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TCR 93-3449

**Logistics report for a  
 heliborne magnetic and radiometric survey  
 over Oceana, Yolande River, Sterling River,  
 Tullah Gap and Murchison Range, Farrell Range,  
 Lake Mackintosh, Huskisson River and Dial Range,  
 Western Tasmania  
 for Pasmenco Exploration Pty Ltd**

- 1 Dial Range EL 9/92, 1286 line km
- 2 Lake Mackintosh EL 37/89, 187 line km
- 3 Farrell Range and Tullah Gap EL 22/90 168 line km
- 4 Sterling River EL 24/91 569 line km
- 5 Huskisson River EL 1/93 423 line km
- 6 Yolande River EL 25/91 432 line km
- 7 Oceana RL8809 125 line km

MINES		
FILE REF.		
- 7 JUL 1993		
DOC. REF.		
DATE	FOR ACTION	FOR INFO.
See	EL'S	9/92
37/89	22/90	
24/91	1/93	
25/91	RL8809	
		DATE

**AMG REFERENCE POINTS ADDED**

*authorised to go to open file when  
 any one of the above tenements is  
 relinquished. Approval given by  
 Mr F. G. Fitzgerald Pasmenco Regional  
 Exploration Manager - Tasmania  
 G. Oakes 1.7.93.*

Job No 3-446

June 1993

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## INTRODUCTION

From 8-31 March 1993, Geoterrex Pty Ltd conducted a heliborne magnetometer and spectrometer survey over eight areas on the Queenstown and Burnie 1:250,000 sheets in Tasmania (See Appendix D) for Pasmaico Exploration Pty Ltd. This report summarises the logistics, survey parameters, calibration procedures and processing details of the survey.

A total of 3,190 line kilometres were flown over eight areas for Pasmaico Exploration.

1)	Oceana:	125 line kilometres
2)	Yolande River:	432 line kilometres
3)	Sterling River:	569 line kilometres
4)	Tullah Gap & Murchison Range:	123 line kilometres
5)	Farrell Range:	45 line kilometres
6)	Lake Mackintosh:	187 line kilometres
7)	Huskisson River:	423 line kilometres
8)	Dial Range:	1,286 line kilometres

A line spacing of 100 metres was used in areas 1,3,4,5,6 and 7 and 200m in areas 2 and 8. Both magnetic and radiometric data was collected by helicopter. Preliminary in-field processing was undertaken with final processing at Geoterrex's processing centre in Sydney.

The bases of operations were Queenstown, Tullah and Riana, Tasmania.

## Survey operations summary

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**PART 1**  
**Survey operations summary**

<b>Type of survey:</b>	Magnetic and radiometric
<b>Base of operations:</b>	<b>Area 1-2:</b> Queenstown <b>Area 3-7:</b> Tullah <b>Area 8:</b> Riana
<b>Aircraft:</b>	Aerospatiale Squirrel 350B
<b>Survey Area(s) Name:</b>	<b>Area 1:</b> Oceana <b>Area 2:</b> Yolande River <b>Area 3:</b> Sterling River <b>Area 4:</b> Tullah Gap & Murchison Mine <b>Area 5:</b> Farrell Range <b>Area 6:</b> Lake Mackintosh <b>Area 7:</b> Huskisson River <b>Area 8:</b> Dial Range
<b>Approximate Survey Size:</b>	<b>Area 1:</b> 125 Line Kilometres <b>Area 2:</b> 432 Line Kilometres <b>Area 3:</b> 569 Line Kilometres <b>Area 4:</b> 123 Line Kilometres <b>Area 5:</b> 45 Line Kilometres <b>Area 6:</b> 187 Line Kilometres <b>Area 7:</b> 423 Line Kilometres <b>Area 8:</b> 1,286 Line Kilometres
<b>Flight Line Direction:</b>	<b>Area 1:</b> 90° AMG <b>Area 2:</b> 90° AMG <b>Area 3:</b> 90° AMG <b>Area 4:</b> 90° AMG <b>Area 5:</b> 0° AMG <b>Area 6:</b> 90° AMG <b>Area 7:</b> 90° AMG <b>Area 8:</b> 90° AMG
<b>Line Spacing:</b>	<b>Area 1:</b> 100 metres <b>Area 2:</b> 200 metres <b>Area 3:</b> 100 metres <b>Area 4:</b> 100 metres <b>Area 5:</b> 100 metres <b>Area 6:</b> 100 metres <b>Area 7:</b> 100 metres <b>Area 8:</b> 200 metres
<b>Tie Line Direction:</b>	Orthogonal to traverse lines

<b>Tie Line Spacing:</b>	<b>Area 1:</b>	1,000 metres
	<b>Area 2:</b>	2,000 metres
	<b>Area 3:</b>	1,000 metres
	<b>Area 4:</b>	1,000 metres
	<b>Area 5:</b>	No tie lines
	<b>Area 6:</b>	1,000 metres
	<b>Area 7:</b>	1,000 metres
	<b>Area 8:</b>	2,000 metres

**Minimum Line Length:** 3 Kilometres

**Navigation:** DGPS

**Nominal sensor terrain clearance:** 80 metres, above tree canopy

**Nominal aircraft speed:** 40 metres per second

**Field Personnel:**

<b>Pilot:</b>	D Wood
<b>Navigator:</b>	J Sparkman
<b>Electronics Technician:</b>	D Lyus
<b>Project Manager and Data Compiler:</b>	T Donnollan

Table 1: Survey Progress

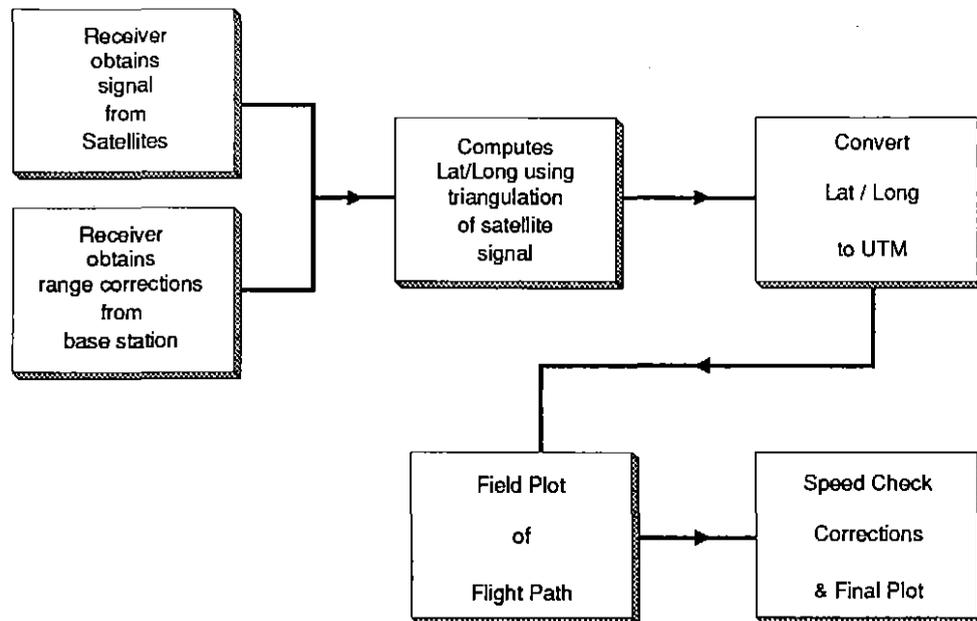
Date	Flight	Production/ shared days	Progress
26-28 February 1993			System installation
3 March 1993		X	Installed DGPS beacon
4-7 March 1993	Flights for another survey		
8 March 1993	1	X Area 5	Lag test
9 March 1993			Move to Tullah
10 March 1993		X	Diurnal day
11 March 1993	2	P Area 6	
12 March 1993		X	Diurnal day
13 March 1993	3	P Area 3	
14 March 1993	4	P Area 3	
15 March 1993	5	P Area 3,7	
16 March 1993	6	P Area 7,4,3	
17 March 1993	7	Area 3,7	
18 March 1993		X	Move to Queenstown
19 March 1993		X	Weather Day
20 March 1993	8	P Area 2	
21 March 1993	9	X Area 2	
22 March 1993		X	Weather Day
23 March 1993		X	Weather Day
24 March 1993	Flights for another survey		
25 March 1993	10	X Area 1	
26 March 1993	11		Cosmic calc flight
27 March 1993			Move to Ulverstone/Riana
28 March 1993	12	P Area 8	
29 March 1993	13	P Area 8	
30 March 1993	14	P Area 8	
31 March 1993	15	P Area 8	
1 April 1993			De-install DGPS beacon

Total number of days:      Production (P):      10  
    Shared (x):                10  
    TOTAL:                        20

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PART 2  
Flight path recovery

DGPS Navigation System Procedures



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 Universal Transverse Mercator (UTM) co-ordinates.

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

**PART 3**  
**Equipment and specifications**

**3.1) MAGNETOMETER**

**Model:** Scintrex cesium vapour optical absorption magnetometer

**Mounting:** Towed Bird

**Sample Interval:** 0.1 seconds

**Sensitivity:** 0.05 nT

**Average noise:** The average noise for the survey data is calculated from the fourth difference monitor using the equation:  
(Fourth difference noise envelope)/16 = Average Data Noise

**System parallax:** The system parallax was determined in a test flight (see Section 4.1)

**3.2) GAMMA RAY SPECTROMETER**

**Model:** Nuclear Data ADC/ND-560

**Detectors:** 4 Harshaw all viewing 2 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, 1.76 MeV)
Thorium	-	2.42 to 2.82 MeV	(Th208, 2.615 MeV)
Cosmic	-	3.0 - 6.0 MeV	

**3.3) GROUND MAGNETOMETER BASE STATION**

**Sensor:** Proton Precession  
**Magnetometer:** Geometrics G856  
**Sample interval:** 5 seconds  
**Sensitivity:** 0.1 nT  
**Full scale deflection:** 50 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 AA100 radio altimeter system  
**Sample interval:** 1.0 second  
**Accuracy:** +/- 1.5% (+/- 1m at 60m)  
**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.

**Barometric altimeter**

**Model:** Rosemount 840F pressure altimeter  
**Sample Interval:** 1.0 second  
**Sensitivity:** 5 mv per foot

**3.5) TRACKING CAMERA**

**Model:** Sony DXC101P Video Camera with a Panasonic video recovery system

The tracking camera is equipped with a 4 mm 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 SYSTEM**

**Model:** 2 Sercel NR103 mobile DGPS receiver and antennae mounted in aircraft and equipped with pilot steering indicator  
**Reference station:** 1 Sercel NDS100 portable differential station UHF and DGPS antennae  
**Base station:** DGPS base station with lap top data logger

### 3.7) DATA ACQUISITION SYSTEM

**Model:** Geotrex 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:** MS8

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:** Kennedy 800

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 NRZI 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 B.

## 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.

**Channels recorded & full-scale values:**

<b>Total magnetic field:</b>	
<b>Fine scale:</b>	100 nT
<b>Coarse scale:</b>	1000 nT
<b>Magnetic field fourth difference:</b>	+/-20 nT
<b>Terrain clearance:</b>	200 metres
<b>Total Count:</b>	2000 counts/sec
<b>Potassium Count:</b>	250 counts/sec
<b>Uranium Count:</b>	100 counts/sec
<b>Thorium Count:</b>	100 counts/sec
<b>Cosmic Count:</b>	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:** No lags occur between traces, other than that which occurs between the magnetic field and its fourth difference.

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

<b>Alpha</b> (Thorium into Uranium)	-	0.443
<b>Beta</b> (Thorium into Potassium)	-	0.424
<b>Gamma</b> (Uranium into Potassium)	-	0.695

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.

An annotated sample analogue record is shown in Figure 1.

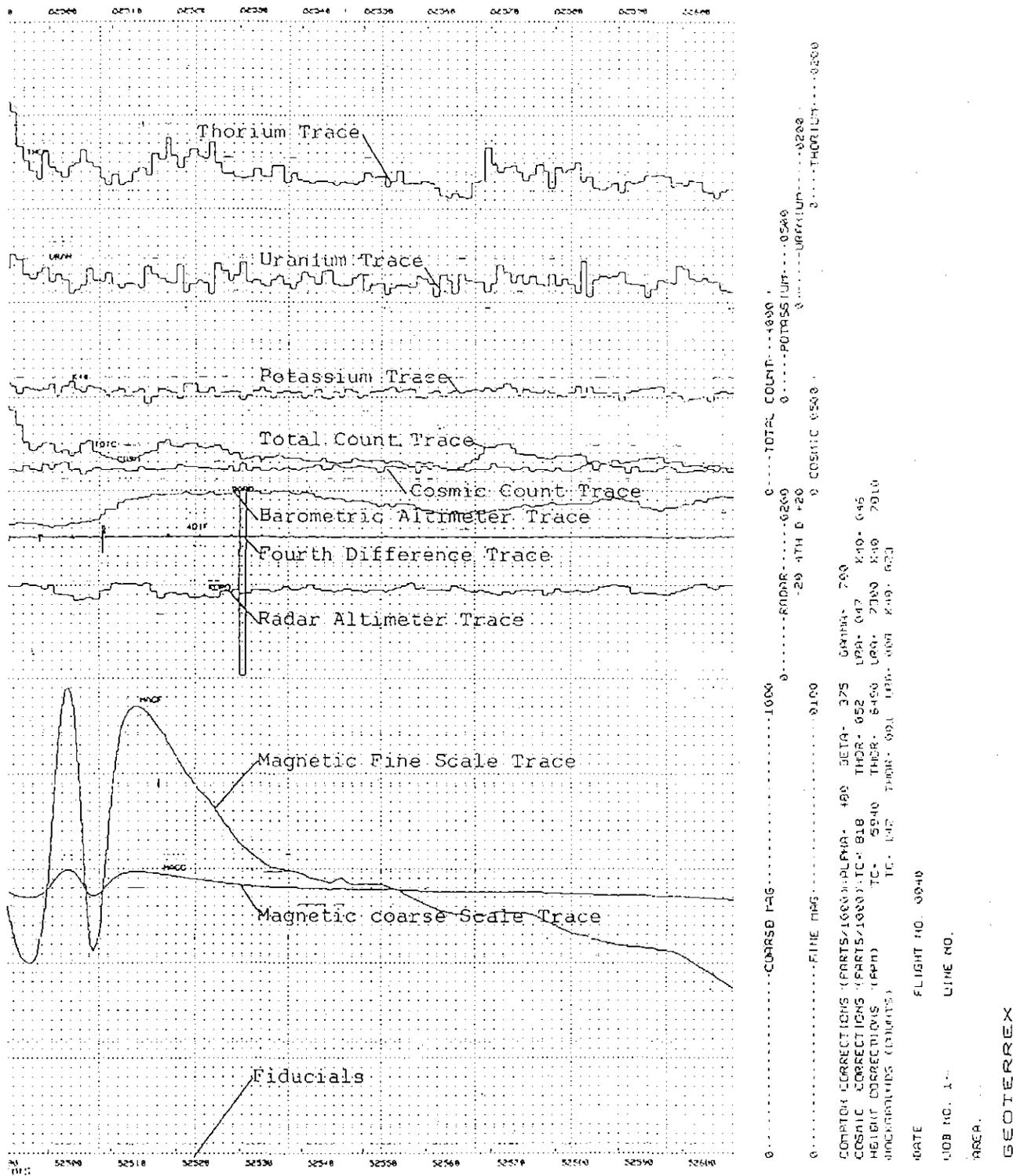


Figure 1: Sample analogue record

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**PART 4**  
**Calibration procedures and results**

**4.1) MAGNETOMETER**

The following calibration tests were carried out on the magnetometer.

**Parallax (also referred to as 'Lag Test')**

This test was carried out on 8 March 1993. 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 which 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 difference of 1.0 seconds was found. Therefore a parallax correction of this magnitude and sense was applied to the magnetic data only.

**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 A. A sample of the spectra plotted with each uranium and thorium source check is presented in Appendix A, Figure A1.

**Compton Stripping Coefficients**

These coefficients have been recently determined and adjusted from 23 source checks conducted during the survey in June 1992.

They are:	<b>Alpha</b>	-	0.421 +/- 0.015
	<b>Beta</b>	-	0.411 +/- 0.024
	<b>Gamma</b>	-	0.678 +/- 0.038
	<b>Delta</b>	-	0.036 +/- 0.017

### Background Determination

This test was carried out on 26 March 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 2000 foot intervals from 2000 feet to 10000 feet ASL.

The best fit linear equations for these tests are:

<b>Th</b>	background	=	0.056 x Cosmic + 0.88
<b>U</b>	background	=	0.049 x Cosmic + 5.36
<b>K</b>	background	=	0.052 x Cosmic + 9.26
<b>TC</b>	background	=	0.825 x Cosmic + 84.84

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 A (Figure A2).

### Height Attenuation Coefficients

Since no height attenuation calibrations were required for the temporary helicopter installation, those used for Geoterrex's permanent fixed wing spectrometer system were used. They were determined using the following procedure:

- An area with "homogeneous" radioactivity, high count rates and relatively flat terrain was selected.
- An easily repeatable line was flown over this area at eight different altitudes: 200 feet, 250 feet, 300 feet, 400 feet, 500 feet, 600 feet, 700 feet and 800 feet. The spectrometer was correctly calibrated for this test flight.
- Sections of each line sharing the most constant terrain clearance and count rate were selected for data processing.
- The altitude data for each line section was corrected using the altitude calibrations recorded on the same flight, and averaged.
- The radiometric data for each line section was background corrected using a height correction for alpha. The resultant data was averaged.
- The resulting count rates in each channel were plotted and attenuation coefficients suitable for an air temperature of 21°C were determined.

Graphs of the results can be found in Appendix A (Figures A3).

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 3.2.

## 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 give an average of 5.63%. Appendix A (Figure A4) 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 an altimeter calibration carried out in March 1993 are presented in Table 2. A graph of the results is presented in Figure 3. Regression analysis provides a line of best fit for values less than 500' and another for values greater than 500'. These have been included on the graph, and the equations are:

$$< 500' \quad \text{Recorded Units} = 1.04 * \text{Altimeter Reading} - 13.4$$

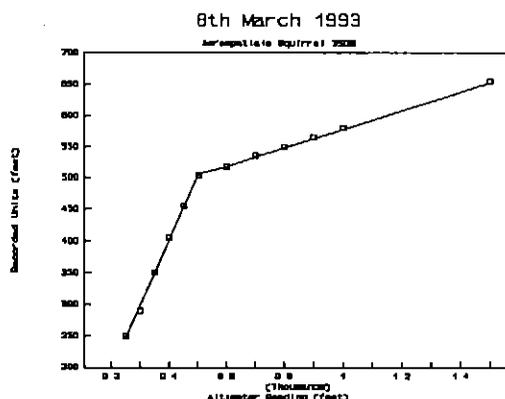
$$> 500' \quad \text{Recorded Units} = 0.15 * \text{Altimeter Reading} + 428$$

Barometric altitude was also recorded to provide an absolute measure of aircraft altitude rather than aircraft terrain clearance which is measured by the radio altimeter.

Table 2: Altimeter calibration results

Indicated Alt (feet)	Recorded Radar Alt (feet)
250	250
300	290
350	350
400	405
450	455
500	503
600	518
700	535
800	550
900	565
1000	580
1500	655

Figure 3: Altimeter calibrations



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## PART 5 Data processing

### 5.1) FIELD TAPES

These are recorded in binary format and are compacted and reformatted in binary code. The following information is transferred to a file as the Compacted Field Tape (CFT).

- flight path
- magnetic reading (0.1 nT)
- radiometric data (256 channels)
- radar altimeter (feet)
- barometric altimeter (feet)
- fiducial (time in tenth seconds after midnight)
- DGPS co-ordinates

All channels are checked and edited for single reading spikes and recording gaps, any single reading spikes are removed manually.

### 5.2) 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 6250 bpi in a format described in Appendix B.

#### Gridded data tape

Gridded data in ER Mapper format with accompanying header files was provided for processed radiometric channels potassium, thorium, uranium and total count and for levelled magnetic data. These files were provided on QIC 150 megabyte cartridge. Gridded data tape for radar altimeter, GPS ASL, digital terrain model was supplied for Tullah Gap area only.

### 5.3) FLIGHT PATH

Processing of the flight path consisted of generating a speed report of the DGPS 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 DGPS data was checked for errors and corrected where necessary.

The following convention is used for line number: 101/2N

where the number preceding the decimal is the line number (eg. 101)  
the number following the decimal is the part number (eg. the line was the second flight along that line)  
the letter represents the flight direction (eg flown to the north)

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Lines 101-137 are traverse lines for Oceana Area 1  
Lines 701-704 are tie lines for Oceana Area 1  
Lines 201-247 are traverse lines for Yolande River Area 2  
Lines 711-715 are tie lines for Yolande River Area 2  
Lines 301-382 are traverse lines for Sterling River Area 3  
Lines 401-430 are traverse lines for Sterling River Area 3  
Lines 721-730 are tie lines for Sterling River Area 3  
Lines 501-535 are traverse lines for Tullah Gap Area 4  
Lines 741-744 are tie lines for Tullah Gap Area 4  
Lines 601-608 are traverse lines for Farrell Range Area 5  
Lines 751-753 are tie lines for Farrell Range Area 5  
Lines 801-852 are traverse lines for Lake Mackintosh Area 6  
Lines 761-764 are tie lines for Lake Mackintosh Area 6  
Lines 1201-1292 are traverse lines for Huskisson River Area 7  
Lines 791-795 are tie lines for Huskisson River Area 7  
Lines 771-780 are tie lines for Dial Range Area 8  
Lines 1001-1102 are traverse lines for Dial Range Area 8

#### 5.4) MAGNETIC DATA

##### a) Corrections

###### Levelling

The base station data is edited and checked for level shifts prior to synchronisation 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 subtracted from the data and a datum of 2000 nanoteslas is then added to ensure that there are no negative magnetic values before contouring.

## b) Product Specifications

## Gridding and Contouring

Grid mesh size: 25 x 25 metres  
 Grid filter: None

Contour maps:	Horizontal scale	-	Areas 1-7:	1:10,000
			Area 8:	1:25,000
	Contour interval	-	Area 1,2,5,6:	1, 10, 100 nT
			Area 4,7:	2, 20, 200 nT
			Area 3:	5, 50, 500 nT
			Area 8:	10,100,1000nT

## 5.5) RADIOMETRIC DATA

## a) Corrections

The radiometric data was corrected for:

## i) 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 msec in a 1 second sample period.

## ii) 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.

## iii) 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.

## iv) Compton scattering

After testing the Compton stripping coefficients determined from the calibration procedures outlined in Section 4, new values were chosen to minimise over compensation for the actual interchannel relationships on each survey line which were found to be less than the ideal relationship measured on the ground during calibration. The values used were:

Alpha	-	0.421
Beta	-	0.411
Gamma	-	0.678
Delta	-	0.036

It should be noted that alpha coefficient is height dependent under the linear relation:  
 true alpha = ground + 0.02 + 0.00025 x height

## v) Height attenuation

To minimise the possibility of over correcting the data for height variations, an altitude tapering function was applied. The data was attenuated to approximately the mean survey terrain clearance minus one standard deviation (110 metres). Tapering began at 175 metres and finished at 200 metres, so for altitudes greater than 200 metres the data was corrected as if it had been collected at 200 metres.

Attenuation constants:

Total count	-	0.00630
Potassium	-	0.00768
Uranium	-	0.00595
Thorium	-	0.00643
Alpha	-	0.00076

## b) Production specifications

Gridding and contouring

Grid mesh size: 25 x 25 metres

Grid filter: None

Full colour map for each radiometric channel

	Map scale	Contour interval (cps)			
		TC	K	U	Th
Area 1:	10,000	50,200	5	2	1
Area 2:	25,000	100,1000	10	2	2
Area 3:	25,000	50,100	5,10	2	2
Area 4:	10,000	20,120	5	2	2
Area 5:	10,000	10,50	2	2	2
Area 6:	10,000	40,200	5	2	2
Area 7:	25,000	50,100	5	2	2
Area 8:	50,000	100,1000	10	10	5

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**PART 6**  
**Items delivered**

Logistics Report

Final Flight Path Maps on film at 1:10,000 scale

Final Residual Magnetic Contour Maps on film (refer to section 5.4b)

Laminated radiometric colour maps for each channel at appropriate scale (refer to section 5.5b)

Binders containing Analogue Charts

Diurnal charts

Located Data Tape

Gridded Data in ER Mapper Format on QIC 150 Mb cartridge

Flight Logs and Index

Mileage listing

Recovered Line Listing

Tracking videos

**APPENDIX A: SPECTROMETER CALIBRATION DATA**

Flight		Pre Flight		Post Flight	
		U Source	Th Source	U Source	TH Source
1	U count	8,391	7,225	8,461	7,110
	Th count	386	16,193	411	16,117
	K count	6,254	7,564	6,030	7,466
	Total count	89,331	207,142	89,087	207,516
2	U count	11,377	9,216	11,202	9,459
	Th count	589	20,934	613	20,813
	K count	7,995	9,875	7,973	9,800
	Total count	117,511	264,735	117,697	265,229
3	U count	11,195	9,023	10,955	9,123
	Th count	548	20,496	505	20,247
	K count	7,915	9,966	7,786	9,715
	Total count	115,716	262,530	112,889	260,048
5	U count	10,289	9,194	11,110	9,253
	Th count	703	20,393	592	20,574
	K count	7,913	10,215	7,898	9,547
	Total count	109,516	261,433	113,797	260,346
6	U count	10,851	9,099	10,978	8,917
	Th count	593	20,450	554	20,415
	K count	7,757	9,951	7,734	9,994
	Total count	113,202	260,043	113,890	259,179
7	U count	11,080	8,992	10,977	9,044
	Th count	469	20,254	463	20,283
	K count	7,779	9,512	7,642	9,703
	Total count	112,708	259,613	113,494	260,874
8	U count	10,730	8,988	10,788	9,222
	Th count	516	19,994	723	20,207
	K count	7,760	9,411	7,693	9,117
	Total count	111,230	253,887	112,519	255,992
10	U count	10,838	9,188	11,034	9,200
	Th count	413	20,053	449	20,186
	K count	7,845	9,533	7,728	9,485
	Total count	112,930	256,019	113,111	257,754
11	U count	10,926	9,339	10,881	8,926
	Th count	466	19,813	378	19,994
	K count	7,662	9,200	7,434	9,683
	Total count	112,298	255,732	113,454	256,603
12	U count	11,506	9,427	11,478	9,300
	Th count	467	20,907	487	20,715
	K count	8,385	10,387	8,338	10,431
	Total count	118,507	268,582	117,823	267,778
13	U count	11,394	9,492	11,039	9,199
	Th count	502	20,719	652	20,931
	K count	8,149	10,234	8,526	10,711
	Total count	117,176	267,103	117,645	267,910
14	U count	11,255	9,128	11,487	9,340
	Th count	446	20,585	620	20,968
	K count	8,189	10,574	8,230	10,453
	Total count	116,864	266,482	119,039	269,298
15	U count	11,411	9,112	11,290	9,336
	Th count	619	20,728	499	21,232
	K count	8,407	10,356	8,281	10,509
	Total count	119,648	266,327	118,580	268,529

FIGURE A1(i) - SAMPLE SOURCE CHECK - URANIUM SOURCE

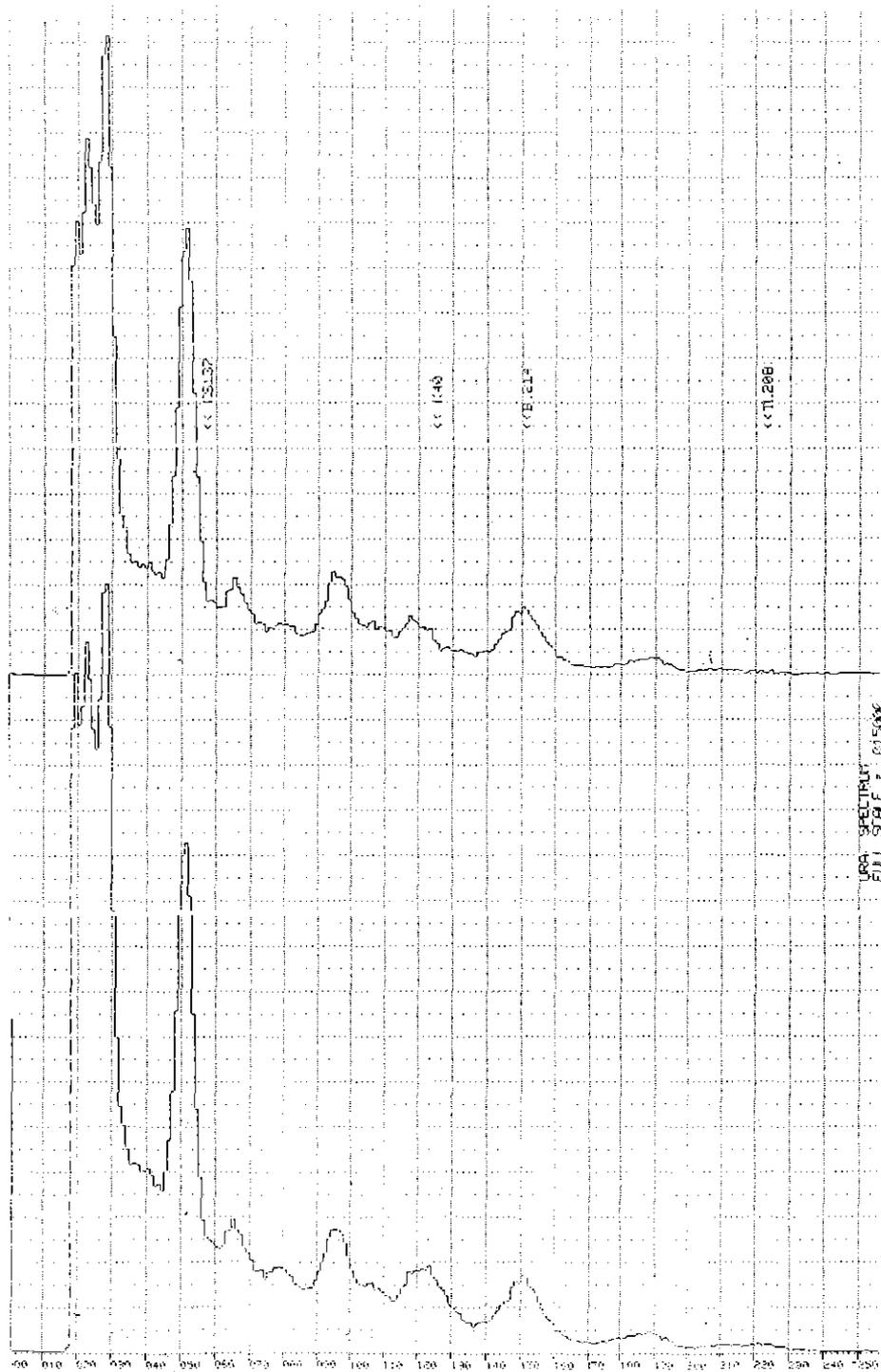


FIGURE A1(ii) - SOURCE CHECK - THORIUM SOURCE

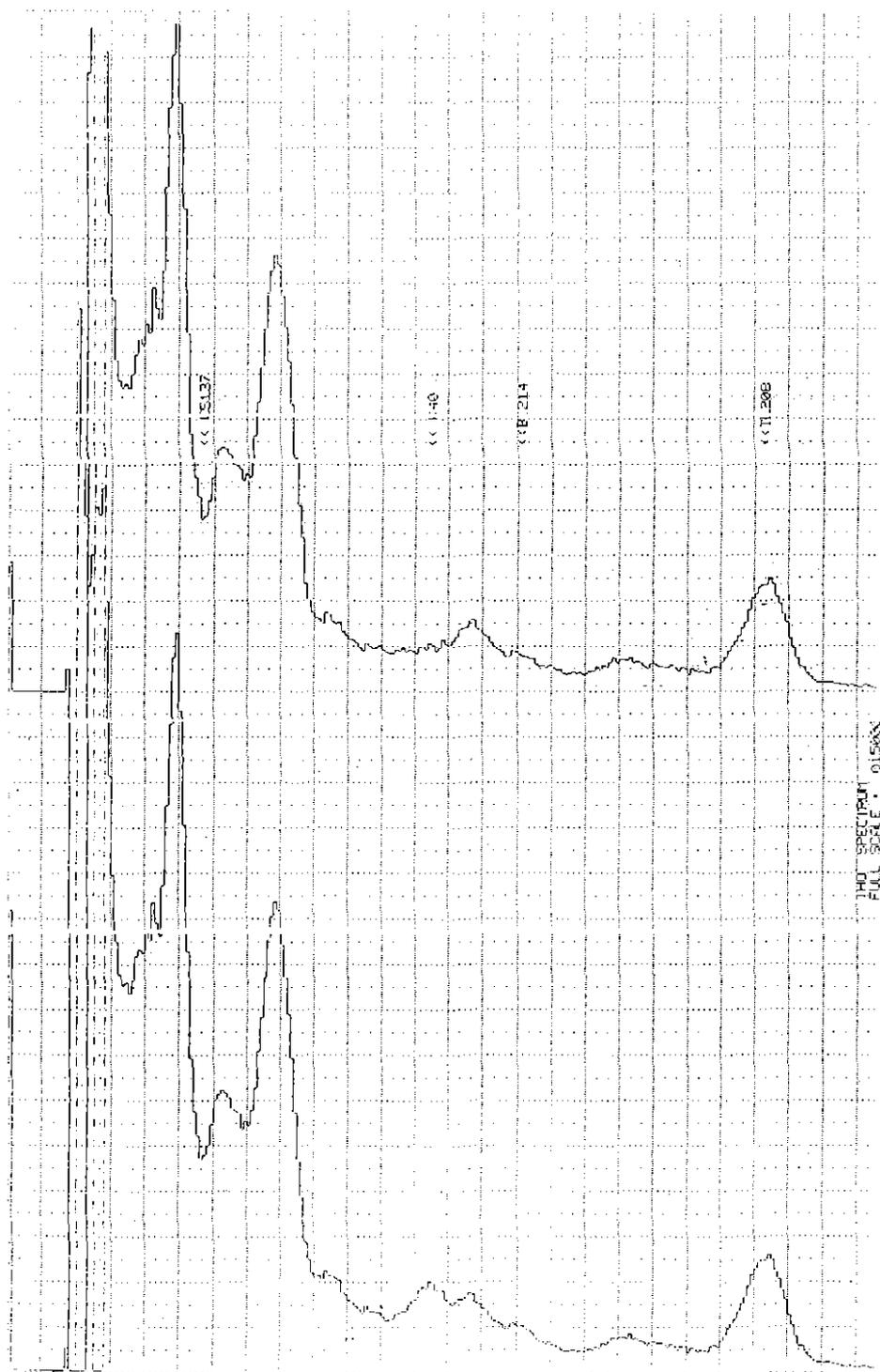
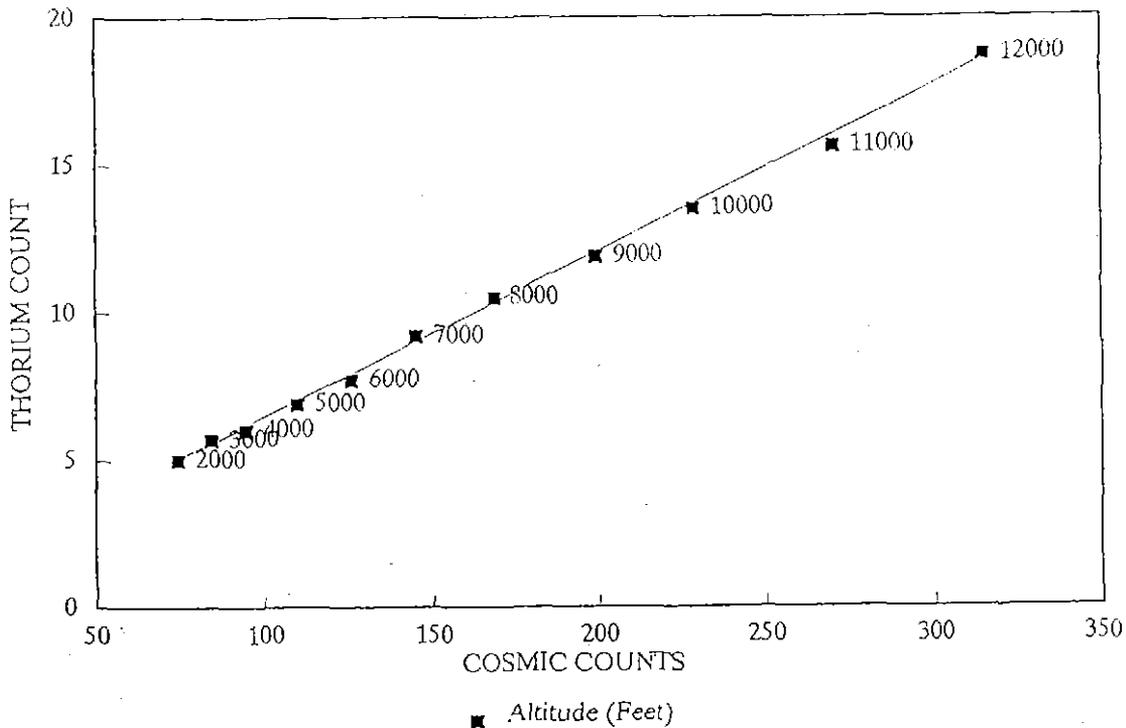


FIGURE A2 COSMIC BACKGROUND TESTS

$$0.056 * \text{cosmic} + 0.88$$

Tasmania Helicopter Mar 93



$$0.049 * \text{cosmic} + 5.36$$

Tasmania Helicopter Mar 93

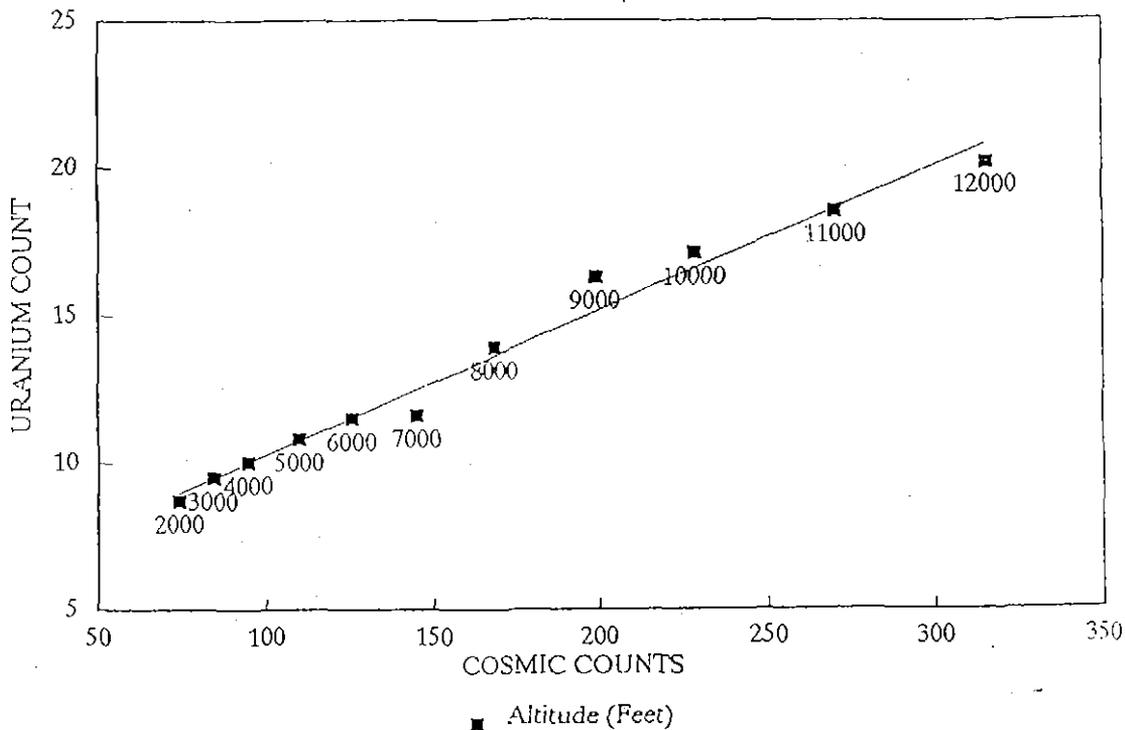
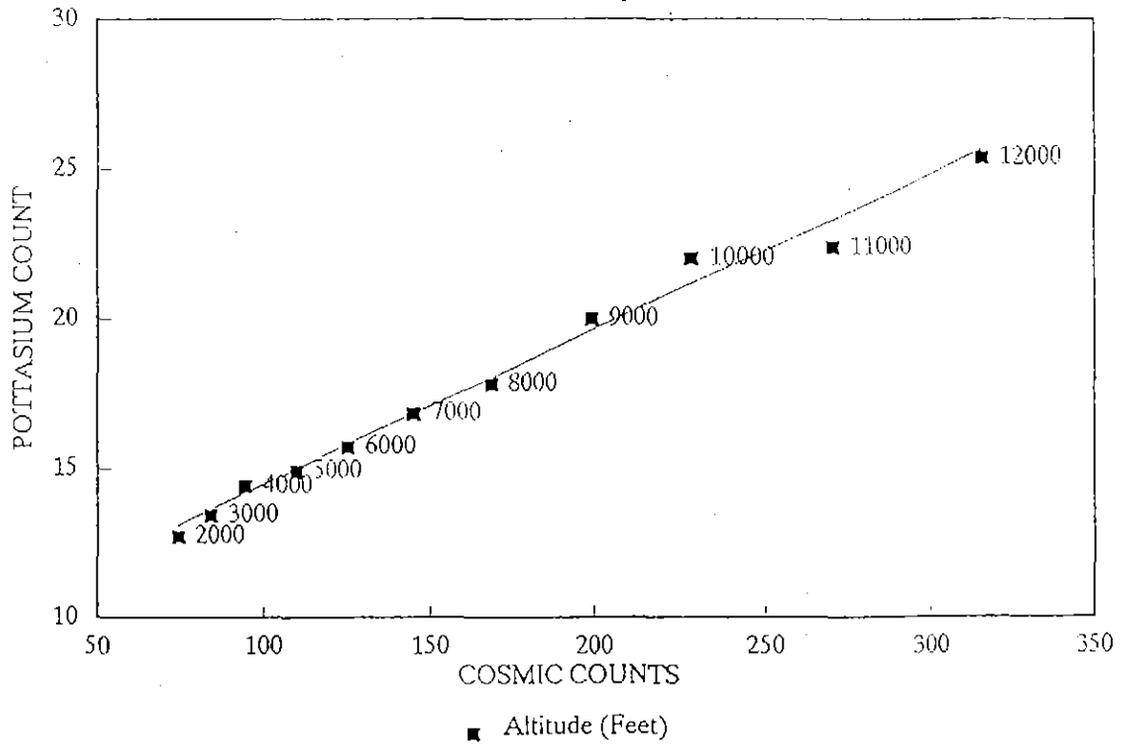


FIGURE A2 COSMIC BACKGROUND TESTS

$$0.052 * \text{cosmic} + 9.26$$

Tasmania Helicopter Mar 93



$$0.825 * \text{cosmic} + 84.84$$

Tasmania Helicopter Mar 93

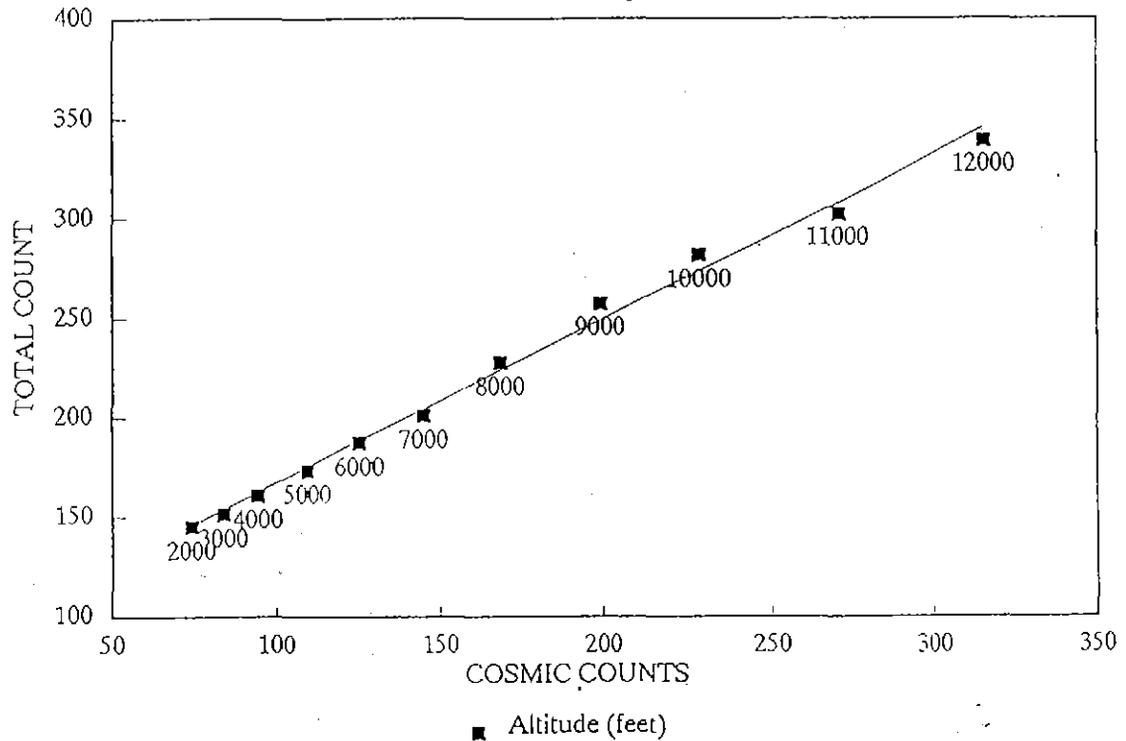
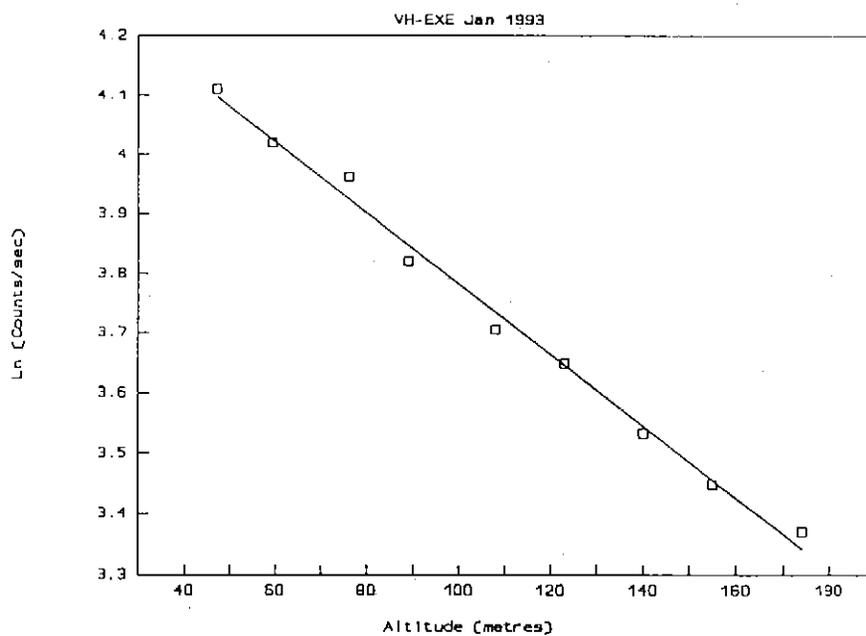


FIGURE A3: HEIGHT ATTENUATION TESTS

## Height Attenuation: Uranium Count



## Height Attenuation: Potassium Count

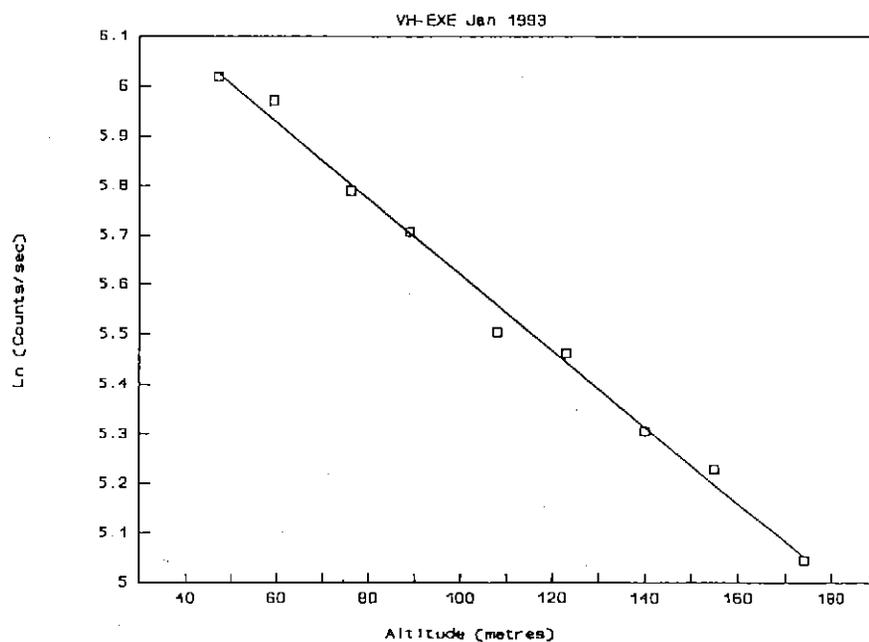
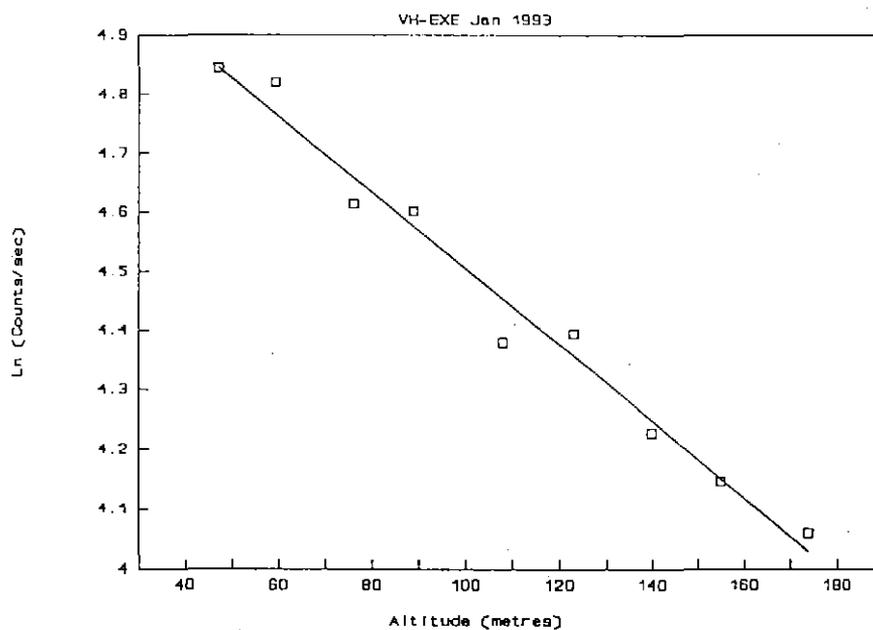


FIGURE A3: HEIGHT ATTENUATION TESTS

## Height Attenuation: Thorium Count



## Height Attenuation: Total Count

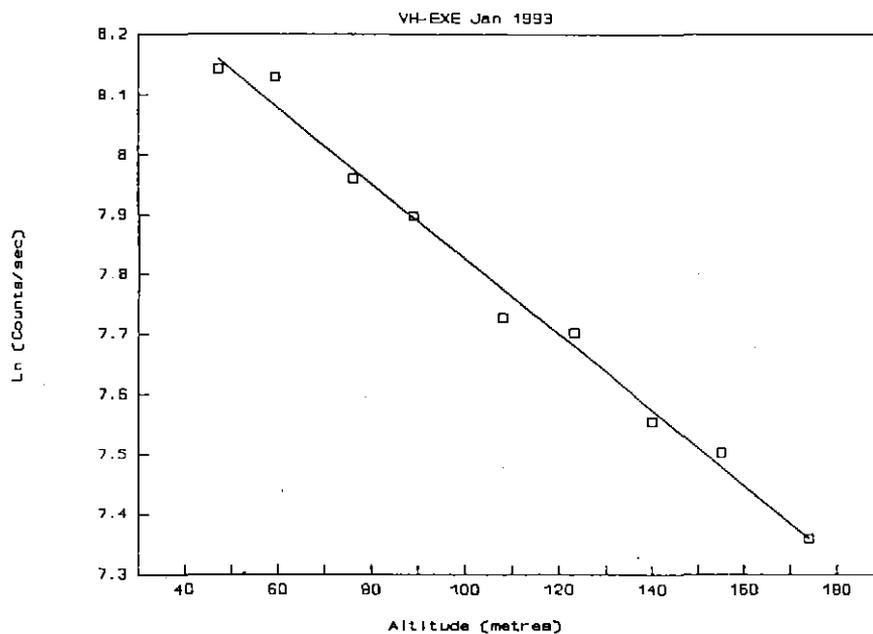
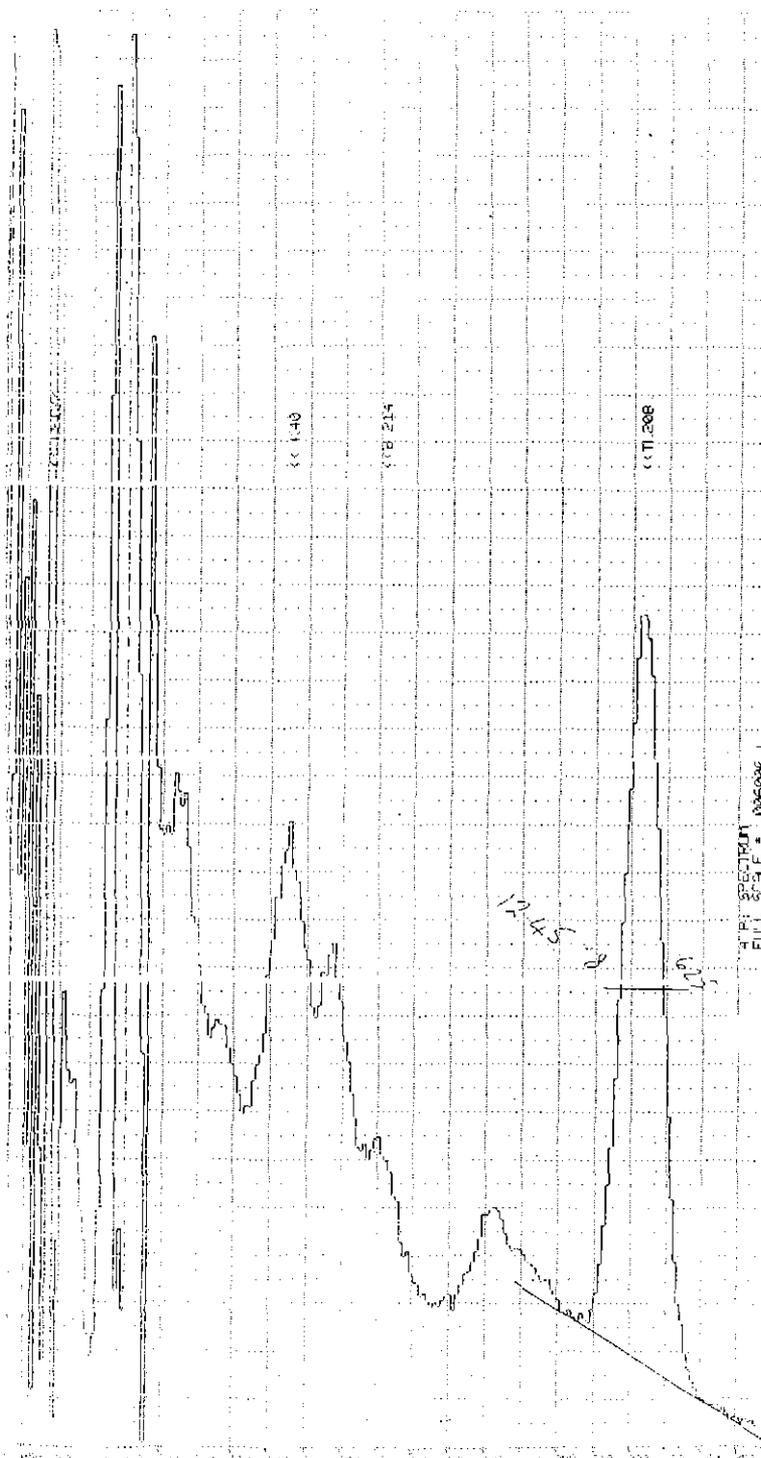


FIGURE A4 (i) - SPECTROMETER RESOLUTION CHECK

March 1993



**APPENDIX B: MAGNETIC DATA TAPE FORMATS****TABLE B1: LOCATED DATA TAPE FORMAT**

Column	Located Data Tape Format Description
1 - 8	Flight
9 - 16	Line
17 - 24	Fiducial
25 - 32	Eastings
33 - 40	Northings
41 - 48	Date (DDMMYY)
49 - 56	Levelled Magnetic Value
57 - 64	Raw Magnetic Value
65 - 72	Diurnal
73 - 80	Uncorrected Total Count
81 - 88	Uncorrected Potassium Count
89 - 96	Uncorrected Uranium Count
103 - 104	Uncorrected Thorium Count
105 - 112	Cosmic Count
113 - 120	Corrected Total Count
121 - 128	Corrected Potassium Count
129 - 136	Corrected Uranium Count
137 - 144	Corrected Thorium Count
145 - 152	Radar Altimeter
153 - 160	GPS ASL

Record Length	160 Bytes
Block Size	10240 Bytes
Density	6250 Bpi
Recording Mode	ASCII

**APPENDIX B: MAGNETIC DATA TAPE FORMATS****TABLE B2: FIELD DATA TAPE FORMAT**MS8 MAG/SPEC WITH SERCEL GPS FEB 93.  
TAPE STRUCTURE

		ASCAN	STRUC
DAY	DS	2	DAY OR FLIGHT NO.
SCANTIME	DS	4	
<b>MAGNETICS</b>			
MAGNET0	DS	4	MAG @ .0 SEC
MAGNET1	DS	4	MAG @ .1 SEC
MAGNET2	DS	4	MAG @ .2 SEC
MAGNET3	DS	4	MAG @ .3 SEC
MAGNET4	DS	4	MAG @ .4 SEC
MAGNET5	DS	4	MAG @ .5 SEC
MAGNET6	DS	4	MAG @ .6 SEC
MAGNET7	DS	4	MAG @ .7 SEC
MAGNET8	DS	4	MAG @ .8 SEC
MAGNET9	DS	4	MAG @ .9 SEC
<b>ANALOG</b>			
RADAR	DS	2	RADAR ALT
PRESSURE	DS	2	PRESSURE ALT OR PRESSURE
TEMPER	DS	2	TEMPERERATURE
RELH	DS	2	RELATIVE HUMIDITY
VLF1	DS	2	FOR VLF ANALOGUE INPUT.
VLF2	DS	2	FOR 2ND VLF ANALOGUE INPUT.
<b>NAV: DOPPLER</b>			
DOPPL1	DS	6	FOR NORTHING
DOPPL2	DS	6	FOR EASTING
DOPPL3	DS	6	FOR ZONE DATA
DOPPL4	DS	6	FOR ID SQUARE DATA
DOPPL5	DS	6	FOR SPEED DATA
DOPPL6	DS	6	FOR DRIFT VELOCITY DATA
DOPPL7	DS	6	FOR HEADING VELOCITY DATA
<b>NAV: GPS</b>			
SERACQ	DS	4	MADACS ACQUIRE TIME OF GPS (B)
SATIME	DS	6	SATELLITE TIME (UTC FID)(A)
GPSLAT	DS	10	GPS LATITUDE (A)
GPSLON	DS	10	GPS LONGITUDE (A)
ASLALT	DS	4	GPS ALTITUDE ASL (A)
SATSU	DS	20	NUMBERS OF SATS USED (A)
QUAIDX	DS	2	PADDING ONLY IGNORE.
<b>SPECTROMETRY</b>			
THOR4	DS	2	THORIUM
URA4	DS	2	URANIUM
K404	DS	2	POTASSIUM
TOTAL4	DS	2	TOTAL COUNT
COSMIC4	DS	2	COSMIC COUNT
LIVE4	DS	2	LIVE TIME
CHANS4	DS	232	FOR CHANS 24-255 INC. 1 BYTE EA
ENDS			

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**APPENDIX C: 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.

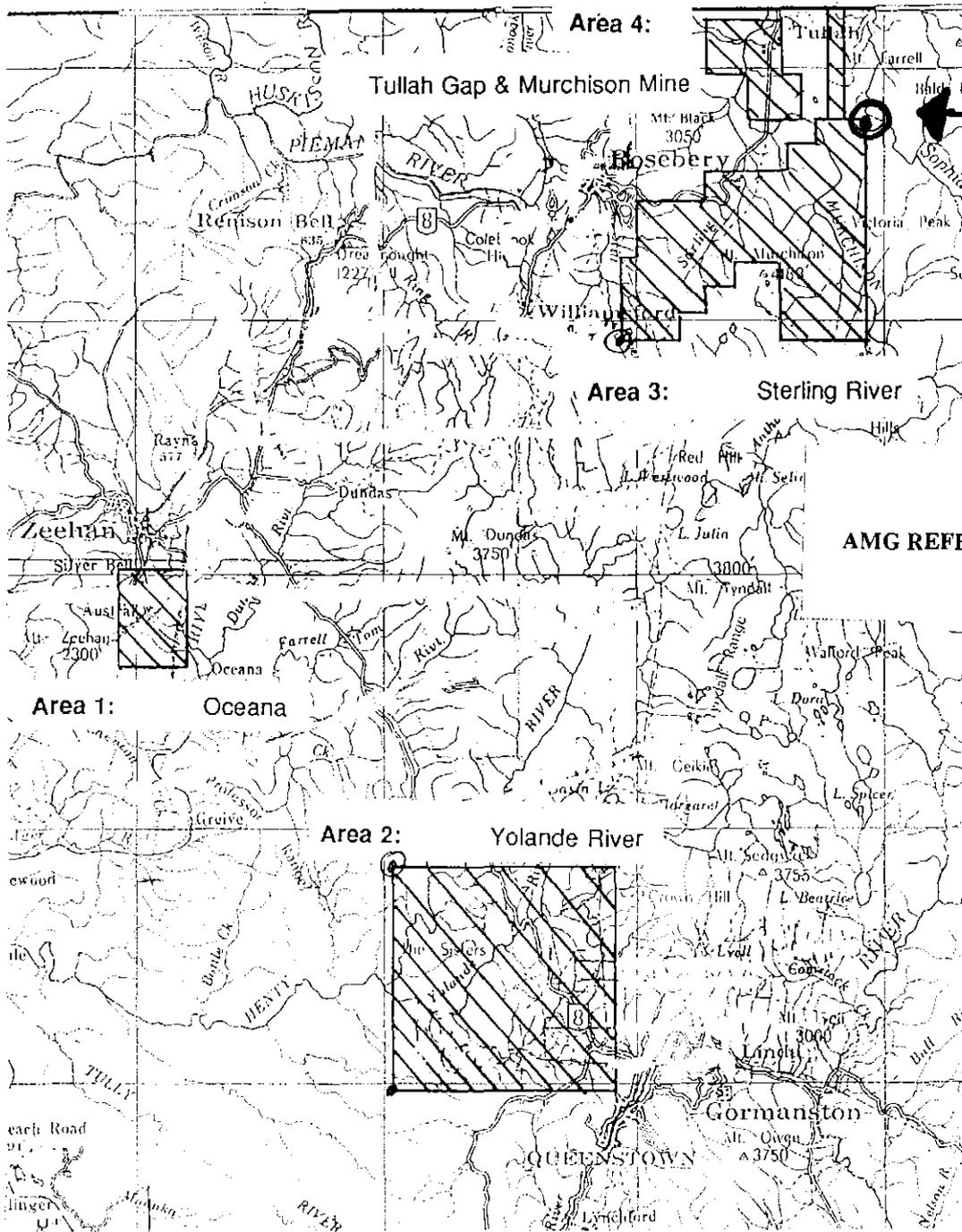
**TO ELIMINATE PAPER FADING:**

- 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.

APPENDIX D: LOCATION MAP

LOCATION MAP

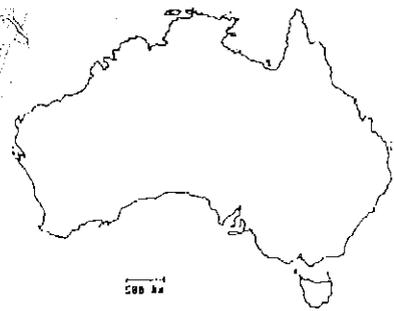
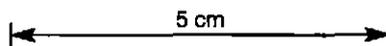
Scale: 1:250,000



5376000N  
380900 E  
EL  
24/91

AMG REFERENCE POINTS ADDED

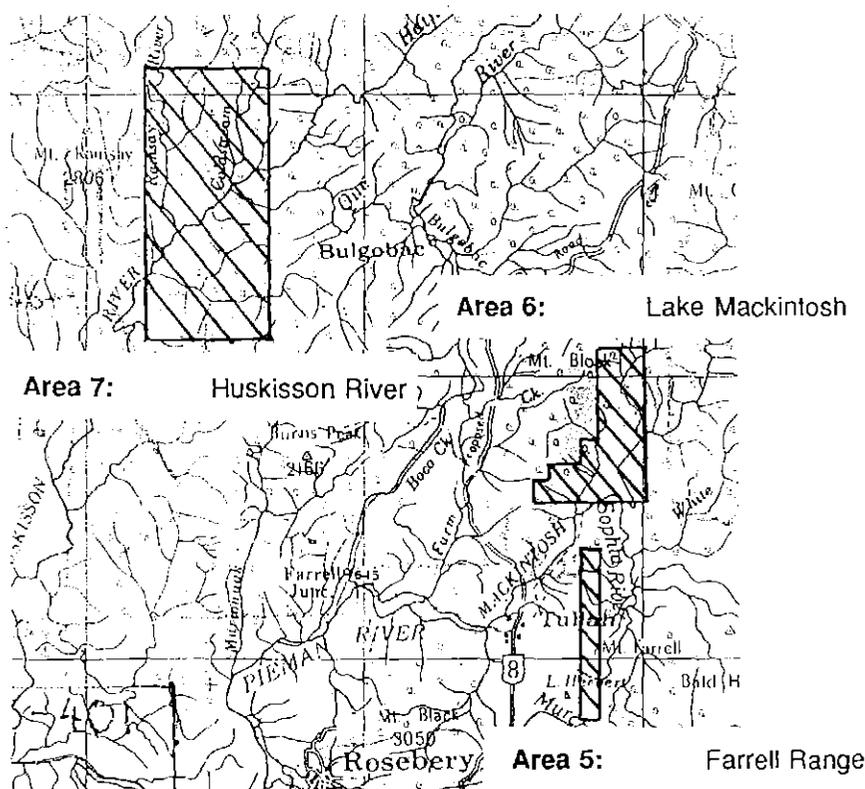
Queenstown 1:250,000 sheet



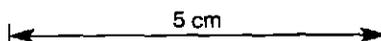
APPENDIX D: LOCATION MAP

LOCATION MAP

Scale: 1:250,000



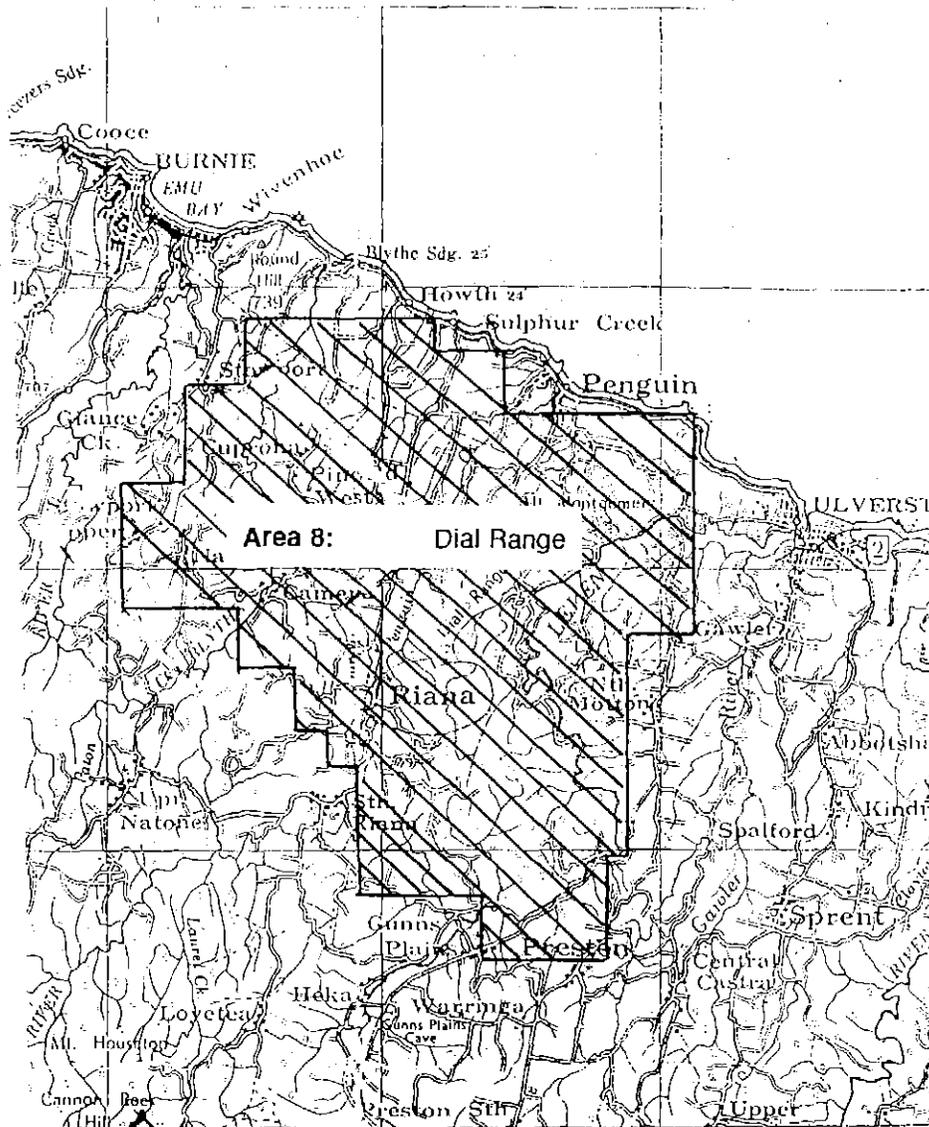
Burnle 1:250,000 sheet



APPENDIX D: LOCATION MAP

LOCATION MAP

Scale: 1:250,000



Burnie 1:250,000 sheet

