PIPERS

LOGISTICS REPORT

FOR AN

AIRBORNE MAGNETIC & RADIOMETRIC SURVEY

TOMAHAWK AND WEYMOUTH, TASMANIA

FOR

MINERAL RESOURCES TASMANIA

JOB NO. 1-451

JANUARY 1994

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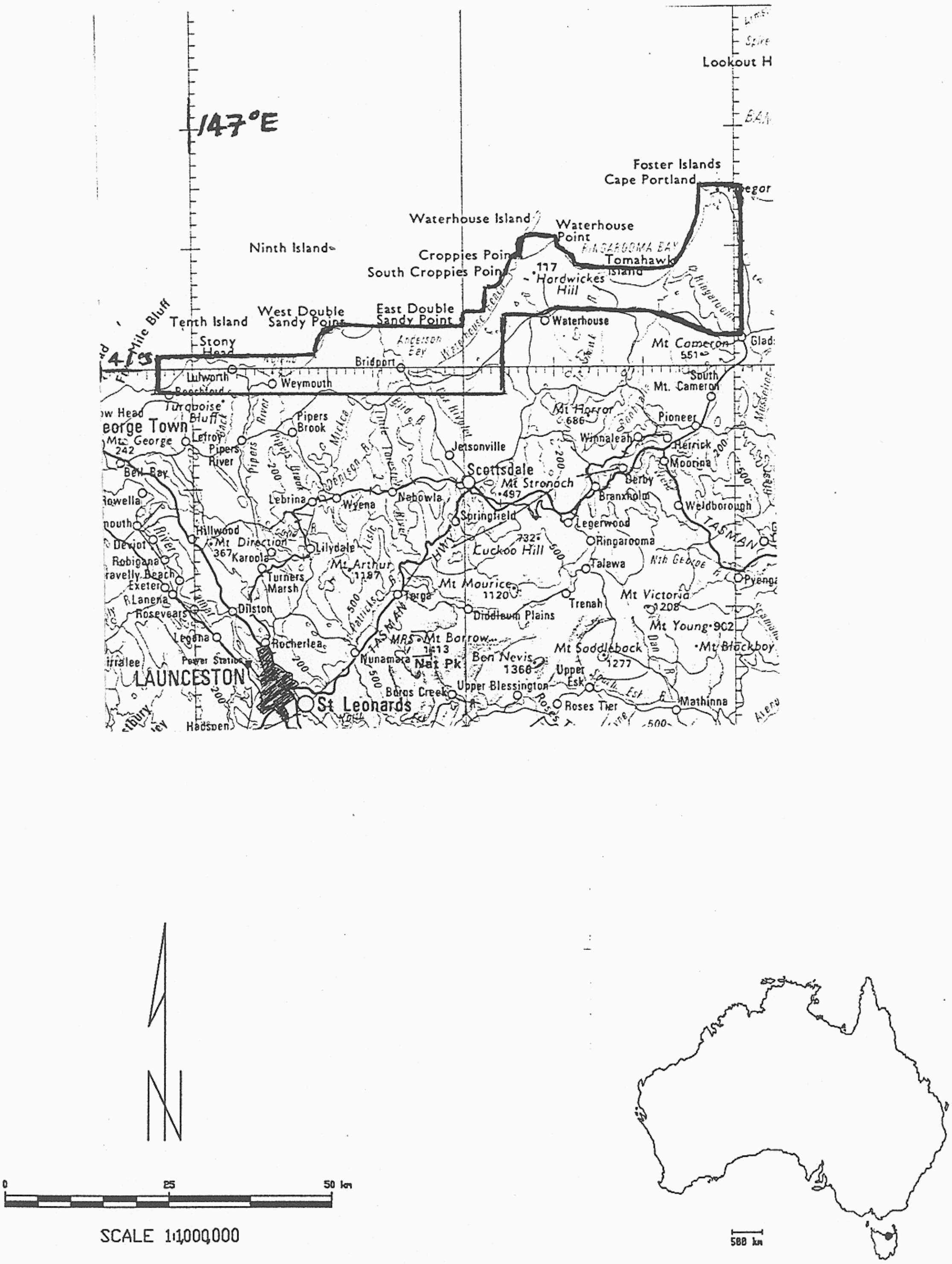
INTRODUCTION

From the 10th to 25th November 1993, Geoterrex Pty Ltd conducted an airborne magnetometer and spectrometer survey over the Tomahawk and Weymouth areas (Figure 1) in Tasmania for Mineral Resources Tasmania. This report summarises the logistics, survey parameters, calibration procedures and processing details of the survey.

The survey area lies on the Launceston (SK 55-4) 1:250,000 Map Sheet, between 146° 56'E, 40° 45'S and 148° 01'E, 41° 02'S. A total of 4356 kilometres of airborne magnetic and radiometric data was collected in 17 flights over the survey area. Lines were flown both North-South and East-West at a 400m line spacing.

The base of operations was Launceston, Tasmania.

FIGURE 1. LOCATION MAP - Tomahawk and Weymouth



1. SURVEY OPERATIONS SUMMARY

TABLE 1. SURVEY OPERATIONS SUMMARY

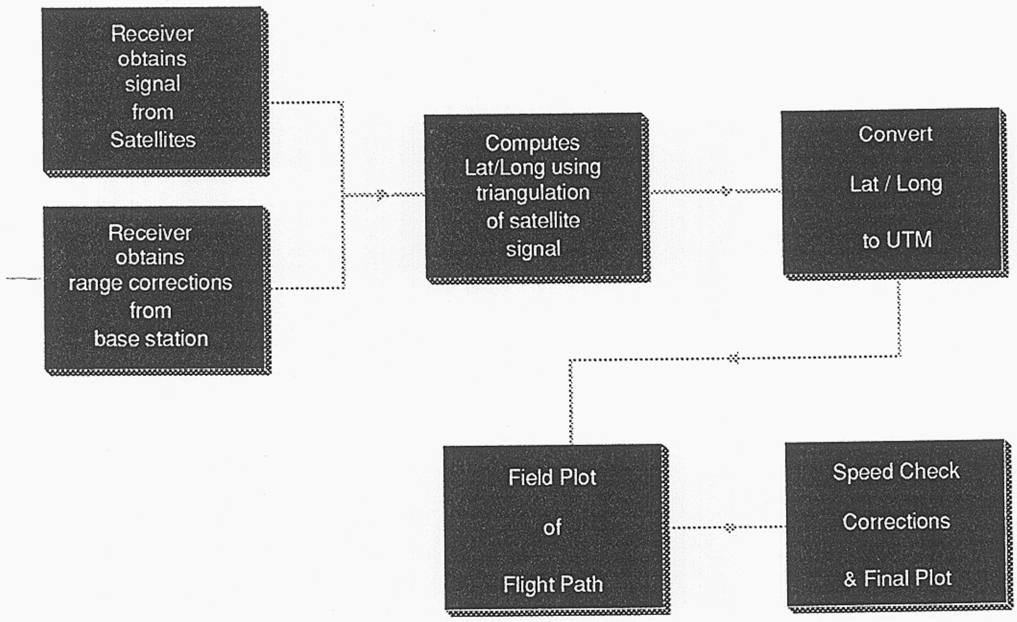
PARAMETER		SPECIFICATION
Type of survey		Magnetic and radiometric
Base of operations		Launceston, Tasmania
Aircraft		Rockwell Shrike Commander 500S. VH-EXE
Nominal aircraft terrain clearance		80 metres
Nominal aircraft speed		65 metres per second
Survey size		4356 kilometres
Traverse line direction		N-S and E-W
Traverse line spacing		400 metres
Average line length		11 kilometres
Navigation		DGPS/Doppler
Field Personnel	Pilot Electronics Technician Supervising Technician Data Compiler / Project Manager	H Thompson I Brown B Woolfrey T Donnollan

TABLE 2. SURVEY PROGRESS

Date	Flight	Progress	Weather
10/11	1	F.O.M, Cloverleaf, Lag	fine
11/11	2	Tomahawk, Weymouth	fine
11/11	4	line 110	fine
12/11	5	Tomahawk	fine
13/11	6,7	Tomahawk	fine
15/11	8,9	Tomahawk, Weymouth	fine
16/11	10	Tomahawk, Weymouth	fine
18/11	11	Tomahawk, Weymouth	ok
19/11	12	Tomahawk, Weymouth	fine
20/11	13	Tomahawk, Weymouth	turbulent
23/11	15	Tomahawk, Weymouth	fine
24/11	16	Tomahawk, Weymouth	windy
25/11	17	Tomahawk, Weymouth, Cloverleaf	fine

2. FLIGHT PATH RECOVERY

FIGURE 2. FLIGHT PATH RECOVERY FLOW DIAGRAM



The DGPS receiver mounted in the aircraft determines which satellites are in operation and receives a signal from them. The base station transmits range corrections to the aircraft receiver, which it applies as it uses 3D triangulation of the satellite response to calculate its position in real time as well as providing the pilots with steering information. The DGPS information is stored digitally as Latitudes and Longitudes (Lat / Longs) and later converted to Australian Map Grid co-ordinates.

The DGPS data is read into the field computer and aircraft flight path is plotted on a daily basis to ensure data quality control and to determine any necessary reflights.

The flight path was plotted at a scale of 1:50,000

3. EQUIPMENT AND SPECIFICATIONS

3.1 AIRBORNE MAGNETOMETER

Model: Scintrex caesium vapour optical absorption magnetometer

Mounting: Tail stinger

Sample interval: 0.1 seconds

Sensitivity: 0.001 nT

Average Noise: The average noise for the data is calculated from the fourth difference monitor using the equation:

Fourth difference noise envelope/16 = Average Data Noise

Calibrations: Test flights are conducted to determine effects of compensation, heading and system parallax. Descriptions and results of these calibrations can be found in Section 4 and Appendix A.

3.2 GAMMA RAY SPECTROMETER

Model: Nuclear Data ADC/ND-560

Detectors: 4 Harshaw all viewing 4 pi NaI(Tl) crystals, totalling 16.8 litres. Crystals, photomultiplier tubes and preamplifiers are all mounted in temperature controlled, insulated compartments.

Sample interval: 1 second

Number of Channels: 256

Synchronisation: The spectrometer sample is allocated to the time recorded at the end of the sample interval.

Window Definitions:

Total Count	-	Channel 68 to 255	
Potassium	-	Channel 116 to 133	
Uranium	-	Channel 141 to 158	
Thorium	-	Channel 206 to 240	
Cosmic	-	Channel 0	

Nominal Window MeV: Ranges

Total Count	-	0.4 to 3.0 MeV	
Potassium	-	1.35 to 1.57 MeV	(K40, 1.46 MeV)
Uranium	-	1.63 to 1.89 MeV	(Bi214, 176 MeV)
Thorium	-	2.42 to 2.82 MeV	(Tl208, 2.615 MeV)
Cosmic	-	above 3.0 MeV	

3.3 GROUND MAGNETOMETER BASE STATION

Sensor:	Proton Precession
Magnetometer:	G856
Sample interval:	5 seconds
Sensitivity:	0.1 nT

The base station was used to monitor the diurnal field. The sensor was placed in a suitable position which minimises the effects of high magnetic gradients and man-made interference.

3.4 ALTIMETERS

Radar Altimeter

Model:	Sperry Stars AA200 radio altimeter system
Accuracy:	+/- 1.5% (+/- 1.35m at 90m)

Barometric Altimeter

Model:	Rosemount 8404 pressure altimeter
Sensitivity:	5 mv per foot
Sample interval:	1.0 second
Synchronisation:	The average of the output of the altimeter over each second is calculated and assigned to the time recorded at the end of each sample.

3.5 TRACKING CAMERA

Model: Sony DXC101P Video Camera

The tracking camera is equipped with a 4mm wide-angle lens. The video tape is synchronised with the geophysical record by a digital fiducial display that increments every second. These fiducials are recorded on the video tape and displayed on the bottom left of the video screen. Times are recorded from the digital information provided by the MADACS system.

3.6 POSITIONING / NAVIGATION SYSTEMS

Doppler Equipment:	Singer Kearfott AN/ASN 128, Sperry VG-14 Vertical Gyroscope, Sperry C-12 Compass.
DGPS Equipment:	Sercel NR103 mobile DGPS receiver and antennae mounted in aircraft and equipped with pilot steering indicator.
Reference station:	Sercel NDS100 Portable Differential Station UHF and DGPS antennae.

3.7 DATA ACQUISITION SYSTEM

Model: Geoterrex Pty Ltd MADACS

The MADACS is a computer based software system that is used to control and command the operations of all the ancillary equipment. This includes the magnetometer, spectrometer, camera, altimeter, tape drive and analogue chart recorder. The system has the following features.

Communication system

The MADACS uses a lap top operating as a terminal for operator-system communication. Recorded spectrum are monitored via an oscilloscope trace during acquisition.

Software system

Program: AMS9A

The key feature of this system is that all data collection, verification, buffering, and recording is software-controlled. Therefore, the acquisition system may be economically altered to fit almost any requirement. Critical parameters are automatically monitored during flight, with visual and aural alarms provided for the operator.

Survey parameters are displayed during flight in their correct physical units, simplifying operator analysis. The survey program operates on a request-response basis, with the system pre-empting the operator and rejecting all illegal responses.

Tape Drive

Model: Digi-Data 1639 magnetic tape drive

The tape drive has a feature which allows checking of the recording process as many times as the particular application permits.

Precision Clock

The system is controlled by a precision clock which allows data to be collected at any multiple of 0.1 seconds. Time is digitally recorded as a six-figure number called a "fiducial". A fiducial number equals the real time in tenths of seconds after midnight, for example, 000000 corresponds to midnight and 360000 corresponds to 10.00am. Fiducials are generated on digital tape, video or film and analogue charts at ten second intervals. The fiducial numbers are calculated from the clock time by the computer.

Computer

Model: Interdata 6/16 mini-computer.

Multiple buffers permit recording, processing and acquisition of data to be carried out simultaneously with no dead time. The computer has the following interfaces:

- **Digital Input/Output Bus** This bus is capable of recording from, writing to, testing and controlling 16 external digital devices.
- **ADC / DAC.** This interface is a caesium analogue to digital converter and a digital to analogue converter.
- **Magnetic Tape Controller** This interface/controller is capable of handling four 9-track NR21 tape transports. Tapes are written in an IBM compatible binary format with full parity, cyclic redundancy and longitudinal check characteristics.
- **Magnetometer Interface** This interface converts the signal from the high sensitivity caesium vapour magnetometer into a format acceptable to the MADACS.
- **Camera Controller** The interface allows the MADACS to control and monitor all aspects of the tracking camera's operation and can synchronise timing and navigation data to the video tape.
- **Operator's Console** This interface provides communication between the operator and the system. While on line during survey, all parameters are continuously displayed on the monitor unless the system senses an abnormal condition in which case a diagnostic message and the time sensed are displayed. The message remains until acknowledged by the operator.

Recorded Digital Data

Each second:	Flight number Time Radar Altitude Barometric Altitude Positioning data Spectrometer windows 256 channels of radiometric data Live time
Each 0.1 seconds:	Total magnetic field

Tape formats are documented in Appendix C.

3.8 ANALOGUE CHART RECORDER

Model:	RMS GR33 Thermal Dot Matrix Printer
Chart speed:	10 cm/minute; time increases from left to right.
Chart width:	30 cm
Event marks:	10 second marks are recorded on both sides of the chart with the associated fiducial numbers being printed at the base of the chart.

TABLE 3. ANALOGUE CHART SCALES

Channels Recorded		Full Scale Values
Total Magnetic Field	Fine Scale	50 nT
	Coarse Scale	500 nT
Magnetic Field 4th Difference		+/-20 nT
Terrain Clearance		500 feet
Total Count		2000 counts/sec
Potassium Count		500 counts/sec
Uranium Count		200 counts/sec
Thorium Count		200 counts/sec
Cosmic Count		500 counts/sec

All fields increase in value towards the top of the chart.

Zero Positions: These zero positions are annotated on the analogue sample. The zero position of each radiometric channel is calibrated automatically at the start of each line. Between lines each trace resides in its mid-range position.

Synchronisation: The only lag between traces is that between the magnetic field and its fourth difference.

Compton Effect: Corrections: The analogue radiometric channels have been Compton corrected using

Alpha (Thorium into Uranium)	-	0.325
Beta (Thorium into Potassium)	-	0.373
Gamma (Uranium into Potassium)	-	0.769

The radiometric data recorded on the field tapes has not been corrected.

Cosmic Background correction: The analogue radiometric channels have been corrected in real time, for aircraft and cosmic background using the equations set out in Section 4.

A sample analogue record is shown in Figure 3.

FIGURE 3. SAMPLE ANALOGUE RECORD

4. CALIBRATION PROCEDURES AND RESULTS

4.1 MAGNETOMETER

The following calibration tests were carried out on the magnetometer.

Manoeuvre test to determine Figure of Merit (FOM)

Figure Of Merit = sum of noise envelopes produced by ten degree roll, pitch and yaw manoeuvres heading N, S, E and W.

This test was carried out on 10th November 1993 and is considered the most important of the magnetometer tests. The settings of the compensation coils determined from this test remain fixed during the heading effect test and during the survey. The Figure of Merit for this test was 0.68 nT. A Table of Results (Table A1) can be found in Appendix A.

Parallax

This test was carried out on 10th November 1993 and is also known as a lag test. The aircraft was flown in opposite directions over a sharp magnetic anomaly with the tracking camera and magnetometer operating. The video system records the fiducial (time and X-Y position) of the body that was the source of the sharp magnetic anomaly. When this was compared to the fiducial (time and X-Y position) of the sharp magnetic anomaly recorded on the digital tape a lag of 1 second was found. A correction was applied to the magnetic data accordingly.

Copies of the parallax test analogues can be found in Appendix A, Figure A3

Heading Effect Test

This test was conducted on 10th and 25th November 1993. Test lines with bearings of 000, 090, 180 and 270 degrees were flown over a common point. These lines were flown, in a low gradient area, while the ground station was running and synchronised. It is necessary to use a low gradient area so that slight deviations in the test line navigation do not significantly affect the results of this test. The results of this heading test can be found in Appendix A (Table A2 and Figure A2).

4.2 SPECTROMETER

The following checks and determinations were carried out for the radiometric data.

Pre and Post-flight Source Check Procedures

- Pre and post-flight U and Th source checks with samples in a standard position relative to the crystals and the aircraft in a standard parking position - recorded for 100 seconds.
- Pre and post-flight test line recorded at survey altitude.

The results of the pre and post-flight uranium and thorium source checks can be found in Appendix B, Table B1. A sample of the spectra plotted with each uranium and thorium source check is presented in Appendix B, Figure B1.

Compton Stripping Coefficients

These coefficients have been determined from source checks.They are:

Alpha	-	0.325 +/- 0.015
Beta	-	0.373 +/- 0.024
Gamma	-	0.769 +/- 0.038
Delta	-	0.036 +/- 0.017

Background Determination

This test was carried out in May 1993 to determine the relationship between cosmic events (energies greater than 3.0 MeV) and counts recorded in other channels. The test was flown overland with the spectrometer system correctly calibrated as for survey work. Data was recorded at 1000 foot intervals from 2000 feet to 12000 feet ASL.

The best fit linear equations for these tests are:-

Th	background	=	0.055 x Cosmic + 0.9
U	background	=	0.057 x Cosmic + 3.0
K	background	=	0.055 x Cosmic + 15.5
TC	background	=	0.883 x Cosmic + 81.3

where

cosmic = counts of energies greater than 3.0 MeV stored in channel 0.
\# background = counts to be subtracted from window #.

Graphs of these equations are presented in Appendix B (Figure B2).

Height Attenuation Coefficients

Height attenuation coefficients were determined using the procedure outlined below:

a) An area with "homogeneous" radioactivity, high count rates and relatively flat terrain was selected.

b) An easily repeatable line was flown over this area at different altitudes. The spectrometer was correctly calibrated for this test flight.

c) Sections of each line sharing the most constant terrain clearance and count rate were selected for data processing.

d) The altitude data for each line section was corrected using the altitude calibrations recorded on the same flight, and averaged.

e) The radiometric data for each line section was background corrected using a height correction for alpha. The resultant data was averaged.

f) The resulting count rates in each channel were plotted and attenuation coefficients suitable for an air temperature of 18°C were determined.

Graphs of the results can be found in Appendix B (Figures B3).

The coefficients are:	Total count	0.00630 per metre
	Potassium count	0.00768 per metre
	Uranium count	0.00595 per metre
	Thorium count	0.00643 per metre

During all spectrometer tests the data used is the window data recorded on field tapes. The widths of these windows are specified in Section 3.

Resolution

The resolution of the spectrometer is defined as the full width of the Thorium peak at its half peak height position, expressed as a percentage of the peak MeV value. The spectrometer resolution was checked before during and after the survey. The results ranged from 5.95% to 6.6%, with an average of 6.33%. Appendix B (Figure B4) is a copy of a sample source check.

4.3 ALTIMETER

The Sperry radio altimeter is a high quality instrument whose output is factory calibrated. It is fitted with a test function which checks the calibration of a terrain clearance of 100 feet and altitudes which are multiples of 100 feet. Calibration of the recorded terrain clearance, both analogue and digital, with respect to the altimeter reading is carried out using a potentiometer to vary the reading while recording the altimeter's output. The results of a recent altimeter calibration carried out in June 1993 are presented in Table 4.

TABLE 4. ALTIMETER CALIBRATION RESULTS

Indicated Alt (ft)	Recorded Alt (ft)
100	90
200	200
300	290
400	400
500	500

5. DATA PROCESSING

On receipt of all the data in Sydney, path recovery, analogue records and flight logs were checked for consistency of line numbering.

5.1 FIELD TAPES

These are recorded in binary format (see Appendix C for detailed description) Data recovered on the field tapes was verified each evening in the field and copied to the located data tape to ensure data security.

The 256 channels of radiometric data are not selected from the field tape unless there is some indication in the thorium and caesium peak positions that the radiometric channels have drifted away from the normal window settings. If it is necessary to re-construct radiometric data due to channel drift, summed spectral plots are produced for each survey line. These are examined to determine at what stage the drift began and which new channel positions define the principal radiometric windows.

Due to the difference in the sample interval between the magnetic and the radiometric data, the radiometric values are repeated for each magnetic sample interval between 1 second radiometric readings. All channels are checked and edited for single reading spikes and recording gaps, any single reading spikes are removed manually.

5.2 FLIGHT PATH PROCESSING

Processing of the flight path consisted of generating a speed report of the Doppler / GPS flight path that was checked for erroneous points by comparing the average aircraft speed between adjacent fixes (being real time values in seconds) and the average speed for the entire line. Significant speed changes over short intervals were noted and the Doppler / DGPS data was checked for errors and corrected where necessary. The final flight path maps were then plotted at a scale of 1:50,000.

5.3 MAGNETICS

__Corrections__

Levelling

The base station data is edited and checked for level shifts prior to synchronised to the airborne data for subtraction.

The aeromagnetic data is corrected for parallax error and then tie line levelled. The tie lines are levelled to a common datum first and then the traverse lines are levelled to the tie line network. The method involves the fitting of polynomials to the observed flight line/tie line intersection errors along each traverse line in the survey. These intersection locations are adjusted to give minimum intersection errors. The aircraft heading effect is eliminated by the levelling process and therefore is not subtracted as a separate process before levelling.

International Geomagnetic Reference Field
The International Geomagnetic Reference Field known as IGRF (1990) is updated to the date of survey flying and then is subtracted from the data and a datum of 2000 nanoteslas is then added to ensure that there are no negative magnetic values before contouring.

Product Specifications

Gridding and Contouring

Grid mesh size:	50 x 50 metres
Grid filter:	None
Contour interval:	2.5, 25 & 250 nT
Horizontal scale:	1:25,000

5.4 RADIOMETRICS

Corrections

The radiometric data was corrected for:

Spectrometer dead time
"Dead time" is the fraction of 1 second when the spectrometer is actually counting the energy levels and not registering the incoming counts. A typical "dead time" is 15 msecs in a 1 second sample period.

Cosmic effect and aircraft background
Through test flying outlined in Section 4, Geoterrex Pty Ltd has established the coefficients for the linear relationship between the incoming cosmic counts (energies greater than 3 MeV) and their contribution to the background in each window.

Changes in ambient air temperatures
The effects of changing air temperature are incorporated in the notion of a temperature corrected altitude that will be used in other calculations. The field operator records the outside temperature at regular intervals throughout each flight while at survey altitudes.

Compton scattering
These coefficients were determined from the calibration procedures outlined in Section 4. It should be noted that alpha coefficient is height dependent under the linear relation:

$$\text{true alpha} = \text{ground} + 0.02 + 0.00025 \times \text{height}$$

Height attenuation
The survey data was exponentially height attenuated to a common datum of the nominal survey altitude, using the coefficients determined in Section 4.

Product Specifications

Gridding and Contouring

Channel:	All channels (Total Count, Potassium, Uranium, Thorium)
Grid mesh size:	50 x 50 metres
Grid filter:	None
Contour interval	250, 500 & 1000
Horizontal scale	1:50,000

5.5 DATA TAPES

Located Data Tape

A levelled located data tape, containing all traverse line, tie line and calibration line data, was recorded in 9-track ASCII code at a density of 1600 bpi in a format described in Appendix C.

~~Gridded Data Tape~~

~~A gridded data tape containing the magnetic, uranium, potassium, thorium and total count grids was recorded in 9-track ASCII code at a density of 1600 bpi in ER-mapper format (described in Appendix C)~~

6. ITEMS DELIVERED

Logistics Report.

Final Flight Path Maps on film and paper at 1:50,000 scale

Final Residual Magnetic Contour Maps on film at 1:50,000 scale (NS / EW / all lines)
Final Residual Magnetic Contour Maps on paper at 1:15,000 scale (NS / EW)
Final Stacked Profiles of Magnetic Data on film at 1:50,000 scale (NS / EW)
Final Stacked Profiles of Magnetic Data on Paper at 1:50,000 scale
Preliminary Magnetic Contour Maps at 1:25,000

Final Total Count Amplitude Colour Maps on film at 1:50,000 scale (NS / EW / all lines)

Binders containing Analogue Charts
Diurnal charts

Summary Radiometric Count Files

Located Data Tapes (Exabyte)
Located Data Tapes (ASCII)
~~Gridded Data Tapes~~
Field Tape (Relinquishment form)

Flight Logs and Index
Mileage listing
Recovered Line Listing

Tracking video.

APPENDIX A: MAGNETOMETER CALIBRATION DATA

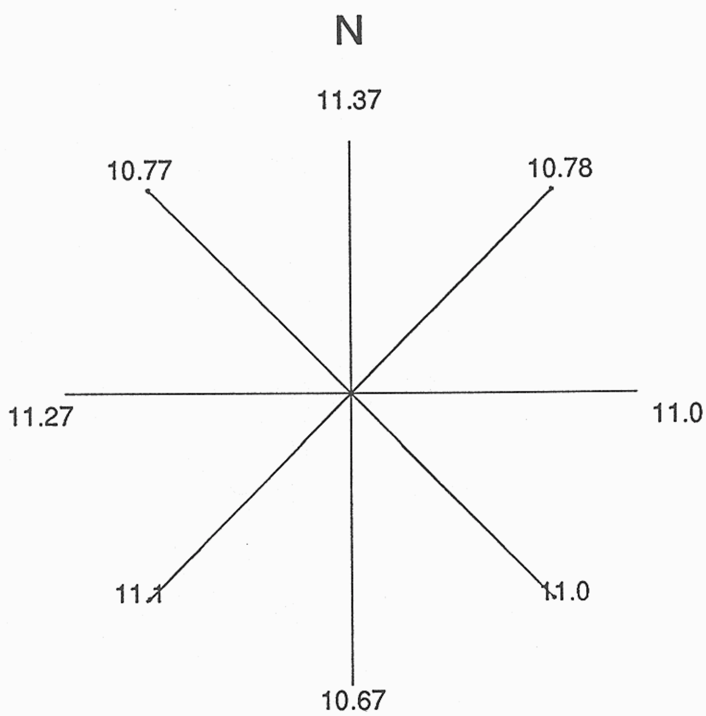
TABLE A1 FIGURE OF MERIT TEST RESULTS 10/11/9

Heading	Rolls	Pitches	Yaws	Total
North	0.08	0.07	0.08	0.23
East	0.08	0.06	0.08	0.22
South	0.05	0.07	0.08	0.20
West	0.05	0.08	0.05	0.18
			F.O.M	0.83 cm 0.68 nT

TABLE A2 CLOVERLEAF/HEADING TEST 25/11/93

Heading	Fiducial	Magnetic Value (nT)	Diurnal Correction (nT)	Altimeter Correction (nT)	Corrected Mag Value (nT)
North	477022	183.6	0	0	183.6
South	477818	182.8	+1	+0.13	183.93
East	478603	182.4	+1	+0.63	184.03
West	479269	188.2	+2	+0.45	188.85
North	480098	187.3	-1	+0.60	192.3
Heading Variation		North-South:		8.70 nT	
		East-West:		4.82 nT	
Total Variation				8.70 nT	

FIGURE A1 HEADING TEST DIAGRAM



APPENDIX B: SPECTROMETER CALIBRATION DATA

TABLE B1 SOURCE CHECKS

Flight		Pre Flight		Post Flight	
		U Source	Th Source	U Source	Th Source
1	U count	1950	24111	-	-
	Th count	30226	11887		
	K count	21994	10423		
	Total count	315351	292642		
2	U count	2005	24178	-	-
	Th count	29709	12078		
	K count	22222	10290		
	Total count	314916	292244		
5	U count	2053	23929	1536	23672
	Th count	30050	11724	29526	11036
	K count	22306	10812	22019	10820
	Total count	318624	293157	314351	291182
6	U count	1806	23986	1704	24101
	Th count	29945	11474	30149	11158
	K count	22131	10673	21828	10984
	Total count	316568	292492	317545	293558
7	U count	-	-	2123	24145
	Th count			30422	12340
	K count			23062	10424
	Total count			321674	297259
8	U count	1751	23905	1500	23627
	Th count	30231	11452	29550	10690
	K count	22235	10736	21687	11358
	Total count	314718	290178	315422	290340
9	U count	-	-	1515	23327
	Th count			30161	10967
	K count			21939	11040
	Total count			316465	291949
10	U count	1576	23717	1627	23766
	Th count	29342	11062	30231	11168
	K count	21790	10889	22280	1151
	Total count	31198	289658	316795	295537
11	U count	1807	23776	1599	23770
	Th count	29982	11741	30037	10918
	K count	22371	10108	22258	1093
	Total count	316840	29353	317417	290254

TABLE B1 SOURCE CHECKS cont

Flight		Pre Flight		Post Flight	
		U Source	Th Source	U Source	Th Source
12	U count	1911	24036	1427	23423
	Th count	30257	11098	29674	10640
	K count	22723	10494	21753	11405
	Total count	319199	295761	317034	789374
13	U count	1964	24115	1698	23927
	Th count	29730	11664	30113	11308
	K count	22420	10276	22135	11083
	Total count	315606	292108	317734	294345
15	U count	1989	24044	1967	23964
	Th count	30018	11726	30146	11674
	K count	22242	10234	22441	10295
	Total count	316211	290895	319706	292142
16	U count	1966	24193	1748	23957
	Th count	29652	11830	30352	11638
	K count	22265	10497	22789	10790
	Total count	316559	293309	320541	293569
17	U count	2010	23986	1693	23586
	Th count	30186	11595	29802	10390
	K count	22307	10303	21941	11529
	Total count	316058	287967	317350	291491

FIGURE B1(I) SAMPLE SOURCE CHECK - URANIUM SOURCE

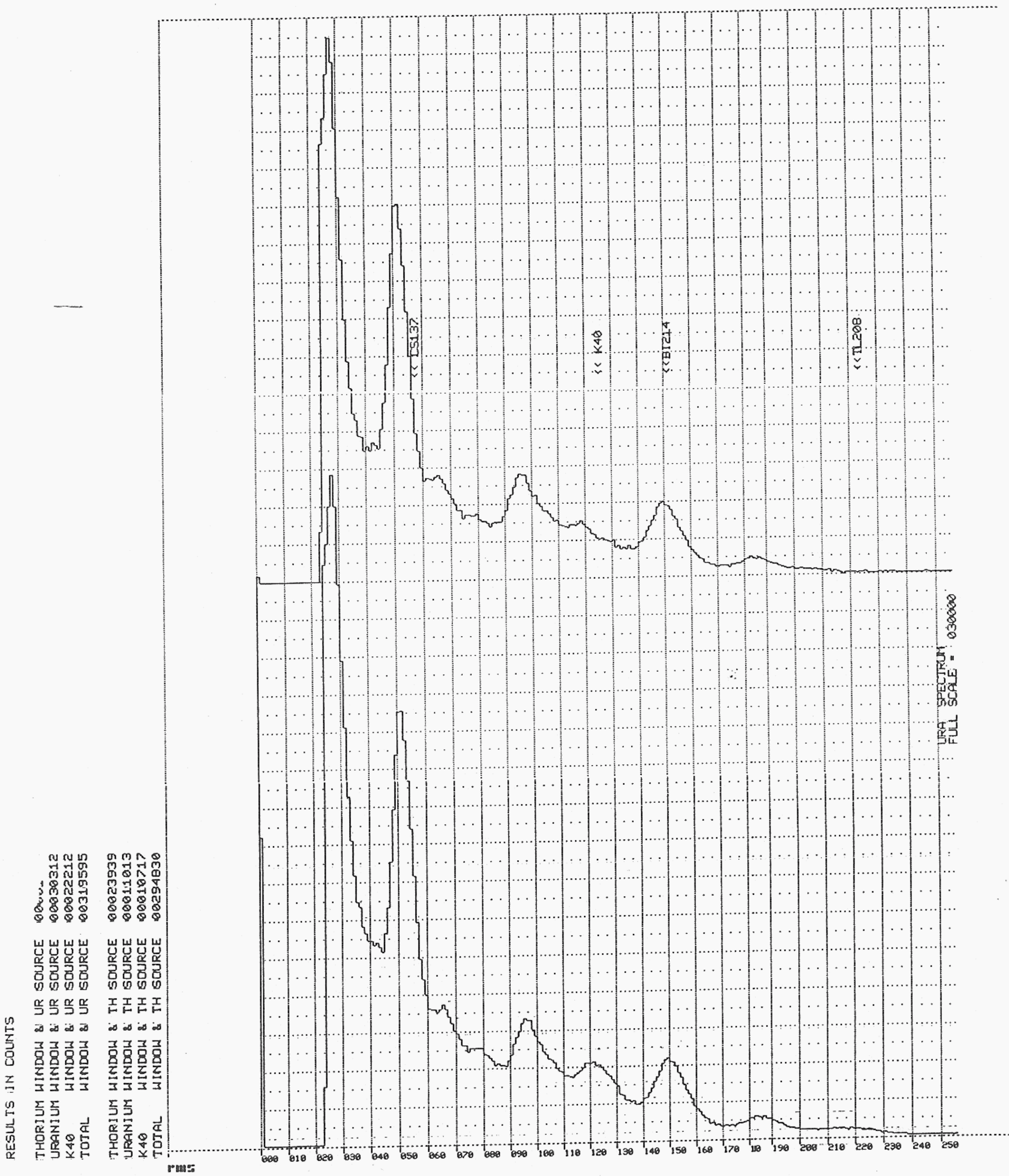


FIGURE B1(ii) SAMPLE SOURCE CHECK - THORIUM SOURCE

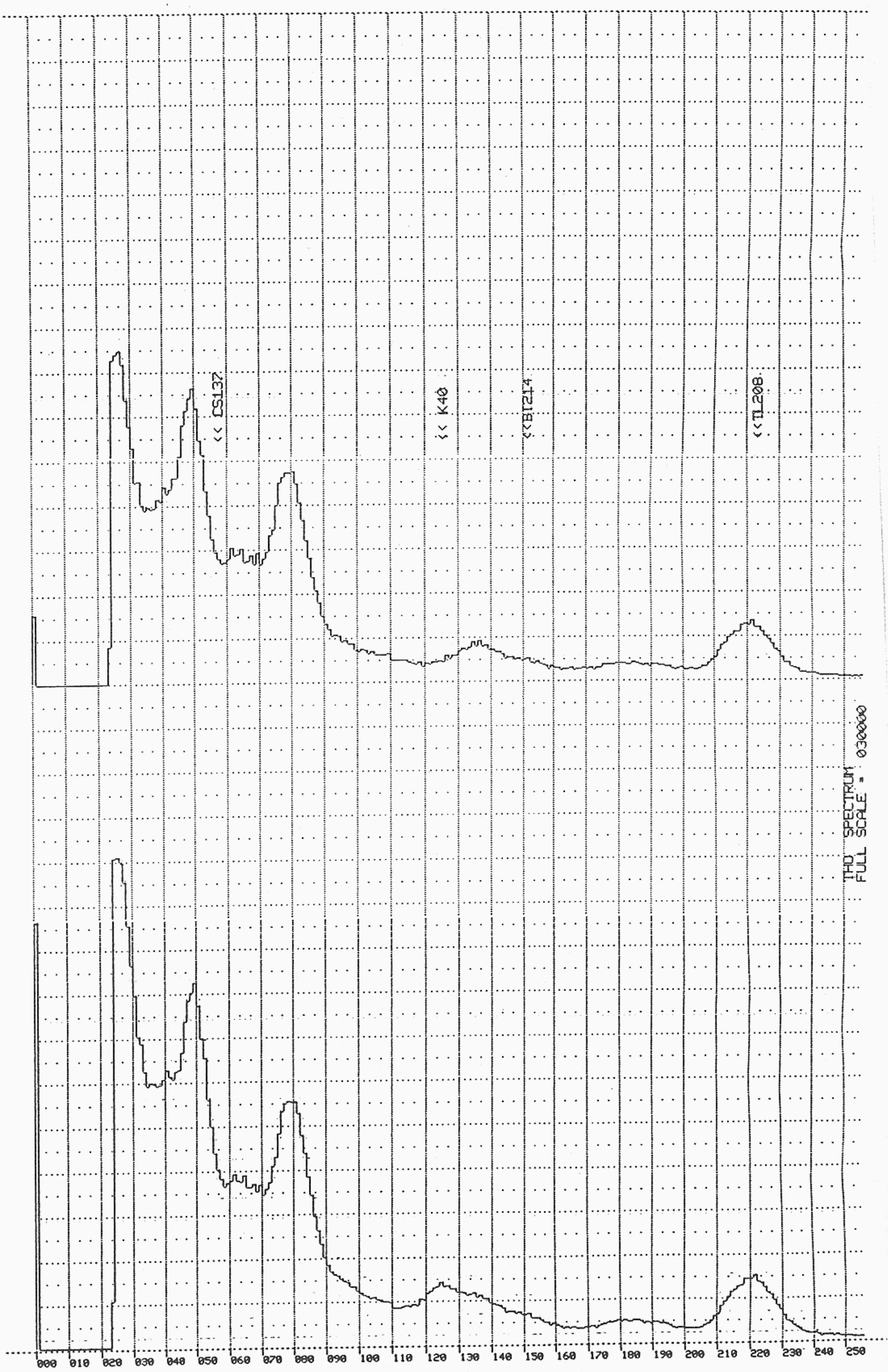
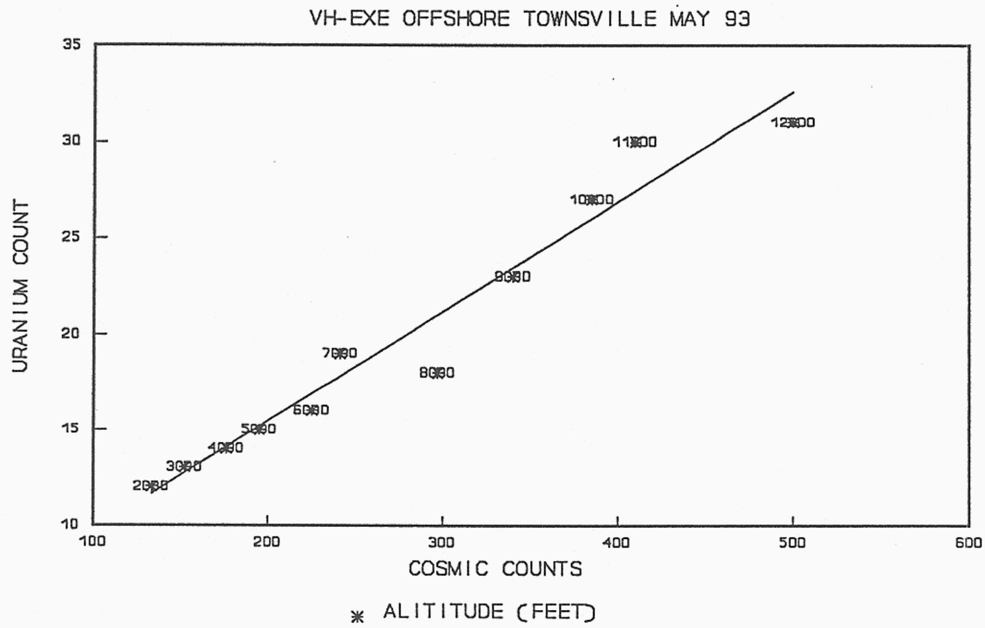


FIGURE B2(i) COSMIC BACKGROUND TESTS

0.057*COSMIC + 4.08



0.052*COSMIC + 16.5

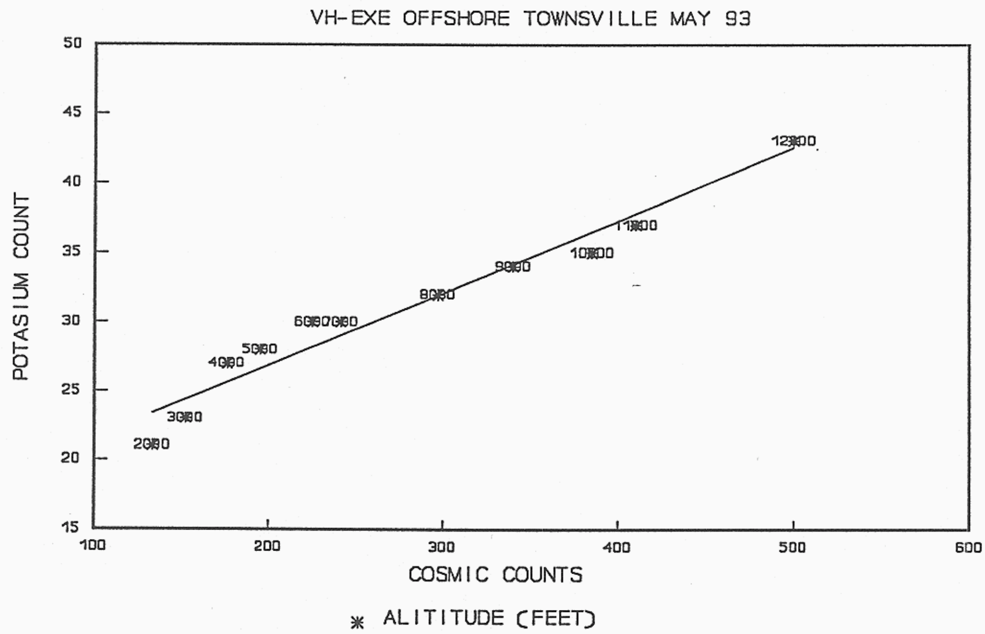
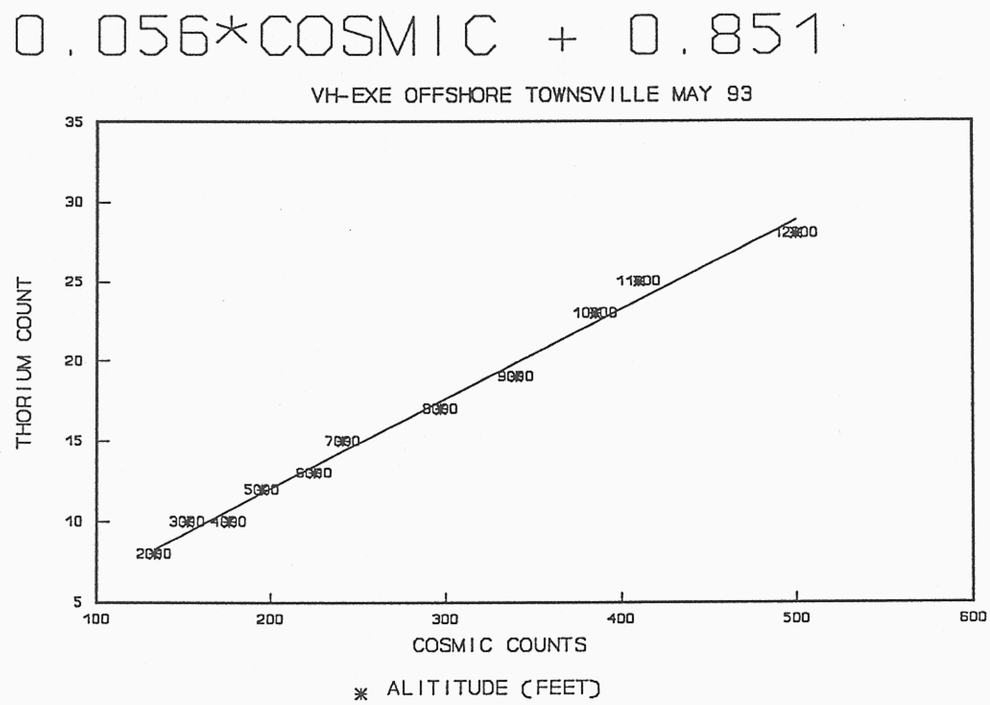


FIGURE B2(ii) COSMIC BACKGROUND TESTS cont



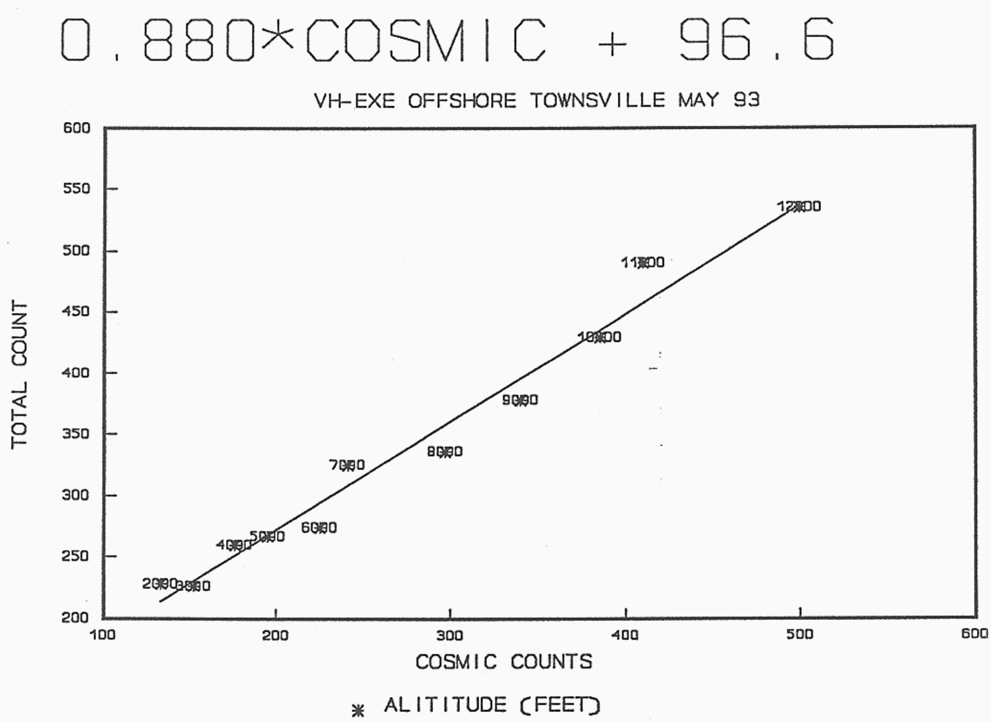
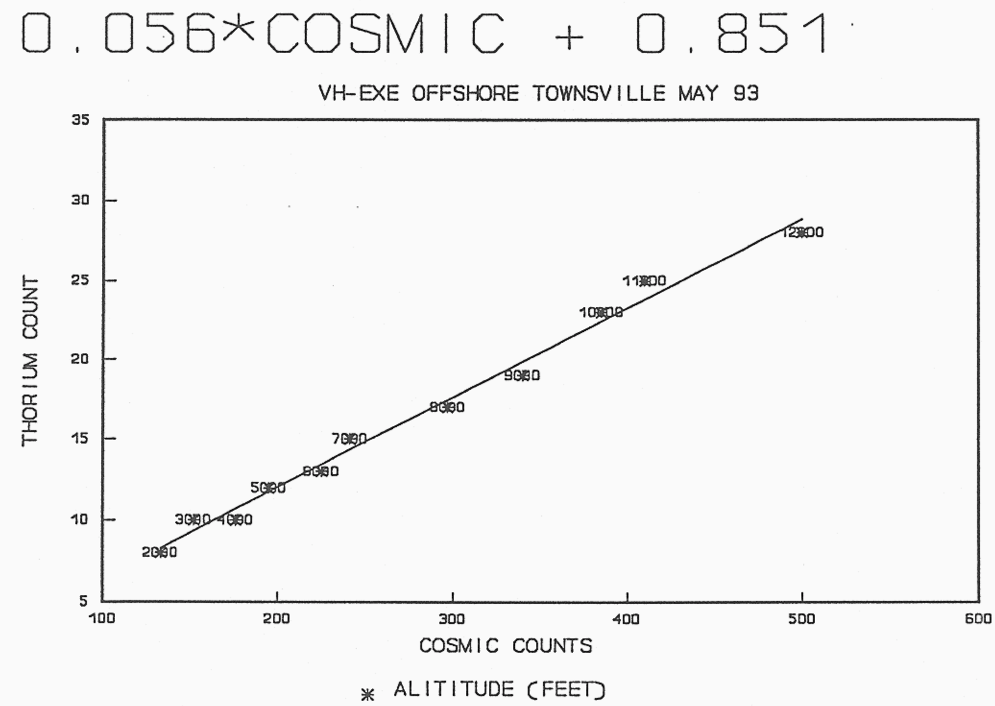


FIGURE B2(ii) COSMIC BACKGROUND TESTS cont



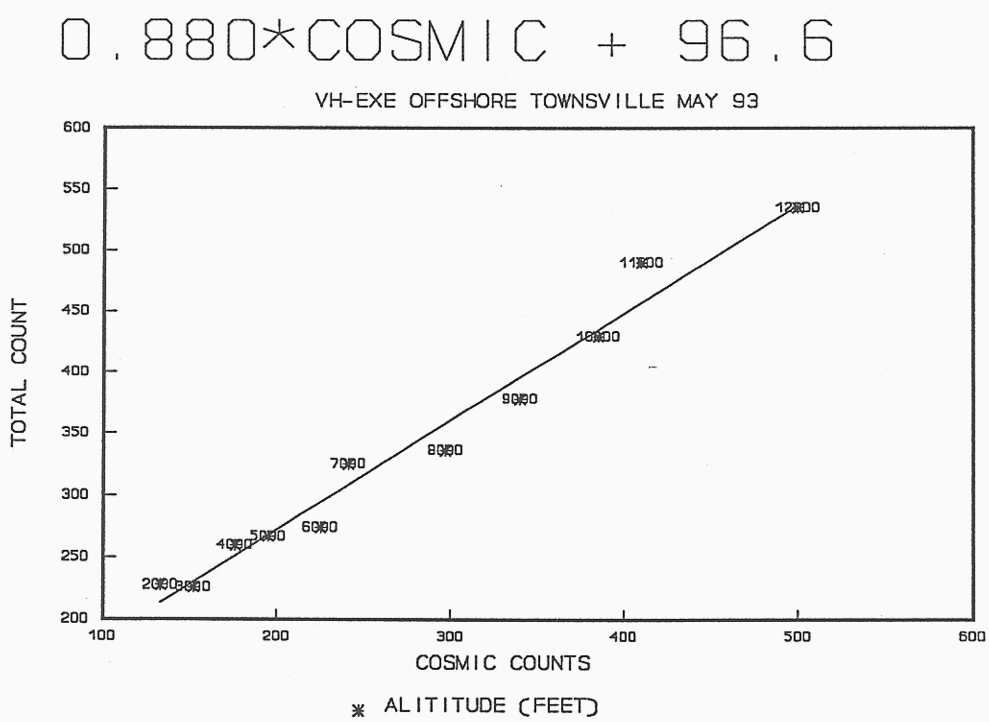
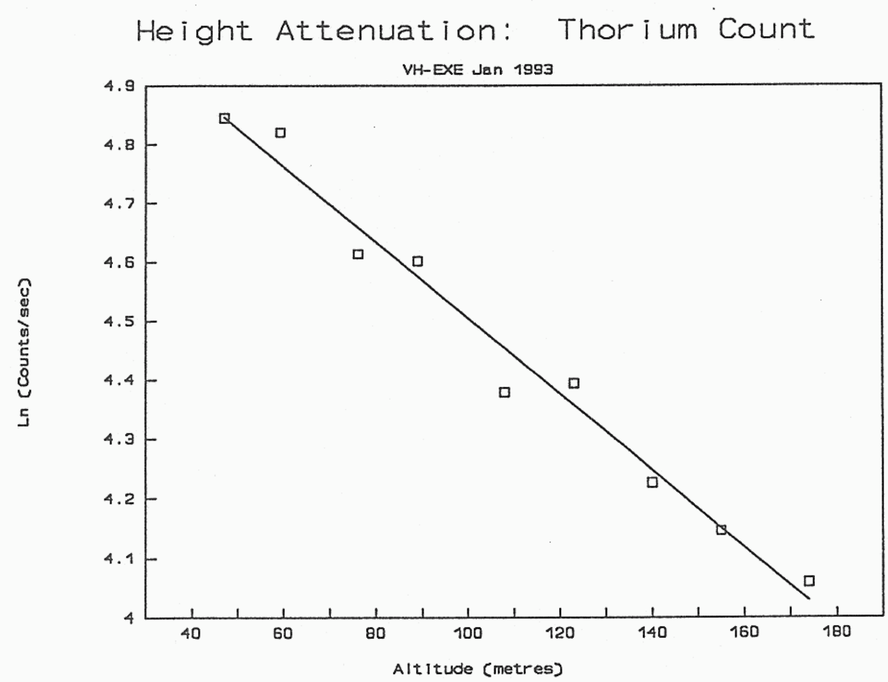


FIGURE B3(I) HEIGHT ATTENUATION TESTS



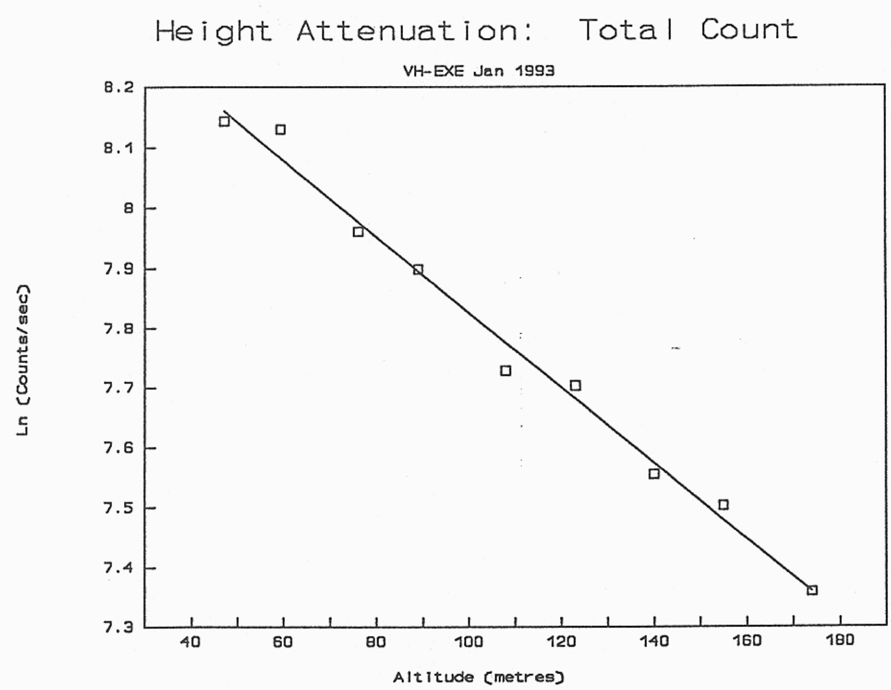
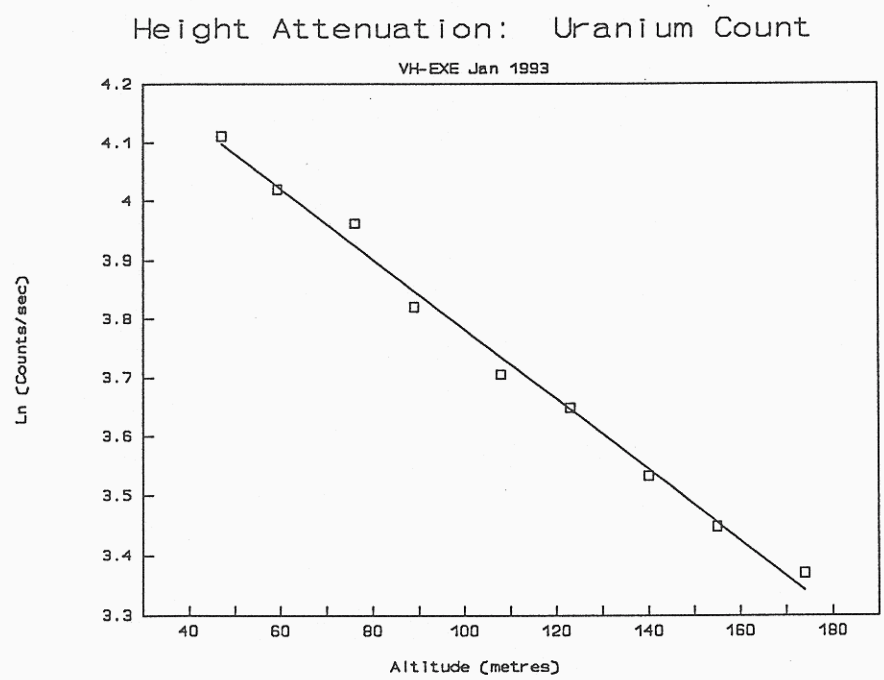


FIGURE B3(II) HEIGHT ATTENUATION TESTS cont



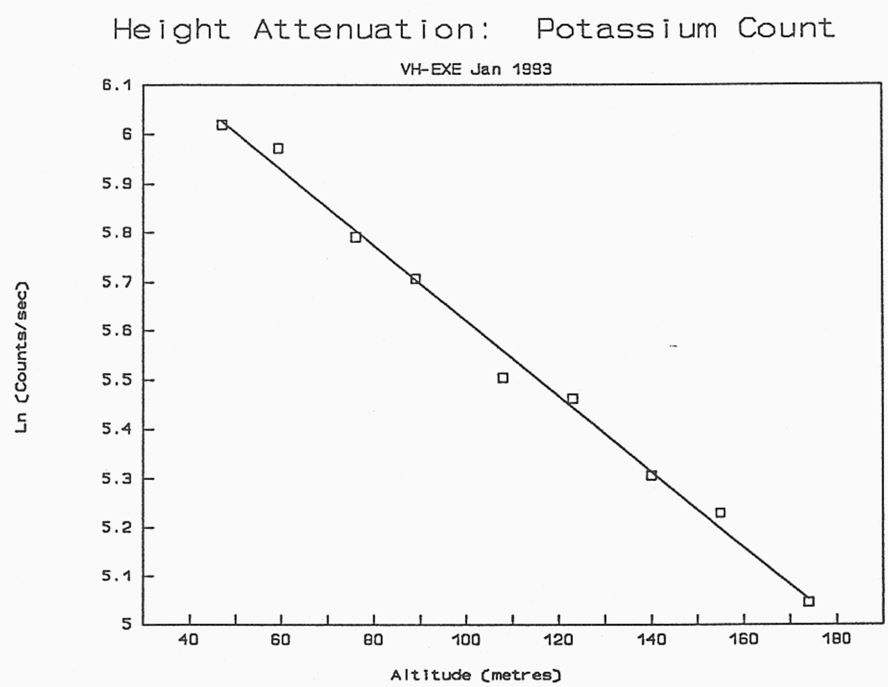
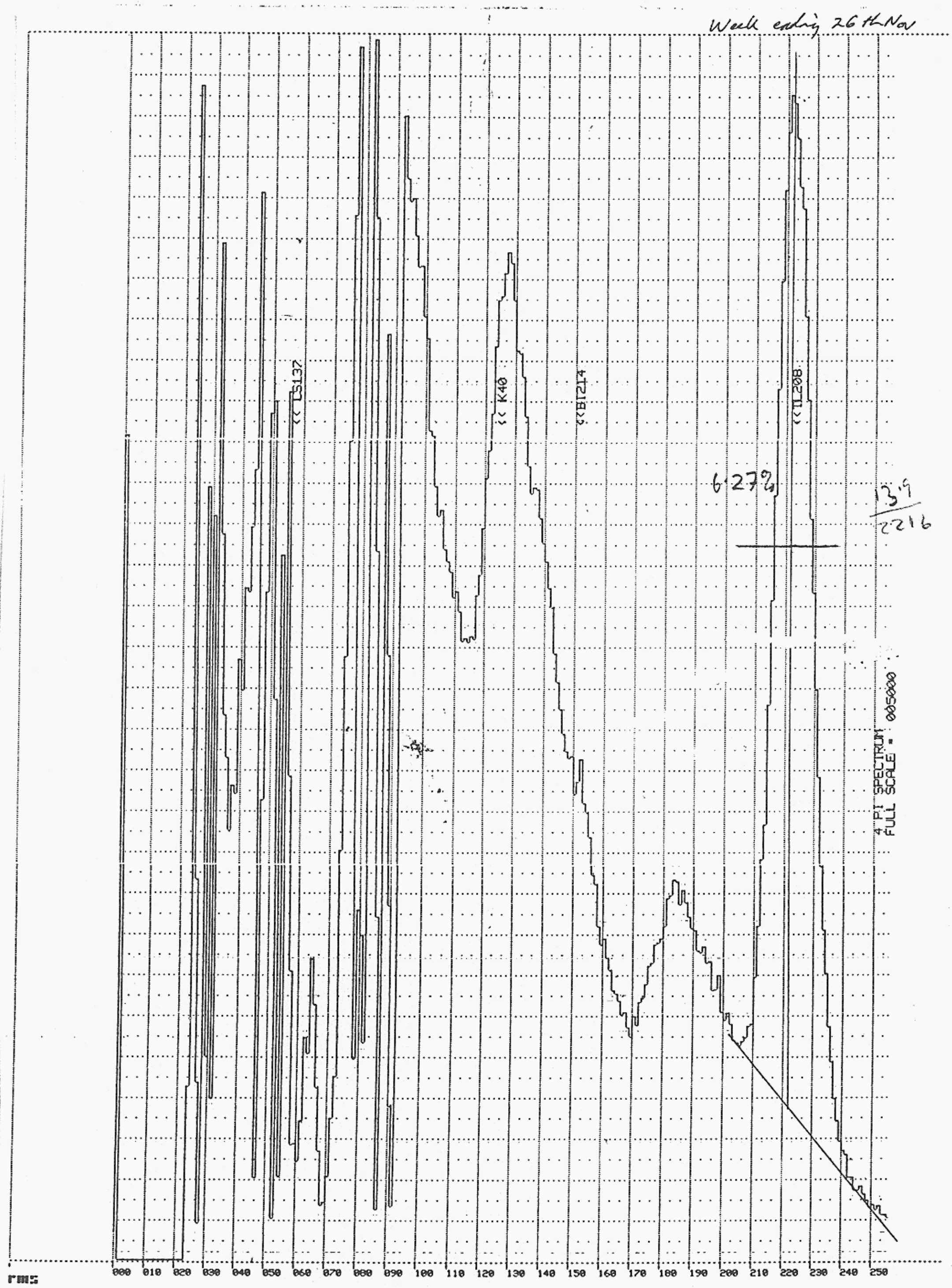


FIGURE B4 SPECTROMETER RESOLUTION CHECK
26/11/93



APPENDIX C: MAGNETIC DATA TAPE FORMATS

TABLE C1 LOCATED DATA TAPE FORMAT

Column	Located Data Tape Format Description
1 - 8	Flight
9 - 16	Line
17 - 24	Date (DDMMYY)
25 - 32	Fiducial
33 - 40	Easting
41 - 48	Northing
49 - 57	Raw Magnetic Value
58 - 66	Levelled Magnetic Value
67 - 75	Diurnal
76 - 84	IGRF
85 - 92	Barometric Altimeter
93 - 100	GPS asl
101 - 108	Topography (GPS asl - Radar alt)
109 - 116	Radar Altimeter
117 - 124	Corrected Total Count
125 - 132	Corrected Potassium Count
133 - 140	Corrected Uranium Count
141 - 148	Corrected Thorium Count
149 - 156	Raw Total Count
157 - 164	Raw Potassium Count
165 - 172	Raw Uranium Count
173 - 180	Raw Thorium Count
181 - 188	Raw Cosmic Count
189 - 196	Time (sec after midnight)

Record Length	196 Bytes
Block Size	12544 Bytes
Density	ASCII
Recording Mode	ASCII

TABLE C2 FIELD DATA TAPE FORMAT

Byte Position	Number	Description	General Information
0 - 3	2	Flight Number	
4 - 7	4	Fiducial Number	
8 - 27	20	Magnetometer @ t-0.0 seconds [1]	
28 - 47	20	Magnetometer @ t-0.1 seconds	
48 - 67	20	Magnetometer @ t-0.2 seconds	Record Length = 972 Bytes
68 - 87	20	Magnetometer @ t-0.3 seconds	Block Size = 972 Bytes
88 - 107	20	Magnetometer @ t-0.4 seconds	
108 - 127	20	Magnetometer @ t-0.5 seconds	Recording Mode = Binary
128 - 147	20	Magnetometer @ t-0.6 seconds	(IBM Compatible)
148 - 167	20	Magnetometer @ t-0.7 seconds	
168 - 187	20	Magnetometer @ t-0.8 seconds	
188 - 207	20	Magnetometer @ t-0.9 seconds	
208 - 209	2	Thorium	
210 - 211	2	Uranium	
212 - 213	2	Potassium	
214 -215	2	Total Count	
216 -217	2	Cosmic Count	
218 -219	2	Live Time	
220 - 451	232	For Channels 24-255 inc. 1 byte each	
452 - 455	4	Radar Altimeter	
456 - 459	4	Barometric Altimeter	
460 - 463	4	Temperature	
464 - 467	4	Relative Humidity	
468 - 471	4	Spare Analogue Input	
472 - 475	4	Spare Analogue Input	
476 - 479	4	Acquire Time (Binary Milliseconds)	
480 - 483	4	Doppler Northing	
484 - 487	4	Doppler Easting	
488 - 491	4	For ID Square	
492 - 495	4	For Speed Data	
496 - 499	4	For Drift Velocity	
500 - 503	4	For Heading Velocity	
504 -507	4	STR4 Data Acquired Time	
508 - 511	4	STR4 Y-Coordinate	
512 - 515	4	STR4 X-Coordinate	
516 - 519	4	STR4 Quality of fix	
520 - 523	4	STR4 Measurement of Delay	
524 - 527	4	MADACS Acquire Time for GPS	
528 - 531	4	Satellite Time	
532 - 535	4	GPS Latitude	
536 - 539	4	GPS Longitude	
540 - 543	4	GPS Altitude ASL	
544 - 547	4	NO. of Satellites Used (coded)	
548 - 551	4	Differential Link Status	
552 - 971	420	Raw Differential Data (Post Processing)	

1. Each magnetometer reading contains:
- Raw magnetic
- Compensated total magnetic field
- Flux Gate X-Component
- Flux Gate Y-Component
- Flux Gate Z-Component

APPENDIX D: RMS THERMAL PAPER STORAGE INSTRUCTIONS

PAPER STORAGE AND HANDLING, RMS 2030 THERMAL PAPER

STORAGE:

Ambient Temperature: Less than 25°C
Relative Humidity: Less than 65%
Storage Location: In darkness before and after exposure.

Under these conditions, the paper should retain its characteristics and the printed images will remain legible for at least 5 years, although in the case of blue image paper, there may be some slight fading.

TO ELIMINATE PREMATURE PAPER DEVELOPMENT:

- Colour development begins at temperatures between 70 to 100°C, and reaches saturation density between 80 and 120°C. Premature development of the paper may occur at lower temperatures, and particularly if the humidity is greater than 65%.
  eg. If the paper is stored for 24 hours at a temperature of 60°C, some development may occur. Or if the paper is stored for 24 hours at a temperature of 45°C when the relative humidity is 90%, development may also occur.

- Avoid use of solvent-type adhesives. Adhesives containing volatile organic solvents such as alcohol, ester, ketone, etc causes colour formation and therefore rubber-type adhesives etc should not be used. Starch, PVA and CMC type adhesives are recommended.

- Frictional heat generated by rubbing a finger nail or sharp object over the surface will cause images to develop.

- Thermal paper will develop colour if brought into contact with freshly processed Diazo copying paper.

TO ELIMINATE PAPER FADING:

- Thermal paper will turn yellow, and blue printed images will tend to fade if exposed to direct sunlight or to fluorescent lighting for long periods. File exposed paper in the dark immediately after exposure. Do not store paper near windows.

- Prolonged contact with PVC film containing plasticisers such as ester phthalate will reduce the image forming ability of the paper and cause printed images to fade. We recommend that files made of polyethylene, polypropylene, polyester, etc be used.

- Self-adhesive cellophane tapes containing an alcohol type plasticiser will cause the image to fade. Double-sided adhesive tape is recommended for use instead of paste.

- Handling thermal paper with dirty or sweaty fingers might cause images to fade.

- Do not store developed paper with the sensitised surfaces touching as images might be transferred from one sheet to another.