connections.

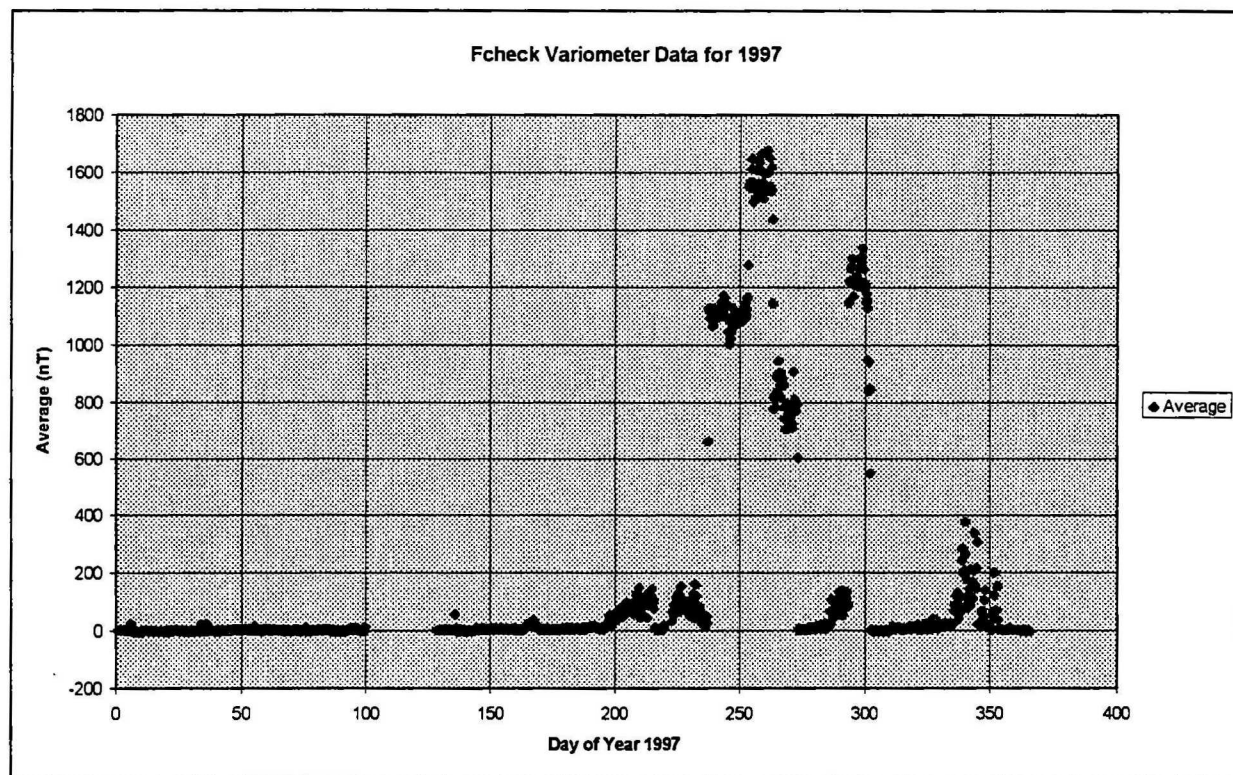
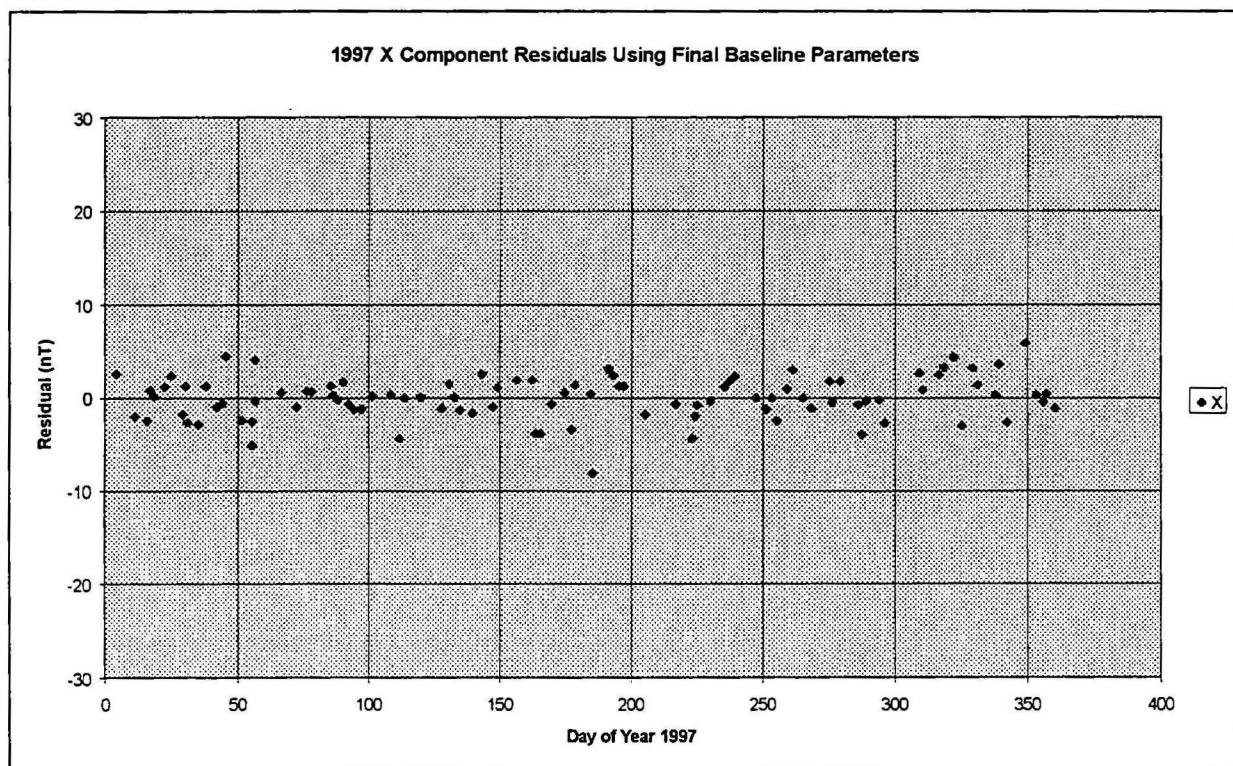
**Figure 8: Mawson X Residuals using Final Variometer Parameters**

Figure 9: Mawson Y Residuals using Final Variometer Parameters

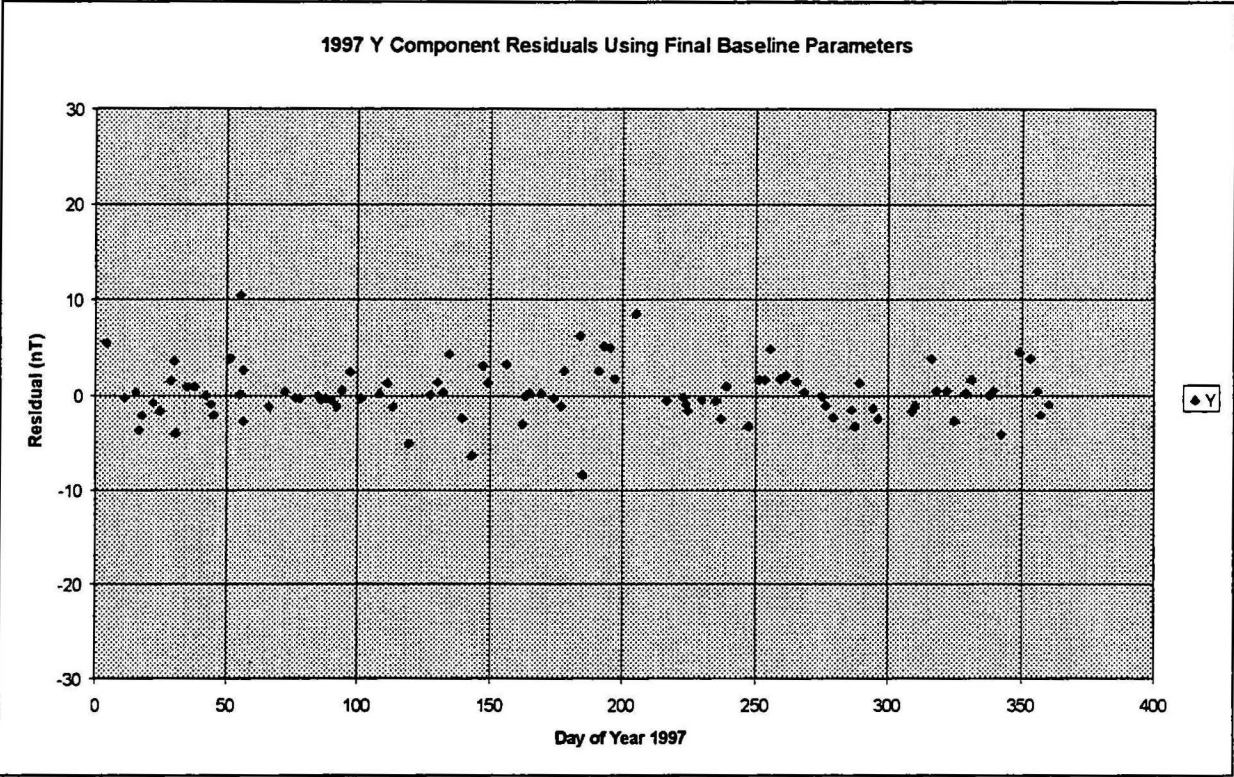


Figure 10: Mawson Z Residuals using Final Variometer Parameters

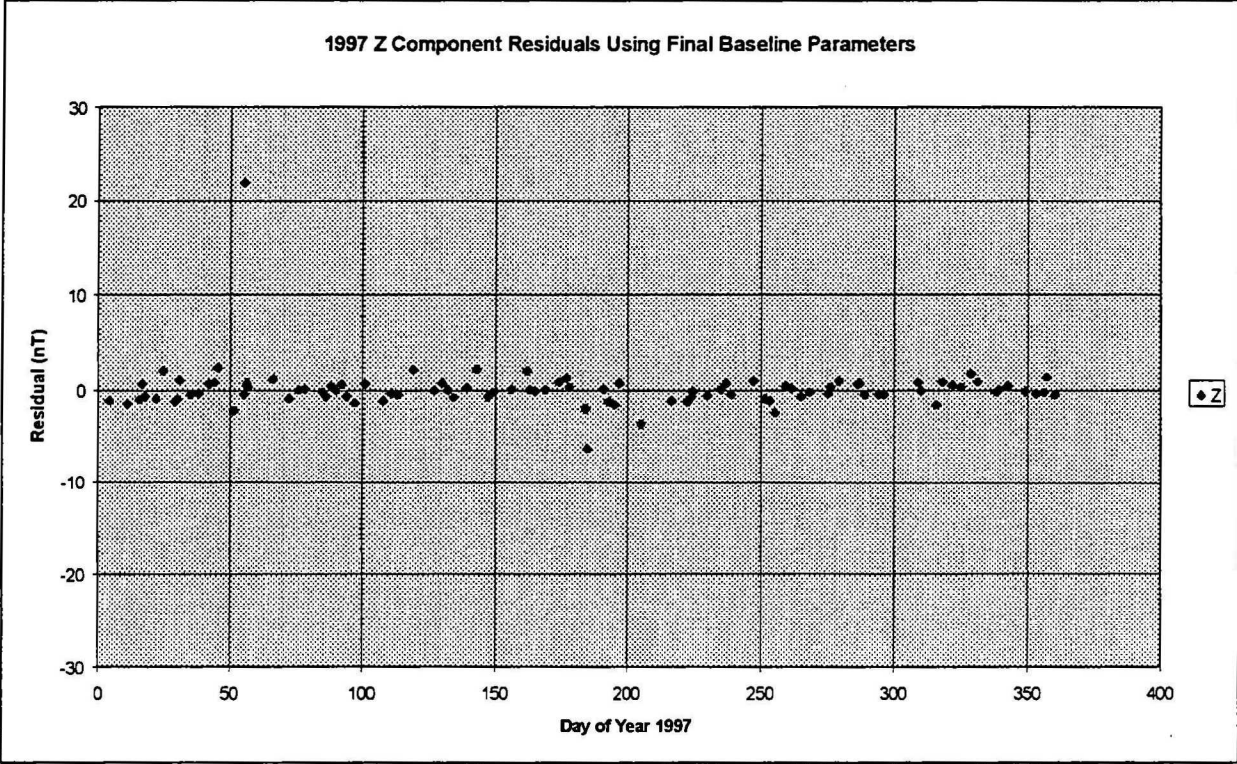
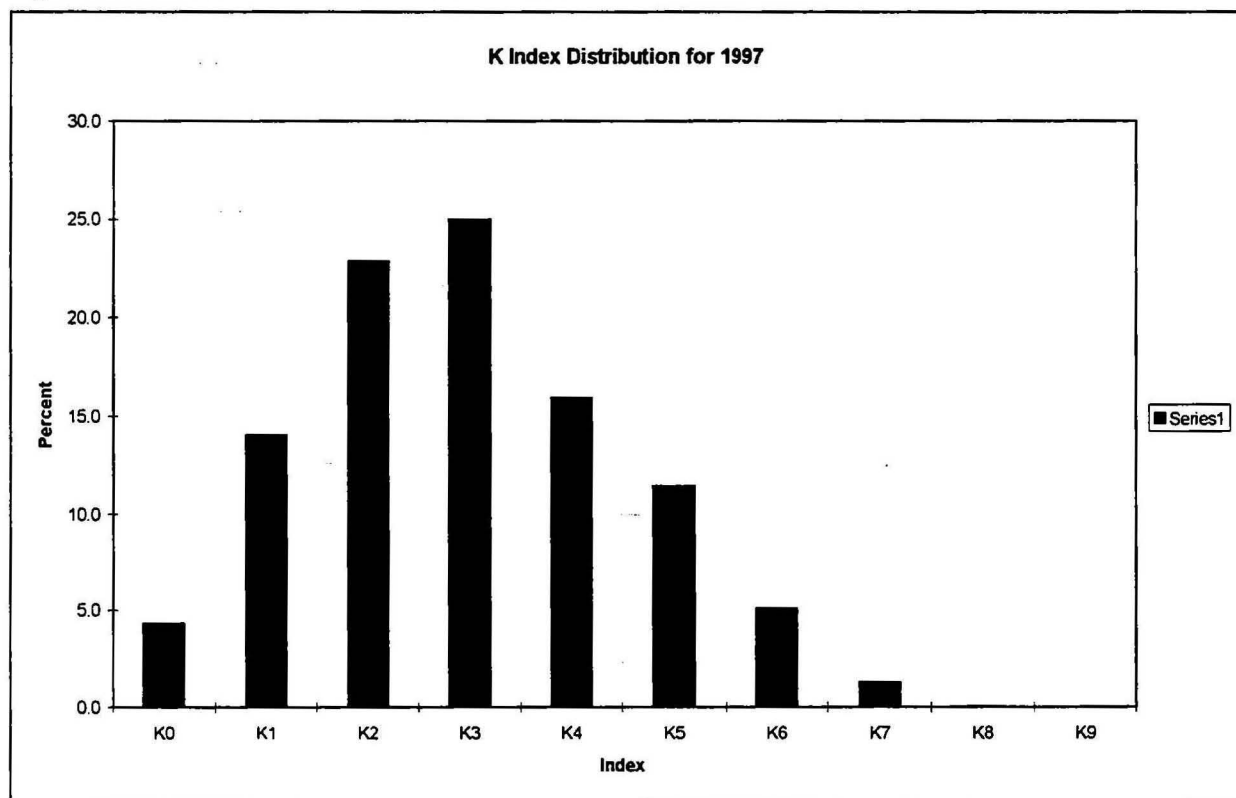


Figure 11: Mawson K Index Distribution for 1997



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3.0 SEISMOLOGICAL OBSERVATORY

3.1 Introduction

Seismic activity is monitored and continuously recorded by two separate systems at the Mawson Observatory. One consists of short and long period analogue seismometers recording to local Helicorder; the second consists of wide band Guralp seismometers whose data is transmitted in real time to AGSO's Australian Seismological Centre in Canberra. Seismometers for both systems are located in a vault at the bottom of a 13 metre deep shaft beneath the Cosray Building.

3.2 Analogue System

3.2.1 Background

The locally recorded analogue system consists of a Benioff short period vertical (SPZ) seismometer and a Press-Ewing long period vertical (LPZ) seismometer. The output from both these instruments is preamplified and frequency filtered by TAM5 amplifier units and then transmitted via a long 10 pair data cable running between the Cosray Vault and the Science Building. These analogue signals are recorded on Helicorder hot pen drum recorders in the Science Building. The short period records at a chart rate of 60 mm/minute (four revolutions per hour) and the long period records at a rate of 15 mm/minute (one revolution per hour). The system parameters are shown in Table 13.

The local system was checked monthly for TAM5 offset voltages, AR320 amplifier balance, and mechanical/electrical Helicorder pen centre position. The LPZ seismometer mass was recentred when required, usually once per month. Temperature conditions within the vault were maintained by an electric heater using a fast cycle thermostat controller to a temperature of 13 ± 0.5 °C.

Observatory timing was provided by the GED clock in the Science Building. The GED also provided minute pulses to the AR320 seismic amplifiers in the seismic instrument rack in the Science Building to produce minute marks on the charts of the analogue system. Time accuracy (except due to equipment failures) of ± 50 ms of UTC was maintained.

3.2.2 System Performance During 1997

Both SPZ and LPZ records were intermittently affected by high frequency interference, lasting several minutes, from local HF and VHF radio communications transmitted from antennae close to the Cosray Building. Chart noise during windy days (particularly over summer during the melt) made it necessary to increase the AR320 amplifier attenuation on those days.

At various times throughout the year the clutch mechanism of the LPZ Helicorder would "stick" causing as corruption of chart traces. The problem can be minimised by ensuring the clutch is fully disengaged for each chart change.

On the 25/03/97 one minute pulses to chart data failed. The problem was sourced to a faulty IC (HCF4049) which had shorted internally hence loading down the one minute pulse line. Although the IC was replaced it no longer seems to serve a purpose for the current system.

Several problems with the timing system caused timing pulses on chart data to either drift or be missing entirely. These occurred due to faults with the GED clock or the GPS 1pps from Aeronomy. For further information on timing system problems see Section 5.1.2. Table 11 summaries data losses and other problems associated with the SPZ and LPZ systems. See also the Log Book Summary in APPENDIX B.

Table 11: LPZ and SPZ Data Losses and Problems

23/12/96 (1405 UT) - 25/09/96 (1539 UT):	LPZ preamp (in Vault) left on SHO (short).
07/01/97 (1131 UT) - 08/01/97 (1043 UT):	LPZ Helicorder clutch stuck.
18/01/97 (1829 UT) - 18/01/97 (1928 UT):	LPZ Helicorder clutch stuck.
25/01/97 (1852 UT) - 18/01/97 (1928 UT):	LPZ Helicorder clutch stuck.
03/02/97 (0503 UT) - 04/01/97 (0529 UT):	LPZ Helicorder clutch stuck.
04/02/97 (1143 UT) - 04/01/97 (1216 UT):	LPZ Helicorder clutch stuck.

04/02/97 (2155 UT) - 04/01/97 (0029 UT):	LPZ Helicorder clutch stuck.
25/03/97 (0642 UT) - 25/03/97 (1912 UT):	LPZ time marks missing.
25/03/97 (0642 UT) - 25/03/97 (1912 UT):	SPZ time marks missing.
26/03/97 (1444 UT) - 27/03/97 (1050 UT):	LPZ Helicorder clutch stuck.
15/04/97 (1120 UT) - 17/03/97 (1046 UT):	LPZ Helicorder clutch stuck.
15/05/97 (2257 UT) - 16/05/97 (0001 UT):	LPZ Helicorder power failure.
15/05/97 (2257 UT) - 16/05/97 (0001 UT):	SPZ Helicorder power failure.
23/05/97 (1931 UT) - 23/03/97 (2130 UT):	LPZ Helicorder clutch stuck.
24/05/97 (0530 UT) - 24/03/97 (0730 UT):	LPZ Helicorder clutch stuck.
25/05/97 (0500 UT) - 25/03/97 (1030 UT):	LPZ Helicorder clutch stuck.
26/05/97 (0330 UT) - 26/03/97 (1325 UT):	LPZ Helicorder clutch stuck.
24/06/97 (1220 UT) - 29/06/97 (2359 UT):	LPZ chart time marks not guaranteed to be within 50ms.
24/06/97 (1220 UT) - 29/06/97 (2359 UT):	SPZ chart time marks not guaranteed to be within 50ms.
08/07/97 (0600 UT) - 08/07/97 (0912 UT):	SPZ Helicorder clutch stuck.
09/07/97 (0452 UT) - 09/07/97 (1107 UT):	SPZ Helicorder clutch stuck.
11/07/97 (0000 UT) - 12/07/97 (2359 UT):	LPZ chart time marks not guaranteed to be within 50ms.
11/07/97 (0000 UT) - 12/07/97 (2359 UT):	SPZ chart time marks not guaranteed to be within 50ms.
01/08/97 (1900 UT) - 03/08/97 (1118 UT):	LPZ Helicorder clutch failure.
21/08/97 (1536 UT) - 22/08/97 (0759 UT):	SPZ Helicorder motor failure.
22/09/97 (1114 UT) - 23/09/97 (1106 UT):	SPZ preamp (in Vault) left on SHO (short).
07/11/97 (1630 UT) - 08/11/97 (0629 UT):	LPZ Helicorder clutch stuck.
08/11/97 (1531 UT) - 09/11/97 (1104 UT):	LPZ Helicorder clutch stuck.
10/12/97 (2031 UT) - 11/12/97 (1110 UT):	LPZ Helicorder clutch stuck.
19/12/97 (0621 UT) - 19/12/97 (1041 UT):	LPZ chart time marks missing.
19/12/97 (0621 UT) - 19/12/97 (1041 UT):	SPZ chart time marks missing.

3.2.3 Annual Calibration

3.2.3.1 Background

Calibration pulses were applied daily at the beginning and end of each locally recorded seismogram to monitor the operation and continuity of the system. Annual Calibrations were performed in November of 1997. Note that only SPZ calibrations were performed as LPZ calibrations were considered unnecessary due to the long term stability of the LPZ seismometers. Weight lift and current pulse tests were performed to determine the value of the seismometer motor constant, G , given by:

$$G = g \cdot \frac{X_p}{I_p} \cdot \frac{m}{X_w}$$

Where g is the acceleration due to gravity, (9.81 ms^{-2})

X_p is the pen deflection amplitude (mm) for applied current I_p

I_p is the current pulse amplitude (mA)

m is the mass of the test weight (g)

X_w is the pen deflection amplitude (mm) for weight lift test

From the results of frequency response tests the seismometer amplification for sinusoidal input functions of various frequencies is calculated using the equation :

$$\text{Mag.} = \frac{A \cdot (2\pi f)^2 \cdot M}{G \cdot I_s}$$

where Mag is the seismometer magnification

A is the peak to peak pen deflection amplitude (mm)

f is the frequency of the input sinusoidal signal (Hz)

I_s is peak to peak current through the coil of the input signal (mA)

M is the seismometer mass (kg)

3.2.3.2 SPZ Seismometer

Equipment Settings

TAM5 Gain:	96 dB
Attenuation:	12 dB
Bandpass:	1 to 5 Hz
AR320 Attenuation:	24 dB
Effective System Gain:	60 dB

Weight Lift Tests

Test Equipment Used: Weight Set (in black box kept in the vault).

Results: refer Table 14.

Current Pulse Tests

Test Equipment Used:

- Fluke Multimeter (Model: 8060A, S/N: 3000047, kept in vault) for measurement of V_{r+} , V_{r-}
- Feedback Function Generator (Model: TWG 501, S/N: 3143, kept in vault. For square wave source (10 Hz)
- $R=1004 \text{ ohm}$

Results: refer Table 15.

Calculation of G and K

The following formulae and parameters were used in the calculation of G and K. The results are presented in Table 16.

$$G = g \cdot (X_p / I_p) / (X_m / m)$$

$$K = G / (4 \cdot \pi^2 \cdot M)$$

$$g = 9.81 \text{ m/s}^2$$

$$M = 107.5 \text{ kg}$$

Frequency Response

Test Equipment Used:

- Measurement V - Tektronix Oscilloscope (Model: 2235, S/N: B041407, kept in Cosray)
- Measurement of f - HP Universal Counter (Model: 5315A, S/N: 2510A03426). Borrowed from Aeronomy
- Sine wave source - Feedback Function Generator (Model: TWG 501, S/N: 3143, kept in vault)

Equipment Settings:

- $V=0.7\text{ Vpp}$
- $\text{Gain} = 60\text{ dB} = 1000$
- $R=1004\text{ ohm}$
- $I_s = (V*\text{Gain})/R = 0.697\text{ A}$

Results: refer Table 17 and Figure 12.

3.3 Guralp System

3.3.1 Background

The remotely recorded system consists of three (nominally north, east and vertical) Guralp CMG-3 wide band seismometers. The analogue output from these instruments is preamplified and filtered before being digitised by a PDP11/23 computer housed in the Cosray Building. Data is transmitted to the Operations Building via a pair of SUMMIT SADCM-3N asynchronous modem line drivers. The digital data is then telemetered via the ANARESAT system in real time to the ASC.

Timing for the Guralp system was taken from the internal clock of the PDP11/23 computer which is synchronised to 12V minute pulses of 2 second duration from the GED clock via the long data cable to the Cosray Building.

Calibration of the Guralp wide band seismometers was last done on 28 July 1993; results were calculated by Graeme Small at ASC and are given in Table 19 to Table 22.

3.3.2 System Performance During 1997

The ANARESAT link to Australia frequently dropped out but usually only for short periods. On such occasions the link would re-establish automatically, however data from the down period was lost.

Several problems with the timing system caused timing pulses to the PDP 11/23 to either drift or be missing entirely. These occurred due to faults with the GED clock or the GPS 1pps from Aeronomy. For further information on timing system problems see Section 5.1.2. Table 12 summaries data losses and other problems associated with the Guralp system.

Table 12: Guralp Data Losses and Problems

02/02/97 (2222 UT) - not known:	Data transmission loss.
18/04/97 (1038 UT) - 18/04/97 (1128 UT):	PDP rebooted.
02/05/97 (1416 UT) - not known:	Data transmission loss.
15/06/97 (1100 UT) - not known:	Data transmission loss.
24/06/97 (1220 UT) - 29/06/97 (2359 UT):	PDP time base not guaranteed to be within 50ms.
11/07/97 (0000 UT) - 12/07/97 (2359 UT):	PDP time base not guaranteed to be within 50ms.
11/07/97 (0000 UT) - 12/07/97 (2359 UT):	PDP time base not guaranteed to be within 50ms.
10/12/97 (0615 UT) - 11/07/97 (1149 UT):	PDP crashed causing data loss.
19/12/97 (0621 UT) - 19/12/97 (1041 UT):	PDP time signal to Cosray down.
19/12/97 (0621 UT) - 19/12/97 (1041 UT):	PDP time signal to Cosray down.

3.4 Data Tables and Figures

Table 13: Mawson Seismic System Parameters

Component	SPZ	LPZ
Seismometer	Benioff	Press-Ewing
Model	1051	SV-282
Serial No.	55	11
Free Period (secs)	(0.96)	(14.0)
Mass (kg)	(107.5)	(6.9)
Coil Resist. (Ω)	(1000)	(500)
Damping Resist. (Ω)	(387)	(5120)
Preamplifier	-	TAM5 s/n 24
Gain (dB)	96	96
Attenuation (dB)	12	24
Bandpass Filter(Hz)	1.0 - 5.0	0.01 - 0.2
Power Supply	PP2	PP2
Recorder Amplifier	Geotech AR320	Geotech AR320
Recorder	Geotech RV301	Geotech RV301B
Chart Rate (mm/min)	60	15
Polarity	Up-Up	Up-Up
Motor Const (G N/A)	1.539	(0.194)
Cal. Coil Resist (Ω)	(247)	(3300)

() bracketed values taken from previous reports.

Table 14: SPZ Calibration (Weight Lift Tests)

Mass (mg)	Xm (ave) (mm)	Xm/m (mm/mg)
111.5	4.7	0.0422
202.2	9.1	0.0450
301.5	13.1	0.0434
357.4	14.9	0.0417
	Average :	0.0431
	Std dev :	0.0015

Table 15: SPZ Calibration (Current Pulse Tests)

Vr+	Vr-	Ip	Xp (ave)	Xp/Ip
(V)	(V)	(mA)	(mm)	(mm/mA)
0.408	0.418	0.823	5.20	6.321
0.912	0.929	1.834	11.20	6.108
1.575	1.604	3.166	19.12	6.039
1.906	1.938	3.829	23.23	6.067
			Average :	6.134
			Std dev :	0.128

Table 16: SPZ Calibration (Calculation of G and K)

m	Ip	(Xp/Ip)/(Xm/m)	G	K
(mg)	(mA)	(mg/mA)	(N/A)	(m/s^2)
111.5	0.823	149.946	1.471	0.000347
202.2	1.834	135.718	1.331	0.000314
301.5	3.166	138.978	1.363	0.000321
357.4	3.829	145.535	1.428	0.000336
		Average :	142.544	1.398
		Std dev :	6.404	0.063
				0.000329
				0.000015

Table 17: SPZ Calibration (Frequency Response)

Nominal Frequency (Hz)	Measured Frequency , f (Hz)	Calculated Period (s)	Amplitude, A (mm)	Magnification Af^2/KIs
5.00	5.008	0.200	0.3	32762
3.50	3.504	0.285	0.9	48116
3.00	3.009	0.332	1.4	55194
2.50	2.503	0.400	2.2	60015
2.00	2.003	0.499	4.1	71625
1.90	1.906	0.525	5.0	79092
1.80	1.808	0.553	5.5	78285
1.70	1.704	0.587	6.3	79652
1.60	1.599	0.625	7.7	85724
1.50	1.503	0.665	8.7	85576
1.40	1.402	0.713	10.2	87300
1.30	1.309	0.764	11.8	88040
1.20	1.201	0.833	13.0	81648
1.15	1.147	0.872	14.5	83064
1.10	1.104	0.906	13.8	73238
1.05	1.051	0.951	13.5	64932
1.00	1.001	0.999	13.4	58464
0.90	0.903	1.107	12.0	42606
0.80	0.803	1.245	10.5	29481
0.70	0.700	1.429	8.8	18776
0.60	0.604	1.656	7.0	11120
0.50	0.502	1.992	5.3	5816
0.40	0.402	2.488	3.7	2604
0.30	0.302	3.311	2.3	913
0.20	0.205	4.878	1.5	274
0.10	0.100	10.000	0.5	22

Table 18: Record of SPZ and LPZ Seismometer Parameters 1987 - 1997

Note: the Free Period signal on the SPZ analogue chart for the 1997 Calibration was not visible.

Year	LPZ		SPZ	
	G (N/A)	Free Period (s)	G (N/A)	Free Period (s)
1997	-	-	1.40	-
1996	-	-	1.54	0.96
1995	1.98	14.0	1.53	0.95
1994	-	-	1.54	0.95
1993	0.194	12.16	1.55	0.95
1992	0.23	12.8	1.50	0.95
1991	0.210	13.2	1.52	0.946
1990	0.24, 0.19	13.7, 12.6	1.55	0.947
1989	0.17	16.2	1.48	0.948
1988	0.203	12.8	1.54, 1.45	0.98
1987	-	-	-	-

Table 19: Guralp Seismometer Calibration Values

Channel	Cal Const (A/m/s*s)	Cal Current (P-P) (*E-06 Amps)
V311 (Z)	0.472	19.15
H313 (N/S)	0.537	19.15
H314 (E/W)	0.582	19.15

Table 20: Guralp Seismometer Vertical Channel Calibrations

Vertical channel:			
T (sec)	Disp(nm)	P-P counts	Counts/nm
0.1	10	188	18.3
0.15	23	368	15.9
0.26	70	952	13.7
1.05	1130	4128	3.64
2.07	4400	8128	1.85
5.2	27800	20608	0.74
10.8	120000	41984	0.35
15.5	247000	54016	0.22
27.2	760000	55296	0.073
57.5	3400000	31232	0.0042
127.2	16660000	15104	0.00041

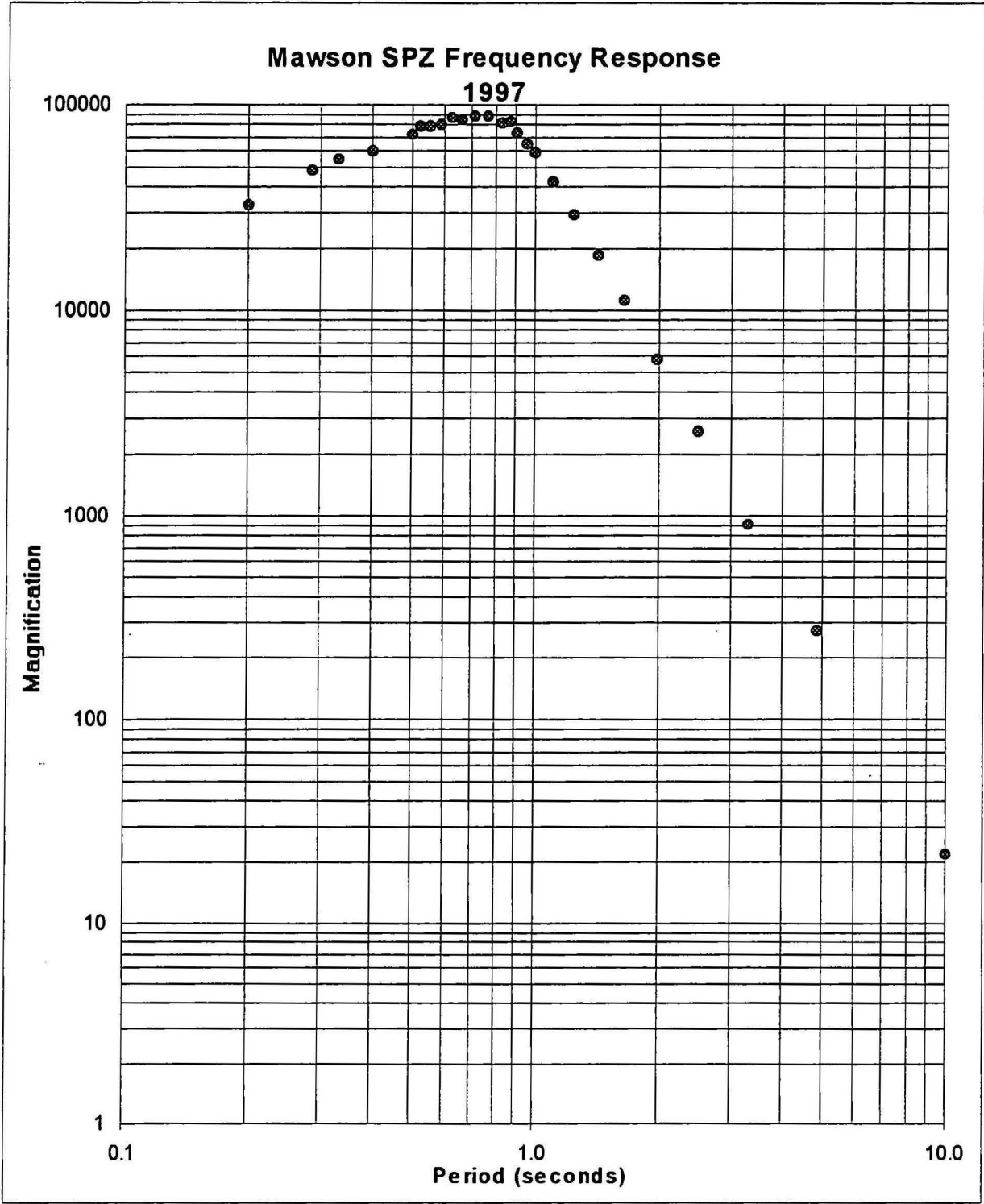
Table 21: Guralp Seismometer East-West Channel Calibrations

East - West channel:			
<i>T (sec)</i>	<i>Disp(nm)</i>	<i>P-P counts</i>	<i>Counts/nm</i>
0.1	8	172	20.6
0.15	19	380	20.3
0.26	56	928	16.5
1.07	950	4160	4.36
2.04	3470	8000	2.31
5.2	22500	20992	0.93
11.1	103000	43520	0.42
15.5	200000	54784	0.27
27.2	616000	55296	0.089
58	2800000	30464	0.011
126.4	13310000	14976	0.00113

Table 22: Guralp Seismometer North-South Channel Calibrations

North- South channel:			
<i>T (sec)</i>	<i>Disp(nm)</i>	<i>P-P counts</i>	<i>Counts/nm</i>
0.1	9	172	19
0.15	20	384	18.9
0.26	61	888	14.6
1.06	1020	4128	4.07
2.06	3800	8128	2.12
5.2	24400	20736	0.85
11	109000	42240	0.39
15.1	207000	53504	0.26
27.3	673000	54528	0.018
56.8	2910000	30720	0.011
127.2	14610000	14720	0.001

Figure 12: SPZ Calibration (Frequency Response)



4.0 TIDAL GRAVITY OBSERVATORY

4.1 Introduction

In 1995 the Australian Geological Survey Organisation and the National Institute of Polar Research (NIPR) of Japan agreed to collaborate in research of tidal gravimetry. AGSO was to be responsible for the installation and maintenance of the gravimeter and for training the officer who operates the system at Mawson. The LaCoste and Romberg gravity meter (Model G, S/N 477) with a Harrison-Sato-type feedback amplifier was supplied by NIPR for use in the tidal gravity measurements at Mawson. The gravity meter and peripheral equipment required for the data logging were installed in the Cosray building on 21 May 1996. The location of the equipment during 1997 is indicated below:

Seismic Vault	Cosray Building
Gravity meter	NEC Powermate II personal computer
Battery charger	Uninterruptable power supply
Battery	DT2805 A/D converter board
Feedback amplifier box	DT707 connection board

Variation of the gravitational field was measured using a system similar to the acquisition system for the geomagnetic observatory. An NEC Powermate II personal computer with a Data Translation analogue to digital conversion board (Model DT2805/5716A) measured the analogue signal from the feedback amplifier at a sampling rate of 60 seconds during normal recording and at 5 sec intervals during calibrations. The analogue to digital converter accepted an input range of ± 10 V and gave 16 bit resolution of the digitised value.

The acquisition software on the PC was MACQ Version 0310 ([4] Crosthwaite, P., 1994). Data was retrieved from the acquisition PC in the Cosray building approximately every second day using floppy disks and was transferred from the office PC in the science building to the AGSO UNIX system in Canberra using Winsock-FTP.

On the 11th January 1998 the Tidal gravity Project at Mawson was discontinued upon instructions from head office. All equipment relating to the project was packed up and RTA'd on Voyage 5 of the 1997/98 season with author.

4.2 System Performance During 1997

The system performed well during 1997 with very little maintenance or servicing required. The summary of the log book (see APPENDIX B) contains specific information relevant to the performance of the system.

For the Gravity meter it should be noted that the Longitudinal and Transverse Levels tend to drift slightly over time. The sensitivity does drift with it but readings taken over time reveal that sensitivity remains within the 9 to 11 eyepiece divisions.

4.3 Calibration

A calibration for the Tidal Gravity System was performed in May 1997.

Date Done:	27/05/97 (Day 147) and 28/05/97 (Day 148).
Observer:	Perry Roberts
Data File(s):	h97147.cma and h97148.cma
Gravity Meter:	Lacoste & Romberg G-477
Station:	96989090 (Seismic Vault)

Preliminary Readings

Counter Reading	= 60738
Null Dial Reading	= 7.9 div
Meter (eyepiece) Reading	= 3.00 div
Meter Temp	= 52.50 deg C
Vault Temp	= 14.00 deg C

Feedback Voltage at OUT2 = 1.70 Volts

Sensitivity Check

The Gravimeter was levelled and the Longitudinal Level adjusted to obtain the Sensitivity reading shown below. The Longitudinal Level Vial was adjusted to true level.

Bottom Stop + Two Meter Divisions:

Counter Reading = 60733
Null Dial Reading = 3.4 div
Meter (eyepiece) Reading = 2.50 div

One Clockwise Revolution of Null Dial:

Counter Reading = 60743
Null Dial Reading = 3.4 div
Meter (eyepiece) Reading = 3.50 div
Meter Deflection = 10 div
Sensitivity = 10:10

Reading Line

The Gravimeter was re-adjusted to obtain the following reading line:

Counter Reading = 60738
Null Dial Reading = 8.1 div
Meter (eyepiece) Reading = 3.00 div

Table 23: Gravity System Calibration 1 (Feedback Amplifier Voltages)

Time (UTC)	Null Dial Offset	Null Dial Reading	Counter Reading	OUT2 (Volts)
0918	-1.5	3.1	60723	-7.360
0920	-1.0	8.1	60728	-4.239
0922	-0.5	3.1	60733	-1.045
0924	0.0	8.1	60738	+2.119
0926	0.5	3.1	60743	+5.284
0928	1.0	8.1	60748	+8.437

Table 24: Gravity System Calibration 2 (Feedback Amplifier Voltages)

Time (UTC)	Null Dial Offset	Null Dial Reading	Counter Reading	OUT2 (Volts)
0930	-1.5	3.1	60723	-7.412
0932	-1.0	8.1	60728	-4.239
0934	-0.5	3.1	60733	-1.053
0936	0.0	8.1	60738	+2.117
0938	0.5	3.1	60743	+5.278
0940	1.0	8.1	60748	+8.436

Table 25: Gravity System Calibration 3 (Feedback Amplifier Voltages)

Time (UTC)	Null Dial Offset	Null Dial Reading	Counter Reading	OUT2 (Volts)
0942	-1.5	3.1	60723	-7.418
0944	-1.0	8.1	60728	-4.243
0946	-0.5	3.1	60733	-1.063
0948	0.0	8.1	60738	+2.110
0950	0.5	3.1	60743	+5.281
0952	1.0	8.1	60748	+8.436

Table 26: Gravity System Final Readings

Time (UTC)	Null Dial Offset	Null Dial Reading	Counter Reading	OUT2 (Volts)
0956	0.0	8.1	60738	+2.107

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5.0 GENERAL

5.1 Equipment

5.1.1 Power Supplies

Station power was supplied by three diesel generators as 240V, 50 Hz. Several short power outages occurred during the year with minimal data loss resulting.

The *Science Building* has an Invertech SPS-100-FF-P rated at 100VA /50Hz UPS to provide backup power to the following:

- SPZ, LPZ Helicorder
- Primary GED clock (with D cell battery backup if UPS fails)
- Secondary GED clock
- AR320 seismic amplifiers

The office PC was run from the mains supply through a surge protector. The Invertech was tested for 15 mins each month to cycle the battery.

The *Variometer Building* has an Invertech Precision Power SPS-1000UPS to provide backup power to the following:

- NEC acquisition computer
- RCF controller unit.
- 9V DC adaptor for Black Box line driver
- Doric Trendicator
- Statronics 53/3B power supply for E820 PPM

The *Cosray Building* has a General Systems UPS (model GPS-1K245RV4) to backup the Guralp systems. Two Invertech Precision Power SPS-1000UPS provides additional backup power to the Guralp and Tidal Gravity systems. The analogue seismic rack in the vault was powered by 12V DC from the battery backed inverter supply and converted to $\pm 8V$ by a PP2 low power converter.

5.1.2 Timing System

5.1.2.1 Background

A primary and secondary GED master clock (crystal oven type 105) provide a timing reference for observatory operations. The secondary clock was not functional throughout 1997 due to its numerous faults and was used only for spares for the primary clock. Typically the primary clock was maintained to within ± 50 ms of UTC except during periods of faults or down time for adjustments. The GED time reference is by means of a 1 pulse per second (pps) signal from a Truetime GPS clock in the Aeronomy Building (operated by the Atmospheric Space Physics section of the Australian Antarctic Division). Output signals from the GED go via a time mark relay driver box and opto isolator box to be distributed to monitoring equipment (an oscilloscope) in the AGSO office and to seismology equipment in the Cosray Building.

5.1.2.2 System Performance During 1997

A number of problems occurred with the timing system throughout 1997 both with the GED clock itself and the 1pps signal from Aeronomy. On the 18/04/97 it was reported, from HO, that Mawson arrival times for the digital seismic data were drifting beyond the ± 50 ms specification. At that time the PDP-11/23 acquisition computer was re-booted. No more drift problems were reported until the 24/06/97 at which time detailed tests were performed to source the problem. A fault was traced to the 1pps signal coming from Aeronomy which initially failed only intermittently then ultimately (sometime in June) the signal failed completely. The ASP engineer traced the problem to a faulty Truetime antenna/receiver. No spare was available. The failure of the time reference to the GED clock caused the GED itself to lose timing accuracy causing the time to drift. To minimise GED drift rates the referenced signal was shifted from the Truetime system to an Austron clock also in Aeronomy. The Austron in

turn was referenced to the Truetime clock. In the absence of a Truetime signal the GED would obtain its time reference from the free running Austron clock. The Austron's drift rate were in the order of microseconds per day which was more than adequate for AGSO purposes.

5.1.3 Office PC

The PC in the AGSO office had an extra hard drive installed on the 14/06/97. This enabled more convenient access to processing and data files as well more efficient software backup routines using an Iomega zip drive also installed during 1997. The PC now has two hard drives, namely, Disk 0 (C: drive, 245 MBytes which is used for system and application software and Disk 1 (D: drive, 272 MBytes) for AGSO data and processing files.

New software routines (batch files and windows based icon menu's) were developed during the year. This increased efficiency of the processing routine absolute data and transferring data to Canberra.

5.2 Buildings

Four buildings were in use for the operation of the Mawson Geophysical Observatories during 1997. Their resource allocations are listed in the table below.

Table 27: Building Resources

Building	Room	Equipment Summary	Use
<i>Science Building</i> (<i>"Wombat"</i>)	AGSO office	Seismic Helicorder, GED clocks, office PC	General office and processing duties
"	IPS office	Ionosonde, computers and spares. Biologists paraphernalia	Ionosonde operation. Biologists office. (Not used by AGSO)
"	AGSO workshop	Tools, equipment spares, test equipment	Repairs and testing.
"	IPS darkroom	Developing equipment and chemicals	Not in use
"	AGSO Darkroom	-	Tea room
<i>Variometer Building</i>	Sensor room	Ringcore variometer	Variometer
"	Recorder room	Acquisition PC, Doric Trendicator, relay box	Data logging
<i>Absolute Hut</i>	-	Absolute magnetometers	Magnetic observations
<i>Cosray Building</i>	Seismic vault and Cosray hut	Analogue and digital seismometers, PDP computer	Seismic monitoring

The Science Building (Wombat) is adequate for AGSO's needs but the floor plan does not optimise the available space. Some moisture does penetrate the building near the roof line as the blizz tail against the western outside wall reaches roof height. In late 1997 a second Ethernet connection was installed in the Office to allow a second office PC to be connected to the Mawson LAN.

The Magnetic Absolute Hut remains in reasonable condition. The pier, however, is unstable in strong winds making absolute measurements difficult at these times. Some drift snow encroaches inside during blizzards. Temperatures inside the hut can drop by 10° C during long windy periods and overall temperature regulation inside the hut is difficult to attain. The Variometer Building is in generally good condition. Temperature stability in both the sensor room and the recorder room is good. The Cosray Building and vault remain in excellent condition. Vault temperatures are stable.

6.0 CASEY AND DAVIS GEOMAGNETIC RESULTS

6.1 Introduction

The geomagnetic program at Davis and Casey is conducted in association with the Atmospheric and Space Physics (ASP) section of the Australian Antarctic Division. The Antarctic Division purchased, installed and now operate EDA FM100 fluxgate magnetometers at both stations to assist upper atmospheric physics investigations. AGSO provided assistance with the fluxgate installation at Davis. The variometers are not calibrated to observatory standard. However using the digital variometer data in association with absolute observations provides much better estimates of monthly field values than relying on absolute observations alone.

In 1997 absolute measurements were performed 2 to 4 times per month at Casey and Davis in order to calibrate the variometers. At Davis the observer was Mike Manion (1997 ASP Engineer) and at Casey the observer was Anthony Breed (1997 ASP Physicist).

Variometer output was logged as 10 second data, at 12 bit resolution, by IBM compatible personal computers on station, using a program developed by the Antarctic Division called ADAS which is common to several of ASP's experiments. Late in 1997 data sampling rates at Casey and Davis were increased to 1 second and data resolution was increased to 16 bits (during December 97). The data is collected in daily files and are periodically transferred back to the VAX network at the Antarctic Division. These files are then archived some days/weeks later.

The monthly averages derived by AGSO for Davis and Casey, and published in the Australian Geomagnetism Report, are averages of the 5 Quiet Days as determined from Mawson data. Once the Mawson Quiet Days are determined (using K indices), the Casey and Davis raw digital data are averaged over those 5 days using another Antarctic Division program called VIEW which also runs on IBM compatible computers. The Microsoft spreadsheet package EXCEL was then used to convert the raw data to geomagnetic field components.

6.2 Variometer Equipment

The variometer systems at Davis and Casey consist of EDA FM100 fluxgate magnetometers measuring X, Y and Z aligned along geographic north, east and the zenith, respectively. They were bought, installed and operated by Antarctic Division. The Davis variometer was installed by the Antarctic Division engineer, Alistair Urie and AGSO geophysicist Wendy Welsh. It commenced analogue recording on 4 January 1986. The analogue output signal is passed through a signal conditioner and A/D converter before being logged by ADAS software. The system is described by two separate equations and sets of parameters so that changes to either the magnetometer or conditioner/converter can be maintained as direct changes to only the relevant parameters. The terminology used in the ASP monthly magnetometer reports is adopted here for ease of reference to the ASP system in future work.

The first equation characterises the signal conditioner and A/D converter and gives the magnetometer output voltage in terms of the logged digital value. It is determined only by the status of the conditioner and converter hardware and the parameters are determined in annual calibrations. For the X component, the first equation is:

$$V_x = (D_x - \text{Off}_x) / (205 * G_x)$$

where V_x = the analogue output from the magnetometer, in volts.

D_x = the recorded digital value.

Off_x = the offset value,

ie. the digital value recorded when the magnetometer output is 0V.

G_x = the gain of the signal through the conditioner/converter in digits/volt.

The second equation characterises the magnetometer only; it gives the value of the magnetic field corresponding to a given magnetometer output voltage. For the X component it is:

$$B_x = S_x * V_x + BL_x$$

where B_x = value of the magnetic field, in nT.

S_x = sensitivity of the magnetometer, in nT/volt.

BL_x = the baseline value in nT,

ie. the value of the field when the magnetometer output is 0V.

Combining these, the equation for the complete system is:

$$B_x = SV_x * D_x + Int_x$$

where $SV_x = S_x / (205 * G_x)$.

= the scale value for the complete system, in nT/digit.

and $Int_x = BL_x - SV_x * Off_x$.

= the value of the field when the system output is 0 digital units.

The signal conditioner and A/D converter parameters are determined by applying a series of input voltages and recording the digital output. Linear regression is performed on a set of voltages covering the full range of digital values and these calibrations are performed annually.

6.3 Absolute Observations and Reductions

Absolute magnetic observations were performed 2 - 4 times per month at Casey and Davis during 1997. The standard instruments were a Declination Inclination Magnetometer (DIM), purchased by the Antarctic Division, and a proton precession magnetometer (PPM), supplied by AGSO, at both stations. A Quartz Horizontal Magnetometer (QHM) is provided by AGSO at both stations to maintain a backup capability. Raw magnetic absolute observations were reduced by the ASP personnel on station using AGSO programs. Zero instrument corrections in D and I for the DIM's have been adopted in both cases. Corrections for F are detailed in Sections 6.4.1 and 6.4.2 for Casey and Davis respectively.

6.4 Absolute Instruments and Corrections

In late 1992 two DIM's were purchased by ASP, compared against the Australian standards at Canberra by AGSO, and have been used as the primary absolute instruments at Casey and Davis since 1993. The QHM's were used as a backup and comparison instrument. Details of the instruments, parameters and corrections for 1997 are given in Table 28 for Casey and Table 29 for Davis.

6.4.1 Casey

The corrections adopted for 1997 to bring the Casey standard instrument combination of DIM 2591 and PPM G816/1023 and G816/1024 into line with the Australian standards are:

$$D = 0.0'$$

$$I = 0.0'$$

$$F = -9.8 \text{ nT (G816/1023 PPM used in obs from 01/01/97 to 24/12/97)}$$

$$F = +3.0 \text{ nT (G816/1024 PPM used in obs from 25/12/97 to 31/12/97)}$$

The F correction of -9.8 nT was adopted based on comparisons done by Suzanne Barr (AGSO Mawson 1995) at Casey in November 1994. Note, however, that this high F correction is considered questionable. A better F

correction of +3.0 nT was adopted based on comparisons done by Stewart Dennis in October and November of 1997. In addition to the DIM/PPM instrument correction there is also a pier difference which is applied to all DIM/PPM readings to correct for the different height between DIM and QHM observations. The corrections must be applied to all DIM/PPM observations to make them equivalent to observations at the height of a QHM, which until 1993 was the standard instrument at Casey. The corrections are:

$$\begin{aligned} D &= +15.1' \\ I &= +0.2' \\ F &= +45.0 \text{ nT} \end{aligned}$$

In terms of X, Y and Z these are:

$$\begin{aligned} X &= +42.0 \text{ nT} \\ Y &= -11.5 \text{ nT} \\ Z &= -44.0 \text{ nT} \end{aligned}$$

The above instrument corrections and pier differences have been applied to the mean field values presented in this report.

6.4.2 Davis

The corrections adopted for 1997 to bring the Davis standard instrument combination of DIM 2506 and PPM G816/1025 into line with the Australian standards are:

$$\begin{aligned} D &= 0.0' \\ I &= 0.0' \\ F &= +0.6 \text{ nT} \end{aligned}$$

6.5 Baselines

The baselines for Casey were adopted from the monthly reports produced by Anthony Breed during 1997. These are given in Table 30 with the pier difference and the adopted DIM/PPM instrument corrections applied. The baselines for Davis were adopted from the monthly reports produced by Mike Manion during 1997. These are given in Table 31 with the adopted DIM/PPM instrument corrections applied.

6.6 Monthly Quiet Day Averages

The monthly quiet day averages for Casey (Table 32) were adopted from the monthly reports produced by Anthony Breed during 1997. The quiet day averages for Davis (Table 33) were adopted from the monthly reports produced by Mike Manion during 1997.

6.7 Casey and Davis Data Tables

Table 28: Casey Absolute Instrument Parameters and Corrections

CASEY	
DIM	E810/2591
Theodolite	356514
D correction	0.0' (compared at CMO ¹ Aug 92)
I correction	0.0' (compared at CMO ¹ Aug 92)
QHM	493 (arrived early 1992)
Circle	QHM circle 94
QHM constant, K	7624 nT
" " k1	$41.2 \times 10^{-5} \text{ }^{\circ}\text{C}^{-1}$
" " k2	$140 \times 10^{-10} \text{ nT}^{-1}$
H correction	-3 nT (compared at CMO ¹ in Sep 1992).
Collimation angle	70.8'
D correction	-10.3' (compared at CMO ¹ in Sep 1992).
Thermometer	1084
Thermometer correction	-0.05 °C @ -20 °C -0.10 °C @ -10 °C -0.05 °C @ 0 °C -0.05 °C @ 10 °C 0.00 °C @ 20 °C
PPM	G816/1023
F correction	-9.8 nT (used in Obs for 01/01/97 to 24/01/97)
PPM	G816/1024
F correction	+3.0 nT (used in Obs for 25/12/97 to 31/12/97)
Pier	A in mag obs hut for H & D. Pier in magapple for F
Pier difference	-423 nT in F. (maghut - magapple)
Main azimuth mark	G11
Azimuth of mark	307° 41.03'

Table 29: Davis Absolute Instrument Parameters and Corrections

DAVIS	
DIM	E810/2592 (or 2506 - has 2 serial numbers)
Theodolite	355939
D correction	0.0' (compared at Davis in Dec 93)
I correction	0.0' (compared at Davis in Dec 93)
QHM	492 (arrived late 1992)
Circle	QHM circle 73
QHM constant, K	7659 nT
" " k1	$42.9 \times 10^{-5} \text{ }^{\circ}\text{C}^{-1}$
" " k2	$115 \times 10^{-10} \text{ nT}^{-1}$
H correction	-8.0 nT (compared at Davis in Dec 1993)
Collimation angle	-8.0'
D correction	0.0' (compared at Davis in Dec 1993)
Thermometer	N152
Thermometer correction	+0.05 °C @ 0 °C +0.15 °C @ 10 °C +0.20 °C @ 20 °C
PPM	G816/1025 (arrived Nov 93)
F correction	+0.6 nT
Pier	C in absolute hut used for H, D, I, and F
Main azimuth mark	PP (erected Dec 1990)
Azimuth of mark	312° 0.8'

Table 30: Casey Adopted Baseline Values for 1997

X Component				
<i>Period</i>	<i>BL_x</i>	<i>S_x</i>	<i>Off_x</i>	<i>205*G_x</i>
1 Jan - 24 Jan	-491.4	-187	-2.82	403.87
25 Jan - 31 Jan	-491.4	-187	-2.09	403.87
1 Feb - 29 Feb	-509.0	-187	-2.09	403.87
1 Mar - 31 Mar	-498.4	-187	-2.09	403.87
1 Apr - 30 Apr	-504.4	-187	-2.09	403.87
1 May - 31 May	-503.7	-187	-2.09	403.87
1 Jun - 30 Jun	-502.4	-187	-2.09	403.87
1 Jul - 31 Jul	-501.7	-187	-2.09	403.87
1 Aug - 31 Aug	-491.4	-187	-2.09	403.87
1 Sep - 30 Sep	-478.0	-187	-2.09	403.87
1 Oct - 31 Oct	-484.7	-187	-2.09	403.87
1 Nov - 30 Nov	-472.2	-187	-2.09	403.87
1 Dec - 15 Dec	-468.8	-187	-2.09	403.87
16 Dec - 31 Dec	-468.8	-187	-5.12	3273.2
Y Component				
1 Jan - 24 Jan	-9990.6	-201	-3.64	405.30
25 Jan - 31 Jan	-9990.6	-201	-3.27	404.89
1 Feb - 29 Feb	-9988.6	-201	-3.27	404.89
1 Mar - 31 Mar	-10002.1	-201	-3.27	404.89
1 Apr - 30 Apr	-10006.0	-201	-3.27	404.89
1 May - 31 May	-10001.6	-201	-3.27	404.89
1 Jun - 30 Jun	-10011.6	-201	-3.27	404.89
1 Jul - 31 Jul	-10016.7	-201	-3.27	404.89
1 Aug - 31 Aug	-10003.8	-201	-3.27	404.89
1 Sep - 30 Sep	-10024.0	-201	-3.27	404.89
1 Oct - 31 Oct	-10010.2	-201	-3.27	404.89
1 Nov - 30 Nov	-9992.5	-201	-3.27	404.89
1 Dec - 15 Dec	-9996.6	-201	-3.27	404.89
16 Dec - 31 Dec	-9996.6	-201	-4.86	3276.5
Z Component				
1 Jan - 24 Jan	-64092.9	-200	4.18	404.89
24 Jan - 31 Jan	-64092.9	-200	3.18	404.68
1 Feb - 29 Feb	-64090.9	-200	3.18	404.68
1 Mar - 31 Mar	-64099.4	-200	3.18	404.68
1 Apr - 30 Apr	-64091.9	-200	3.18	404.68
1 May - 31 May	-64092.8	-200	3.18	404.68
1 Jun - 30 Jun	-64090.2	-200	3.18	404.68
1 Jul - 31 Jul	-64089.4	-200	3.18	404.68
1 Aug - 31 Aug	-64090.5	-200	3.18	404.68
1 Sep - 30 Sep	-64094.4	-200	3.18	404.68
1 Oct - 31 Oct	-64093.3	-200	3.18	404.68
1 Nov - 30 Nov	-64089.3	-200	3.18	404.68
1 Dec - 15 Dec	-64098.0	-200	3.18	404.68
16 Dec - 31 Dec	-64098.0	-200	3.14	3276.8

Table 31: Davis Adopted Baseline Values for 1997

X Component				
Period	BL_x	S_x	Off_x	$205 \cdot G_x$
1 Jan - 31 Jan	3749.0	-194.8	-501.7	406.64
1 Feb - 7 Feb	3736.8	-194.8	-501.7	406.64
8 Feb - 29 Feb	3736.8	-194.8	-503.2	406.64
1 Mar - 31 Mar	3720.5	-194.8	-503.2	406.64
1 Apr - 30 Apr	3701.3	-194.8	-503.2	406.64
1 May - 31 May	3695.0	-194.8	-503.2	406.64
1 Jun - 30 Jun	3696.0	-194.8	-503.2	406.64
1 Jul - 31 Jul	3699.0	-194.8	-503.2	406.64
1 Aug - 31 Aug	3698.3	-194.8	-503.2	406.64
1 Sep - 31 Sep	3698.5	-194.8	-503.2	406.64
1 Oct - 31 Oct	3707.0	-194.8	-503.2	406.64
1 Nov - 30 Nov	3736.3	-194.8	-503.2	406.64
1 Dec - 31 Dec	3754.0	-194.8	-503.2	406.64
Y Component				
1 Jan - 31 Jan	-16058.0	200.7	-0.4	405.64
1 Feb - 7 Feb	-16062.0	200.7	-0.4	405.64
8 Feb - 29 Feb	-16062.0	200.7	-1.2	404.97
1 Mar - 31 Mar	-16055.3	200.7	-1.2	404.97
1 Apr - 30 Apr	-16051.5	200.7	-1.2	404.97
1 May - 31 May	-16050.0	200.7	-1.2	404.97
1 Jun - 30 Jun	-16054.0	200.7	-1.2	404.97
1 Jul - 31 Jul	-16053.0	200.7	-1.2	404.97
1 Aug - 31 Aug	-16053.8	200.7	-1.2	404.97
1 Sep - 31 Sep	-16053.5	200.7	-1.2	404.97
1 Oct - 31 Oct	-16055.0	200.7	-1.2	404.97
1 Nov - 30 Nov	-16074.5	200.7	-1.2	404.97
1 Dec - 31 Dec	-16076.5	200.7	-1.2	404.97
Z Component				
1 Jan - 31 Jan	-52124.5	195.6	-700.0	410.15
1 Feb - 7 Feb	-52149.5	195.6	-700.0	410.15
8 Feb - 29 Feb	-52149.5	195.6	-702.6	410.03
1 Mar - 31 Mar	-52160.8	195.6	-702.6	410.03
1 Apr - 30 Apr	-52168.3	195.6	-702.6	410.03
1 May - 31 May	-52164.5	195.6	-702.6	410.03
1 Jun - 30 Jun	-52165.5	195.6	-702.6	410.03
1 Jul - 31 Jul	-52168.0	195.6	-702.6	410.03
1 Aug - 31 Aug	-52169.5	195.6	-702.6	410.03
1 Sep - 31 Sep	-52169.5	195.6	-702.6	410.03
1 Oct - 31 Oct	-52171.0	195.6	-702.6	410.03
1 Nov - 30 Nov	-52169.0	195.6	-702.6	410.03
1 Dec - 31 Dec	-52164.3	195.6	-702.6	410.03

Table 32: Casey Monthly Five Quiet Day Averages for 1997

	X (nT)	Y (nT)	Z (nT)	F (nT)	H (nT)	D (deg)	I (deg)
Jan	-447.1	-9628.7	-63762.5	64487.0	9639.1	-92.659	-81.404
Feb	-461.6	-9625.1	-63774.5	64498.4	9636.2	-92.746	-81.408
Mar	-443.6	-9624.5	-63783.7	64507.3	9634.7	-92.639	-81.410
Apr	-457.3	-9617.4	-63785.6	64508.2	9628.3	-92.723	-81.416
May	-458.8	-9595.5	-63782.1	64501.5	9606.5	-92.738	-81.435
Jun	-463.1	-9611.5	-63777.8	64499.6	9622.7	-92.758	-81.420
Jul	-462.5	-9607.9	-63775.0	64496.3	9619.1	-92.756	-81.423
Aug	-451.4	-9594.2	-63768.7	64488.0	9604.8	-92.694	-81.434
Sep	-455.2	-9621.4	-63783.5	64506.7	9632.2	-92.709	-81.412
Oct	-485.0	-9595.9	-63781.3	64500.9	9608.2	-92.893	-81.433
Nov	-442.0	-9599.1	-63759.6	64479.6	9609.3	-92.636	-81.429
Dec	-415.3	-9621.6	-63758.9	64482.1	9630.6	-92.471	-81.411
Average	-453.6	-9611.9	-63774.4	64496.3	9622.6	-92.702	-81.420

Table 33: Davis Monthly Five Quiet Day Averages for 1997

	X (nT)	Y (nT)	Z (nT)	F (nT)	H (nT)	D (deg)	I (deg)
Jan	3419.3	-16413.3	-51685.0	54336.2	16765.6	-78.232	-72.028
Feb	3406.6	-16416.4	-51715.6	54365.5	16766.1	-78.277	-72.037
Mar	3394.5	-16412.4	-51712.6	54360.7	16759.8	-78.315	-72.043
Apr	3399.8	-16412.9	-51716.8	54365.1	16761.4	-78.297	-72.043
May	3394.3	-16414.5	-51705.5	54354.5	16761.8	-78.317	-72.038
Jun	3384.7	-16416.8	-51706.7	54355.7	16762.1	-78.350	-72.039
Jul	3384.4	-16416.8	-51695.7	54345.3	16762.0	-78.351	-72.035
Aug	3383.8	-16417.6	-51702.7	54352.2	16762.7	-78.354	-72.037
Sep	3373.1	-16416.0	-51705.2	54353.4	16758.9	-78.389	-72.041
Oct	3372.2	-16424.6	-51701.3	54352.2	16767.2	-78.398	-72.032
Nov	3394.9	-16442.4	-51697.6	54355.5	16789.2	-78.334	-72.008
Dec	3386.5	-16440.0	-51701.0	54357.5	16785.1	-78.360	-72.014
Average	3391.2	-16420.3	-51703.8	54354.5	16766.8	-78.331	-72.033

7.0 OTHER DUTIES

All participants in ANARE are required to assist in the general station operations. These duties are either on a roster system or on a need to basis. These duties are summarised below:

- Daycare (approximately 6 hours per month)
- Station Duties (approximately 3 hours per week)
- Slushy (approximately 8 days per winter period)
- Sunday Cook (approximately 2 - 4 days per winter period)

Other regular duties around the station are assigned on a voluntary basis. The author participated in the following:

- Brew Master (approximately 2 days per month)
- Tide Gauge Operator (approximately 2 hours per month)
- Muster Coordinator (on a need to basis)

In addition toward the end of the 1997 winter, due to a serious medical problem with another expeditioner, the author assisted in the care of that expeditioner. This lasted for a period of six weeks and approximately 60 hours of work time were lost. On occasion other duties were required (eg. resupply) on a ad hoc basis.

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6. Roberts, P., 1997, Mawson Geophysical Observatory 1997 Instructions Manual
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APPENDIX A: HISTORY OF MAWSON INSTRUMENTATION

A brief summary of the development of the Mawson Geophysical Observatory up to February 1998

A1: Geomagnetic Observatory

May 1955	Absolute instruments used for regular observation of H, D and Z (Oldham, 1957)
July 1955	Recording commenced by three component normal La Cour variometer (Oldham, 1957)
1957	Bar-fluxmeter magnetograph installed (Pinn, 1961)
January 1961	Three component insensitive La Cour magnetograph installed and recording commenced (Merrick, 1961)
December 1967	Bar-fluxmeter magnetograph withdrawn (Dent, 1971)
September 1968	Insensitive La Cour magnetograph converted to medium sensitivity and renamed normal magnetograph. The normal La Cour magnetograph was renamed sensitive magnetograph (Smith, 1971)
February 1975	15 mm/hr normal recorder replaced with 20 mm/hr recorder (Hill, 1978)
December 1975	15 mm/hr sensitive recorder replaced with 20 mm/hr recorder (Hill, 1978)
March 1981	MNS2 proton precession magnetometer installed for absolute measurements
August 1982	La Cour sensitive magnetograph removed (Silberstein, 1984)
July 1983	PhotoElectronic Magnetometer X and Y components installed (Cechet, 1984) MNS2 proton precession magnetometer ceased operation (Cechet, 1984)
May 1984	Digital recording of PEM X and Y component data began (Crosthwaite, 1986)
December 1985	La Cour normal magnetograph ceased operation. X, Y and Z PEM variometer commenced operation in new variometer building (Kelsey, 1987)
March 1986	X, Y and Z PEM temperature compensated to less than 1nT/°C (Hutchinson, 1987)
January 1988	Declination-Inclination Magnetometer (DIM) introduced for testing as an absolute and field survey instrument (Hutchinson, 1989)
February 1988	MNS2 PPM replaced with Elsec 820 PPM
January 1989	Independent recording of geomagnetic data in Australia via ANARESAT commenced (Crosthwaite, 1991)
May 1989	NEC IBM-AT based digital recording system installed (Crosthwaite, 1991)
August 1989	X and Y PEM altered to +/- 2000nT sensitivity (Crosthwaite, 1991)
January 1991	ASP began monitoring and logging PEM analogue output (De Deuge, 1992)
January 1993	Ring Core Fluxgate (RCF) Variometer & PC logging system installed (Rada, 1994)
January 1994	PEM recording (by AGSO and Antarctic Division's ASP) discontinued after blasting in quarry caused misalignment in all channels. RCF used as primary variometer
February 1994	One second recording of X, Y and Z using RCF began on 28 February (Day 059)
February 1998	A wireless Ethernet Link between the Variometer Building and the Green Store (allowing access to the local network and the internet) became operational (Roberts, 1998).

A2: Seismological Observatory

July 1956	Three component Leet-Blumberg seismograph (pen and ink recorder) in with the pier difference stalled
1960	Three component seismograph installed consisting of Benioff seismometers (free period 1.0 s) and three channel AGSO single drum recorder. Z galvanometer 0.2s free period, horizontal galvanometers free period 70s (Merrick, 1961)
February 1963	AGSO recorder replaced by Benioff 60 mm/hr three channel recorder. 14s free period horizontal galvanometers installed (Black, 1965)
September 1970	14s free period horizontal galvanometer replaced by short period (0.2s) galvanometer (Robertson, 1972)
December 1973	Z seismometer transferred to vault beneath Cosray Building (Almond, 1975)
April 1977	Transfer of Geophysics office, including power and timing, to Wombat (Science Building)
1978	Recording of SPN Benioff seismometer discontinued (Petkovic, in prep)
July 1981	Helicorder hot pen recorder installed for SPZ and LPZ; SPN Benioff restored
March 1983	Cosray vault fully concreted in readiness for movement of SPN and SPE. Thermostatically controlled heating installed to stabilise LPZ (Cechet, 1984).
August 1983	Four Teledyne Geotech seismic amplifiers (AR320) installed for connection to twin hot pen recorders (Cechet, 1984)
May 1984	Horizontal seismometer and the Benioff photographic recorder disconnected (Crosthwaite, 1986)
February 1985	Horizontal seismometers reinstalled in Cosray Vault, connected to visual hot pen recorders and converted to dual channel (Crosthwaite, 1986, Kelsey, 1987)
February 1986	SPZ rectilinear pen Helicorder installed. Two pen Helicorder for SP horizontals (Hutchinson, 1987)
January 1988	Guralp wide band seismic system installed in the Cosray Vault (Hutchinson, 1989)
January 1988	Short period horizontal seismometers removed from Cosray Vault (Hutchinson, 1989)

APPENDIX B: LOG SUMMARIES

B1: Geomagnetic Observatory

22/12/96 1997 Observer, Perry Roberts, arrived Mawson station on Voyage 4.

25/12/96 1996 Observer, Adrian Giffen, departed Mawson station on Voyage 4.

04/01/97 Logging stopped on acquisition PC in the Variometer Building at 0536 UT to change year number in MCOPY.BAT from 96 to 97. Logging recommenced at 0538 UT.

06/01/97 Station power cut 0106 UT - 0114 UT.

14/01/97 0730 UT onwards. Surveyors and Roger Handsworth working at edge of magnetic quiet zone looking for suitable site for Tide Gauge.

21/01/97 Discovered circuit breaker #13 on electrical board in Variometer Building had closed. No power to Variometer Building or the Absolute Hut. Problem sourced to shorted heater element in Variometer Building. Power restored later that afternoon.

22/01/97 0400 UT. Replaced element in Absolute Hut heater.

25/01/97 At the end of obs set Declinometer fibre broke when weight put back on.

03/02/97 Station power cut 0118 UT - 0125 UT.

04/02/97 Declinometer back in operation with new fibre.

05/02/97 Station power cut 0556 UT - 0607 UT. Routine maintenance of Variometer Building's outer door by carpenter.

06/02/97 Station power cut 0756 UT - 0801 UT.

15/02/97 Replaced batteries in DIM electronics box. Cardboard jacketed batteries were used.

20/02/97 0845 UT. Acquisition PC in the Variometer Building not responding to keystrokes. Data logging unaffected Shutdown PC at 0844 UT. Rebooted PC at 0849 UT.

24/02/97 Station power cut 0015 UT - 0023 UT.

17/03/97 0730 UT. Discovered acquisition PC in the Variometer Building had crashed again. Rebooted PC at 0853 UT. Suspect hard disk becoming segmented. Hard disk was purged of old files to make more room. PC rebooted again at 1114 UT to check data files.

18/03/97 Started secondary survey around mark 85/2. Could not complete due to windy weather.

19/04/97 Station power cut 1445 UT - 1455 UT.

21/04/97 Adjusted temperature controller in west room of Variometer Building by 1/4 turn clockwise.

22/04/97 Adjusted temperature controller in west room of Variometer Building by 1/2 turn clockwise.

23/04/97 Adjusted temperature controller in west room of Variometer Building by 1/4 turn anticlockwise.

24/04/97 A round of angles was performed.

08/05/97 Discovered the acquisition PC in the Variometer Building was not logging PPM data (COM2 port). The PC was rebooted which cleared the COM2 port and logging recommenced at 1000 UT.

10/05/97 Installed new software (MACHWIEW.EXE, MACQ.EXE, MACQCMD.EXE, MACQMON.EXE) on the acquisition PC in the Variometer Building. PC shutdown at 0820 UT. Rebooted at 0829 UT.

15/05/97 Station power cut 2235 UT - 2301 UT.

16/05/97 Station power cut 0955 UT - 1000 UT.

27/05/97 Mark 89/2 in magnetic quiet zone now completely obscured by drift tail.

04/08/97 Very short station power cut 0233:10 UT - 0233:20 UT.

- 11/08/97 Again discovered the acquisition PC in the Variometer Building was not logging PPM data (COM2 port). The PC was rebooted which cleared the COM2 port and logging recommenced at 0723 UT.
- 20/10/97 Replaced faulty (noise problem) Elsec 820 PPM sensor with one that arrived on Voyage 2. Installed 0856 UT - 0902 UT. New sensor also faulty (open circuit). Put back old sensor 0909 UT - 0910 UT.
- 12/11/97 Adjusted temperature controller in west room of Variometer Building by 1/4 turn anticlockwise.
- 02/12/97 Station power cut 1005 - 1020 UT.
- 13/12/97 Adjusted temperature controller in west room of Variometer Building by 1/2 turn anticlockwise.
- 22/12/97 A round of angles was performed.
- 26/12/97 1998 Observer, Maria De Deuge, arrived Mawson station on Voyage 4.
- 28/12/97 Mawson PPM E770/199 was compared with the travelling standard E770/210. Comparison done by Maria De Deuge.
- 30/12/97 A second comparison of Mawson PPM E770/199 and the travelling standard E770/210 was done by Maria De Deuge.
- 31/12/97 Second replacement Elsec 820 PPM sensor arrived on Voyage 4. Replaced faulty (noise problem) 0814 UT - 0921 UT. New sensor has only small number of noise spikes present.
- 01/01/98 1998 Observer, Maria De Deuge, took over responsibility for observatory operations.
- 11/02/98 1997 Observer, Perry Roberts, departed Mawson station on Voyage 5.

B2: Seismological Observatory

- 22/12/96 1997 Observer, Perry Roberts, arrived Mawson station on Voyage 4.
- 23/12/96 Discovered the REC switch on the LPZ seismic preamps had been left on SHO when Decembers monthly checks were done.
- 25/12/96 1996 Observer, Adrian Giffen, departed Mawson station on Voyage 4. A fuse blew in 12V DC supply (calibration pulse supply) to the seismic rack in vault.
- 06/01/97 Station power cut 0106 UT - 0114 UT.
- 03/02/97 Station power cut 0118 UT - 0125 UT.
- 05/02/97 Station power cut 0556 UT - 0607 UT.
- 06/02/97 Station power cut 0756 UT - 0801 UT.
- 24/02/97 Station power cut 0015 UT - 0023 UT.
- 03/03/97 Received email from HO (Canberra) regards loss of digital data transmission. Mawson data from 02/02/97 (2222 UT). PDP system ok. Probable ANARESAT outage.
- 25/03/97 1 minute pulses to chart data failed. Sourced problem to a faulty IC (HCF4049). The IC had shorted out internally loading down the 1 minute pulse line. The IC was replaced.
- 19/04/97 Station power cut 1445 UT - 1455 UT.
- 15/05/97 Station power cut 2235 UT - 2301 UT.
- 16/05/97 Station power cut 0955 UT - 1000 UT.
- 18/04/97 Received an email from HO (Canberra) regarding Mawson arrival times being -3.18 seconds to 10.02 seconds out. Rebooted system 1038 UT and logging recommenced at 1128 UT.
- 03/05/97 Received email from HO (Canberra) regards loss of digital data transmission. Mawson data from 02/05/97 (1416 UT). PDP system ok. Probable ANARESAT outage.

- 15/06/97 Received email from HO (Canberra) regards loss of digital data transmission. Mawson data from 15/06/97 (1100 UT). PDP system ok. Probable ANARESAT outage.
- 24/06/97 GED clock (in Wombat) output pulses to Cosray failed. Part of the problem sourced to failing 1 second pulse from Aeronomy. This problem was not resolved until 30/06/97. The 50ms time accuracy of all seismic systems cannot be guaranteed during this period.
- 11/07/97 More GED clock problems relating to time pulses. The problem was not resolved until 12/07/97
- 23/09/97 Discovered the REC switch on the LPZ seismic preamps had been left on SHO when Septembers monthly checks were done.
- 29/09/97 SPZ annual calibration started.
- 17/11/97 More SPZ annual calibrations.
- 19/11/97 More SPZ annual calibrations.
- 20/11/97 More SPZ annual calibrations.
- 02/12/97 Station power cut 1005 - 1020 UT.
- 11/12/97 Received an email from HO (Canberra) regarding loss of digital data. Trades work was being carried out in Cosray. Possible disturbances to PDP or data lines. System rebooted 1149 UT
- 19/12/97 GED clock (in Wombat) failed. Fault traced to a shorted LED Display segment. Component replaced. GED clock pulses to the PDP were down 0353 UT - 1145 UT.
- 01/01/98 1998 Observer, Maria De Deuge, took over responsibility for observatory operations.
- 11/02/98 1997 Observer, Perry Roberts, departed Mawson station on Voyage 5.

B3: Tidal Gravity Observatory

- 22/12/96 1997 Observer, Perry Roberts, arrived Mawson station on Voyage 4.
- 26/12/96 Replaced batteries in acquisition PC UPS. System down 0930 UT to 0945 UT.
- 03/01/97 Shut down acquisition PC at 0547 UT to 0553 UT to enable GCOPY.BAT to be modified to reflect change of year.
- 06/01/97 Station power cut 0106 UT - 0114 UT.
- 16/01/97 Rebooted acquisition PC using MACQMON/XSV=10.
- 03/02/97 Station power cut 0118 UT - 0125 UT.
- 05/02/97 Station power cut 0556 UT - 0607 UT.
- 06/02/97 Station power cut 0756 UT - 0801 UT.
- 24/02/97 Station power cut 0015 UT - 0023 UT.
- 19/04/97 Station power cut 1445 UT - 1455 UT.
- 14/05/97 Discovered (0516 UT) 12V GE330 globe had blown in gravity meter. No spare so I put in nearest replacement available (26V).
- 15/05/97 Station power cut 2235 UT - 2301 UT.
- 16/05/97 Station power cut 0955 UT - 1000 UT.
- 27/05/97 Started calibration of Gravity Meter.
- 28/05/97 Completed calibration of Gravity Meter.
- 24/11/97 At 1000 UT adjusted level and sensitivity of Gravity Meter. Spirit level seems to drift.
- 02/12/97 Station power cut 1005 - 1020 UT.

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APPENDIX C: LINEAR REGRESSION RESULTS**Table 34: DIM Linear Regression Results**

DIM DATA						
X COMPONENT REGRESSION (X versus a, b, c, th, te, date)						
Period (DOY)		S Xz	S Xy	S Xx	Degrees of Freedom	Correlation
001 - 365	Scale Value	-0.0001	0.0233	-0.0076	89	0.994
	Standard Error	0.0003	0.0002	0.0004		
001 - 149	Scale Value	0.0003	0.0231	-0.0079	35	0.998
	Standard Error	0.0003	0.0002	0.0004		
150 - 280	Scale Value	-0.0006	0.0239	-0.0074	26	0.981
	Standard Error	0.0005	0.0009	0.0011		
281 - 365	Scale Value	-0.0034	0.0205	-0.0041	14	0.977
	Standard Error	0.0016	0.0010	0.0016		
Y COMPONENT REGRESSION (Y versus a, b, c, th, te, date)						
Period (DOY)		S Xz	S Xy	S Xx	Degrees of Freedom	Correlation
001 - 365	Scale Value	0.0003	-0.0080	-0.0235	89	0.986
	Standard Error	0.0003	0.0002	0.0004		
001 - 149	Scale Value	0.0000	-0.0079	-0.0231	35	0.991
	Standard Error	0.0004	0.0002	0.0005		
150 - 280	Scale Value	0.0001	-0.0090	-0.0248	26	0.966
	Standard Error	0.0005	0.0009	0.0010		
281 - 365	Scale Value	-0.0026	-0.0093	-0.0213	14	0.977
	Standard Error	0.0019	0.0012	0.0018		
Z COMPONENT REGRESSION (Z versus a, b, c, th, te, date)						
Period (DOY)		S Xz	S Xy	S Xx	Degrees of Freedom	Correlation
001 - 365	Scale Value	0.0251	-0.0001	0.0001	89	0.999
	Standard Error	0.0001	0.0001	0.0002		
001 - 149	Scale Value	0.0253	-0.0001	0.0000	35	0.999
	Standard Error	0.0002	0.0001	0.0002		
150 - 280	Scale Value	0.0247	0.0002	0.0006	26	0.999
	Standard Error	0.0002	0.0003	0.0004		
281 - 365	Scale Value	0.0248	-0.0007	-0.0003	14	0.996
	Standard Error	0.0007	0.0004	0.0006		

Table 35: QHM 300 Linear Regression Results

QHM 300 DATA						
X COMPONENT REGRESSION (X versus a, b, c, th, te, date)						
Period (DOY)		S Xz	S Xy	S Xx	Degrees of Freedom	Correlation
001 - 365	Scale Value	-0.0003	0.0237	-0.0079	59	0.997
	Standard Error	0.0002	0.0002	0.0004		
001 - 149	Scale Value	0.0001	0.0235	-0.0080	19	0.999
	Standard Error	0.0002	0.0001	0.0004		
150 - 280	Scale Value	-0.0017	0.0278	-0.0124	16	0.993
	Standard Error	0.0003	0.0010	0.0016		
281 - 365	Scale Value	-0.0001	0.0219	-0.0073	10	0.986
	Standard Error	0.0019	0.0011	0.0014		
Y COMPONENT REGRESSION (Y versus a, b, c, th, te, date)						
Period (DOY)		S Xz	S Xy	S Xx	Degrees of Freedom	Correlation
001 - 365	Scale Value	0.0001	-0.0081	-0.0231	59	0.995
	Standard Error	0.0002	0.0002	0.0004		
001 - 149	Scale Value	0.0002	-0.0081	-0.0229	19	0.997
	Standard Error	0.0004	0.0002	0.0006		
150 - 280	Scale Value	-0.0005	-0.0078	-0.0260	16	0.973
	Standard Error	0.0004	0.0012	0.0019		
281 - 365	Scale Value	-0.0023	-0.0099	-0.0223	10	0.985
	Standard Error	0.0019	0.0011	0.0014		
Z COMPONENT REGRESSION (Z versus a, b, c, th, te, date)						
Period (DOY)		S Xz	S Xy	S Xx	Degrees of Freedom	Correlation
001 - 365	Scale Value	0.0250	0.0002	-0.0002	59	0.997
	Standard Error	0.0002	0.0002	0.0005		
001 - 149	Scale Value	0.0250	0.0003	-0.0002	19	0.993
	Standard Error	0.0006	0.0004	0.0010		
150 - 280	Scale Value	0.0249	-0.0004	0.0012	16	0.999
	Standard Error	0.0001	0.0005	0.0008		
281 - 365	Scale Value	0.0248	-0.0004	-0.0004	10	0.994
	Standard Error	0.0009	0.0005	0.0007		

Table 36: Combined DIM and QHM Linear Regression Results

COMBINED DIM & QHM 300 DATA						
X COMPONENT REGRESSION (X versus a, b, c, th, te, date)						
Period (DOY)		$S X_z$	$S X_y$	$S X_x$	Degrees of Freedom	Correlation
001 - 365	Scale Value	-0.0002	0.0235	-0.0077	155	0.995
	Standard Error	0.0002	0.0001	0.0003		
001 - 149	Scale Value	0.0003	0.0233	-0.0080	59	0.999
	Standard Error	0.0002	0.0001	0.0003		
150 - 280	Scale Value	-0.0009	0.0246	-0.0081	51	0.981
	Standard Error	0.0003	0.0007	0.0008		
281 - 365	Scale Value	-0.0020	0.0213	-0.0060	31	0.977
	Standard Error	0.0011	0.0007	0.0010		
Y COMPONENT REGRESSION (Y versus a, b, c, th, te, date)						
Period (DOY)		$S X_z$	$S X_y$	$S X_x$	Degrees of Freedom	Correlation
001 - 365	Scale Value	0.0002	-0.0081	-0.0233	155	0.990
	Standard Error	0.0002	0.0001	0.0003		
001 - 149	Scale Value	0.0001	-0.0080	-0.0232	59	0.994
	Standard Error	0.0003	0.0001	0.0004		
150 - 280	Scale Value	-0.0001	-0.0089	-0.0243	51	0.961
	Standard Error	0.0003	0.0007	0.0008		
281 - 365	Scale Value	-0.0024	-0.0096	-0.0219	31	0.978
	Standard Error	0.0012	0.0007	0.0011		
Z COMPONENT REGRESSION (Z versus a, b, c, th, te, date)						
Period (DOY)		$S X_z$	$S X_y$	$S X_x$	Degrees of Freedom	Correlation
001 - 365	Scale Value	0.0250	0.0000	-0.0001	155	0.997
	Standard Error	0.0001	0.0001	0.0002		
001 - 149	Scale Value	0.0252	0.0000	-0.0002	59	0.995
	Standard Error	0.0003	0.0002	0.0004		
150 - 280	Scale Value	0.0248	0.0001	0.0007	51	0.999
	Standard Error	0.0001	0.0002	0.0003		
281 - 365	Scale Value	0.0250	-0.0006	-0.0004	31	0.995
	Standard Error	0.0005	0.0003	0.0004		

Table 37: Adopted Scale Values for 1997

Component	S x	S y	S z
X	-0.0079	0.0235	0
Y	-0.0232	-0.0080	0
Z	0	0	0.0250

APPENDIX D: VARIOMETER PARAMETERS**D1: File 1997mac.maw (equivalent to trial.con)**

#-----

MAW 1997 info.con created from std. BLV file by abslob on 01/06/1998 14:49LT

#-----

STATION MAW 1997 001.0 1997 366.0 -67.4 62.9 7751. -16868. -45652. 1500

#=====

MAW model for interval: 1997 Jan 01 00:00 to Apr 09 09:07 (98.38055 days)

#-----

VARIOMETER MAW MAW 1997 1.00000 1997 99.37986 A RCF0\

7494.30 -.00790 .02350 .00000 .00000 .00000\

-16332.20 -.02320 -.00800 .00000 .00000 .00000\

-45560.60 .00000 .00000 .02500 .00000 .00000\

.00 .00 .00\

11.8100 .1370 10.0000 11.8100 .1370 10.0000\

17 15 -57 32136.0 32083.0 32075.0\

.03860 .04000 -.02100 .10 F

#=====

MAW model for interval: 1997 Apr 09 09:08 to Jun 01 19:56 (53.45070 days)

#-----

VARIOMETER MAW MAW 1997 99.38055 1997 152.83060 A RCF0\

7498.10 -.00790 .02350 .00000 .00000 .00000\

-16328.20 -.02320 -.00800 .00000 .00000 .00000\

-45562.70 .00000 .00000 .02500 .00000 .00000\

.00 .00 .00\

11.8100 .1370 10.0000 11.8100 .1370 10.0000\

17 15 -57 32136.0 32083.0 32075.0\

.03860 .00800 .00290 .10 F

#=====

MAW model for interval: 1997 Jun 01 19:57 to Jul 20 07:41 (48.48958 days)

#-----

VARIOMETER MAW MAW 1997 152.83130 1997 201.32010 A RCF0\

7500.20 -.00790 .02350 .00000 .00000 .00000\

-16327.80 -.02320 -.00800 .00000 .00000 .00000\

-45562.60 .00000 .00000 .02500 .00000 .00000\

.00 .00 .00\

11.8100 .1370 10.0000 11.8100 .1370 10.0000\

17 15 -57 32136.0 32083.0 32075.0\

-02170 .00800 .00290 .10 F

#=====

MAW model for interval: 1997 Jul 20 07:42 to Oct 09 19:37 (81.49722 days)

#-----

VARIOMETER MAW MAW 1997 201.32080 1997 282.81740 A RCF0\

7499.20 -.00790 .02350 .00000 .00000 .00000\

-16327.40 -.02320 -.00800 .00000 .00000 .00000\

-45562.40 .00000 .00000 .02500 .00000 .00000\

.00 .00 .00\

11.8100 .1370 10.0000 11.8100 .1370 10.0000\

17 15 -57 32136.0 32083.0 32075.0\

-02170 .00800 -.01960 .10 F

#=====

MAW model for interval: 1997 Oct 09 19:38 to Oct 29 19:19 (19.98750 days)

#-----

VARIOMETER MAW MAW 1997 282.81810 1997 302.80490 A RCF0\

7497.50 -.00790 .02350 .00000 .00000 .00000\

-16326.70 -.02320 -.00800 .00000 .00000 .00000\

-45564.00 .00000 .00000 .02500 .00000 .00000\

.00 .00 .00\

11.8100 .1370 10.0000 11.8100 .1370 10.0000\

17 15 -57 32136.0 32083.0 32075.0\

-02170 .00800 .02170 .10 F

#=====

MAW model for interval: 1997 Oct 29 19:20 to Dec 31 23:59 (63.19444 days)

#-----

VARIOMETER MAW MAW 1997 302.80550 1997 365.99930 A RCF0\

7497.00 -.00790 .02350 .00000 .00000 .00000\

-16326.60 -.02320 -.00800 .00000 .00000 .00000\

-45563.50 .00000 .00000 .02500 .00000 .00000\

.00 .00 .00\

11.8100 .1370 10.0000 11.8100 .1370 10.0000\

17 15 -57 32136.0 32083.0 32075.0\

.01220 .00800 .02170 .10 F

#=====

MAW BLVs at end of 1997 are: X= 7497.77, Y=-16326.09, Z=-45562.13

#=====

D2: File 1997blv.maw

!! MAWSON MAGNETIC OBSERVATORY

!!!! 1997 !!!!

!! (Modified by PIR 01.06.98)

!! Parameters are final

!!!Instrument Corrections (1997 adopted value of +4.5 nT for E770/199)

MAW,AX,1997,01,01,00,00, +0.7

MAW,AY,1997,01,01,00,00, -1.5

MAW,AZ,1997,01,01,00,00, -4.2

!!! year month dy hr min value!!! (1997 values)

!!!! M=ANNUAL MEAN FIELD VALUES!!!!

MAW,MX,1997,01,01,00,00, 7751

MAW,MY,1997,01,01,00,00,-16868

MAW,MZ,1997,01,01,00,00,-45652

!!!!O=ZERO RECORDING LEVEL

MAW,OX,1997,01,01,00,00, 0.0

MAW,OY,1997,01,01,00,00, 0.0

MAW,OZ,1997,01,01,00,00, 0.0

MAW,OT,1997,01,01,00,00, 0.0

MAW,Ot,1997,01,01,00,00, 0.0

!!!! TS=STANDARD TEMPERATURE

MAW,TS,1997,01,01,00,00, 10.0

MAW,tS,1997,01,01,00,00, 10.0

!!!!!!Temp S=SCALE VALUE

MAW,ST,1997,01,01,00,00, 0.137

MAW,St,1997,01,01,00,00, 0.137

!!!!!!B=BASELINE

MAW,BT,1997,01,01,00,00, 11.81

MAW,Bt,1997,01,01,00,00, 11.81

!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!

! RCF DATA PERIOD 1 DAY 01 TO DAY 99

!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!

MAW,BX,1997,01,01,00,00, +7494.3

MAW,BY,1997,01,01,00,00, -16332.2

MAW,BZ,1997,01,01,00,00, -45560.6

MAW,DX,1997,01,01,00,00, 0.0386

MAW,DY,1997,01,01,00,00, 0.0400

MAW,DZ,1997,01,01,00,00, -0.0210

!!!!!!S=SCALE VALUES

MAW,SX,1997,01,01,00,00, -0.0079

MAW,SXY,1997,01,01,00,00, 0.0235

MAW,SXZ,1997,01,01,00,00, 0.0

MAW,SYX,1997,01,01,00,00, -0.0232

MAW,SY,1997,01,01,00,00, -0.0080

MAW,SYZ,1997,01,01,00,00, 0.0

MAW,SZX,1997,01,01,00,00, 0.0

MAW,SYZ,1997,01,01,00,00, 0.0

MAW,SZ,1997,01,01,00,00, 0.0250

!!!!!!Q=TEMPERATURE COEFFICIENTS

MAW,QX,1997,01,01,00,00, 0.0

MAW,QY,1997,01,01,00,00, 0.0

MAW,QZ,1997,01,01,00,00, 0.0

!!!!!!N=STANDARD RANGE FOR EACH RINGCORE CHANNEL

MAW,NX,1997,01,01,00,00, 17

MAW,NY,1997,01,01,00,00, 15

MAW,NZ,1997,01,01,00,00, -57

!!!!!!R=RANGE WIDTH FOR EACH RINGCORE CHANNEL

MAW,RX,1997,01,01,00,00, 32136

MAW,RY,1997,01,01,00,00, 32083

MAW,RZ,1997,01,01,00,00, 32075

!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!

! RCF DATA PERIOD 2 DAY 99 TO DAY 152

!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!

MAW,BX,1997,04,09,09,08, +7498.1

MAW,BY,1997,04,09,09,08, -16328.2

MAW,BZ,1997,04,09,09,08, -45562.7

!!!!!!D=DRIFT

MAW,DX,1997,04,09,09,08, 0.0386

MAW,DY,1997,04,09,09,08, 0.0080

MAW,DZ,1997,04,09,09,08, 0.0029

!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!

! RCF DATA PERIOD 3 DAY 152 TO DAY 201

!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!

MAW,BX,1997,06,01,19,57, +7500.2

MAW,BY,1997,06,01,19,57, -16327.8

MAW,BZ,1997,06,01,19,57, -45562.6

!!!!!!D=DRIFT

MAW,DX,1997,06,01,19,57, -0.0217

MAW,DY,1997,06,01,19,57, 0.0080

MAW,DZ,1997,06,01,19,57, 0.0029

!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!

! RCF DATA PERIOD 4 DAY 201 TO DAY 282

!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!

MAW,BX,1997,07,20,07,42, +7499.2

MAW,BY,1997,07,20,07,42, -16327.4

MAW,BZ,1997,07,20,07,42, -45562.4

!!!!!!D=DRIFT

MAW,DX,1997,07,20,07,42, -0.0217

MAW,DY,1997,07,20,07,42, 0.0080

MAW,DZ,1997,07,20,07,42, -0.0196

!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!

! RCF DATA PERIOD 5 DAY 282 TO DAY 302

!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!

MAW,BX,1997,10,09,19,38, +7497.5

MAW,BY,1997,10,09,19,38, -16326.7

MAW,BZ,1997,10,09,19,38, -45564.0

!!!!!!D=DRIFT

MAW,DX,1997,10,09,19,38, -0.0217

MAW,DY,1997,10,09,19,38, 0.0080

MAW,DZ,1997,10,09,19,38, 0.0217

!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
! RCF DATA PERIOD 6 DAY 302 TO DAY 366
!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!

MAW,BX,1997,10,29,19,20, +7497.0
MAW,BY,1997,10,29,19,20, -16326.6
MAW,BZ,1997,10,29,19,20, -45563.5
!!!!!!D=DRIFT
MAW,DX,1997,10,29,19,20, 0.0122
MAW,DY,1997,10,29,19,20, 0.0080
MAW,DZ,1997,10,29,19,20, 0.0217

APPENDIX E: ROUNDS OF ANGLES

Rounds of angles were performed using the standard technique on the 24/4/97 and on the 22/12/97. For the set of 22/12/97 mark 85/2 could not be used as it was not visible due excessive snow accumulation. All measurements are referenced to mark BMR 89/2 with an assumed azimuth of 19 deg 13.7 min (19.228 deg).

Table 38: Rounds of Angles for the 24/04/97

Theodolite 352229 Readings												
	Mark 1		Mark 2		Mark 3		Mark 4		Mark 5		Ref	
	85/2		SOH		89/1		LEE		A		89/2	
	(deg)	(min)	(deg)	(min)	(deg)	(min)	(deg)	(min)	(deg)	(min)	(deg)	(min)
VCR	140	52.9	174	3.1	250	25.7	256	53.8	258	24.1	279	2.9
VCL	320	52.9	354	3.9	70	25.2	76	53.8	78	24.0	99	2.7
VCL	80	52.6	114	3.8	190	25.2	196	53.6	198	24.0	219	2.6
VCR	260	52.4	294	3.7	10	25.1	16	53.1	18	23.8	39	2.4
VCR	20	52.2	54	3.2	130	25.1	136	53.1	138	23.9	159	2.3
VCL	200	52.2	234	3.8	310	25.1	316	53.2	318	23.9	339	2.3

Results				
Mark 1	Mark 2	Mark 3	Mark 4	Mark 5
85/2	SOH	89/1	LEE	A
(deg)	(deg)	(deg)	(deg)	(deg)
241.061	274.246	350.606	357.076	358.585

Table 39: Rounds of Angles for the 22/12/97

Theodolite 352229 Readings										
	Mark 1		Mark 2		Mark 3		Mark 4		Mark 5	
	85/2		SOH		89/1		LEE		A	
	(deg)	(min)	(deg)	(min)	(deg)	(min)	(deg)	(min)	(deg)	(min)
VCR	*	*	174	6.8	250	28.7	256	56.8	258	27.0
VCL	*	*	354	6.3	70	28.1	76	56.2	78	26.9
VCL	*	*	114	6.8	190	28.3	196	56.2	198	27.0
VCR	*	*	294	6.9	10	28.2	16	56.2	18	26.7
VCR	*	*	54	6.8	130	28.8	136	56.8	138	26.9
VCL	*	*	234	0.7	310	28.9	316	56.8	318	27.0

Results				
Mark 1	Mark 2	Mark 3	Mark 4	Mark 5
85/2	SOH	89/1	LEE	A
(deg)	(deg)	(deg)	(deg)	(deg)
-	274.229	350.609	357.076	358.583

APPENDIX F: QNX NETWORK CONFIGURATION

F1: Hardware

Ethernet Card

Type: KNE2000LC
 Node Address: 00C0 F00D F777
 I/O Address: 300
 IRQ: 000A in Hex, 10 in decimal

Network Addresses and Names

IP Address: 147.66.40.154 charnockite
 Subnet Mask 255.255.248.0
 Gateway: 147.66.40.1 mawson
 Server (DNS): 147.66.8.1 antdiv.gov.au

Note: the Australian Antarctic Division has charnockite registered as "agsol.mawson.antdiv.gov.au".

Partitions

DOS Type 6: 250 Mb (Cylinders 000 - 253)
 QNX Type 77: 105 Mb (Cylinders 254 - 360)
 QNX Type 78: 454 Mb (Cylinders 361 - 821)

Note: the default boot partition is QNX Type 77 (default keystroke '2'). To boot from the DOS partition use keystroke '4'.

F2: Software

The QNX system use TCP/IP as an network protocol. The network driver software for the KNE2000LC card is listed below.

/etc/config/sysinit.1

```
set -i
export TZ=utc00
rtc -l hw
Dev &
Dev.con -n 6 &
reopen //0/dev/con1
Dev.ser &
Dev.par &
mousetrap start
Fsys.floppy &
Pipe &
emu87 &
freeze -cdz /etc/logo.F
tinit -T /dev/con* -t /dev/con1 &
/etc/netstart
/etc/netstart1
```

/etc/netstart

```
Net &
Net.ether1000 -l1 -i10 &
Socket charnockite &
ifconfig lo0 localhost up
ifconfig en1 charnockite up netmask 255.255.248.0
route add 0.0.0.0 147.66.40.1
Dev.ptty &
```

/etc/nestart1

```
portmap
nfsd
mountd -n /etc/exports
inetd
routed
```

/etc/hosts

```
#
# Host Database
# This file should contain the addresses and aliases
# for local hosts that share this file.
# It is used only for "ifconfig" and other operations
# before the nameserver is started.
#
#
127.1          localhost localhost.my.domain
#
# Imaginary Network.
10.2           myname.my.domain myname
10.3           myfriend.my.domain myfriend
#
# Local and Wide Area Network.
147.66.40.154  charnockite
147.66.40.1    mawson
147.66.8.1     antdiv.gov.au
#
# Note: the Antarctic Division has charnockite
# registered as agsol.mawson.antdiv.gov.au
```

/etc/gateways

```
net 0.0.0.0 gateway mawson metric 1 active
```

/etc/resolv.conf

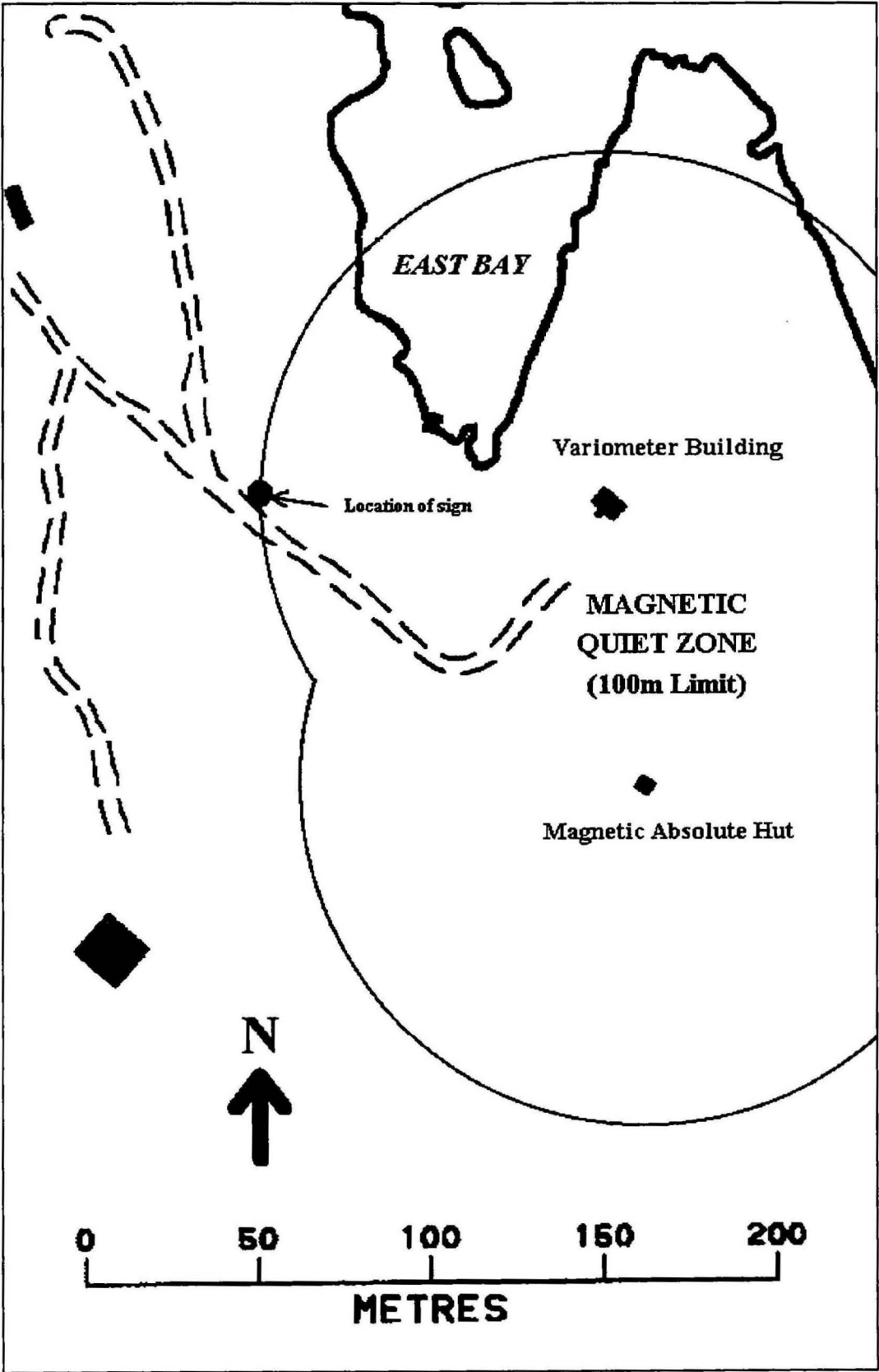
```
domain antdiv.gov.au
nameserver 147.66.8.1
```

/etc/exports

```
/
```

```
/d/hd0t77
```

APPENDIX G: MAGNETIC QUIET ZONE MAP



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APPENDIX H: MAWSON HOURLY MEAN VALUES**MAWSONANTARCTIC 1997 North component (X) 7500 + tabular values in nano Teslas**

UT	00	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	Mean	
Jan	286	274	250	218	177	199	225	246	259	283	292	299	307	311	313	315	316	315	309	293	304	304	295	290	A	278
	285	266	227	234	218	236	261	272	275	281	287	291	293	294	297	301	304	308	305	301	308	309	302	314	Q	282
	289	285	285	222	139	183	151	187	212	268	287	296	326	329	336	329	318	323	302	247	326	280	249	257	D	268
Feb	253	248	222	203	181	177	200	233	256	268	281	292	303	305	314	311	300	297	291	287	277	284	279	280	A	264
	261	244	215	203	224	236	246	255	266	275	280	287	295	295	295	294	293	298	294	292	291	271	275	287	Q	270
	251	218	133	146	101	133	124	179	224	240	266	281	300	312	322	312	301	273	266	276	241	278	247	254	D	236
Mar	241	245	220	214	194	184	210	245	260	270	276	284	290	293	299	298	288	281	276	264	267	267	251	249	A	257
	265	266	260	248	249	250	249	250	255	263	269	274	278	280	282	283	285	289	280	287	285	276	281	280	Q	270
	200	209	179	194	168	154	201	247	266	267	274	294	310	310	322	316	272	274	272	210	234	249	221	209	D	244
Apr	217	218	192	197	196	196	216	239	257	269	274	278	282	284	285	291	287	280	271	257	248	249	240	214	A	247
	221	249	261	267	262	260	261	258	260	263	266	268	270	273	274	276	279	282	273	238	280	264	250	226	Q	262
	185	169	159	157	167	143	159	207	245	268	277	281	294	288	282	297	281	254	259	230	228	220	222	213	D	229
May	211	199	201	206	220	231	239	245	256	265	268	268	272	275	278	282	280	272	262	255	249	240	231	223	A	247
	243	246	251	254	253	255	258	260	262	264	268	269	269	270	270	269	269	268	270	271	269	266	258	254	Q	262
	205	161	149	156	159	175	182	180	224	259	255	247	254	264	267	286	278	259	239	219	174	246	222	172	D	218
Jun	228	212	203	195	191	206	224	242	252	263	268	276	279	283	282	280	279	273	273	264	248	247	235	231	A	247
	237	238	234	240	248	253	253	257	260	264	265	268	268	267	267	266	266	266	267	268	266	247	258	243	Q	257
	208	190	175	167	134	155	165	212	234	253	254	286	297	306	300	299	280	266	289	266	199	231	230	229	D	234
Jul	234	229	222	206	223	228	238	252	261	267	271	272	274	274	273	274	273	267	263	262	259	251	252	239	A	253
	242	228	219	223	240	255	257	255	258	262	264	264	265	264	264	265	265	266	266	266	245	256	259	260	Q	255
	234	235	196	138	192	196	214	247	256	277	287	299	298	292	277	275	273	240	228	243	250	202	247	223	D	243
Aug	233	220	209	209	204	202	229	241	251	259	261	263	266	268	272	272	270	264	260	255	246	237	234	238	A	244
	233	219	201	217	251	256	254	256	255	254	253	253	253	255	257	260	262	265	264	260	255	250	242	232	Q	248
	217	213	229	203	161	103	170	197	235	264	267	273	277	276	274	275	252	233	229	235	228	200	211	262	D	228
Sep	225	211	173	164	159	183	205	223	237	250	256	263	270	269	270	274	265	260	253	246	243	245	238	237	A	234
	230	220	229	231	220	241	242	237	239	242	244	247	252	254	259	260	266	265	256	265	260	248	249	252	Q	246
	212	221	104	96	89	157	173	208	240	257	261	273	281	283	274	272	261	247	233	224	244	226	220	210	D	219
Oct	234	211	183	175	153	158	169	202	228	237	248	257	267	271	273	269	274	267	260	241	255	245	236	246	A	232
	237	217	210	215	219	221	224	231	233	236	241	250	257	261	261	263	264	268	259	257	252	242	259	250	Q	243
	226	212	115	97	48	47	15	146	215	215	244	252	267	280	271	270	287	264	262	247	280	241	235	267	D	208
Nov	248	237	208	167	125	127	165	207	220	238	251	264	266	288	288	277	279	272	276	271	261	267	275	255	A	239
	241	241	224	192	168	204	216	221	224	233	241	246	248	249	248	246	253	256	261	266	263	252	256	254	Q	238
	270	260	173	159	146	25	56	154	157	219	243	271	246	325	326	304	309	288	310	292	263	262	297	213	D	232
Dec	247	231	199	180	186	191	200	221	229	240	247	258	270	268	270	270	270	272	275	272	268	274	271	259	A	245
	237	228	218	213	214	235	241	242	246	247	247	252	254	255	258	253	252	261	263	265	264	269	267	269	Q	248
	227	232	211	160	149	72	83	185	202	231	247	277	311	284	276	288	300	287	307	288	280	291	275	260	D	238
Year	238	228	207	194	184	190	210	233	247	259	266	273	279	282	285	284	282	277	273	264	260	259	253	247	A	249
	244	238	229	228	231	242	247	249	253	257	260	264	267	268	269	270	271	274	271	270	270	263	263	260	Q	257
	227	217	176	158	138	129	141	196	226	251	263	277	289	296	294	294	284	267	266	248	246	244	240	231	D	233

Q and D indicate International Quiet and Disturbed days respectively; A indicates all days.

MAWSONANTARCTIC 1997 East component (Y) -16500 - tabular values in nano Teslas.

UT	00	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	Mean	
Jan	346	362	357	358	341	361	370	369	356	355	362	365	379	381	380	378	376	379	358	329	326	325	319	339	A	357
	356	355	325	357	365	382	386	380	368	352	346	345	355	358	363	370	379	382	383	377	374	340	323	364	Q	362
	348	377	381	375	294	349	342	357	356	383	418	404	444	432	380	356	323	358	262	162	271	270	253	302	D	342
Feb	325	347	340	350	352	355	347	353	354	349	359	371	384	378	391	384	372	357	340	327	306	310	322	328	A	350
	334	344	344	357	376	383	373	367	363	357	357	359	365	370	373	375	378	388	379	371	346	313	327	353	Q	361
	313	325	272	321	308	361	300	319	347	363	377	402	399	393	398	388	378	274	207	204	146	203	250	261	D	313
Ma	336	349	337	355	349	337	349	361	358	357	358	362	370	379	391	391	384	376	356	324	320	316	293	328	A	352
	363	370	372	369	374	375	371	365	359	353	350	354	359	363	367	371	376	382	380	375	376	349	378	378	Q	368
	293	308	315	357	339	325	352	361	355	357	360	372	389	410	426	406	371	376	305	214	183	228	204	276	D	328
Apr	326	335	315	336	347	354	357	358	359	362	365	371	378	380	385	394	389	382	368	345	305	296	288	292	A	349
	320	360	372	380	383	384	380	377	371	366	363	364	368	372	375	377	379	386	376	359	346	338	333	306	Q	364
	310	317	299	301	344	330	344	342	347	355	371	382	399	389	393	408	385	356	329	305	231	241	257	281	D	334
Ma	323	322	340	350	360	368	370	361	358	364	367	369	374	378	387	392	389	381	361	367	349	333	314	305	A	358
	353	362	368	372	376	377	377	376	373	372	372	374	376	378	379	380	380	380	381	382	379	375	363	352	Q	373
	310	257	301	329	329	347	357	319	317	347	360	358	359	359	378	392	376	358	347	338	287	314	289	249	D	332
Jun	348	342	344	345	341	348	353	358	358	363	371	383	391	396	395	394	393	395	384	374	349	339	326	331	A	363
	354	361	361	368	371	379	378	377	374	368	368	374	380	380	380	381	382	383	385	386	381	363	357	354	Q	373
	343	325	342	344	302	305	311	324	340	354	368	403	418	425	419	410	392	400	388	352	253	265	321	330	D	351
Jul	353	360	363	351	367	374	375	377	377	374	374	383	389	393	393	395	394	395	396	386	381	367	354	345	A	376
	360	360	359	364	375	388	391	386	383	377	376	380	383	384	388	388	388	391	394	394	384	383	382	382	Q	381
	364	372	350	308	346	355	362	365	359	354	363	396	407	407	397	406	393	376	370	334	344	316	305	311	D	361
Aug	352	353	353	360	360	353	369	374	373	370	372	377	386	390	394	396	396	391	387	380	368	337	337	353	A	370
	361	356	343	360	389	394	390	387	384	378	377	378	379	380	381	385	387	394	395	389	375	374	353	356	Q	377
	322	349	376	371	326	251	295	338	350	352	369	377	391	392	394	393	381	357	337	345	323	252	289	356	D	345
Sep	354	350	329	343	351	373	374	374	371	374	379	385	390	391	394	398	389	382	363	344	329	329	341	353	A	365
	370	362	377	383	382	399	399	390	381	374	369	368	372	380	386	387	394	403	387	384	378	369	372	375	Q	381
	344	373	302	308	327	366	344	368	357	371	390	397	399	408	396	396	374	359	288	248	257	259	300	309	D	343
Oct	355	353	352	370	366	368	366	365	372	371	373	381	392	392	392	388	395	381	366	346	342	331	333	359	A	367
	373	367	376	393	399	400	396	388	378	373	368	371	376	383	384	392	394	401	394	386	372	345	374	381	Q	382
	316	346	294	318	288	319	295	323	370	361	373	387	405	394	376	364	362	318	309	279	317	306	290	337	D	335
Nov	359	384	380	381	371	367	372	375	370	376	392	402	402	427	414	401	410	404	394	379	354	360	366	353	A	383
	376	395	395	389	399	413	402	389	377	368	364	366	372	381	386	388	396	401	406	403	389	359	364	361	Q	385
	349	415	345	352	390	308	304	337	334	381	438	448	395	474	422	368	409	376	372	353	282	320	327	277	D	366
Dec	376	381	376	389	407	405	397	394	379	374	383	396	405	402	399	399	401	399	399	400	388	382	372	375	A	391
	379	381	395	404	417	423	410	400	389	384	382	379	381	384	392	391	392	403	403	407	401	391	397	392	Q	395
	326	360	347	348	368	322	332	378	368	373	425	480	492	435	386	380	380	343	351	368	362	360	362	388	D	376
Yea	346	353	349	357	359	364	367	368	365	366	371	379	387	391	393	393	391	385	373	358	343	335	330	338	A	365
	358	364	366	374	384	391	388	382	375	368	366	368	372	376	379	382	385	391	389	384	375	358	360	363	Q	375
	328	344	327	336	330	328	328	344	350	363	384	400	408	410	397	389	377	354	322	292	271	278	287	306	D	344

Q and D indicate International Quiet and Disturbed days respectively; A indicates all days.

MAWSONANTARCTIC 1997 Vertical intensity (Z) -45500 - tabular values in nano Teslas.

UT	00	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	Mean	
Jan	235	240	239	231	195	152	146	153	163	174	175	179	175	167	154	151	139	131	147	145	169	182	214	222	A	178
	207	230	205	170	158	135	144	152	157	163	171	172	173	178	180	183	177	173	162	150	152	162	205	213	Q	174
	258	272	276	279	217	155	176	197	199	196	175	176	135	75	62	85	61	87	163	168	228	266	246	236	D	183
Feb	254	259	250	252	238	199	167	167	168	169	173	173	165	153	152	154	137	129	145	168	170	195	212	236	A	187
	226	244	228	183	158	151	151	151	160	168	176	181	184	184	184	179	177	172	158	150	159	165	189	206	Q	179
	291	328	278	294	300	272	206	201	162	165	161	119	142	130	127	115	94	37	112	235	226	259	312	306	D	203
Ma	246	253	256	240	222	183	159	152	163	173	179	188	186	177	166	159	142	135	131	123	153	185	205	224	A	183
	183	186	183	173	165	160	158	156	159	164	171	177	179	178	178	177	170	168	147	149	165	177	173	176	Q	170
	301	327	319	300	276	218	181	153	170	176	186	204	191	151	146	120	68	71	138	104	203	227	249	281	D	199
Apr	255	270	260	257	227	195	173	161	164	174	180	182	182	180	172	171	161	150	141	145	142	171	217	246	A	191
	194	189	174	174	169	165	165	165	166	168	172	174	176	177	176	176	178	173	150	119	104	147	175	185	Q	167
	317	330	370	368	340	311	249	181	169	175	185	182	187	180	145	153	143	140	157	171	139	183	242	256	D	220
Ma	231	228	220	207	187	165	160	159	160	163	171	175	175	176	167	162	155	144	142	126	147	164	186	219	A	175
	186	179	171	164	159	158	158	160	162	164	167	169	170	169	169	168	168	167	167	163	160	159	157	182	Q	166
	267	277	263	284	286	240	206	201	184	166	172	175	176	175	140	141	127	127	128	119	143	209	233	313	D	198
Jun	203	214	216	197	171	160	149	143	153	159	163	170	164	160	159	163	155	141	138	134	138	142	155	182	A	164
	179	175	177	174	162	154	153	153	155	160	164	169	168	167	165	166	167	167	166	161	156	155	160	183	Q	165
	212	252	265	257	186	172	206	151	148	152	153	173	138	131	136	148	104	86	116	133	151	133	207	217	D	168
Jul	178	176	179	176	161	140	133	135	140	150	157	164	163	157	156	153	148	144	131	124	119	131	148	168	A	151
	164	166	159	158	153	153	148	143	147	151	158	162	165	161	160	159	160	160	158	149	123	137	136	149	Q	153
	186	197	208	195	190	136	115	123	130	150	160	174	159	139	132	109	91	85	64	91	96	108	162	194	D	141
Aug	188	196	193	185	173	155	141	142	142	147	156	161	161	159	156	146	142	135	123	123	125	135	156	174	A	155
	178	193	184	171	151	147	144	148	149	150	153	155	156	157	159	161	160	153	143	143	132	147	154	152	Q	156
	218	217	199	208	250	223	159	148	141	137	157	170	167	162	164	137	89	75	75	101	141	144	179	184	D	160
Sep	212	223	238	225	194	157	148	140	140	153	156	161	162	160	152	140	123	120	115	122	146	173	178	198	A	164
	190	185	171	166	152	150	146	143	145	147	152	160	166	165	164	163	161	137	114	114	137	144	149	165	Q	154
	258	245	296	294	280	216	211	164	135	155	159	150	146	143	131	108	87	71	72	102	178	198	249	239	D	179
Oct	236	242	230	229	199	169	157	145	146	152	160	161	149	156	161	146	137	125	129	146	155	174	200	207	A	171
	195	209	184	158	142	134	132	138	141	149	154	163	170	171	167	163	144	139	149	147	156	144	164	180	Q	158
	288	293	290	338	338	255	188	131	132	137	149	126	71	111	137	136	144	113	110	180	187	206	243	270	D	190
Nov	235	240	259	255	219	171	156	160	161	166	167	152	134	134	127	119	130	125	129	133	147	168	193	207	A	170
	217	203	199	191	143	121	127	134	140	148	156	163	166	168	166	165	164	159	150	142	145	153	181	195	Q	162
	259	279	337	342	338	339	303	292	244	228	180	81	6	39	31	7	70	96	104	129	190	183	235	226	D	189
Dec	201	199	197	178	160	147	129	125	131	142	149	150	152	142	141	136	135	134	131	122	133	141	166	182	A	151
	176	174	163	150	138	139	136	134	132	137	144	151	157	161	161	156	154	151	137	134	133	143	158	164	Q	149
	238	236	252	279	288	264	171	131	134	163	163	132	114	37	50	45	63	84	107	86	129	145	182	195	D	154
Yea	223	228	228	219	196	166	151	149	152	160	166	168	164	160	155	150	142	134	134	134	145	163	186	205	A	170
	191	194	183	169	154	147	147	148	151	156	162	166	169	170	169	168	165	160	150	143	143	153	167	179	Q	163
	258	271	279	287	274	233	198	173	162	167	167	155	136	123	117	109	95	89	112	135	168	188	228	243	D	182

Q and D indicate International Quiet and Disturbed days respectively; A indicates all days.

MAWSONANTARCTIC 1997 Total intensity (F) 49000 + tabular values in nano Teslas.

UT	00	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	Mean	
Jan	357	365	359	346	301	272	273	283	289	303	308	314	316	310	297	295	283	277	283	269	292	303	330	343	A	307
	334	352	312	293	281	269	282	290	290	291	298	299	303	310	313	319	317	315	305	291	293	290	323	347	Q	305
	379	402	407	398	299	268	280	310	315	331	327	324	304	245	217	228	193	229	265	226	331	359	330	338	D	304
Feb	362	374	359	361	345	310	281	288	293	294	303	309	308	295	300	298	277	264	273	288	282	307	327	351	A	310
	341	358	339	299	286	284	282	282	290	297	305	312	317	319	321	317	315	315	298	287	287	279	307	333	Q	307
	392	426	348	382	376	372	289	300	280	291	296	268	290	280	281	264	240	147	192	307	274	329	389	389	D	308
Ma	357	368	363	353	331	290	276	279	290	300	307	318	320	316	310	304	284	273	263	242	269	298	306	334	A	306
	311	316	314	301	296	292	288	284	286	290	296	303	308	309	311	311	307	307	286	287	302	302	309	313	Q	301
	387	418	408	406	374	314	296	280	297	303	314	339	335	304	308	276	209	213	251	178	264	304	311	364	D	311
Apr	358	375	355	361	336	308	292	285	291	303	311	315	318	317	311	315	303	290	275	268	251	275	314	338	A	311
	300	313	305	309	305	301	299	298	297	298	301	304	307	310	310	311	314	313	287	246	235	270	291	288	Q	296
	405	417	447	445	435	400	350	293	290	302	318	320	332	321	289	304	284	268	275	275	220	263	323	343	D	330
Ma	333	329	328	319	307	291	288	285	287	293	301	306	309	311	307	304	297	283	272	258	271	280	292	318	A	299
	307	304	300	295	291	291	292	293	294	296	300	302	304	304	304	304	304	302	303	300	296	293	286	305	Q	299
	362	347	346	376	378	345	318	300	290	289	299	300	302	302	277	285	266	256	251	236	234	316	326	378	D	307
Jun	319	324	325	307	281	276	270	269	279	289	295	308	306	305	303	305	297	284	278	270	262	262	268	294	A	291
	300	299	300	300	291	288	287	287	288	292	295	302	304	302	301	302	303	304	304	299	292	283	287	304	Q	296
	322	350	366	358	273	264	300	259	266	277	283	319	294	291	292	300	250	234	261	262	233	226	314	326	D	288
Jul	298	298	300	291	286	270	264	270	276	285	292	301	303	299	297	296	290	286	274	264	257	262	274	287	A	284
	289	289	280	282	284	290	287	280	283	286	292	298	302	298	299	297	298	300	298	291	260	274	273	286	Q	288
	309	323	319	284	300	254	239	253	259	280	294	320	310	290	277	259	238	221	198	212	222	216	270	297	D	268
Aug	307	313	309	303	292	272	269	273	274	280	289	296	299	298	298	289	285	276	263	260	256	254	272	295	A	284
	301	310	295	291	288	287	283	286	285	284	287	289	290	292	294	297	297	294	285	282	266	279	278	275	Q	288
	322	330	325	328	344	285	251	259	263	265	290	305	308	303	305	281	229	204	197	225	252	227	274	309	D	278
Sep	329	335	337	328	301	278	274	268	270	285	290	297	301	300	293	285	265	258	246	245	262	287	295	317	A	289
	315	306	300	297	282	289	286	279	278	278	282	289	297	299	301	300	301	282	254	255	274	274	280	297	Q	287
	366	365	370	369	362	326	317	286	261	287	298	294	292	292	276	254	226	204	178	191	267	284	344	336	D	294
Oct	353	354	338	342	310	283	273	267	274	281	291	296	290	297	302	287	281	264	261	267	276	289	312	329	A	297
	322	329	308	291	278	272	269	273	273	279	283	293	302	306	303	302	286	284	290	284	287	265	296	312	Q	291
	386	399	364	414	396	329	254	231	258	260	280	264	222	257	274	269	278	231	225	277	302	310	337	383	D	300
Nov	355	367	379	369	326	280	273	285	286	295	304	295	279	291	280	267	280	273	274	271	274	297	323	328	A	302
	343	337	330	316	271	261	265	268	269	275	283	291	296	301	301	300	303	300	294	287	284	279	308	320	Q	295
	378	417	434	438	446	400	370	386	341	352	331	246	155	225	200	156	229	239	248	262	290	296	352	314	D	313
Dec	330	327	318	302	293	281	262	262	263	273	284	291	298	287	285	280	280	279	277	269	274	280	299	314	A	288
	306	304	297	287	280	286	280	274	270	273	279	285	292	297	300	294	292	294	282	281	278	284	300	305	Q	288
	344	354	361	378	392	342	261	256	258	291	311	305	299	204	198	193	212	217	243	227	263	280	311	330	D	285
Yea	338	344	339	332	309	284	275	276	281	290	298	304	304	302	299	294	285	276	270	264	269	283	301	321	A	297
	314	318	307	297	286	284	283	283	284	287	292	297	302	304	305	305	303	301	290	283	279	281	295	307	Q	295
	363	379	375	381	365	325	294	285	282	294	303	300	287	276	266	256	238	222	232	240	263	284	323	342	D	299

Q and D indicate International Quiet and Disturbed days respectively; A indicates all days.

MAWSONANTARCTIC 1997 Horizontal intensity (H) 18500 + tabular values in nano Teslas.

UT	00	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	Mean	
Jan	59	68	53	41	9	36	55	63	56	65	75	81	97	101	101	100	98	100	79	46	48	47	38	54	A	65
	67	58	14	47	47	70	84	83	74	62	59	59	69	72	78	87	96	100	99	92	93	62	44	86	Q	71
	61	86	90	58	-50	18	-1	27	37	84	124	115	164	154	111	86	51	84	-11	-125	7	-13	-41	6	D	47
Feb	26	43	26	27	20	21	23	43	53	54	68	83	100	95	111	103	88	73	55	41	19	25	34	40	A	53
	37	39	27	33	60	71	66	64	65	63	66	71	79	84	87	88	90	101	91	84	60	23	37	65	Q	65
	14	11	-73	-23	-53	8	-51	-11	34	54	78	107	112	112	121	107	94	-12	-76	-75	-142	-75	-45	-32	D	8
Ma	31	44	23	36	23	8	30	55	59	61	65	72	82	92	104	104	93	84	63	29	27	23	-5	26	A	51
	65	71	70	64	68	70	66	60	57	55	55	60	66	71	75	80	85	93	86	85	85	57	85	85	Q	71
	-26	-8	-15	30	3	-16	28	56	58	61	66	85	108	126	146	125	75	80	15	-93	-112	-65	-98	-37	D	25
Apr	11	19	-9	12	21	28	40	49	58	65	70	77	86	89	93	104	98	88	72	45	5	-2	-14	-21	A	45
	8	56	71	81	82	82	79	74	70	67	65	67	71	77	79	82	85	93	80	50	56	42	32	-3	Q	64
	-17	-17	-37	-36	7	-16	3	21	42	59	77	89	110	98	100	119	91	54	32	-2	-70	-64	-49	-31	D	23
Ma	6	0	17	29	43	55	61	55	57	65	69	72	78	83	92	99	95	85	62	64	46	28	6	-5	A	53
	47	56	64	69	72	74	75	74	73	72	74	77	78	80	81	82	82	82	83	85	82	76	62	51	Q	73
	-9	-75	-40	-11	-10	13	25	-11	6	48	58	53	56	61	80	100	82	58	39	23	-42	13	-21	-77	D	17
Jun	36	24	21	20	14	27	39	50	55	64	73	87	96	103	101	99	98	97	88	75	45	36	19	22	A	58
	45	52	50	59	65	74	74	74	73	69	69	76	82	81	82	82	83	83	86	87	82	58	56	48	Q	70
	23	-1	9	7	-45	-33	-24	7	31	51	65	110	128	139	131	121	98	99	97	56	-63	-38	12	20	D	42
Jul	43	47	47	30	51	59	65	73	76	76	77	86	92	96	95	98	97	95	94	84	79	63	52	38	A	71
	53	47	42	48	65	84	87	82	80	77	76	80	83	83	87	87	87	91	93	94	75	80	80	81	Q	77
	53	60	25	-38	19	29	42	59	58	62	74	109	119	117	101	108	95	66	56	29	42	-3	5	0	D	54
Aug	42	38	33	39	37	30	55	65	68	69	72	77	86	91	96	98	97	90	85	77	61	30	28	44	A	63
	50	39	19	42	83	89	85	83	80	74	73	74	74	76	78	83	86	93	93	87	72	69	47	45	Q	71
	7	30	62	47	-12	-104	-37	14	41	55	71	81	95	96	97	97	76	46	26	36	13	-63	-25	58	D	34
Sep	39	31	-4	5	10	40	50	58	60	68	76	84	92	92	95	100	88	80	60	40	25	26	34	44	A	54
	56	45	63	69	63	87	88	78	70	65	62	62	68	76	83	85	93	101	83	84	77	63	66	71	Q	73
	25	55	-57	-55	-41	23	10	46	49	69	88	99	105	113	99	98	73	54	-17	-56	-40	-46	-11	-7	D	28
Oct	45	33	20	34	21	25	28	41	58	60	67	78	92	93	95	90	97	82	66	39	42	28	25	53	A	55
	63	49	54	71	79	80	78	74	65	62	59	66	73	81	83	91	93	101	91	82	68	38	72	75	Q	73
	6	27	-60	-45	-93	-65	-100	-21	51	42	65	81	104	100	79	67	74	24	15	-19	30	4	-14	42	D	16
Nov	55	72	57	40	14	12	31	51	52	66	85	100	100	133	121	105	114	106	98	82	55	63	72	51	A	72
	67	84	77	58	57	85	80	70	60	56	56	59	67	75	79	80	90	96	102	102	88	55	62	59	Q	73
	54	110	11	11	40	-84	-75	-5	-6	62	124	145	86	191	144	86	125	87	92	67	-10	25	46	-35	D	54
Dec	69	67	49	53	72	72	68	75	65	64	76	92	105	101	100	99	101	100	102	102	89	86	75	74	A	82
	68	66	74	80	93	107	97	89	80	76	75	74	77	80	89	85	86	99	101	105	99	92	97	93	Q	87
	15	48	28	7	21	-52	-39	45	44	60	113	176	201	138	90	90	95	56	71	79	71	74	68	86	D	66
Yea	38	40	28	30	28	34	45	56	60	65	73	82	92	97	100	100	97	90	77	60	45	38	30	35	A	60
	52	55	52	60	69	81	80	76	71	66	66	69	74	78	82	84	88	94	91	86	78	60	62	63	Q	72
	17	27	-5	-4	-18	-23	-18	19	37	59	84	104	116	120	108	100	86	58	28	-7	-26	-21	-14	-1	D	34

Q and D indicate International Quiet and Disturbed days respectively; A indicates all days.

MAWSONANTARCTIC 1997 Declination East (D) -65deg - tabular values in 01 min.

UT	00	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	Mean	
Jan	117	149	187	241	296	274	238	202	170	130	118	110	106	102	98	92	88	93	86	91	72	71	81	104	A	138
	125	158	200	212	246	229	189	167	153	130	115	108	111	111	112	110	112	108	113	115	101	73	72	84	Q	136
	113	142	146	247	324	292	343	293	248	174	170	144	125	110	59	53	45	63	23	39	-10	68	107	132	D	144
Feb	157	182	220	259	299	308	262	210	173	150	135	125	117	110	104	105	114	106	103	100	101	91	111	112	A	156
	150	186	235	265	244	229	204	185	162	144	135	125	116	120	122	126	130	130	129	126	108	116	120	120	Q	155
	151	214	318	334	401	387	355	277	223	206	174	169	134	109	96	106	117	83	41	23	36	17	109	105	D	174
Ma	185	188	220	244	274	282	247	198	169	151	143	133	128	130	130	131	142	149	140	137	129	125	134	166	A	170
	166	169	181	199	201	200	198	191	178	161	148	143	140	140	139	141	141	139	153	137	142	135	149	152	Q	160
	221	218	273	281	311	323	265	194	158	157	148	123	110	127	119	114	160	160	109	142	78	88	115	192	D	174
Apr	218	223	251	260	269	275	243	205	176	158	151	149	149	146	149	145	149	154	158	165	148	140	148	197	A	184
	206	191	179	175	185	189	186	188	180	172	163	161	160	158	159	158	154	155	162	207	125	147	168	187	Q	171
	259	293	295	301	317	347	329	247	186	154	152	153	144	146	160	146	156	179	149	179	124	146	154	189	D	204
Ma	226	246	255	254	238	227	214	198	176	166	163	164	161	160	162	159	160	168	169	185	181	184	185	190	A	191
	195	197	193	191	195	193	187	184	177	174	168	167	168	169	169	172	172	173	171	170	171	173	177	175	Q	178
	226	259	313	322	318	304	301	275	199	164	180	191	180	164	175	152	153	172	196	224	261	158	181	234	D	221
Jun	216	237	255	270	273	254	227	200	183	169	167	162	162	160	162	163	165	176	167	176	183	176	188	198	A	195
	206	210	216	210	199	197	198	190	181	171	169	169	173	175	176	177	178	178	180	178	177	195	173	195	Q	186
	246	262	301	317	340	307	294	224	200	179	188	161	153	144	149	144	163	192	145	156	191	147	192	200	D	208
Jul	209	224	238	255	238	236	220	198	184	170	164	169	171	173	174	174	176	186	194	188	190	192	181	194	A	196
	202	225	241	237	216	201	200	199	191	181	177	180	180	183	185	185	184	184	188	188	216	196	191	188	Q	197
	218	223	272	337	275	275	250	197	176	138	128	134	143	154	170	180	174	217	232	179	176	236	151	197	D	201
Aug	211	233	252	258	265	264	230	215	196	180	179	180	182	180	177	179	182	188	192	195	201	192	197	202	A	205
	218	237	258	244	209	204	204	199	199	196	197	198	198	194	192	190	190	189	192	193	192	199	196	214	Q	204
	213	241	236	277	313	354	273	261	205	157	166	163	166	170	174	171	202	214	206	202	196	189	199	166	D	213
Sep	226	246	295	320	335	310	275	244	218	200	193	185	178	179	180	177	185	188	186	183	175	171	193	204	A	219
	229	241	236	237	255	232	232	232	222	213	205	200	195	196	192	192	187	196	199	181	185	198	199	197	Q	211
	239	247	391	409	436	350	306	266	203	185	192	178	167	169	176	179	180	192	160	145	117	151	192	217	D	227
Oct	211	249	295	324	357	350	330	272	235	218	201	192	184	177	174	177	174	175	175	193	166	174	191	195	A	225
	219	249	268	272	270	269	259	241	230	221	209	196	189	187	188	190	191	189	199	197	195	190	184	204	Q	217
	194	242	365	415	476	501	537	335	256	248	208	206	194	163	165	158	127	131	128	131	104	161	160	142	D	239
Nov	190	228	274	343	408	402	341	273	246	220	211	197	194	176	166	174	178	185	171	167	165	159	150	174	A	225
	216	230	259	309	357	307	278	260	245	223	206	200	201	205	212	216	211	209	205	195	188	184	182	182	Q	228
	145	213	307	335	387	529	474	334	325	257	260	220	222	150	108	103	127	136	96	112	106	136	84	186	D	223
Dec	206	235	286	329	331	322	301	262	239	216	211	201	188	189	185	185	185	180	176	182	179	165	162	184	A	221
	225	241	269	285	292	261	242	231	218	212	210	200	197	198	200	207	209	202	199	200	197	180	187	181	Q	218
	200	218	244	331	364	461	450	312	275	231	243	235	187	190	164	139	120	113	84	130	138	118	148	192	D	220
Yea	198	220	252	280	299	292	261	223	197	177	170	164	160	157	155	155	158	162	160	163	158	153	160	177	A	194
	196	211	228	236	239	226	215	206	195	183	175	171	169	170	170	172	172	171	174	174	166	165	166	173	Q	188
	202	231	288	326	355	369	348	268	221	188	184	173	160	150	143	137	144	154	131	138	127	135	149	179	D	204

Q and D indicate International Quiet and Disturbed days respectively; A indicates all days.

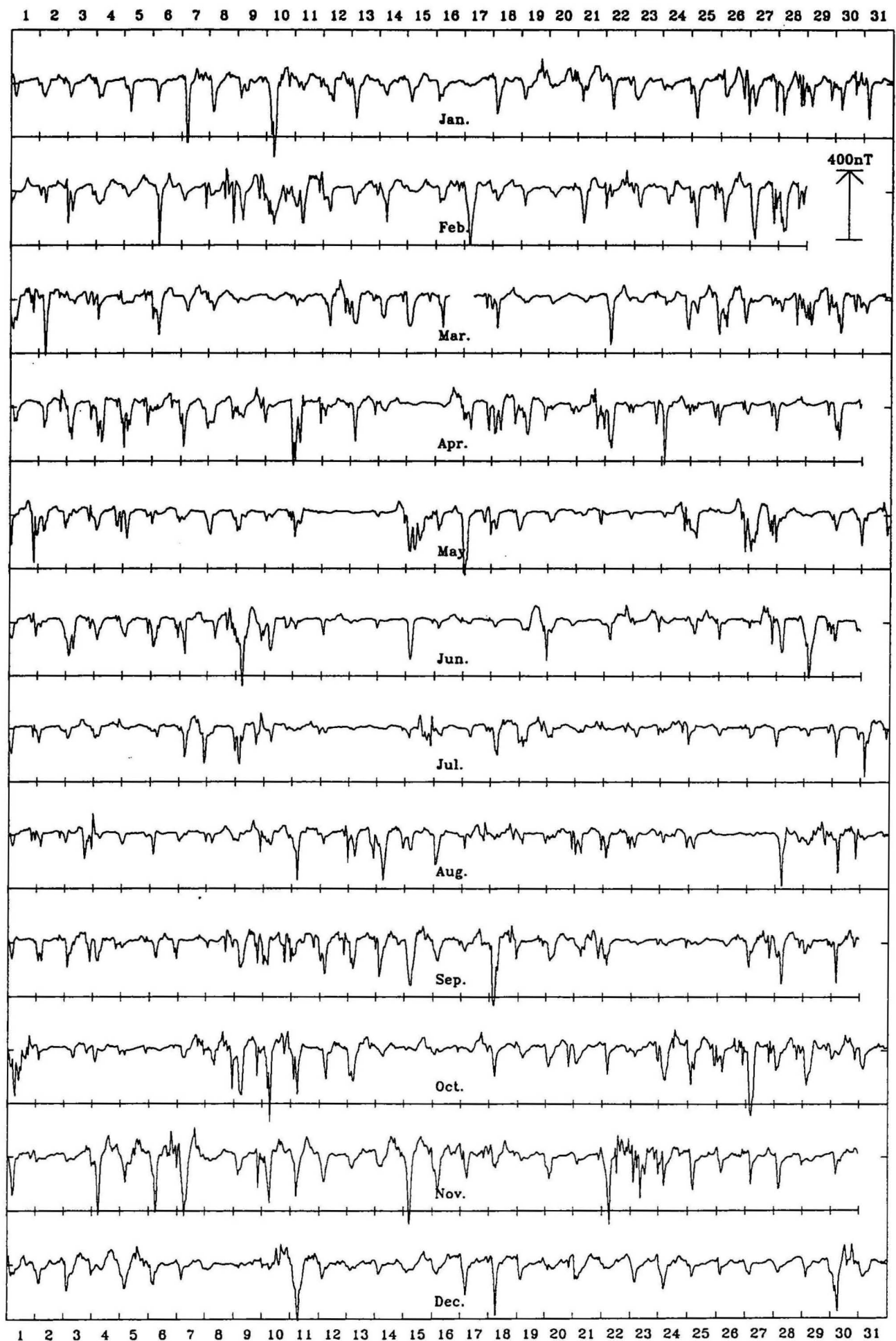
MAWSONANTARCTIC 1997 Inclination (I) -67deg - tabular values in 01 min.

UT	00	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	Mean	
Jan	548	543	552	559	570	541	527	524	531	528	522	519	507	503	499	500	497	494	512	533	538	542	556	548	A	529
	535	547	569	539	535	514	508	510	518	527	531	531	525	524	521	516	509	505	503	504	504	527	549	524	Q	524
	552	540	539	560	614	553	571	558	553	521	490	496	454	444	469	491	507	492	574	649	580	603	616	582	D	542
Feb	574	564	573	573	574	563	553	541	534	534	526	516	503	503	492	498	503	511	527	542	557	559	558	561	A	539
	560	563	567	551	527	518	521	522	524	527	528	526	521	518	516	514	512	504	507	510	527	553	550	537	Q	529
	592	603	644	616	637	590	611	584	545	533	516	486	489	486	480	485	489	542	603	634	675	640	635	625	D	573
Ma	569	562	577	564	567	567	547	529	529	530	529	527	520	512	501	499	501	506	518	538	547	558	581	566	A	539
	530	527	527	529	523	521	523	526	529	532	534	532	528	525	522	519	514	508	507	508	513	534	514	516	Q	523
	620	615	617	584	595	592	554	528	531	531	530	523	505	482	468	475	494	491	551	612	650	626	653	622	D	560
Apr	584	583	598	584	570	557	544	535	530	528	526	522	517	514	509	502	503	507	515	533	558	571	590	602	A	545
	570	538	524	518	516	515	516	519	523	525	527	527	524	521	519	518	516	510	512	523	516	535	550	575	Q	527
	618	622	645	644	609	616	588	558	542	532	523	514	502	508	498	487	503	526	545	570	606	614	619	611	D	567
Ma	581	584	571	560	545	532	527	531	529	525	524	524	520	517	509	503	504	508	522	516	533	549	569	585	A	536
	543	535	528	523	520	518	517	518	520	521	520	519	518	517	516	515	515	515	514	512	513	517	525	539	Q	521
	600	645	619	606	605	579	562	584	569	537	532	536	534	531	510	497	505	520	533	541	589	571	599	656	D	565
Jun	554	565	567	563	560	549	538	529	529	525	520	512	505	500	501	503	501	498	504	511	532	539	553	558	A	530
	542	537	538	532	525	517	517	517	518	522	522	519	515	515	515	515	515	514	513	510	512	528	530	541	Q	522
	565	591	588	587	602	591	594	559	543	531	522	499	478	469	475	485	488	483	492	523	604	584	571	569	D	541
Jul	543	540	541	551	533	523	517	513	512	515	516	512	507	503	504	501	500	500	498	502	505	518	530	544	A	518
	533	538	539	535	522	510	507	509	511	514	516	515	514	513	510	510	510	507	505	503	508	509	509	511	Q	515
	539	537	563	600	562	541	527	518	521	524	518	500	489	485	494	483	487	504	505	529	523	555	564	575	D	527
Aug	546	551	554	548	546	546	526	519	518	518	519	517	511	507	503	499	499	501	502	507	517	540	547	541	A	524
	538	550	560	542	511	505	507	509	512	516	518	517	517	516	516	513	511	504	501	506	512	518	535	535	Q	520
	577	561	537	549	597	650	590	554	535	525	520	517	506	505	505	498	498	514	527	528	553	603	587	535	D	545
Sep	554	563	589	580	569	540	531	524	522	520	516	512	508	507	503	496	499	504	516	531	546	553	549	548	A	533
	538	543	529	523	524	507	506	512	517	521	524	526	524	518	514	512	506	495	500	500	511	521	520	522	Q	517
	575	553	638	637	624	566	573	538	528	520	509	499	495	489	495	489	500	508	554	587	597	606	597	592	D	553
Oct	557	566	571	562	563	553	547	536	525	525	523	516	504	505	505	505	497	504	516	537	538	552	560	544	A	534
	535	547	537	520	510	507	509	513	519	524	527	525	522	517	515	509	502	495	505	510	522	537	521	523	Q	519
	596	583	639	642	672	633	638	572	526	533	521	505	475	489	509	517	514	539	544	584	554	576	596	568	D	564
Nov	551	541	556	565	572	562	545	533	533	525	513	500	495	474	479	488	485	489	495	506	527	528	528	545	A	522
	538	523	527	537	525	501	506	514	522	527	529	529	525	520	517	516	509	504	498	496	506	529	532	537	Q	519
	557	526	606	607	587	667	652	604	592	544	492	452	470	411	439	471	462	494	492	515	580	556	556	606	D	539
Dec	532	533	544	537	520	516	514	509	517	520	514	504	496	496	497	496	494	495	493	491	502	505	519	524	A	511
	526	527	519	512	501	492	497	502	507	511	514	516	516	515	509	510	509	500	495	492	495	502	503	507	Q	507
	577	555	572	592	586	627	594	530	531	528	494	445	424	444	479	478	479	510	506	496	512	515	528	520	D	522
Yea	558	558	566	562	557	546	535	527	526	524	521	515	508	503	500	499	499	501	510	520	533	543	553	555	A	530
	541	540	539	530	520	511	511	514	518	522	524	524	521	518	516	514	511	505	505	506	512	526	528	531	Q	520
	581	578	601	602	607	600	588	557	543	530	514	498	485	479	485	488	494	510	535	564	585	587	593	588	D	550

Q and D indicate International Quiet and Disturbed days respectively; A indicates all days.

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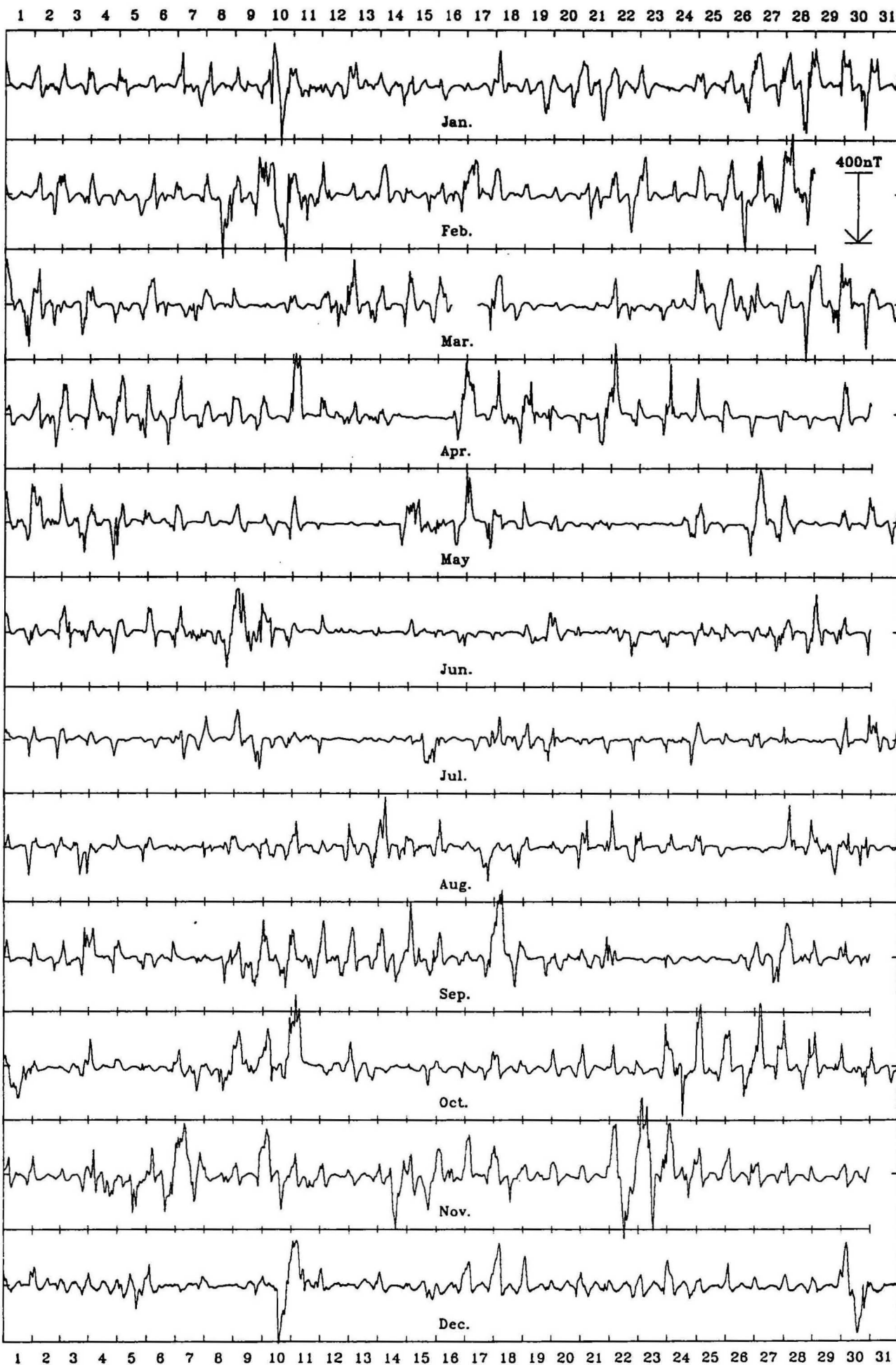
MAWSON ANTARCTIC 1997 North component (X). Scale:30.0 nT/mm.



MAWSON ANTARCTIC 1997 East component (Y). Scale:30.0 nT/mm.



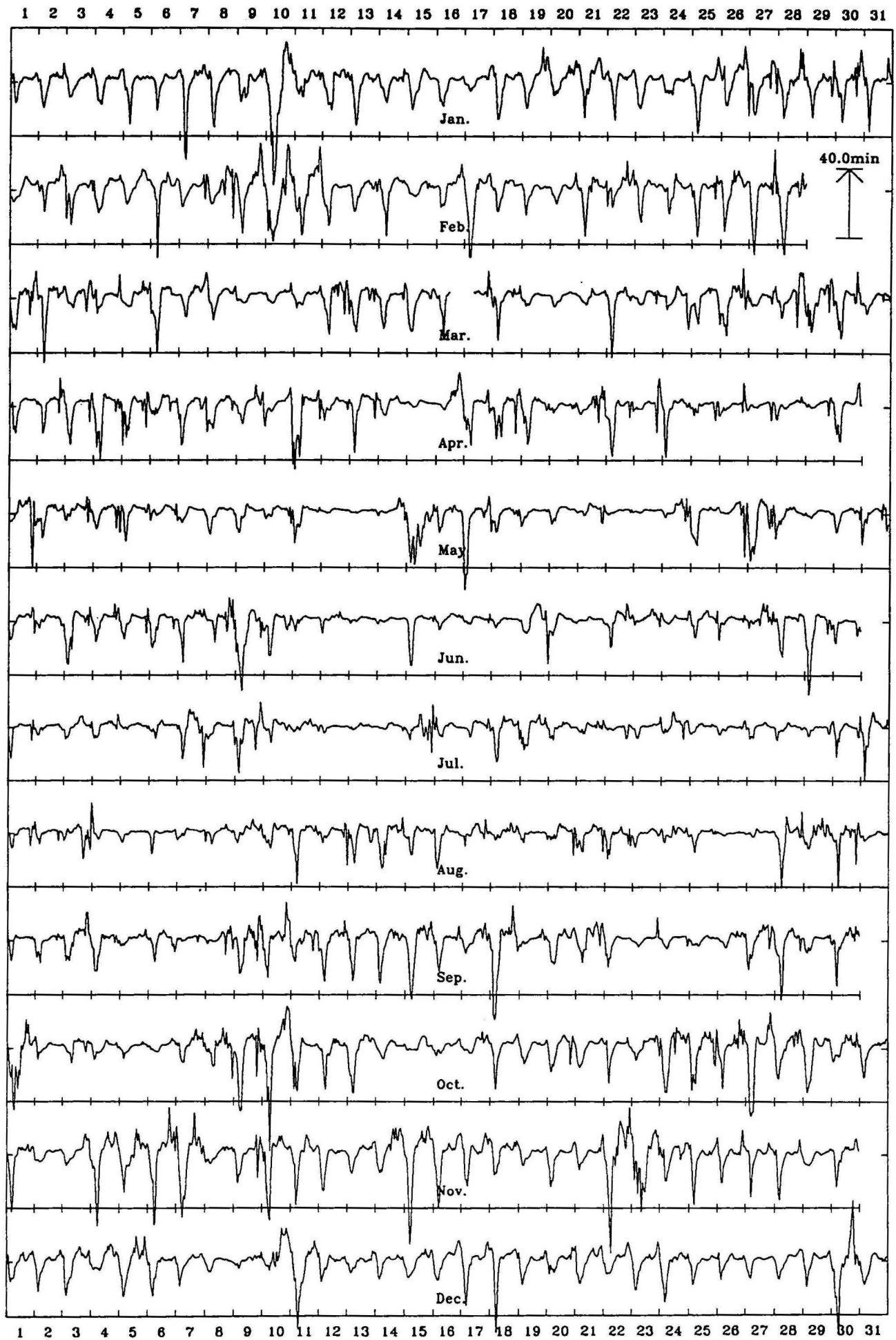
MAWSON ANTARCTIC 1997 Vertical intensity (Z). Scale:30.0 nT/mm.



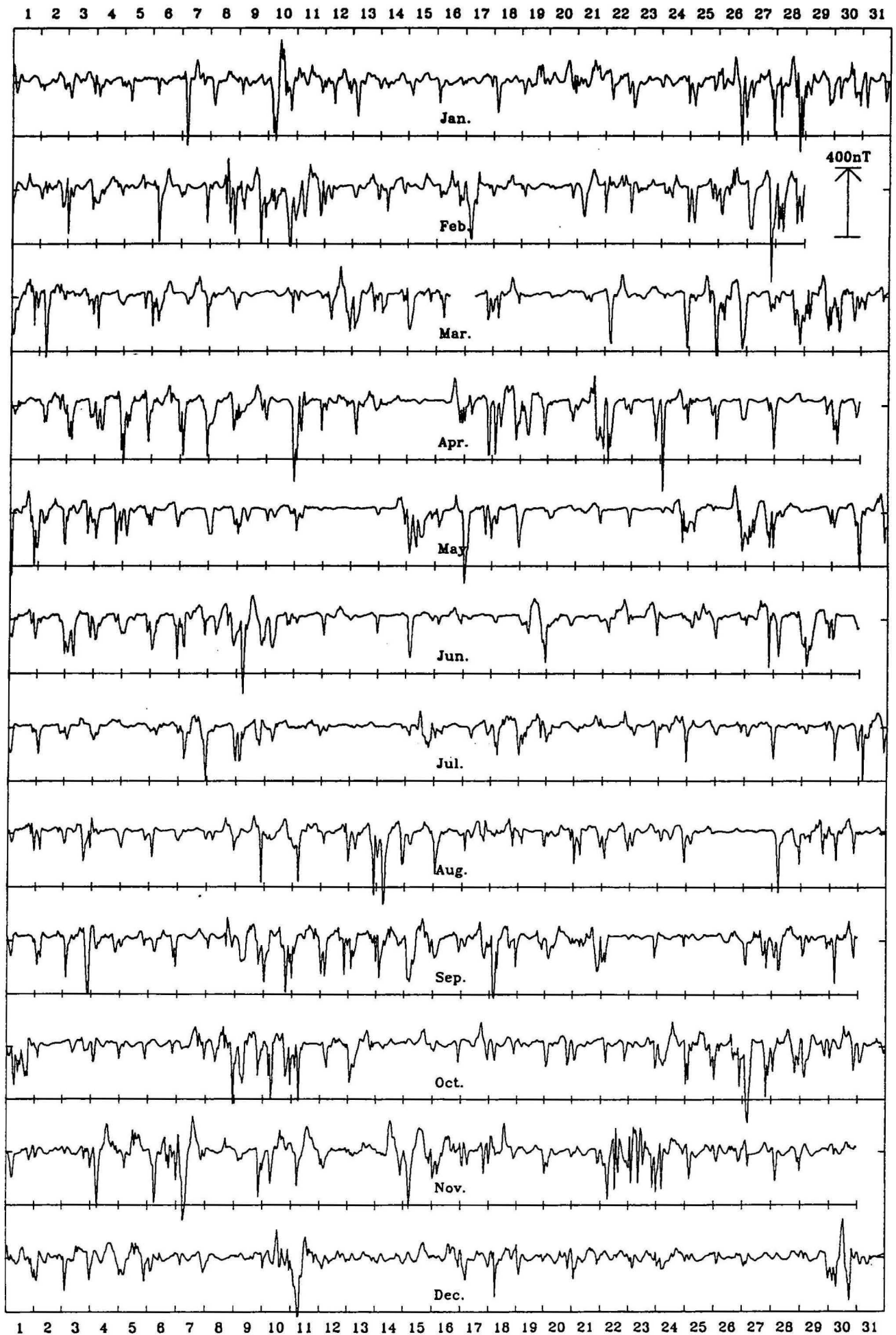
MAWSON ANTARCTIC 1997 Total intensity (F). Scale:30.0 nT/mm.



MAWSON ANTARCTIC 1997 Declination (east) (D). Scale: 3.0 min/mm.



MAWSON ANTARCTIC 1997 Horizontal intensity (H). Scale:30.0 nT/mm.



MAWSON ANTARCTIC 1997 Inclination (I). Scale: 3.0 min/mm.

