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Airborne Geophysical Survey

Survey Report

GEOSCIENCE AUSTRALIA

Murloocoppie (Area 2A), SA

Airborne Magnetic, Radiometric and Digital Elevation Survey

Contract Number: 002292

Project Number: P1280

Prepared by

MAGSPEC Airborne Surveys Pty Ltd

Reference Number: 1047

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Contents

1. GENERAL PROJECT INFORMATION 3
   1.1 Survey Acquisition Summary 4
   1.2 Survey Area 5
   1.3 Survey Area Coordinates and Flight Specifications 5
   1.4 Whyalla Test Lines 6
2. SURVEY EQUIPMENT 7
   2.1 Aircraft 7
   2.2 Data Acquisition System 7
   2.3 Magnetometer 7
   2.4 Gamma-ray Spectrometer 8
   2.5 Altimeters / Ancillaries 8
   2.6 Magnetic Base Stations 8
3. NAVIGATION AND FLIGHT PATH RECOVERY 8
4. CALIBRATIONS AND CHECKS 9
   4.1 Magnetometer 9
   4.2 Altimeters 9
   4.3 Spectrometer 9
      4.3.1 Prior to survey 9
      4.3.2 During survey 9
5. QUALITY CONTROL 10
   5.1 During Flight 10
   5.2 Post Flight 10
6. DATA PROCESSING 11
   6.1 Magnetics 11
   6.2 Radiometrics 11
   6.3 Digital Elevation Model 14

APPENDIX 1 FIELD OPERATIONS AND PROJECT MANAGEMENT
APPENDIX 2 CALIBRATIONS
APPENDIX 3 DIURNAL BASE STATION PLOTS
APPENDIX 4 PROCESSING PARAMETERS AND DELIVERABLES
APPENDIX 5 VERIFICATION IMAGES

1. GENERAL PROJECT INFORMATION

Project Details		
Project Number	1280	
Contract Number	2292	
Client	Geoscience Australia	
Survey Area Name	Muloocoppie (R2a)	
Survey Size (line kms delivered)	109,752.69 kms	
Survey Type	Airborne Magnetics, Radiometrics, Digital Elevation	
Aircraft		
Aircraft Location	Coober Pedy airstrip	
	Cadney airstrip	
Aircraft Make/Model	Cessna 206	
Aircraft Registration	VH-HIS	
Personnel		
Field Operations Base	Oasis Tourist Park, Coober Pedy	
	Cadney Homestead Caravan Park, Cadney	
Field Crew	**Name**	**Position**
	Patchett K.	Pilot
	Twine A.	Pilot
	Wright D.	Pilot
	Stummer N.	Pilot
	Robinson L.	Operator
	Bennett W.	Operator
Project Management / QC	Spencer P.	Operations Manager
Final Data Processing	Johnston C.	Data Processing Manager
Reporting	Lees M.	Sales Manager
Technical Support	McMullen P.	Consultant Technician

1.1 Survey Acquisition Summary

Following a project debrief, the field crew commenced mobilisation to Whyalla on 4th February 2017; to conduct a series of test lines and calibrations on 8th and 9th February 2017. The raw and processed data were assessed and approved by the Client and the field crew then mobilised to the base of operations for the Murloocoppie survey at Coober Pedy, South Australia.

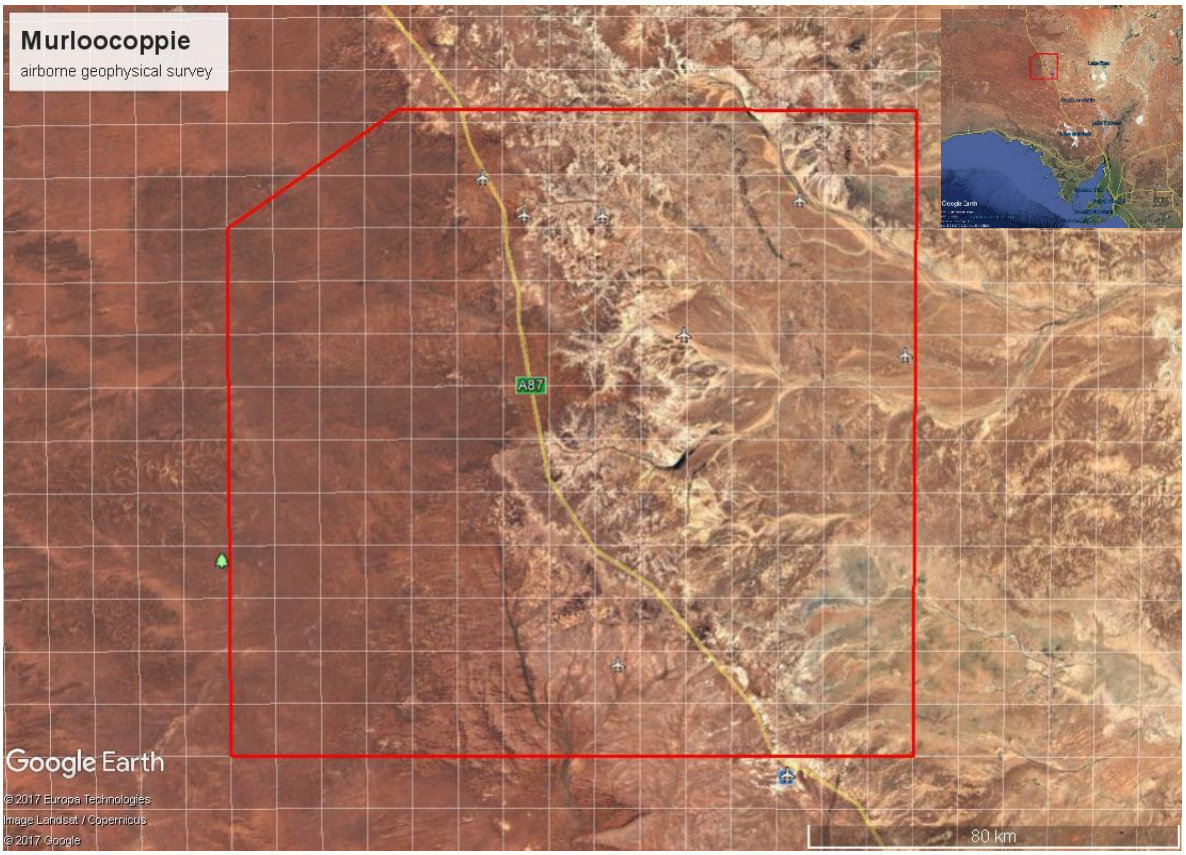
A safety meeting was completed by the crew, base stations were set up and a reconnaissance flight carried out before a compensation flight was performed. A radiometric test line was established.

After the compensation flight was verified and the base stations checked, the first production flight was flown on 11th February 2017.

Production initially commenced at the southern side of the block, working northwards. Periodic maintenance of the aircraft was undertaken at a facility in William Creek. On 25th March 2017, the crew relocated to Cadney Homestead, to more efficiently fly the northern lines, working southwards. The crew flew back to Coober Pedy on 20th April for a short period, then returned to Cadney on 10th May 2017. The final production flight was on 25th May 2017. Conditions throughout the survey period were generally favourable, however there was some downtime due to rain in mid-April and periods of diurnal activity.

1.2 Survey Area

The Murloocoppie survey area is located northwest of Coober Pedy, South Australia, as indicated in the following diagram: -



Murloocoppie (Area 2a)

1.3 Survey Area Coordinates and Flight Specifications

GDA94 Coordinates

Longitude	Latitude
133.500	-28.000
133.875	-27.775
135.000	-27.775
135.000	-29.000
133.500	-29.000

Area Name	Traverse Line spacing (m)	Traverse Line Direction	Tie Line Spacing (m)	Tie Line Direction	Sensor Height (m)	Line Kilometres
Murloocoppie (2a)	200	East-West	2,000	North-South	60	109,752.69

1.4 Whyalla Test Lines

Prior to commencement of the Murloocoppie survey, the aircraft flew a set of 7x test lines approximately 30 kms south of Whyalla, on 8-9th February 2017. The location and coordinates of these lines are shown below:

Whyalla Test Lines

Line No.	Longitude West	Latitude	Longitude East	Latitude
100070	136.746093	-33.330604	137.551397	-33.330604
100060	136.746129	-33.332407	137.551449	-33.332407
100050	136.746165	-33.334209	137.551502	-33.334209
100040	136.746201	-33.336012	137.551554	-33.336012
100030	136.746237	-33.337815	137.551607	-33.337815
100010	136.746273	-33.339617	137.551659	-33.339617
100010	136.746309	-33.34142	137.551712	-33.34142

Area Name	Traverse Line spacing (m)	Traverse Line Direction	Tie Line Spacing (m)	Tie Line Direction	Sensor Height (m)	Line Kilometres
Whyalla Test Lines	200	East-West	N/A	N/A	60	526.30

The raw and processed data were forwarded to the Client for assessment and approval prior to mobilisation to the Murloocoppie survey area.

2. SURVEY EQUIPMENT

2.1 Aircraft

The aircraft used for the survey was a Cessna 206, specially modified for geophysical survey with a tail boom and various other survey configuration modifications.

Registration - VH-HIS

Survey Aircraft

2.2 Data Acquisition System

High speed digital data acquisition system.

- Sample rates up to 20 Hz
- Integrated Novatel OEM GPS receiver providing positional information that is used to tag incoming data streams in addition to providing pilot navigation guidance
- High precision Caesium vapour magnetometer
- Visual real time on-screen system monitoring / error messages to limit re-fights due to equipment failure

2.3 Magnetometer

The survey was flown with a single tail-mounted sensor (stinger housing).

- Model / Type - G-822 Cesium vapour magnetometer
- Resolution - 0.001 nT resolution
- Sensitivity - 0.01 nT sensitivity
- Sample Rate - 20 Hz
- Compensation - 3-axis fluxgate magnetometer
- Magnetometer Counter - Kroum KMAG4

2.4 Gamma-ray Spectrometer

An RSI RS-500 gamma-ray spectrometer was used, incorporating 2x RSX-4 detector packs.

- Total Crystal Volume - 32 L (downward looking)
- Channels - 1024 (256 recorded)
- Sample Rate - 1 Hz
- Multi-peak automatic gain stabilisation

2.5 Altimeters / Ancillaries

A Bendix/King KRA 405 radar altimeter was used.

- Resolution - 0.3 m
- Sample Rate - 20 Hz
- Range - 0-760 m

A Renishaw ILM-500-R laser altimeter was used.

- Resolution - 0.1 m
- Sample Rate - up to 20 Hz
- Range - 0-500 m

Barometric pressure sensor: -

- Accuracy - RSS ±0.25% FS (at constant temp)
- Range - 600-1100 hPa

2.6 Magnetic Base Stations

Scintrex Envimag & Geometrics G-856 proton precession base station magnetometers.

- Resolution - 0.1 nT
- Accuracy - 0.5 nT
- Sample Rate - 0.2 – 0.5 Hz

The Scintrex Envimag sampling at 2 seconds was used for all diurnal corrections.

3. NAVIGATION AND FLIGHT PATH RECOVERY

Integrated Novatel OEM719 GPS receiver:

- L1/L2 + GLONASS Multi Frequency
- 555-channel

Navigation information supplied to the pilot via an LCD steering indicator. All data were synchronised to a one pulse per second triggered by the GPS time.

4. CALIBRATIONS AND CHECKS

4.1 Magnetometer

A compensation box was flown prior to survey. The compensation consisted of a series of pitch, roll and yaw manoeuvres in reciprocal survey headings at high altitude. The measured output from the 3-axis fluxgate magnetometer was recorded and used to resolve a compensation solution. This solution was applied when post-compensating all survey magnetometer data to remove manoeuvre effects and heading error. Post-flight compensation is performed using 18 terms. Refer to Appendix 2 – Calibrations.

4.2 Altimeters

Prior to commencement of survey production, the radar and laser altimeters were checked for linearity by way of a height stack over flat terrain. Refer to Appendix 2 – Calibrations.

4.3 Spectrometer

4.3.1 Prior to survey

The Gamma-Ray spectrometer was calibrated for channel interaction (stripping ratios). A cosmic – background stack was performed to determine cosmic and background radiation ratios. The Carnamah radiometric test range was flown to calculate conversion factors from counts per second to concentrations. Refer to Appendix 2 – Calibrations.

4.3.2 During survey

The system sensitivity and resolution was monitored pre- and post-flight using a thorium source ensuring stability of the spectrometer. The results were tabulated daily and closely monitored. A suitable test line was selected close to the survey area. This test line was flown at survey height each day. The data from the test line was assessed to ensure system stability and compared on daily basis to the test lines flown prior. Refer to Appendix 2 – Calibrations.

5. QUALITY CONTROL

5.1 During Flight

During survey, the pilot is notified of any deviation in system health by prompts overlaid onto the navigation screen. Should errors occur, the flight is aborted and survey does not recommence until system errors are resolved.

The diurnal base stations were monitored by the ground crew.

5.2 Post Flight

Upon completion of each flight all survey data were transferred from the acquisition system to the infield data processing computer. Using customised techniques, the data were checked for any errors and compliance with specifications.

All profiles were visually checked. The flight path was plotted with colour-coded indicators of any out of specification height or cross-track. The data were gridded and visually inspected for errors and compared for continuity with previous flights.

The summed 256-channel spectra were plotted and inspected. The test line and pre- and post-flight ground calibration data were tabulated and reviewed.

6. DATA PROCESSING

6.1 Magnetics

The following steps were performed during the magnetics processing:

- Review or application of compensation
- Parallax correction
- Diurnal filtering and subtraction
- IGRF correction using the updated current IGRF model
- Tie line levelling
- Micro levelling

Compensation of the magnetometer data was applied using the recorded XYZ fluxgate data using Geometrics MagComp Airborne compensation software. A suitable compensation flight (comp box) was processed to obtain the optimum compensation solution which was then applied to all survey data.

The base station magnetometer data were reviewed, de-spiked if necessary and filtered with an 11-point non-linear filter. These data were then subtracted from the measured aircraft data using time that was synchronised to both the acquisition system and the base mag unit.

The IGRF correction was applied using the updated IGRF 2015 model adjusted for height of the aircraft. This correction was calculated and applied at each point.

Tie line levelling was applied by way of a least squares minimisation procedure using a polynomial fit of order 0 over the cross over errors calculated between the traverse and tie line intersections. A fit to ties process was selectively applied and constrained by several parameters such as cross over height differences and maximum and minimum allowable corrections.

Using MAGPSEC Airborne Surveys' proprietary micro levelling techniques, some selective micro levelling was carefully applied and the resulting channel was then considered final.

At all stages of processing the data were stringently checked against and compared to the previous processing stage to ensure the integrity of the data were protected and no detail was removed or altered.

6.2 Radiometrics

Radiometric processing consisted of the following steps:

- 256-channel spectral noise reduction in the form of NASVD
- Dead time, cosmic and background radiation corrections
- Energy recalibration
- Channel interaction correction (stripping) and extraction of ROIs

- Height corrections using STP altitude to the nominal survey height
- Radon removal using the Spectral Ratio method
- Levelling if required

Gamma-ray Spectrometric Data Processing

The raw spectra were first smoothed using the Noise Adjusted Singular Value Decomposition (NASVD) method, (Hovgaard and Grasty, 1997).

For the NASVD process twenty (20) principal components were generated. These components were visually inspected and the final number of components for reconstructing the spectra were determined. Eight (8) components were used to reconstruct the spectra, following consultation with the Client.

For all spectrometers, spectral drift was checked, by monitoring the potassium and thorium channel positions from average spectra along flight lines. The procedure for determining peak positions was the same as used during calibration. If the thorium peak is found to move more than 1 channel or the potassium peak by more than 0.5 channel, energy calibration is performed to determine the count rates in the standard windows.

Both the aircraft 256-channel background spectra and the scaled 256-channel cosmic spectra were subtracted from the 256-channel data. Refer to Appendix 2 – Calibrations.

Deadtime corrections were applied to each spectrum channel or window.

Radon background removal was performed using the Minty Spectral Ratio method (1992).

In areas of significant topographic variation, the altimeter data were first lightly filtered to smooth sudden jumps that can arise when flying over steep terrain (which cause problems when height-correcting the data). These data were then converted to effective height (h_e) at standard temperature and pressure (STP).

The background-corrected count rates in the 3 windows were stripped to give the counts in the potassium, uranium and thorium windows that originate solely from the potassium, uranium and thorium decay series. The window stripping ratios α, β, γ, a and g were estimated from measurements over calibration pads, where:

α - is the thorium into uranium stripping ratio, (equal to the ratio of counts detected in the uranium window to those detected in the thorium window from a pure thorium source);

ß - is the thorium into potassium stripping ratio for a pure thorium source;

γ - is the uranium into potassium stripping ratio for a pure uranium source;

a - is the reversed stripping ratio, uranium into thorium, (equal to the ratio of counts detected in the thorium window to those detected in the uranium window from a pure source of uranium);

g - is the reverse stripping ratio, potassium into uranium for a pure potassium source.

The 3 principal stripping ratios (α, ß and γ) increase with altitude above the ground as shown in the Table 1.1.

Table 1.1. Stripping ratio increase with Aircraft altitude at STP.

Stripping Ratio	Increase per metre
α	0.00049
β	0.00065
γ	0.00069

Each of the 3 main stripping ratios were adjusted for altitude before stripping was carried out. If 5 stripping ratios are used, then the stripped count rates in the potassium, uranium and thorium channels (N_K, N_U, N_{Th}) are given by:

$$N_K = \frac{\left[n_{Th}(\alpha\gamma - \beta) + n_U(a\beta - \gamma) + n_K(1 - a\alpha)\right]}{A}, \quad \text{(A5)}$$

$$N_U = \frac{\left[n_{Th}(g\beta - \alpha) + n_U - n_K g\right]}{A}, \quad \text{(A6)}$$

$$N_{Th} = \frac{\left[n_{Th}(1 - g\gamma) - n_U a + n_K ag\right]}{A}, \quad \text{(A7)}$$

where

$$A = 1 - g\gamma - a(\alpha - g\beta). \quad \text{(A8)}$$

The background-corrected and stripped count rates were corrected for variations in the altitude of the detector using the equation:

$$N_{corr} = N_{obs}\, e^{-\mu(h_0 - h)}, \quad \text{(A9)}$$

where: -

N_{corr} = the count rate normalized to the nominal Survey altitude, h_o;
N_{obs} = the background corrected, stripped count rate at STP height h;
μ = the attenuation coefficient for that window.

Where the STP height above ground level exceeds 300 m, a value of *h* =300 is used in equation A9.

The resulting potassium, uranium, thorium and total count (cps) were converted to concentrations using the coefficients derived from the Carnamah radiometric test line. Refer to Appendix 2 – Calibrations.

Where required, tie line levelling is applied to the Total Count and Uranium channels to remove any effects caused by residual radon background. A least-squares/median filter procedure applied over the calculated cross over errors at each intersection of the flight and tie lines generated a correction value. A new tie-line levelled channel is then output by application of this correction value to the original channel.

Where required, using MAGPSEC Airborne Surveys' proprietary micro levelling techniques, some selective micro levelling is carefully applied and the resulting channel is then considered final.

At all stages of processing the data were stringently checked against and compared to the previous processing stage to ensure the integrity of the data was protected and no detail was removed or altered.

6.3 Digital Elevation Model

DEM processing consisted of the following steps:

- Inspection of height channels
- Parallax correction of radar and laser altimeters
- Subtraction of radar and laser altimeters from GPS height
- Tie line and micro levelling

The GPS, radar and laser heights were visually inspected for errors and any spikes were carefully corrected.

The altimeter data were then subtracted from the GPS height to create the Digital Elevation channels (laser and radar).

Tie line levelling was applied by way of a least squares minimisation procedure using a polynomial fit of order 0 over the cross over errors calculated between the traverse and tie line intersections. Using MAGPSEC Airborne Surveys' proprietary micro levelling techniques, some selective micro levelling was carefully applied and the resulting channel was then considered final. At all stages of processing the data were stringently checked against and compared to the previous processing stage to ensure the integrity of the data was protected and no detail was removed or altered.

APPENDIX 1 FIELD OPERATIONS AND PROJECT MANAGEMENT

Operational Bases

The aircraft and crew were based in Coober Pedy and Cadney Homestead in South Australia. Production of the survey started on the 12th February 2017 and ended on the 25th May 2017. Field crew were regularly rotated as required.

Base Station Magnetometers

The base station magnetometers were positioned near the Coober Pedy airstrip as shown below: -

Coober Pedy Airstrip

Base station 1 (Envimag) location co-ordinates (GDA94): 134° 43' 15.8450" E, 29° 02' 8.0974" S
Base station 2 (G856) location co-ordinates (GDA94): 134° 43' 16.4128" E, 29° 02' 8.2779" S

Base station 1 was used for all diurnal corrections.

APPENDIX 2 CALIBRATIONS

Radiometrics

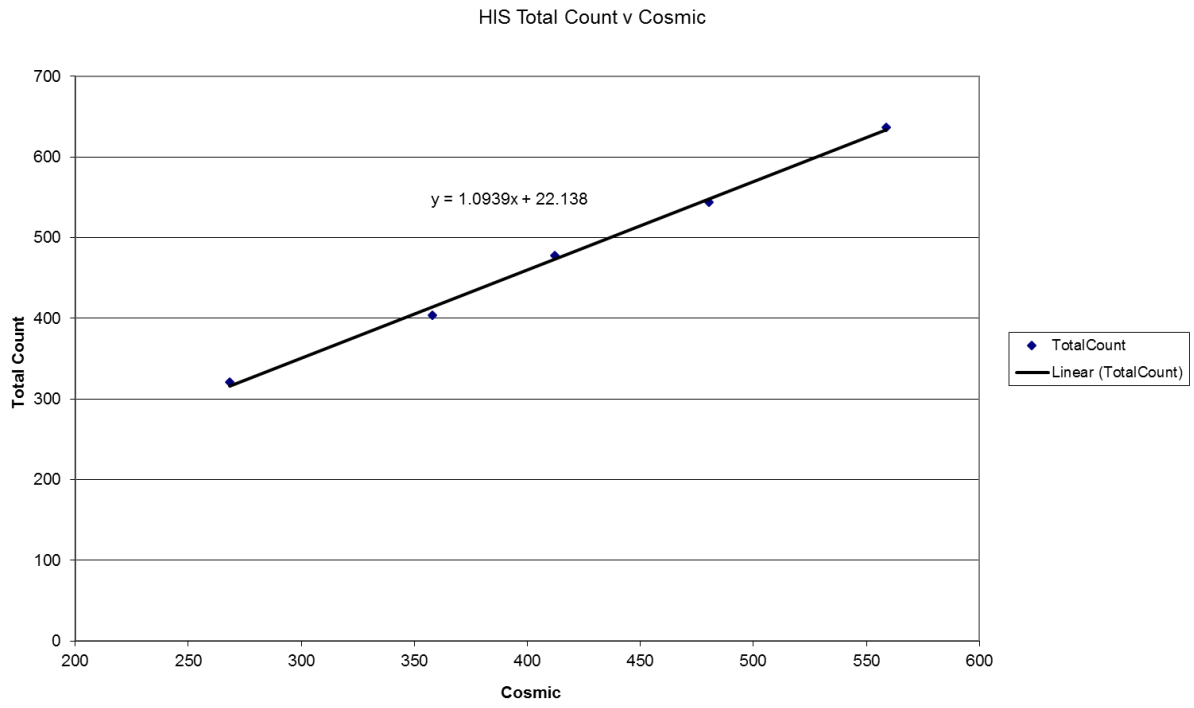
Stripping Ratios

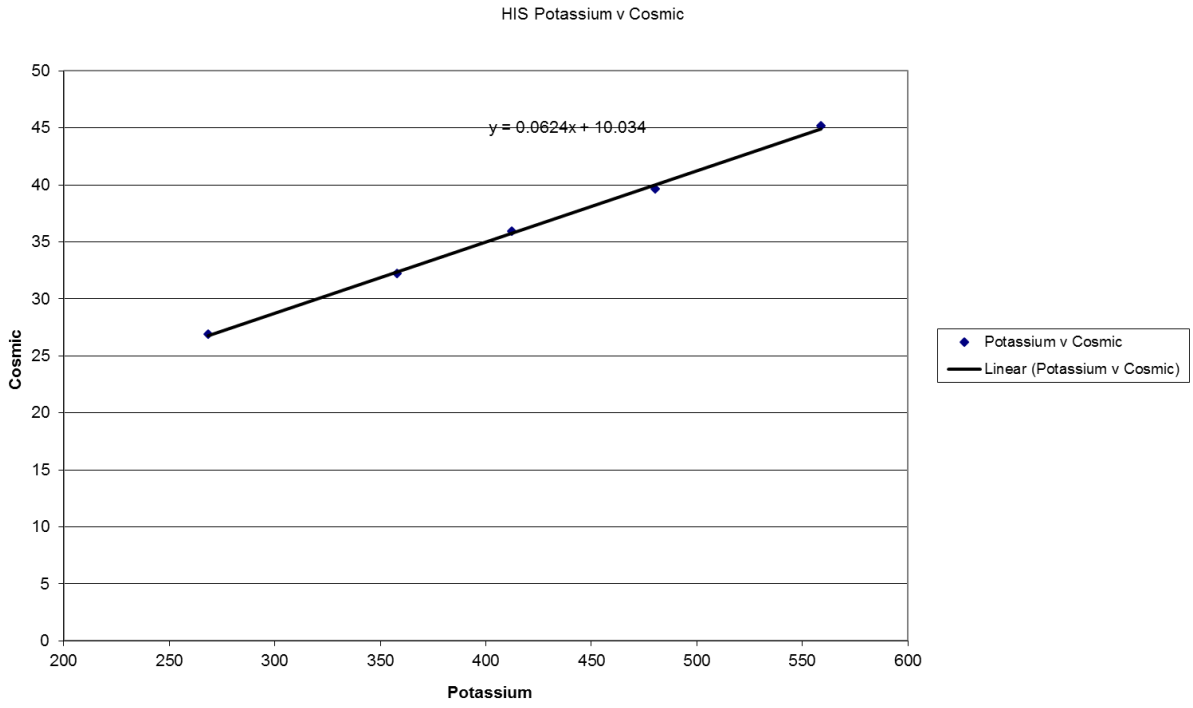
The aircraft's radiometric system was calibrated against factory background, potassium, uranium and thorium test pads, using standard calibration procedures. The resulting stripping coefficients are tabled below: -

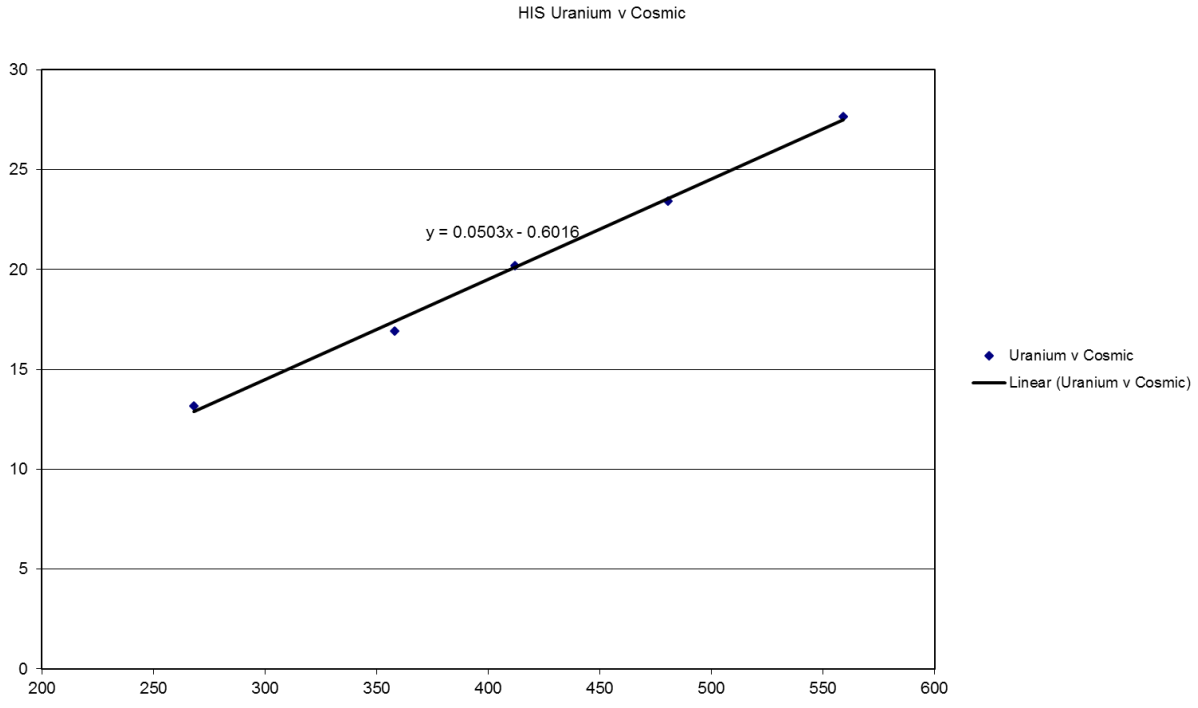
Stripping Constant	Coefficient
Alpha	0.267
Beta	0.401
Gamma	0.745
a	0.045
b	0.001
g	0.0005

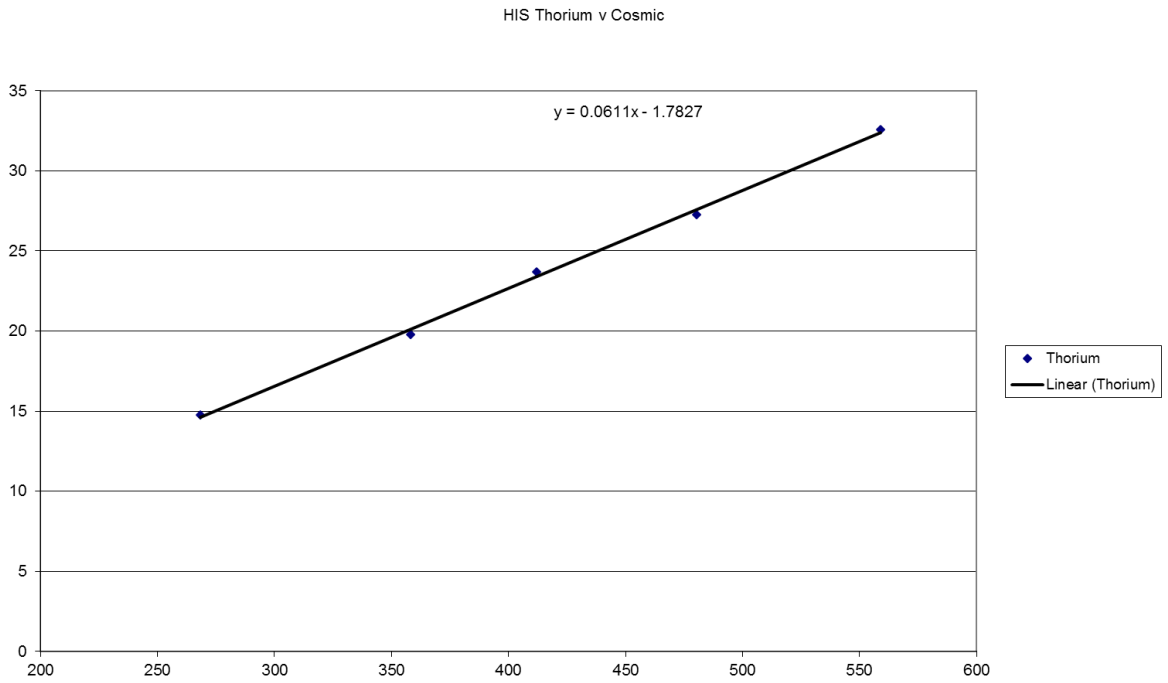
Aircraft Cosmic Background Test Flight

On 29th December 2016, the aircraft was flown offshore Western Australia at high altitude to derive the following plots: -




HIS Potassium v Cosmic
y = 0.0624x + 10.034
Cosmic
Potassium
0
5
10
15
20
25
30
35
40
45
50
200
250
300
350
400
450
500
550
600
Potassium v Cosmic
Linear (Potassium v Cosmic)

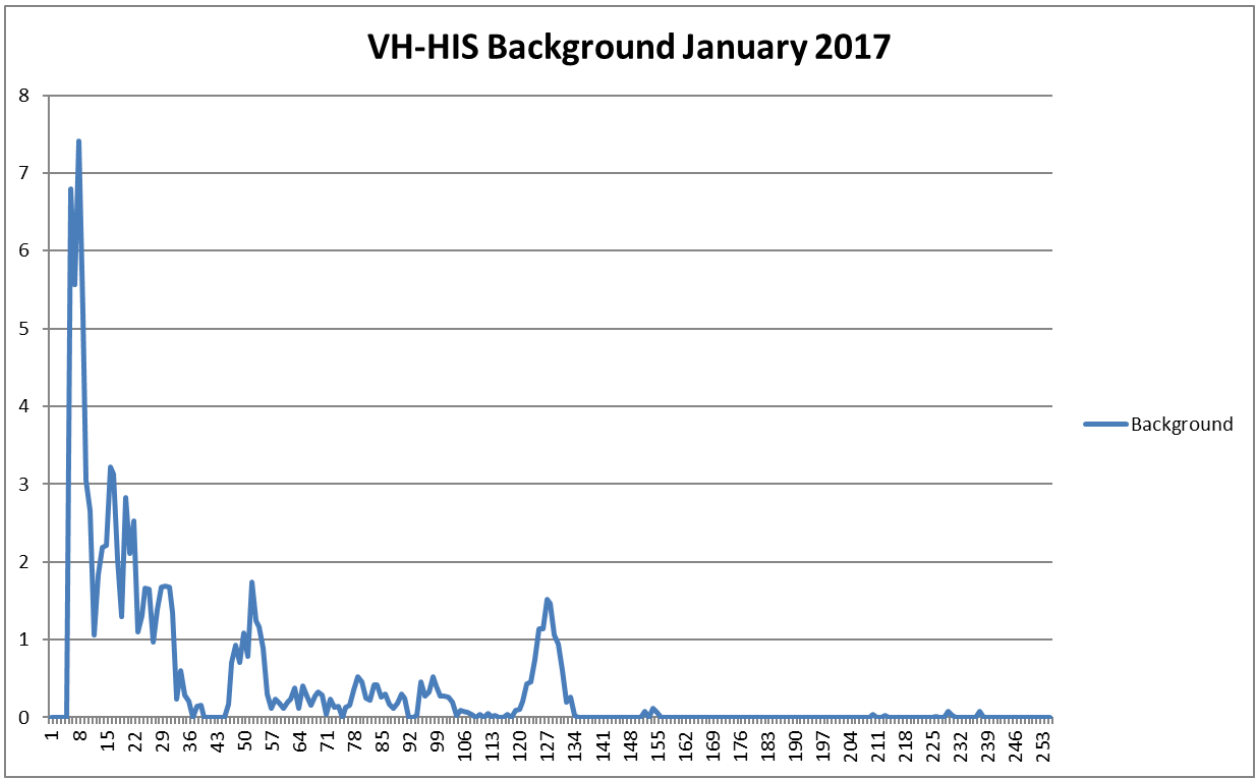

HIS Uranium v Cosmic
y = 0.0503x - 0.6016
0
5
10
15
20
25
30
200
250
300
350
400
450
500
550
600
Uranium v Cosmic
Linear (Uranium v Cosmic)



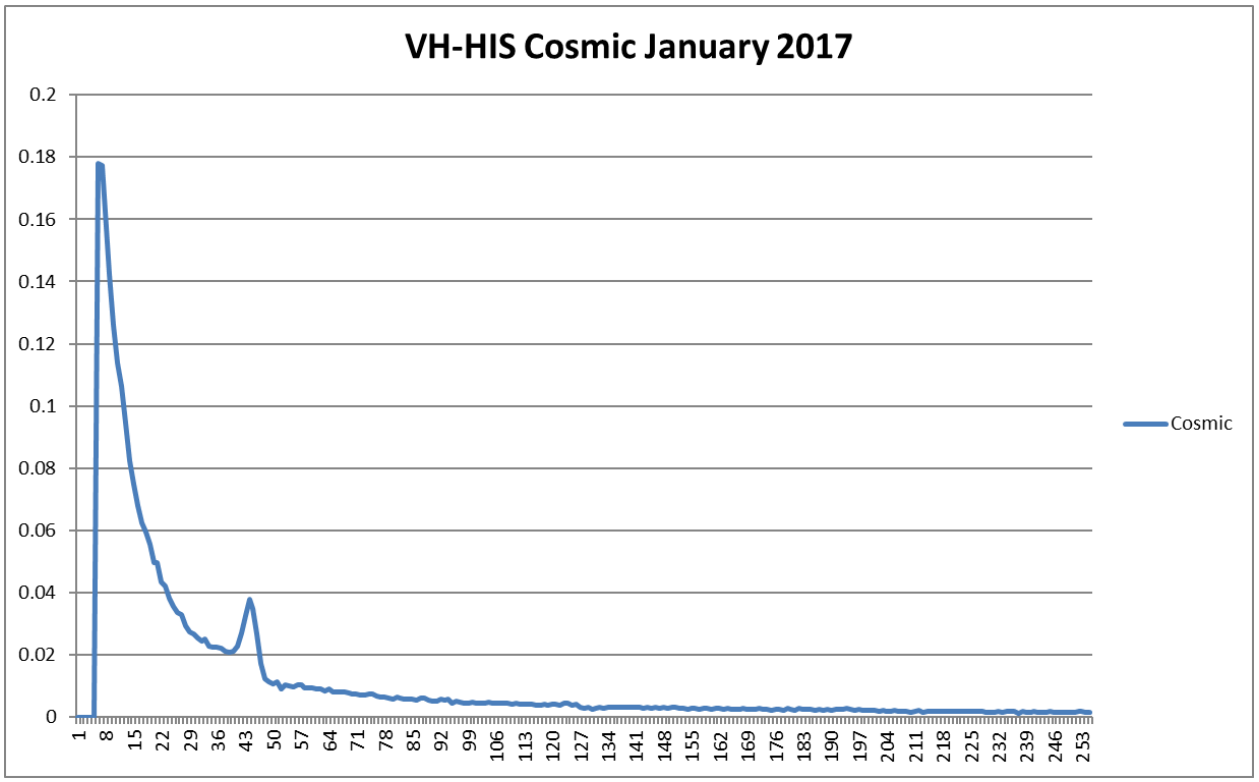
Aircraft Background Cosmic Coefficients

Parameter	Total Count	Potassium	Uranium	Thorium
Aircraft Background	22.138	10.034	0.0000	0.0000
Cosmic	1.0939	0.0624	0.0503	0.0611

Aircraft Background Spectra



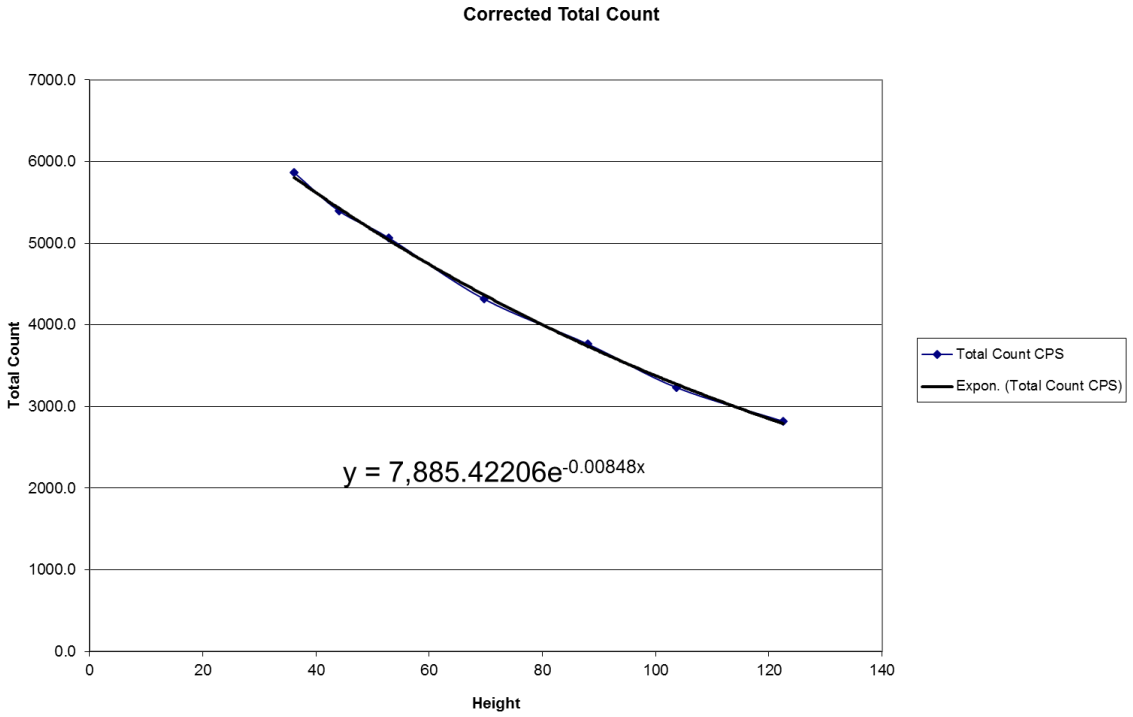
Cosmic Spectra

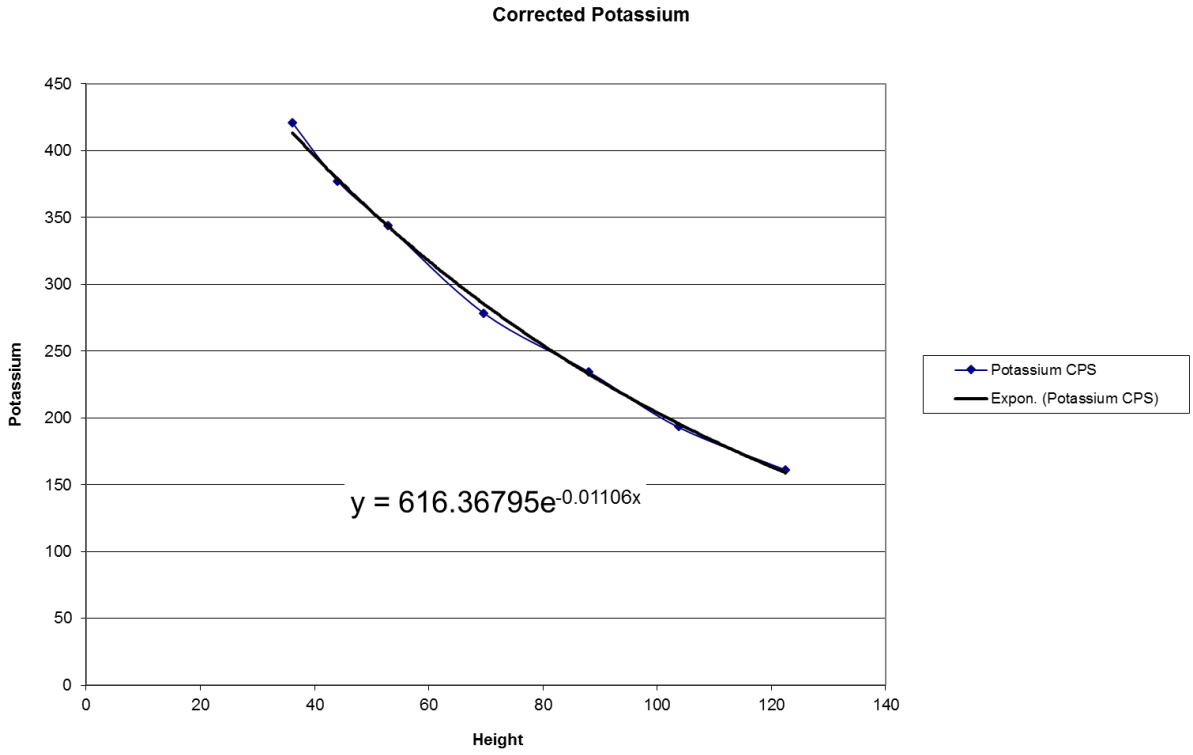


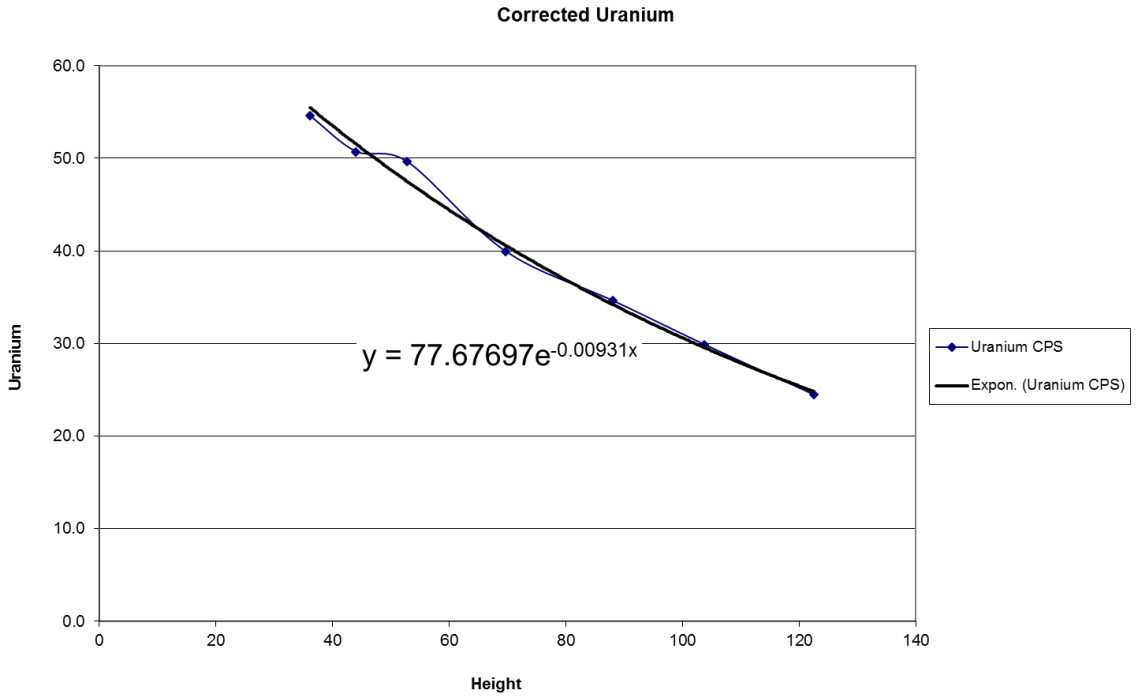
Carnamah Radiometric Test Range

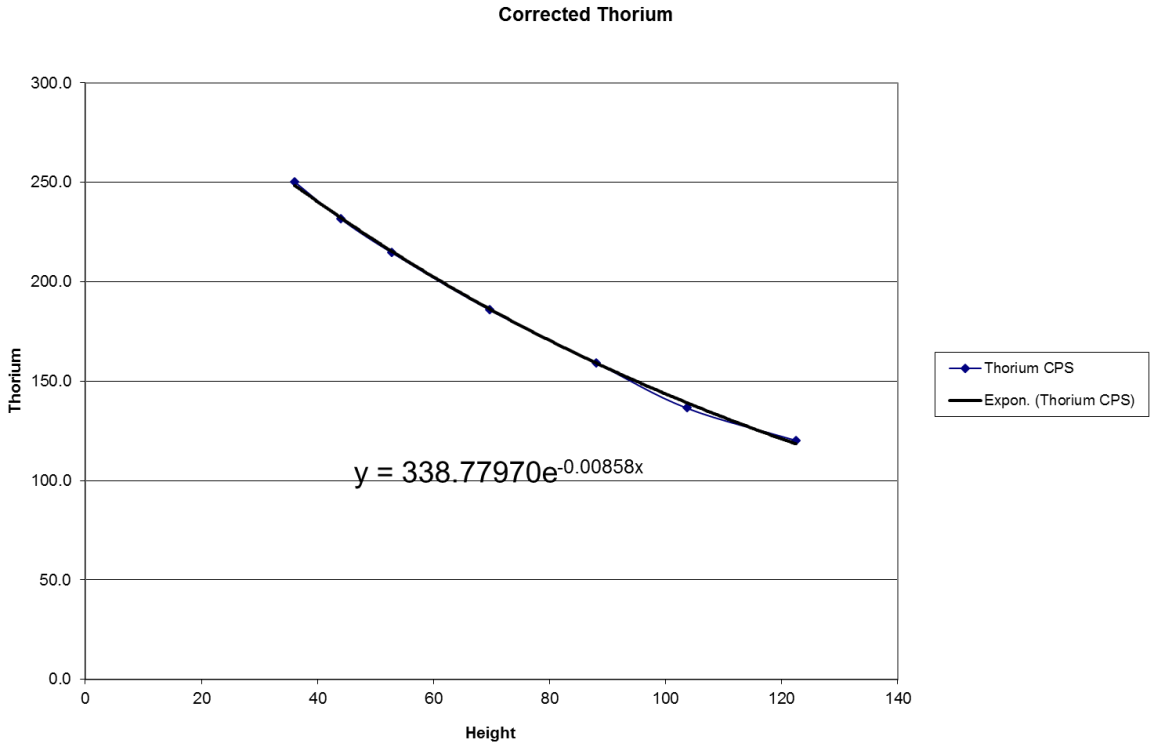
The Carnamah Test Range, north of Perth, was flown by the aircraft on 2nd February 2017.

Aircraft Test Range Flight Plots









The following theoretical height attenuation coefficients were used, based on testing and IAEA values:

Parameter	Total Count	Potassium	Uranium	Thorium
Height Attenuation	-0.0074	-0.0094	-0.0084	-0.0074

Test Range Ground Station Readings

The radiometric concentrations were measured along the Carnamah Test Range, using a hand-held spectrometer, yielding the following results at each station:

Station	K (%)	U (ppm)	Th (ppm)
4	4.44	6.32	46.48
7	3.37	3.08	17.26
10	3.14	2.56	25.50
14	2.64	2.05	26.09
17	2.94	2.54	29.83
20	2.93	3.61	29.60
23	2.93	3.41	41.98
26	3.28	3.41	21.67
28	3.15	2.91	22.85
31	3.44	3.20	24.22
34	3.04	2.18	20.02
37	1.96	2.96	24.33
40	2.34	2.85	20.80
43	3.75	3.42	34.89
46	2.64	2.55	22.71
49	2.42	3.08	24.24
52	2.15	6.98	55.04
55	1.68	4.96	50.48
58	1.70	1.99	15.83
61	1.69	3.48	40.89
64	1.93	2.69	39.40
67	1.35	5.27	31.30
70	1.59	2.86	25.89
73	1.79	1.90	18.26
76	1.44	1.75	20.81
Average	**2.55**	**3.28**	**29.21**

Aircraft Sensitivity Coefficients

Nominal Ht	K cps	K Sens	U cps	U Sens	Th cps	Th Sens	Total cps	Total Sens	Range concentrations		
40	405	158.8	54.6	16.6	250.4	8.6	5861.5	45.2			
50	362.5	142.2	50.7	15.5	231.8	7.9	5393.0	41.6	k%	2.55	
60	330.3	129.5	49.6	15.1	214.9	7.4	5064.1	39.0	U ppm	3.28	
80	266.4	104.5	39.9	12.2	186.0	6.4	4315.3	33.2	Th ppm	29.21	
100	224.8	88.2	34.6	10.5	159.2	5.5	3762.5	29.0	A	129.79	
120	186.4	73.1	29.9	9.1	136.5	4.7	3231.5	24.9			
140	154.6	60.6	24.4	7.4	120.2	4.1	2819.4	21.7			
200	86.9	34.1	15.1	4.6	79.1	2.7	1838.7	14.2			
300	34.9	13.7	7.5	2.3	40.4	1.4	923.6	7.1			

Magnetics

Magnetometer Parallax

On 9th February 2017, a magnetometer parallax test was conducted near Whyalla, by flying the same line in opposite directions. Magnetic profiles of the test are shown below, with the parallax correction determined to be -3.1 fiducials: -

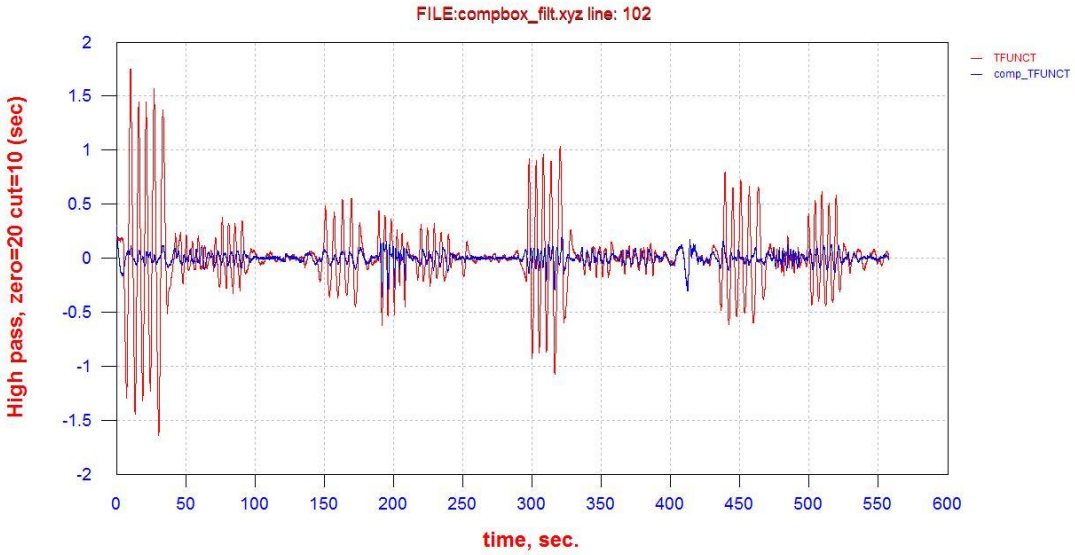
Magnetic profiles before parallax application

Magnetic profiles after parallax application

Magnetometer Compensation

Whyalla

On 9th February 2017, a magnetometer compensation flight was conducted near Whyalla, South Australia. The results of the compensation box are shown below:

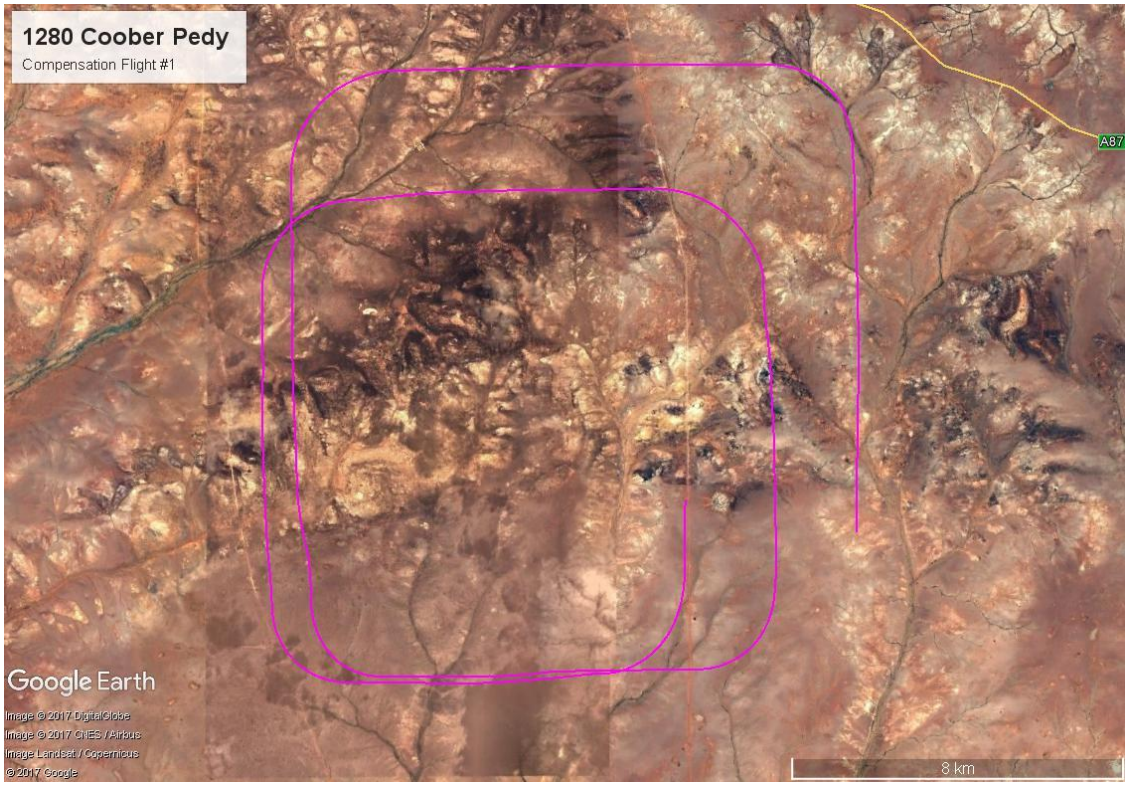


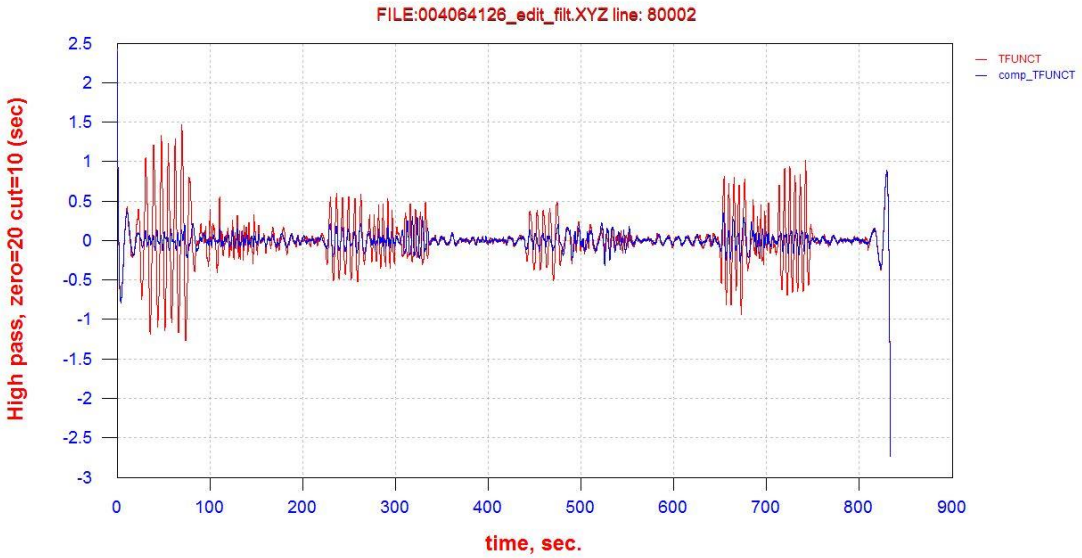
Improvement Ratio

Sensor Channel	Line number	original RMS	compensated RMS	IR
TFUNCT	102	0.313	0.054	5.770

Coober Pedy

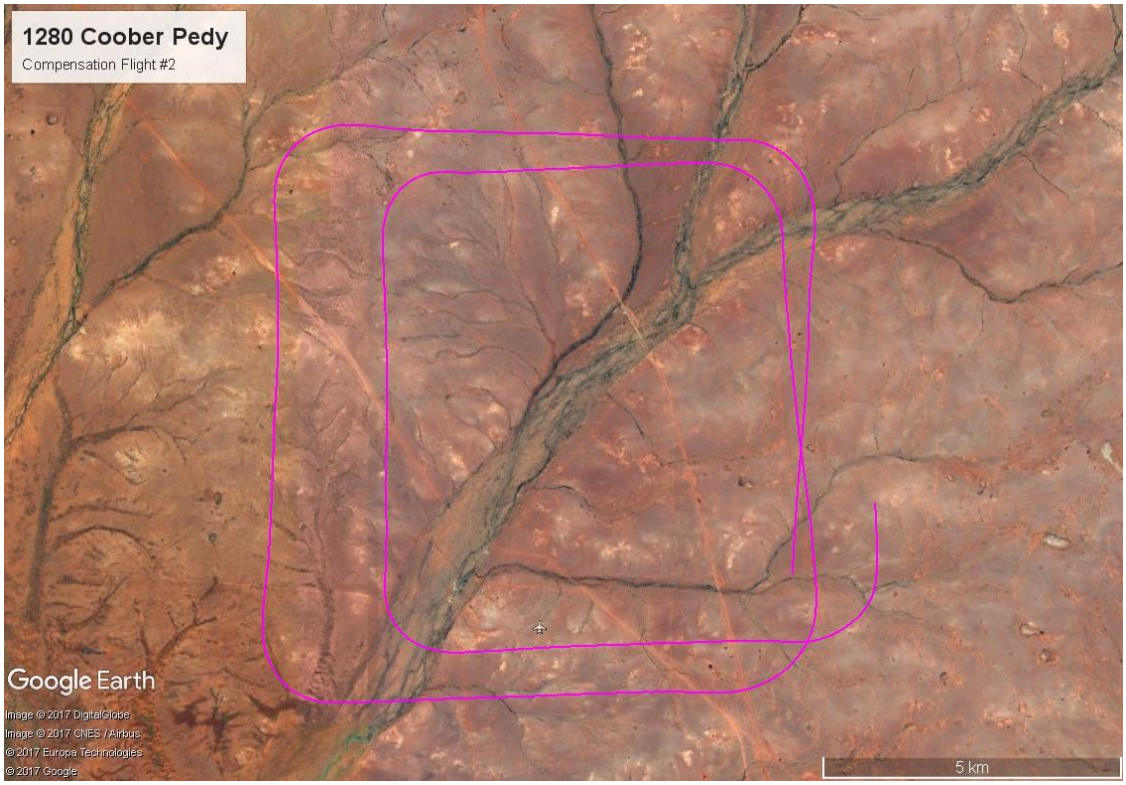
Magnetometer compensation flights were conducted near the base of operations at Coober Pedy on 11th February 2017 and 7th May 2017.

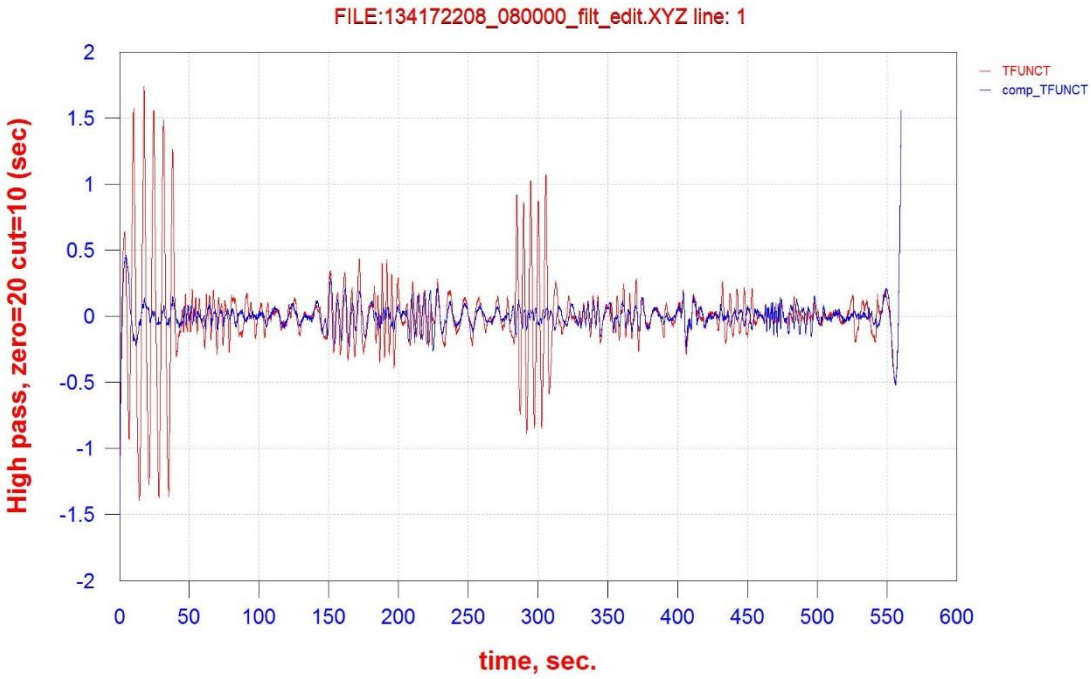




Improvement Ratio

Sensor Channel	Line number	original RMS	compensated RMS	IR
TFUNCT	80002	0.281	0.077	3.660



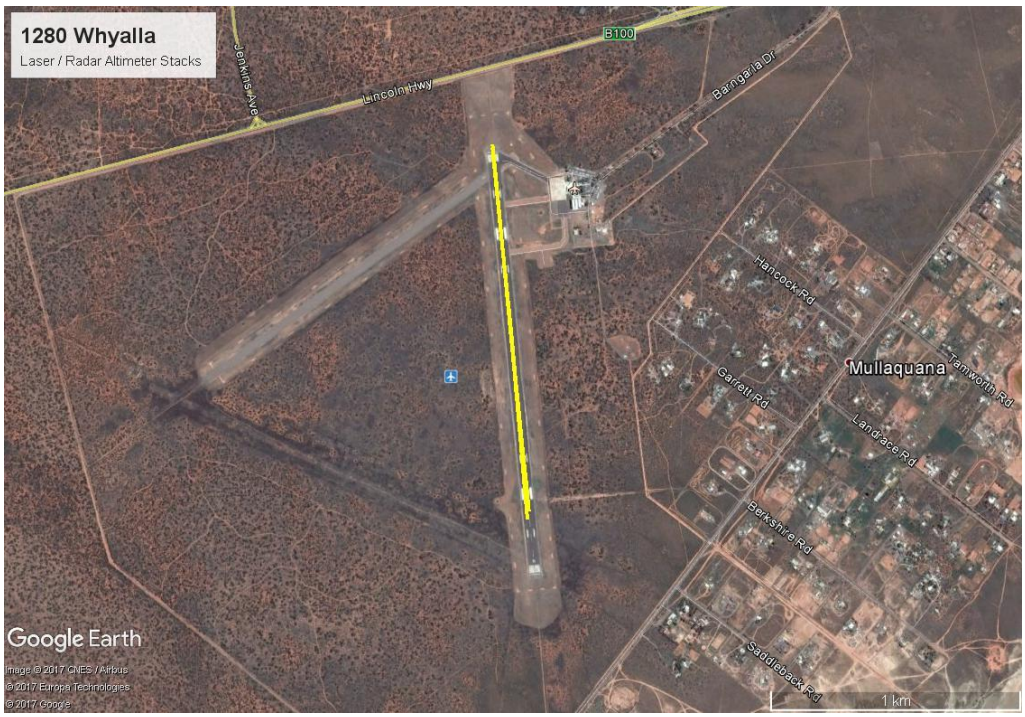


Improvement Ratio

Sensor Channel	Line number	original RMS	compensated RMS	IR
TFUNCT	1	0.283	0.065	4.330

Altimeters

On 9th February 2017, height stacks were performed over the airstrip at Whyalla, South Australia, to check and calibrate the radar and laser altimeters. The GPS height of the airstrip. 8.87m, was removed from the GPS height. Physical offsets between the GPS, radar altimeter and laser altimeter sensors were taken into account.



Altimeter Stack Location

	Altimeter offsets
GPS to airstrip (m)	1.92
Laser to airstrip (m)	1.72
GPS to Laser (m)	0.2
GPS to Radar (m)	1.45

Altimeter Stacks

Flying Height (m)	Adjusted GPS (m)	Adjusted Laser (m)	GPS - Laser Difference (m)	Adjusted Radar (m)	GPS-Radar Difference (m)
Airstrip (0)	0.00	0.00	0.00	0.00	0.00
30	31.03	31.37	-0.34	31.21	-0.17
60	59.35	60.09	-0.74	59.88	-0.53
80	79.89	80.50	-0.61	80.62	-0.73
100	98.55	99.31	-0.76	99.72	-1.17
150	147.92	148.90	-0.98	149.85	-1.93
300	291.91	295.12	-3.21	297.63	-5.72

Daily Calibrations

Ground Calibrations

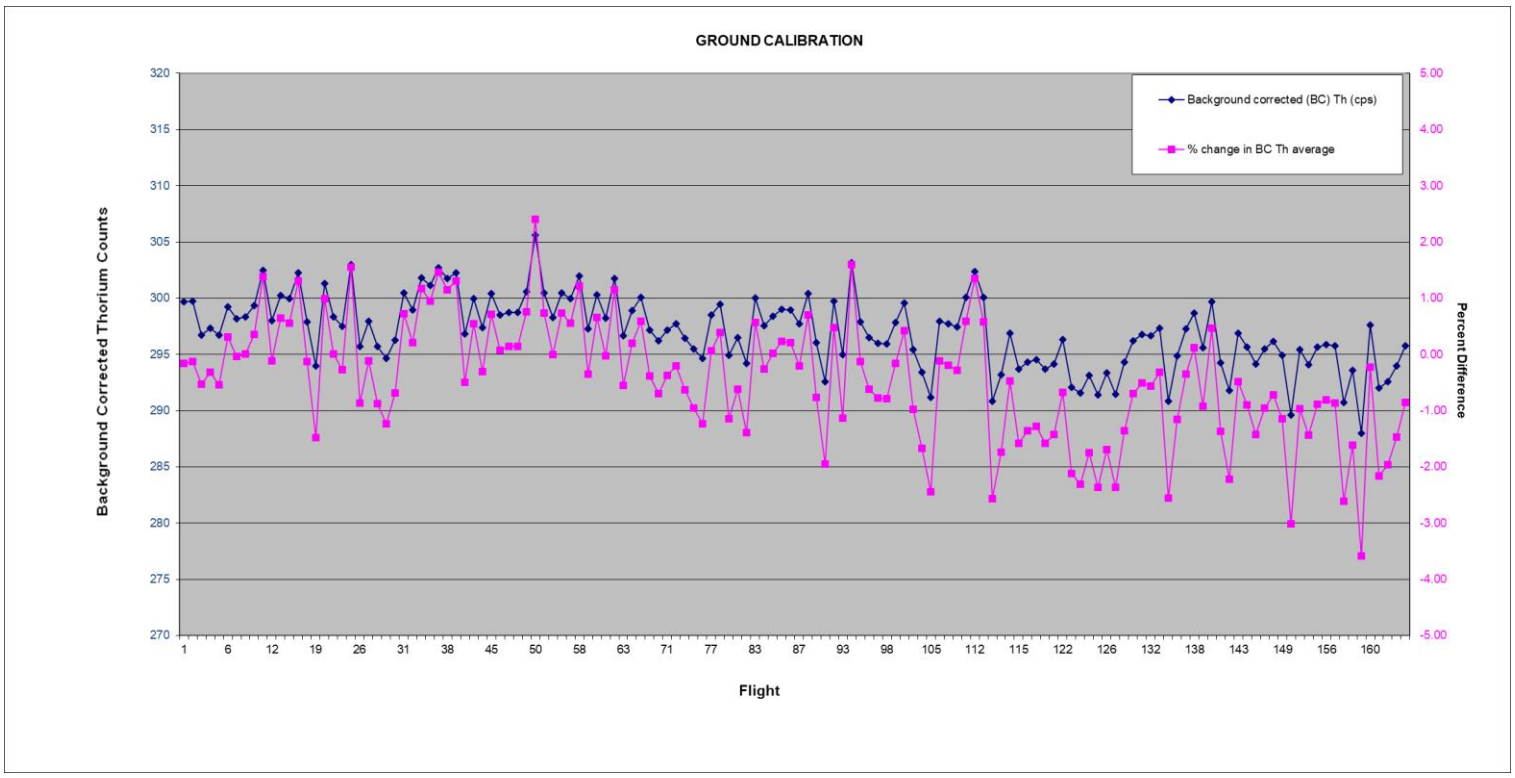
During the survey, pre- and post- flight ground calibration checks were undertaken, to confirm the health of the radiometric system: -

Date	Flight #	Thorium Peak Ch #	Th Peak Resolution	Raw Th Count (cps)	Background Count (cps)	Background corrected (BC) Th (cps)	BC running average Th (cps)	% change in BC Th average
11/02/17	1	217.35	4.40	397.27	97.29	299.68	299.91	-0.16
12/02/17	2	217.29	4.40	397.07	97.32	299.75	300.03	-0.13
13/02/17	3	217.38	4.25	394.21	97.47	296.74	299.07	-0.53
13/02/17	4	217.47	4.27	395.16	97.82	297.35	298.79	-0.32
14/02/17	5	217.29	4.36	395.14	98.45	296.69	298.49	-0.54
14/02/17	6	217.42	4.34	397.31	98.09	299.22	298.58	0.31
15/02/17	7	217.36	4.38	395.58	97.40	298.17	298.53	-0.04
15/02/17	8	217.43	4.37	397.50	99.18	298.32	298.51	0.01
16/02/17	9	217.37	4.33	397.89	98.52	299.37	298.59	0.36
16/02/17	11	217.29	4.22	401.17	98.66	302.51	298.92	1.39
17/02/17	12	217.50	4.36	395.75	97.77	297.98	298.85	-0.11
17/02/17	14	217.44	4.24	398.77	98.52	300.25	298.95	0.65
18/02/17	15	217.40	4.42	398.52	98.54	299.98	299.01	0.56
18/02/17	17	217.32	4.45	400.67	98.42	302.25	299.22	1.31
19/02/17	18	217.34	4.38	396.81	98.89	297.92	299.14	-0.13
19/02/17	19	217.55	4.39	393.67	99.73	293.95	298.85	-1.48
21/02/17	20	217.45	4.35	394.28	93.00	301.28	298.98	0.99
21/02/17	22	217.48	4.26	393.59	95.26	298.33	298.95	0.01
22/02/17	23	217.41	4.33	394.00	96.49	297.51	298.88	-0.27
22/02/17	25	217.42	4.29	398.05	95.05	303.00	299.07	1.55
24/02/17	26	217.36	4.43	391.20	95.47	295.73	298.77	-0.87
24/02/17	26	217.45	4.28	391.90	93.96	297.94	298.74	-0.12
25/02/17	27	217.29	4.35	391.48	95.77	295.71	298.63	-0.88
25/02/17	28	217.36	4.36	390.90	96.25	294.65	298.49	-1.24
26/02/17	29	217.34	4.35	391.20	94.93	296.27	298.41	-0.69
26/02/17	31	217.43	4.31	394.58	94.11	300.47	298.48	0.72
27/02/17	32	217.45	4.39	395.08	96.15	298.93	298.47	0.21
27/02/17	34	217.44	4.32	395.71	93.87	301.83	298.58	1.17
28/02/17	35	217.45	4.36	398.47	97.33	301.15	298.66	0.95
28/02/17	37	217.43	4.37	398.27	95.56	302.71	298.79	1.46
01/03/17	38	217.38	4.37	397.93	96.16	301.77	298.87	1.15
01/03/17	39	217.32	4.45	400.67	98.42	302.25	298.97	1.31
03/03/17	41	217.49	4.39	392.09	95.28	296.81	298.91	-0.50
03/03/17	42	217.51	4.35	396.13	96.19	299.94	298.93	0.55

04/03/17	43	217.33	4.23	393.10	95.71	297.39	298.89	-0.31
04/03/17	45	217.48	4.35	396.49	96.06	300.43	298.93	0.71
05/03/17	46	217.40	4.36	394.61	96.10	298.51	298.92	0.07
05/03/17	47	217.32	4.36	395.15	96.45	298.71	298.92	0.14
06/03/17	47	217.32	4.36	395.15	96.45	298.71	299.01	0.14
06/03/17	49	217.54	4.32	398.48	97.89	300.59	299.04	0.76
07/03/17	50	217.39	4.29	399.88	94.24	305.64	299.20	2.40
07/03/17	52	217.55	4.34	398.52	98.03	300.49	299.23	0.73
08/03/17	53	217.43	4.41	395.19	96.90	298.29	299.21	0.00
08/03/17	55	217.55	4.34	398.52	98.03	300.49	299.24	0.73
09/03/17	56	217.35	4.38	396.97	96.99	299.98	299.25	0.56
09/03/17	58	217.48	4.38	397.71	95.73	301.98	299.31	1.22
10/03/17	59	217.36	4.29	395.73	98.48	297.25	299.27	-0.35
10/03/17	60	217.50	4.30	395.80	95.51	300.28	299.29	0.66
11/03/17	61	217.41	4.34	394.90	96.69	298.21	299.27	-0.03
11/03/17	62	217.58	4.40	396.59	94.83	301.77	299.32	1.15
13/03/17	63	217.24	4.31	391.91	95.25	296.66	299.27	-0.55
13/03/17	65	217.54	4.24	396.93	98.04	298.89	299.26	0.20
14/03/17	66	217.30	4.22	396.24	96.16	300.08	299.27	0.59
14/03/17	68	217.51	4.42	394.15	96.98	297.17	299.24	-0.38
15/03/17	69	217.41	4.34	393.44	97.22	296.21	299.18	-0.70
15/03/17	71	217.57	4.41	395.00	97.81	297.19	299.15	-0.37
16/03/17	72	217.41	4.42	394.56	96.85	297.71	299.12	-0.20
16/03/17	73	217.55	4.43	393.78	97.35	296.44	299.08	-0.63
17/03/17	74	217.36	4.30	391.59	96.10	295.49	299.02	-0.95
17/03/17	76	217.53	4.33	395.01	100.35	294.66	298.95	-1.24
18/03/17	77	217.46	4.31	395.69	97.20	298.49	298.94	0.06
18/03/17	79	217.48	4.38	395.60	96.12	299.48	298.95	0.39
19/03/17	80	217.31	4.38	391.81	96.88	294.93	298.88	-1.14
19/03/17	81	217.53	4.32	394.58	98.12	296.47	298.85	-0.62
20/03/17	82	217.32	4.32	390.99	96.79	294.20	298.78	-1.39
20/03/17	83	217.49	4.36	397.75	97.73	300.02	298.79	0.57
21/03/17	84	217.30	4.36	394.38	96.85	297.53	298.78	-0.26
21/03/17	85	217.50	4.34	396.06	97.69	298.37	298.77	0.02
22/03/17	86	217.32	4.30	394.71	95.71	298.99	298.77	0.23
22/03/17	86	217.46	4.40	397.38	98.44	298.94	298.78	0.21
24/03/17	87	217.31	4.28	396.19	98.49	297.70	298.76	-0.20
24/03/17	88	217.52	4.31	395.67	95.26	300.41	298.78	0.70
25/03/17	89	217.52	4.41	394.86	98.81	296.05	298.75	-0.76
27/03/17	91	217.51	4.28	373.26	80.68	292.59	298.66	-1.95
27/03/17	92	217.42	4.34	380.18	80.45	299.72	298.68	0.48
28/03/17	93	217.44	4.37	378.04	83.06	294.98	298.63	-1.13
28/03/17	94	217.41	4.40	384.44	81.28	303.16	298.69	1.60

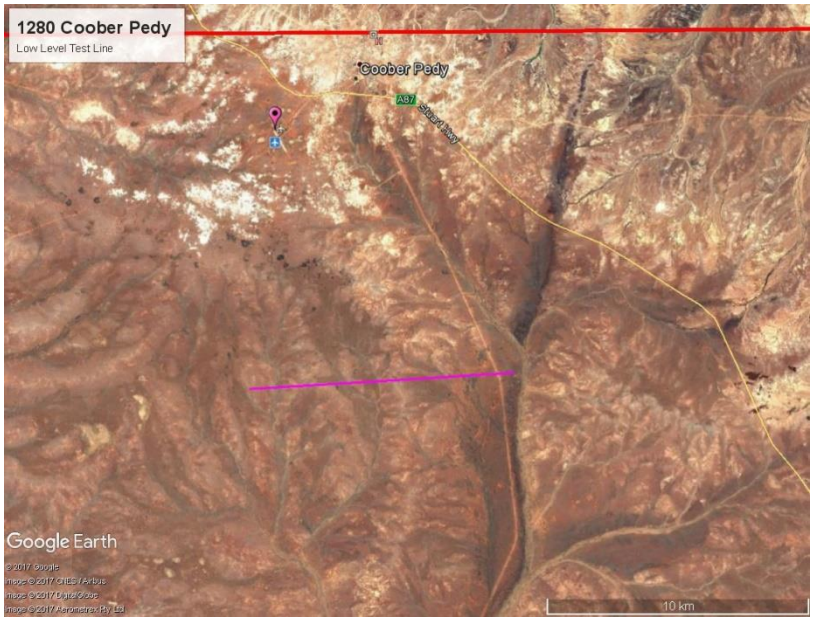
29/03/17	95	217.39	4.24	381.00	83.10	297.90	298.68	-0.13
29/03/17	96	217.38	4.37	378.28	81.81	296.47	298.65	-0.62
30/03/17	97	217.47	4.34	377.58	81.59	295.99	298.62	-0.78
30/03/17	98	217.54	4.30	376.94	80.99	295.95	298.59	-0.79
31/03/17	99	217.35	4.41	381.05	83.22	297.83	298.58	-0.16
31/03/17	101	217.46	4.37	381.94	82.37	299.57	298.59	0.42
01/04/17	102	217.43	4.24	379.33	83.92	295.41	298.55	-0.98
01/04/17	104	217.52	4.40	375.03	81.63	293.39	298.49	-1.67
02/04/17	105	217.35	4.33	374.26	83.07	291.20	298.41	-2.44
02/04/17	106	217.45	4.26	383.15	85.21	297.94	298.40	-0.12
03/04/17	107	217.44	4.32	380.88	83.14	297.74	298.39	-0.19
03/04/17	109	217.43	4.44	379.67	82.20	297.47	298.38	-0.28
04/04/17	110	217.27	4.22	382.11	82.02	300.08	298.40	0.59
04/04/17	112	217.48	4.29	382.68	80.31	302.37	298.45	1.35
05/04/17	113	217.39	4.40	381.24	81.19	300.05	298.46	0.58
05/04/17	113	217.50	4.34	371.56	80.73	290.83	298.38	-2.57
06/04/17	114	217.39	4.45	373.84	80.65	293.20	298.33	-1.74
06/04/17	114	217.49	4.31	376.08	79.17	296.91	298.31	-0.47
07/04/17	115	217.39	4.28	374.78	81.11	293.67	298.26	-1.58
07/04/17	117	217.52	4.39	374.30	80.01	294.29	298.22	-1.36
08/04/17	118	217.40	4.39	375.78	81.24	294.54	298.19	-1.28
08/04/17	120	217.56	4.41	373.37	79.70	293.67	298.14	-1.58
09/04/17	121	217.40	4.33	375.37	81.24	294.14	298.10	-1.42
09/04/17	122	217.40	4.33	374.80	78.51	296.30	298.08	-0.68
10/04/17	123	217.45	4.30	372.92	80.81	292.10	298.03	-2.12
25/04/17	124	217.42	4.42	381.14	89.57	291.56	297.96	-2.31
25/04/17	124	217.56	4.35	381.92	88.76	293.16	297.92	-1.75
26/04/17	125	217.34	4.28	380.78	89.37	291.41	297.86	-2.36
26/04/17	126	217.47	4.32	384.14	90.79	293.35	297.81	-1.69
27/04/17	127	217.34	4.32	382.75	91.32	291.43	297.76	-2.36
27/04/17	128	217.39	4.33	384.28	89.97	294.31	297.72	-1.36
06/05/17	130	217.39	4.30	388.52	92.30	296.22	297.71	-0.70
06/05/17	131	217.53	4.37	387.91	91.13	296.79	297.70	-0.51
07/05/17	132	217.38	4.35	388.95	92.31	296.64	297.69	-0.56
07/05/17	134	217.50	4.38	391.19	93.84	297.35	297.69	-0.32
08/05/17	135	217.36	4.34	386.89	96.03	290.85	297.63	-2.56
08/05/17	136	217.47	4.35	389.93	95.06	294.87	297.61	-1.16
09/05/17	137	217.29	4.33	390.23	92.97	297.26	297.60	-0.35
09/05/17	138	217.43	4.28	393.28	94.62	298.66	297.61	0.12
10/05/17	139	217.39	4.32	390.72	95.14	295.58	297.59	-0.92
10/05/17	140	217.51	4.30	379.74	80.03	299.71	297.61	0.47
11/05/17	141	217.36	4.37	374.48	80.20	294.28	297.58	-1.37
11/05/17	142	217.35	4.29	373.37	81.56	291.81	297.54	-2.22

12/05/17	143	217.35	4.40	377.87	81.00	296.87	297.53	-0.48
12/05/17	145	217.48	4.38	375.93	80.28	295.65	297.52	-0.90
13/05/17	146	217.35	4.35	376.49	82.37	294.12	297.49	-1.42
13/05/17	147	217.57	4.24	377.48	81.99	295.49	297.47	-0.95
14/05/17	148	217.25	4.22	375.51	79.33	296.18	297.46	-0.72
14/05/17	149	217.29	4.27	377.02	82.11	294.91	297.44	-1.15
16/05/17	151	217.43	4.40	371.58	81.99	289.59	297.38	-3.01
16/05/17	152	217.52	4.37	375.77	80.34	295.42	297.37	-0.97
20/05/17	154	217.34	4.26	374.73	80.65	294.08	297.34	-1.44
20/05/17	155	217.46	4.26	374.18	78.51	295.67	297.33	-0.89
21/05/17	156	217.38	4.22	375.99	80.10	295.89	297.32	-0.81
21/05/17	158	217.47	4.35	376.26	80.52	295.74	297.30	-0.87
22/05/17	159	217.42	4.31	372.01	81.30	290.71	297.26	-2.61
22/05/17	159	217.48	4.37	372.84	79.27	293.57	297.23	-1.61
23/05/17	160	217.38	4.30	370.48	82.49	287.99	297.16	-3.58
23/05/17	160	217.46	4.31	379.43	81.80	297.63	297.16	-0.23
24/05/17	161	217.38	4.38	373.60	81.61	291.99	297.13	-2.16
24/05/17	163	217.47	4.33	374.41	81.86	292.56	297.09	-1.96
25/05/17	164	217.41	4.27	375.88	81.90	293.98	297.07	-1.47
25/05/17	165	217.45	4.32	377.47	81.68	295.79	297.06	-0.85

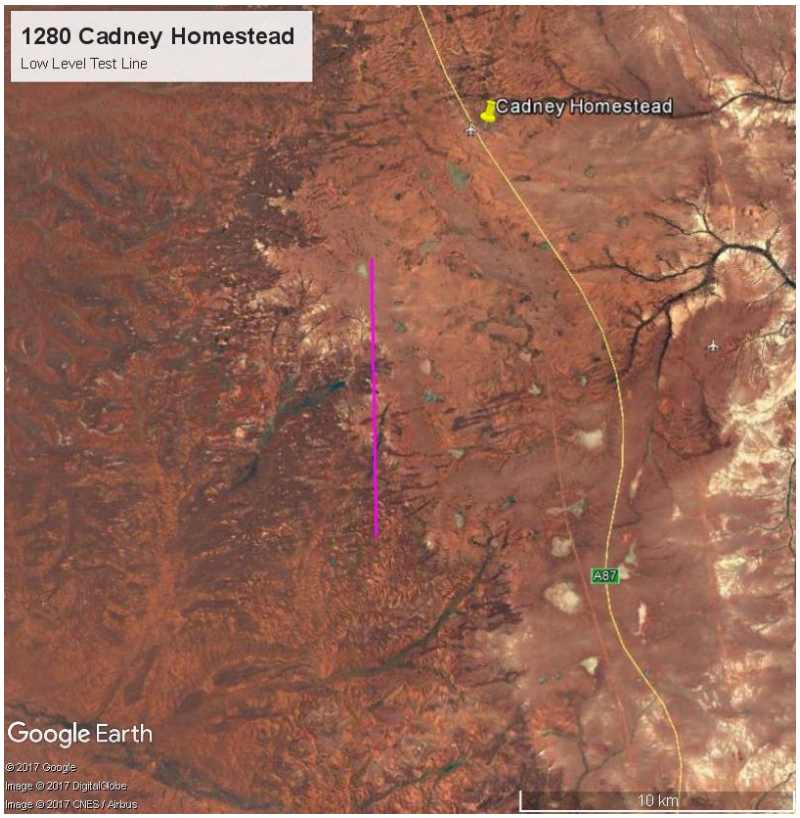


Low Level Test Line

A suitable radiometric low-level test line was established near each base of operation, as shown in the images below. The pre- and post-survey data were collected to monitor the effects of soil moisture: -



Coober Pedy Low-Level Test Line (Start: 471972E 6778153N; End: 482067E 6778794N – MGA Zone 53)



Cadney Low-Level Test Line (Start: 403820E 6898095N; End: 403569E 6908186N – MGA Zone 53)

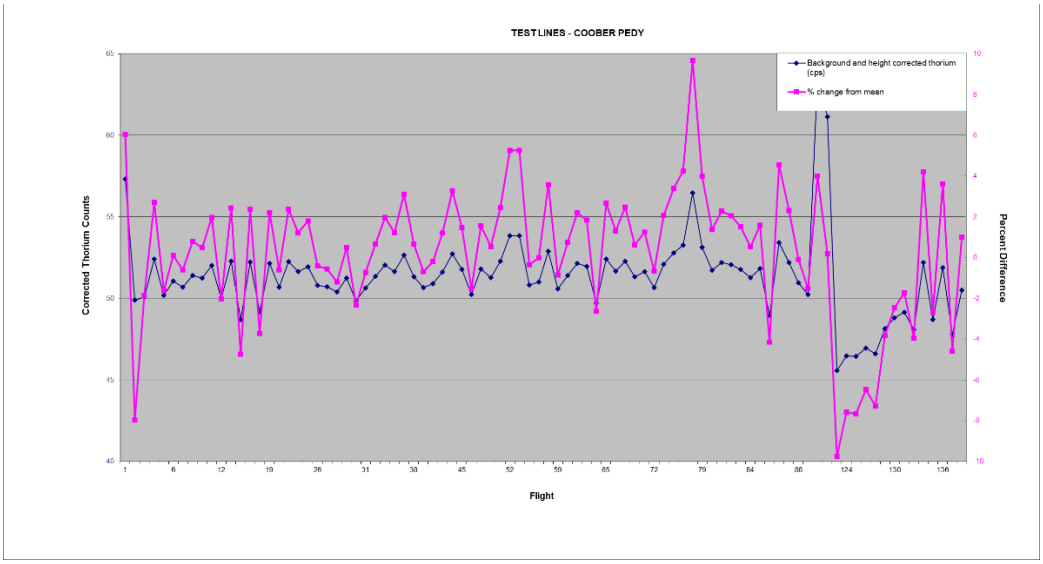
Low Level Test Lines - Coober Pedy / Cadney

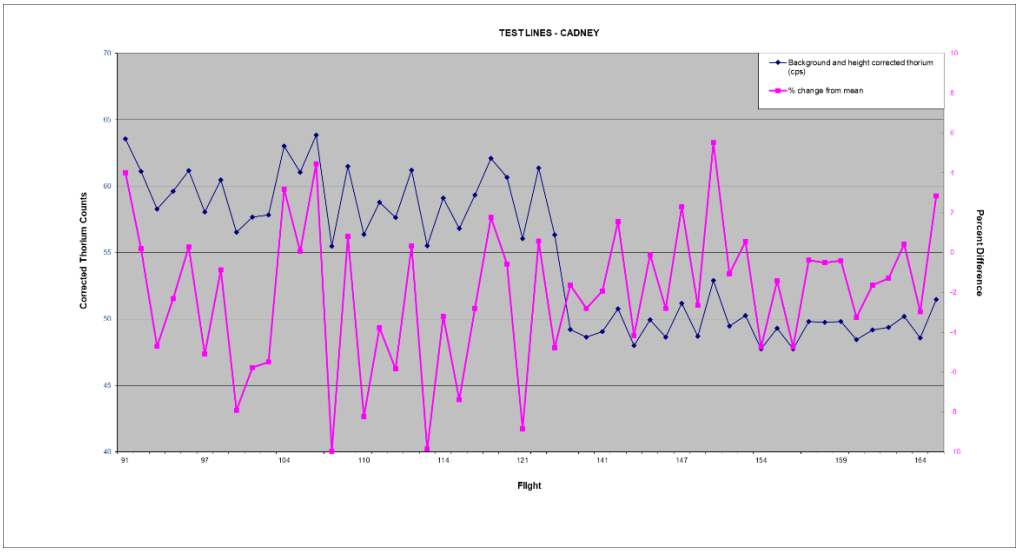
Date	Flight #	Background and height corrected thorium (cps)	% change from mean
11/02/17	1	57.32	6.03
12/02/17	2	49.89	-7.96
13/02/17	3	50.07	-1.85
13/02/17	4	52.42	2.71
14/02/17	5	50.19	-1.61
14/02/17	6	51.05	0.09
15/02/17	7	50.70	-0.60
15/02/17	8	51.41	0.79
16/02/17	9	51.25	0.49
16/02/17	11	52.02	1.97
17/02/17	12	49.99	-2.02
17/02/17	14	52.27	2.43
18/02/17	15	48.69	-4.74
18/02/17	17	52.23	2.36
19/02/17	18	49.17	-3.72
19/02/17	19	52.14	2.19
21/02/17	20	50.69	-0.61
21/02/17	22	52.24	2.37
22/02/17	23	51.63	1.23
22/02/17	25	51.93	1.80
24/02/17	26	50.79	-0.41
24/02/17	26	50.72	-0.56
25/02/17	27	50.40	-1.20
25/02/17	28	51.25	0.50
26/02/17	29	49.84	-2.33
26/02/17	31	50.64	-0.72
27/02/17	32	51.34	0.66
27/02/17	34	52.03	1.97
28/02/17	35	51.63	1.23
28/02/17	37	52.64	3.11
01/03/17	38	51.33	0.64
01/03/17	39	50.66	-0.68
03/03/17	41	50.90	-0.20
03/03/17	42	51.62	1.20
04/03/17	43	52.73	3.28
04/03/17	45	51.77	1.48
05/03/17	46	50.23	-1.54
06/03/17	47	51.81	1.57

06/03/17	49	51.28	0.55
07/03/17	50	52.29	2.46
07/03/17	52	53.83	5.26
08/03/17	53	53.83	5.26
08/03/17	55	50.83	-0.34
09/03/17	56	51.00	0.00
09/03/17	58	52.89	3.57
10/03/17	59	50.57	-0.86
10/03/17	60	51.39	0.76
11/03/17	61	52.14	2.19
11/03/17	62	51.96	1.84
13/03/17	63	49.70	-2.63
13/03/17	65	52.40	2.67
14/03/17	66	51.67	1.30
14/03/17	68	52.29	2.47
15/03/17	69	51.32	0.62
15/03/17	71	51.64	1.24
16/03/17	72	50.66	-0.67
16/03/17	73	52.09	2.08
17/03/17	74	52.78	3.38
17/03/17	76	53.26	4.25
18/03/17	77	56.46	9.66
18/03/17	79	53.12	3.98
19/03/17	80	51.71	1.38
19/03/17	81	52.19	2.28
20/03/17	82	52.06	2.04
20/03/17	83	51.78	1.51
21/03/17	84	51.27	0.52
21/03/17	85	51.82	1.58
22/03/17	86	48.97	-4.15
22/03/17	86	53.43	4.55
24/03/17	87	52.20	2.30
24/03/17	88	50.95	-0.10
25/03/17	89	50.24	-1.52
27/03/17	91	63.54	4.00
27/03/17	92	61.12	0.19
28/03/17	93	58.26	-4.70
29/03/17	95	59.62	-2.32
29/03/17	96	61.17	0.27
30/03/17	97	58.05	-5.09
30/03/17	98	60.47	-0.88
31/03/17	99	56.52	-7.92
31/03/17	101	57.67	-5.78

01/04/17	102	57.82	-5.50
01/04/17	104	63.00	3.17
02/04/17	105	61.05	0.07
02/04/17	106	63.84	4.45
03/04/17	107	55.48	-9.96
03/04/17	109	61.50	0.81
04/04/17	110	56.36	-8.23
04/04/17	112	58.78	-3.78
05/04/17	113	57.64	-5.84
05/04/17	113	61.20	0.33
06/04/17	114	55.52	-9.86
06/04/17	114	59.10	-3.21
07/04/17	115	56.80	-7.39
07/04/17	117	59.33	-2.81
08/04/17	118	62.09	1.76
08/04/17	120	60.65	-0.58
09/04/17	121	56.04	-8.85
09/04/17	122	61.35	0.58
10/04/17	123	56.32	-4.77
25/04/17	124	45.56	-9.74
25/04/17	124	46.48	-7.57
26/04/17	125	46.44	-7.67
26/04/17	126	46.96	-6.47
27/04/17	127	46.60	-7.29
27/04/17	128	48.15	-3.83
06/05/17	130	48.80	-2.47
06/05/17	131	49.15	-1.73
07/05/17	132	48.10	-3.95
07/05/17	134	52.19	4.20
08/05/17	135	48.70	-2.67
08/05/17	136	51.88	3.62
09/05/17	137	47.81	-4.58
09/05/17	138	50.51	1.01
10/05/17	139	49.20	-1.63
10/05/17	140	48.64	-2.80
11/05/17	141	49.05	-1.94
11/05/17	142	50.78	1.54
12/05/17	143	48.01	-4.15
12/05/17	145	49.94	-0.11
13/05/17	146	48.63	-2.81
13/05/17	147	51.17	2.28
14/05/17	148	48.71	-2.65
14/05/17	149	52.91	5.51

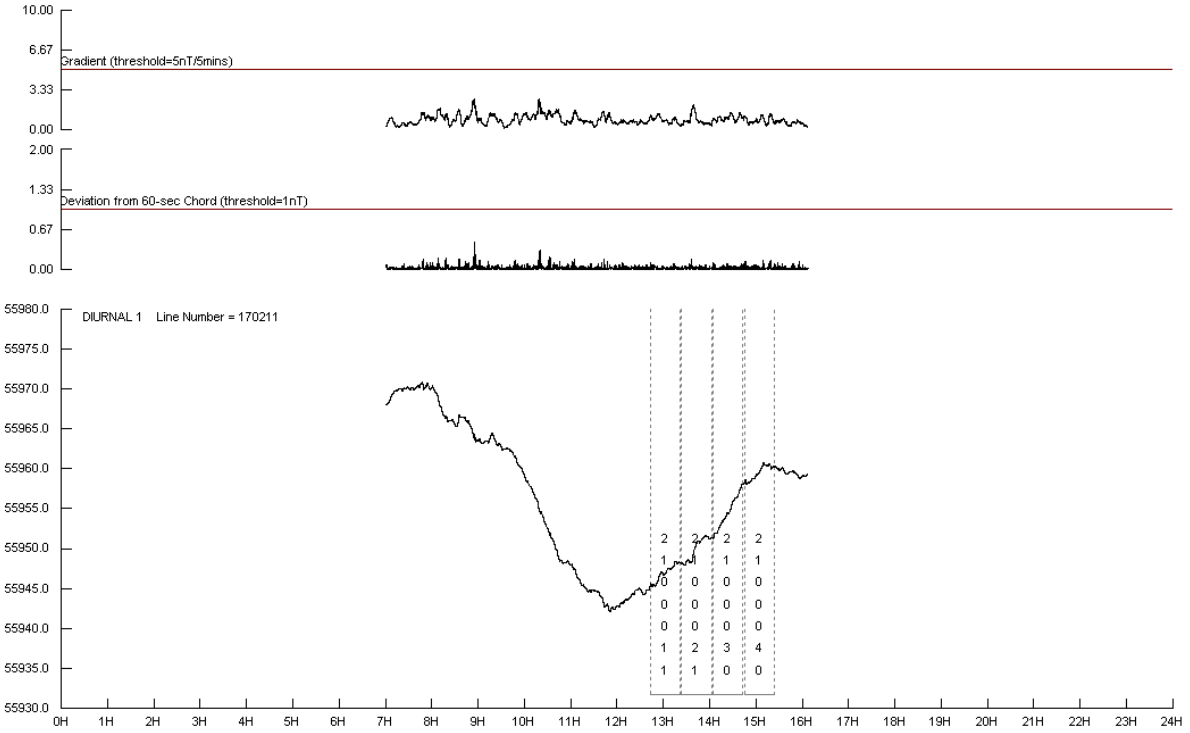
16/05/17	151	49.47	-1.06
16/05/17	152	50.27	0.55
20/05/17	154	47.73	-4.76
20/05/17	155	49.30	-1.42
21/05/17	156	47.74	-4.73
21/05/17	158	49.81	-0.39
22/05/17	159	49.74	-0.51
22/05/17	159	49.80	-0.41
23/05/17	160	48.43	-3.25
23/05/17	160	49.19	-1.64
24/05/17	161	49.36	-1.30
24/05/17	163	50.21	0.43
25/05/17	164	48.56	-2.97
25/05/17	165	51.46	2.84

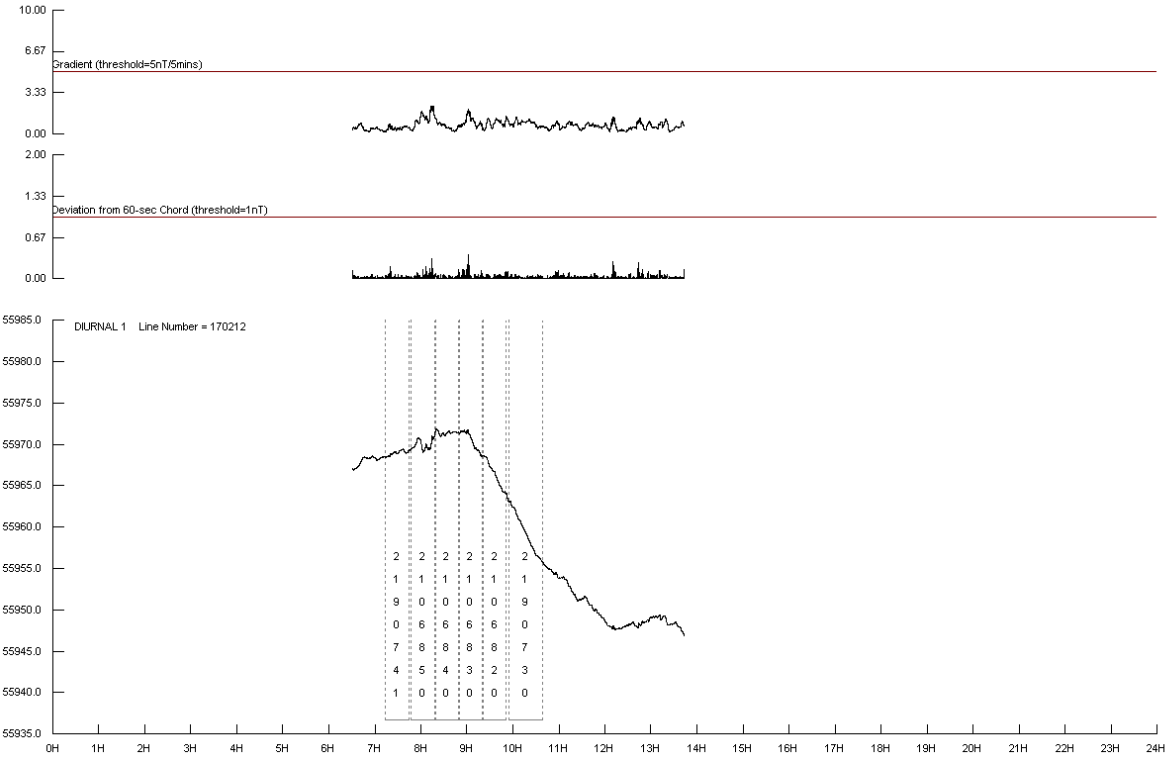


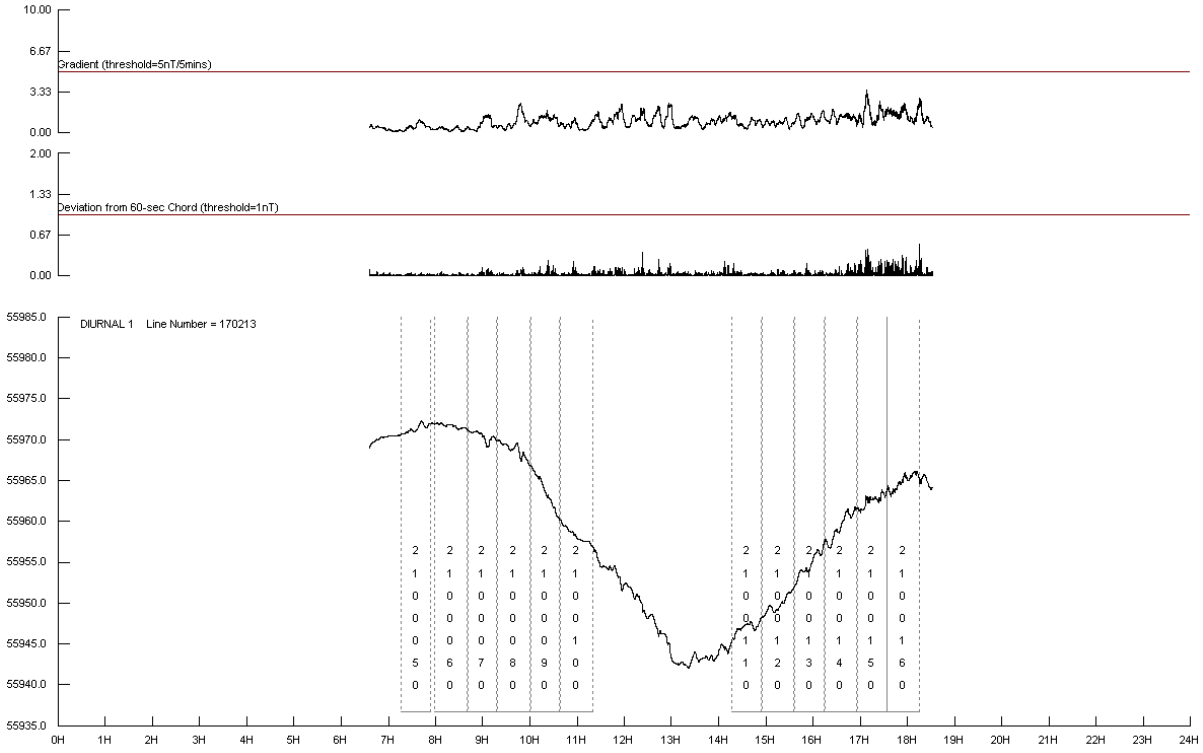


APPENDIX 3 DIURNAL BASE STATION PLOTS

Diurnal 1 Line Number = YYMMDD



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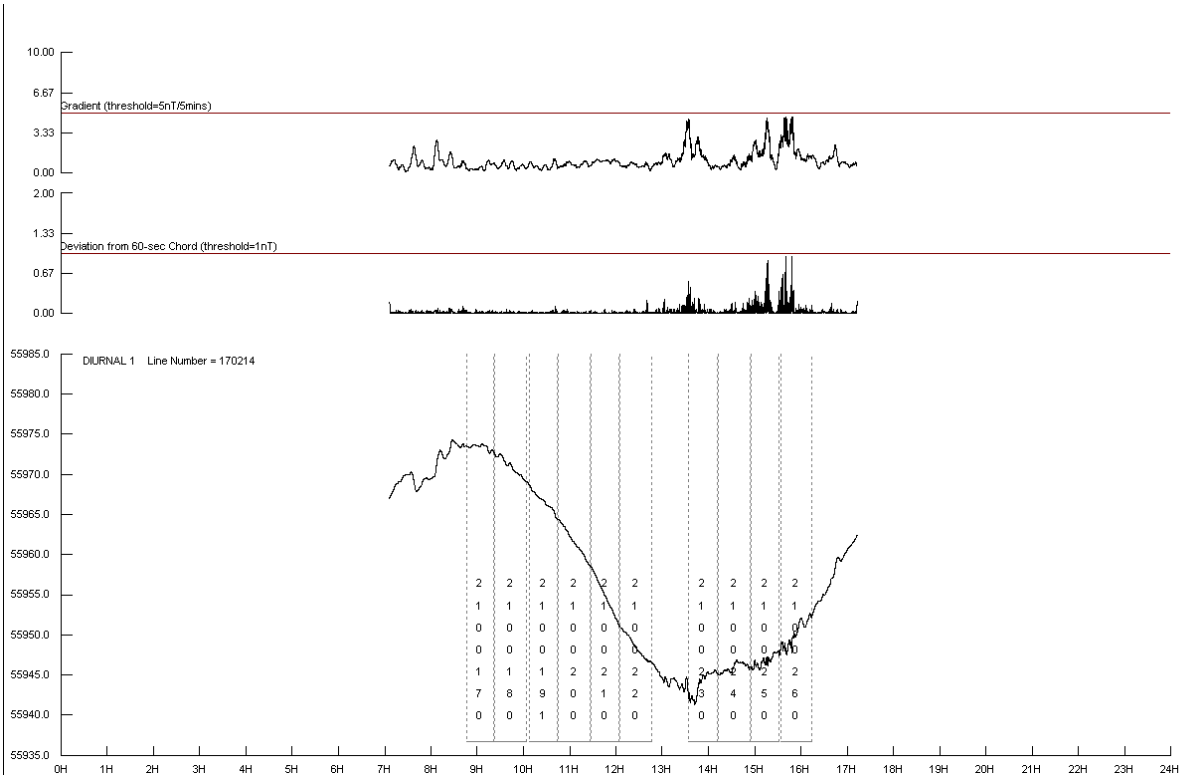
Deviation from 60-sec Chord (threshold=1nT)
DIURNAL 1 Line Number = 170213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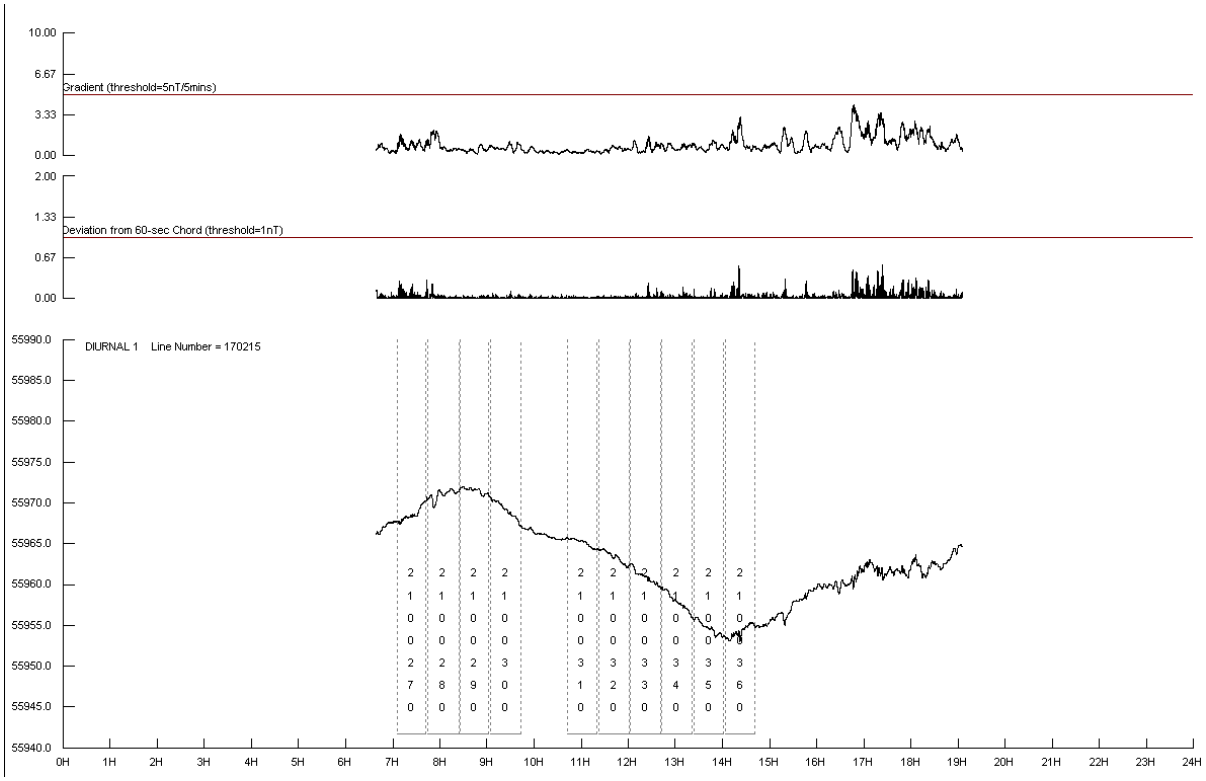
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Deviation from 60-sec Chord (threshold=1nT)
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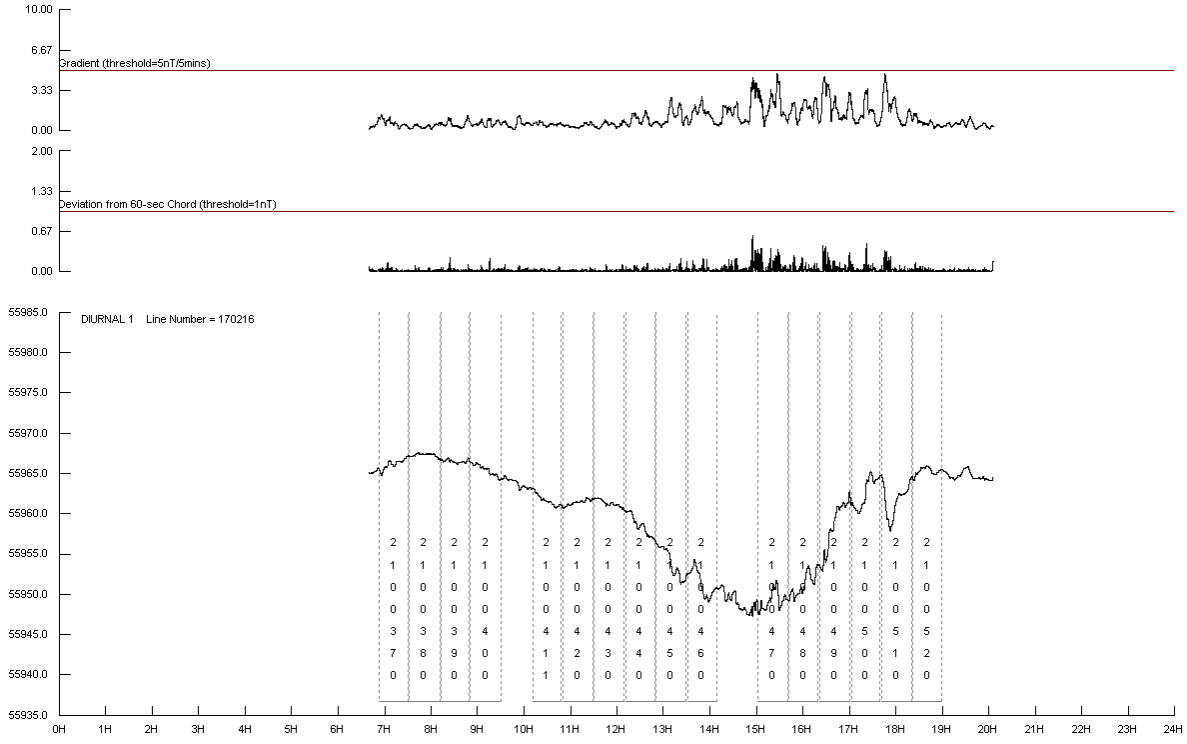
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Deviation from 60-sec Chord (threshold=1nT)
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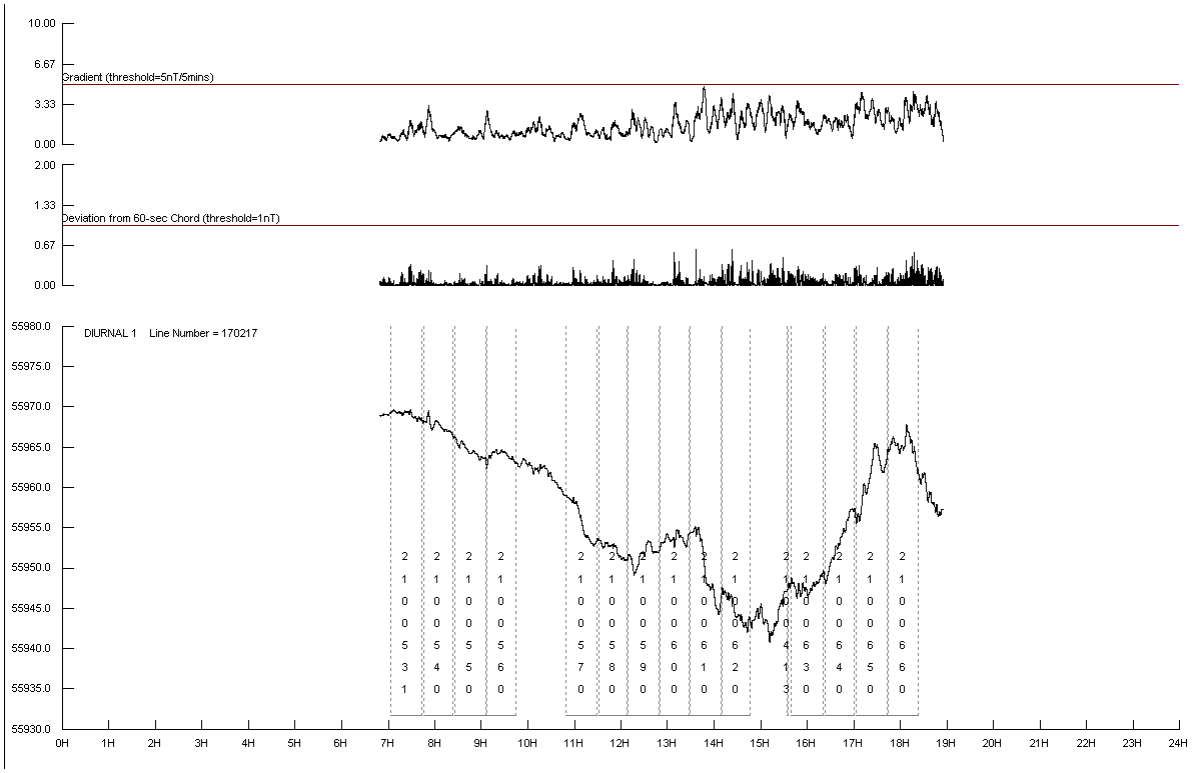
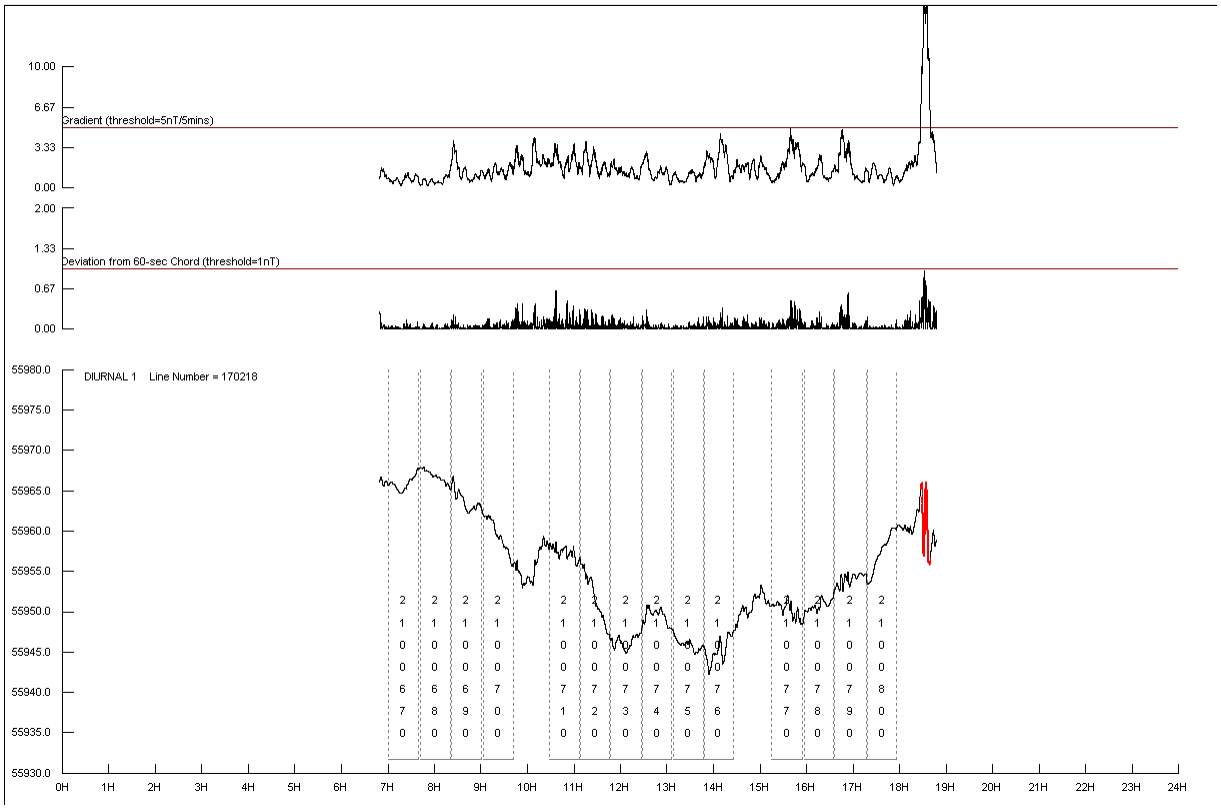
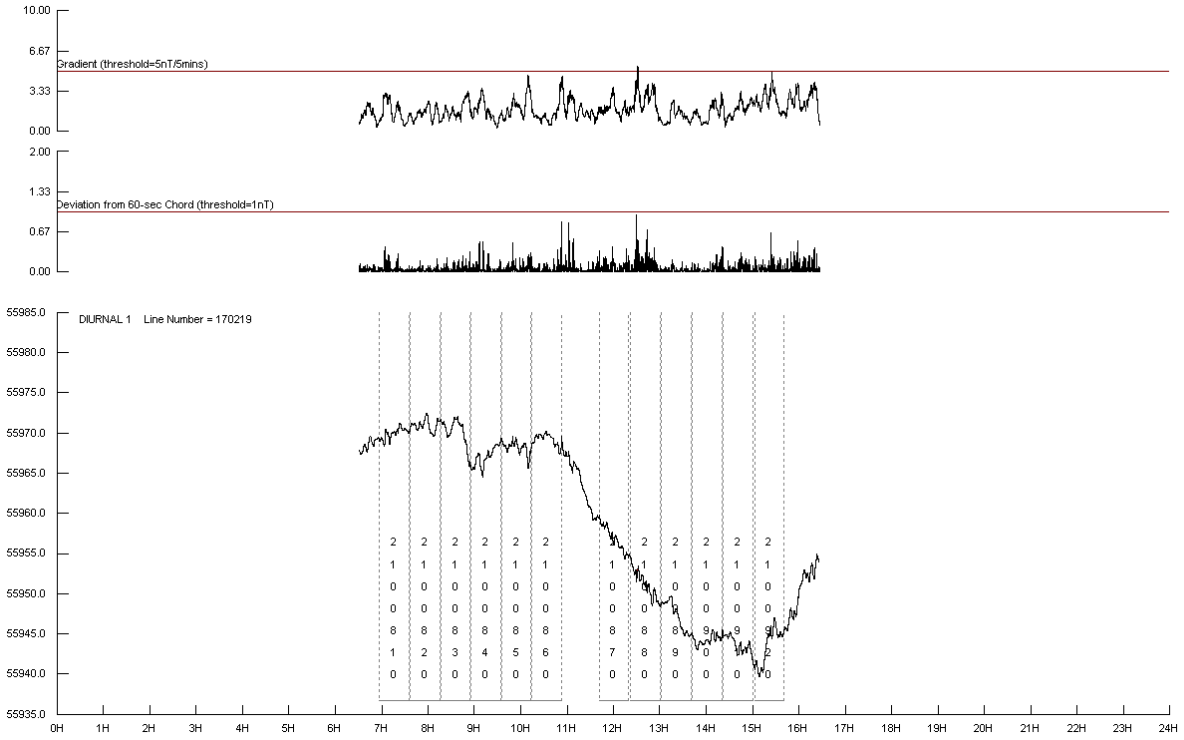

Gradient (threshold=5nT/5mins)
Deviation from 60-sec Chord (threshold=1nT)
DIURNAL 1 Line Number = 170217


Gradient (threshold=5nT/5mins)
Deviation from 60-sec Chord (threshold=1nT)
DIURNAL 1 Line Number = 170218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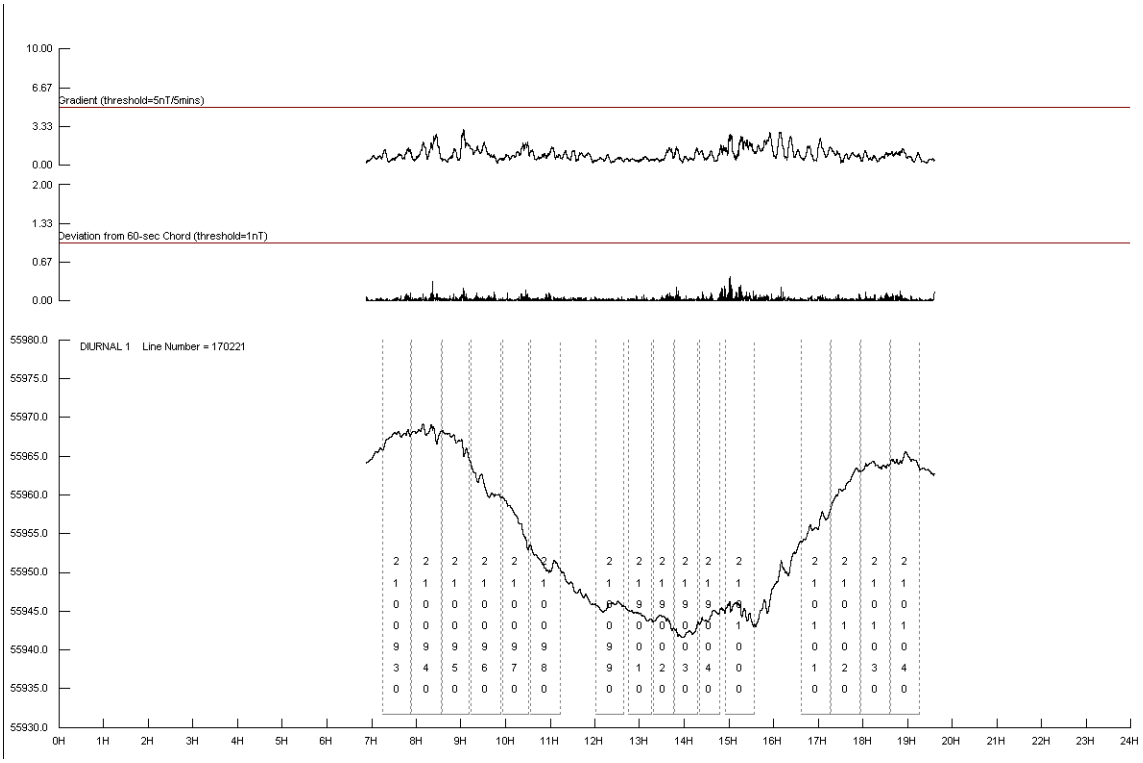
Deviation from 60-sec Chord (threshold=1nT)
DIURNAL 1 Line Number = 170219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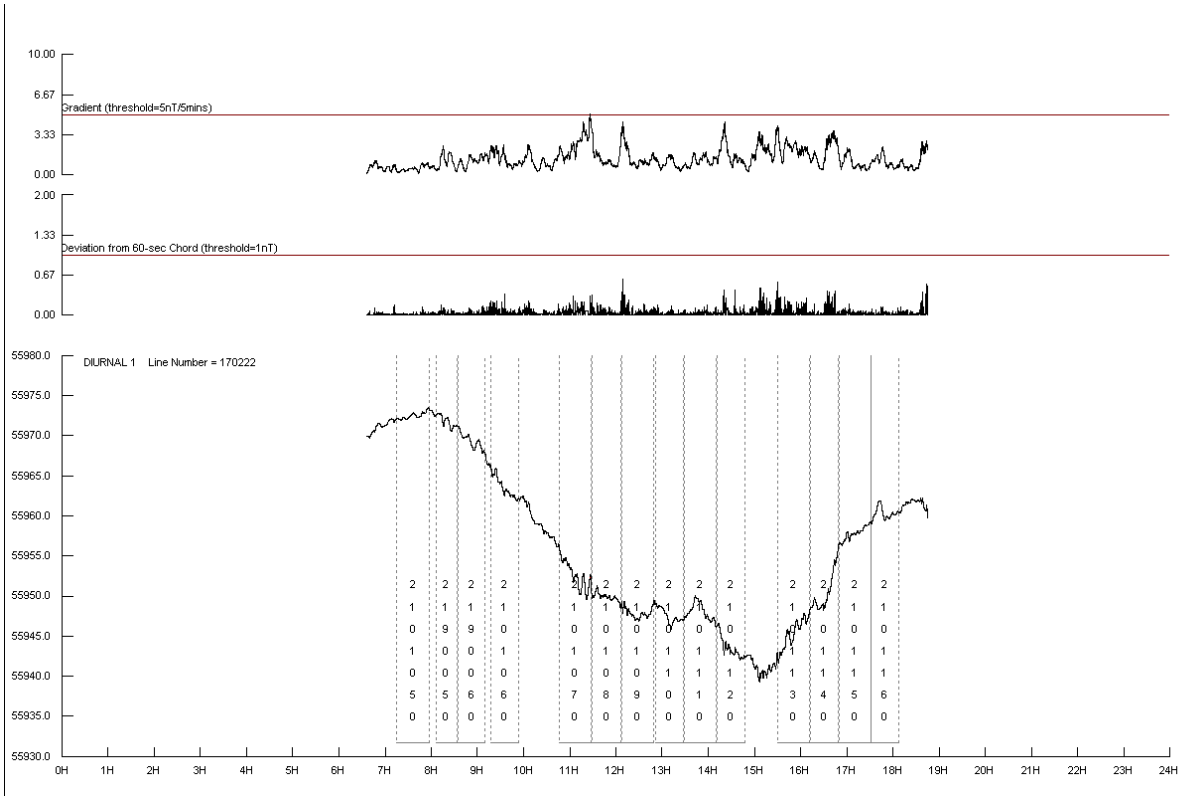
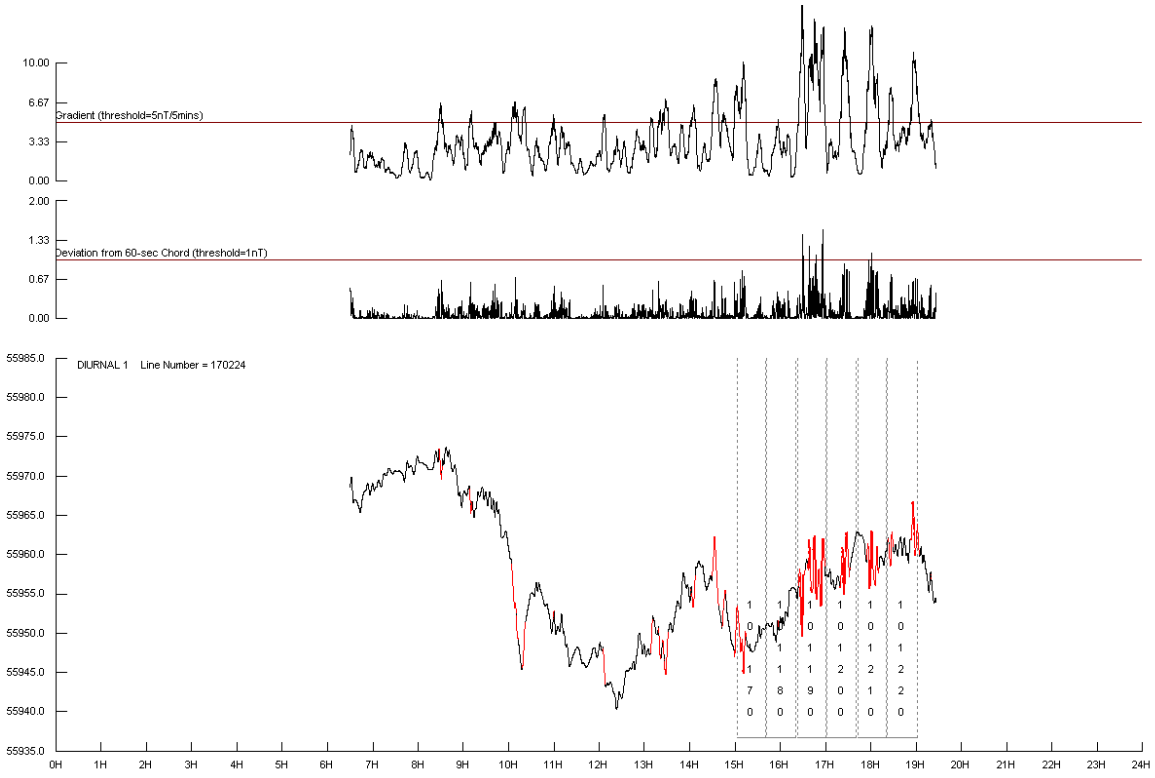
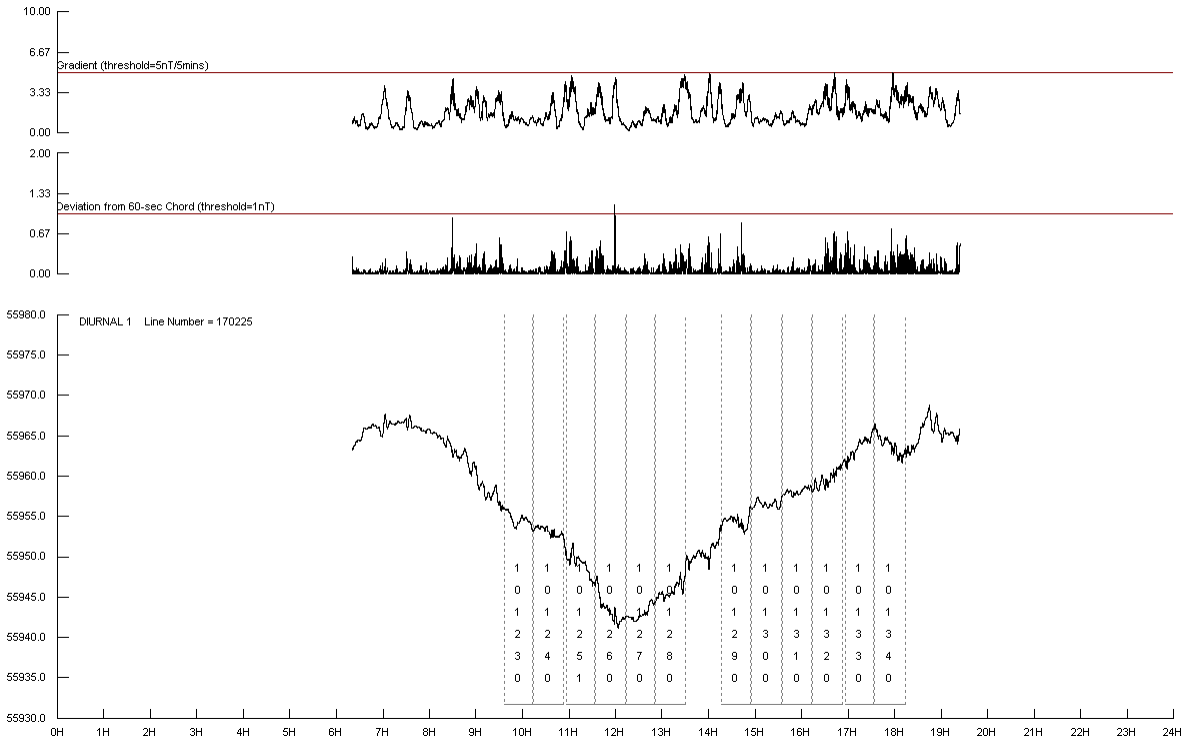
Deviation from 60-sec Chord (threshold=1nT)
DIURNAL 1 Line Number = 170221


10.00
6.67
Gradient (threshold=5nT/5mins)
3.33
0.00
2.00
1.33
Deviation from 60-sec Chord (threshold=1nT)
0.67
0.00
55980.0
DIURNAL 1 Line Number = 170222
55975.0
55970.0
55965.0
55960.0
55955.0
55950.0
55945.0
55940.0
55935.0
55930.0
0H 1H 2H 3H 4H 5H 6H 7H 8H 9H 10H 11H 12H 13H 14H 15H 16H 17H 18H 19H 20H 21H 22H 23H 24H


10.00
6.67
Gradient (threshold=5nT/5mins)
3.33
0.00
2.00
1.33
Deviation from 60-sec Chord (threshold=1nT)
0.67
0.00
55985.0
DIURNAL 1 Line Number = 170224
55980.0
55975.0
55970.0
55965.0
55960.0
55955.0
55950.0
55945.0
55940.0
55935.0
0H 1H 2H 3H 4H 5H 6H 7H 8H 9H 10H 11H 12H 13H 14H 15H 16H 17H 18H 19H 20H 21H 22H 23H 24H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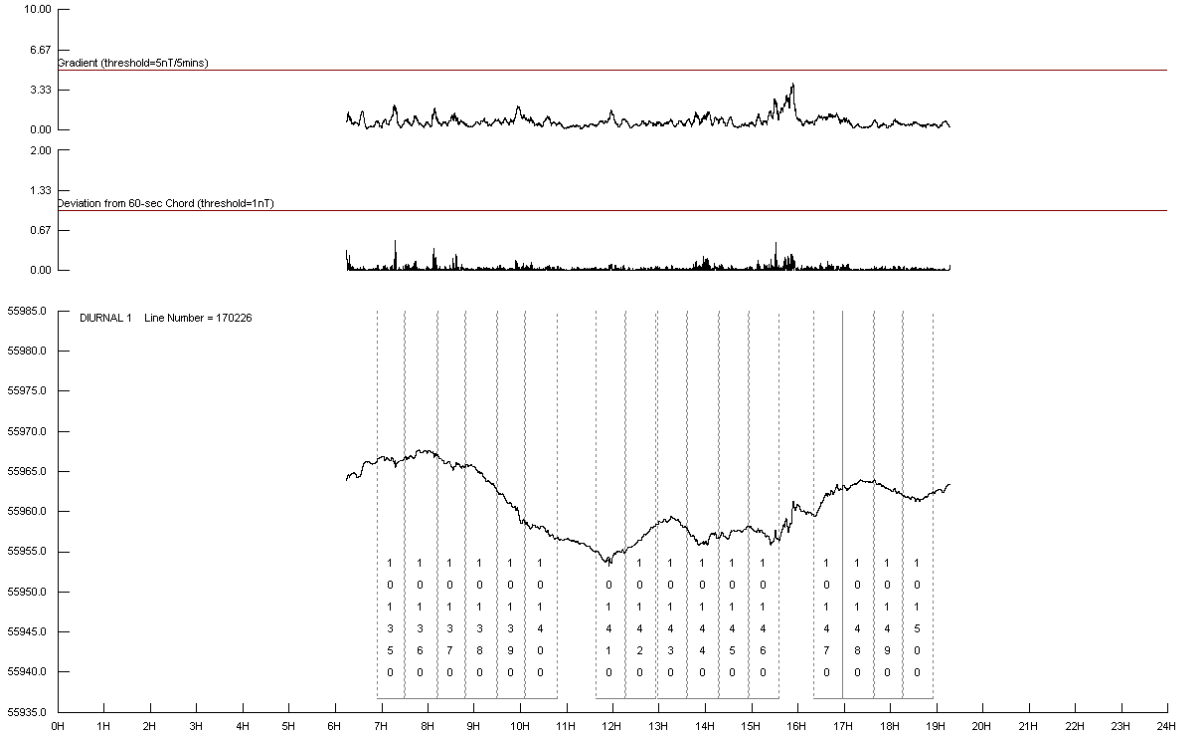
Deviation from 60-sec Chord (threshold=1nT)
DIURNAL 1 Line Number = 170225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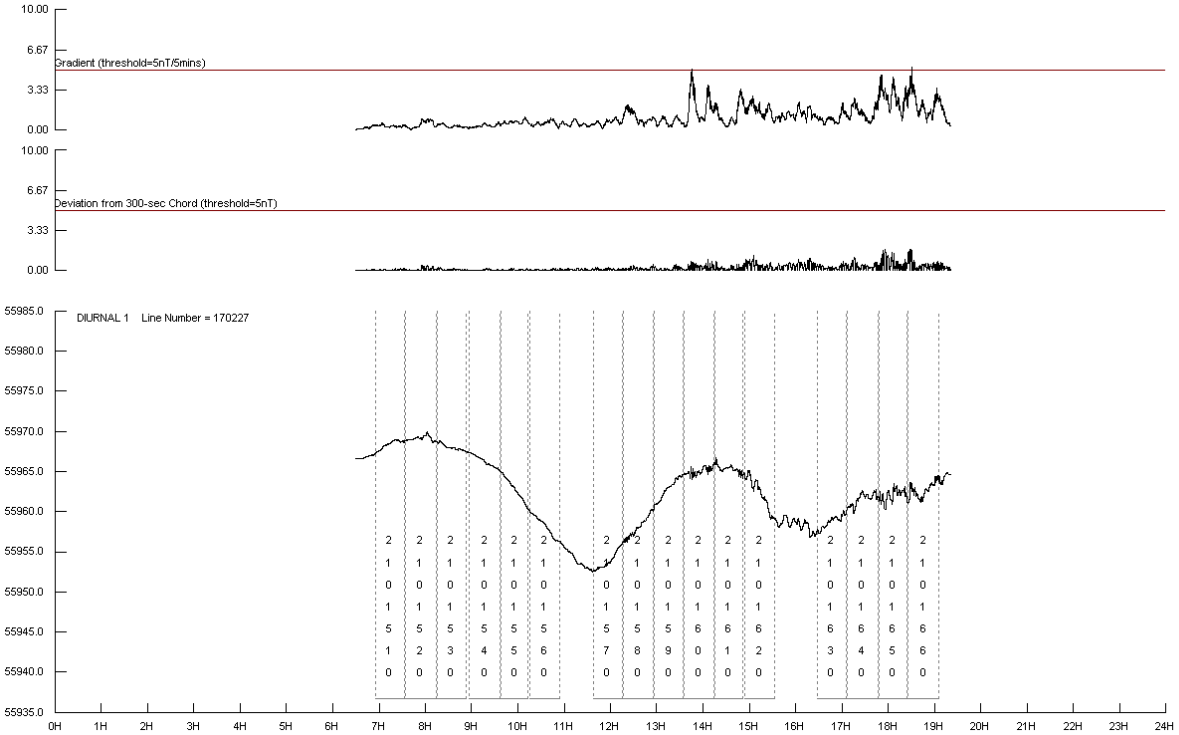
Deviation from 60-sec Chord (threshold=1nT)
DIURNAL 1 Line Number = 170226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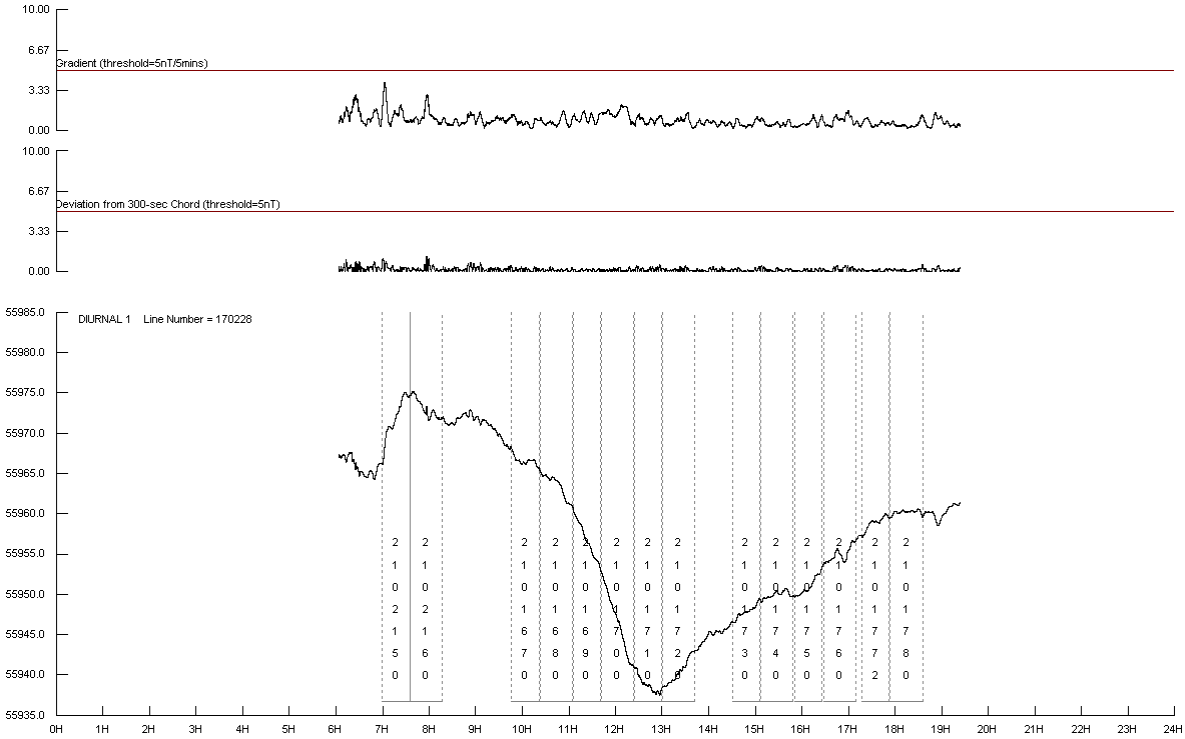
Deviation from 300-sec Chord (threshold=5nT)
DIURNAL 1 Line Number = 170227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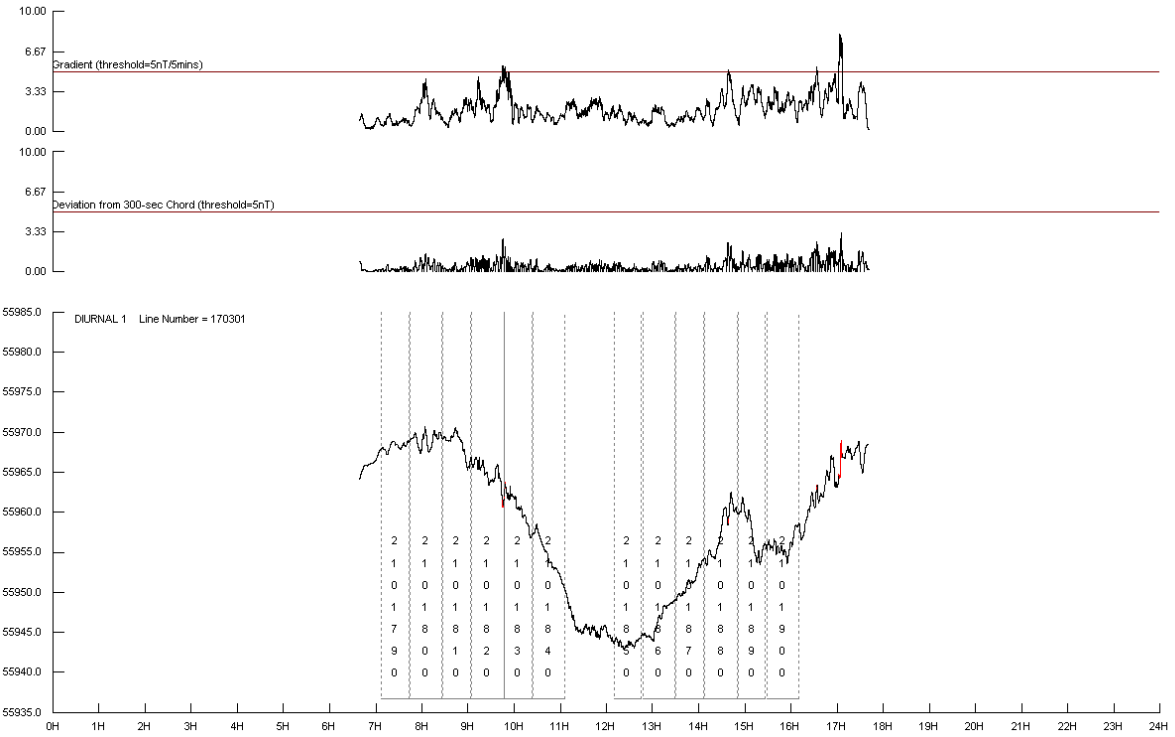
Deviation from 300-sec Chord (threshold=5nT)
DIURNAL 1 Line Number = 170228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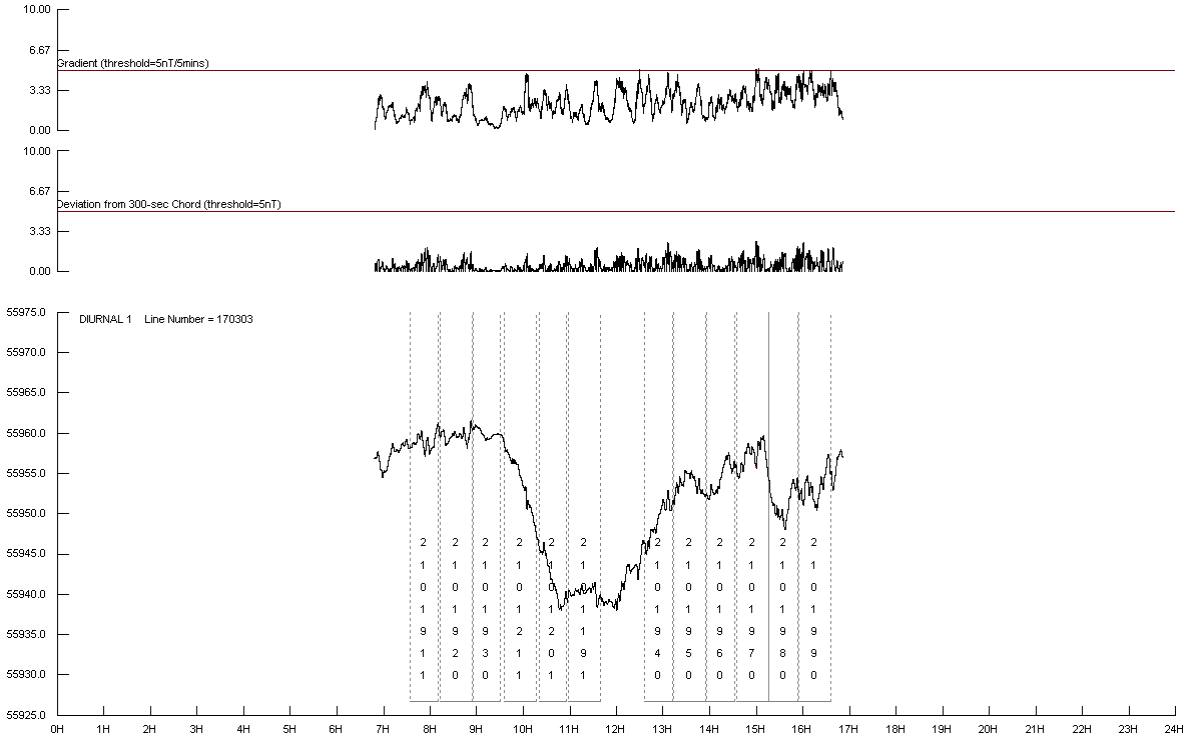
Deviation from 300-sec Chord (threshold=5nT)
DIURNAL 1 Line Number = 170301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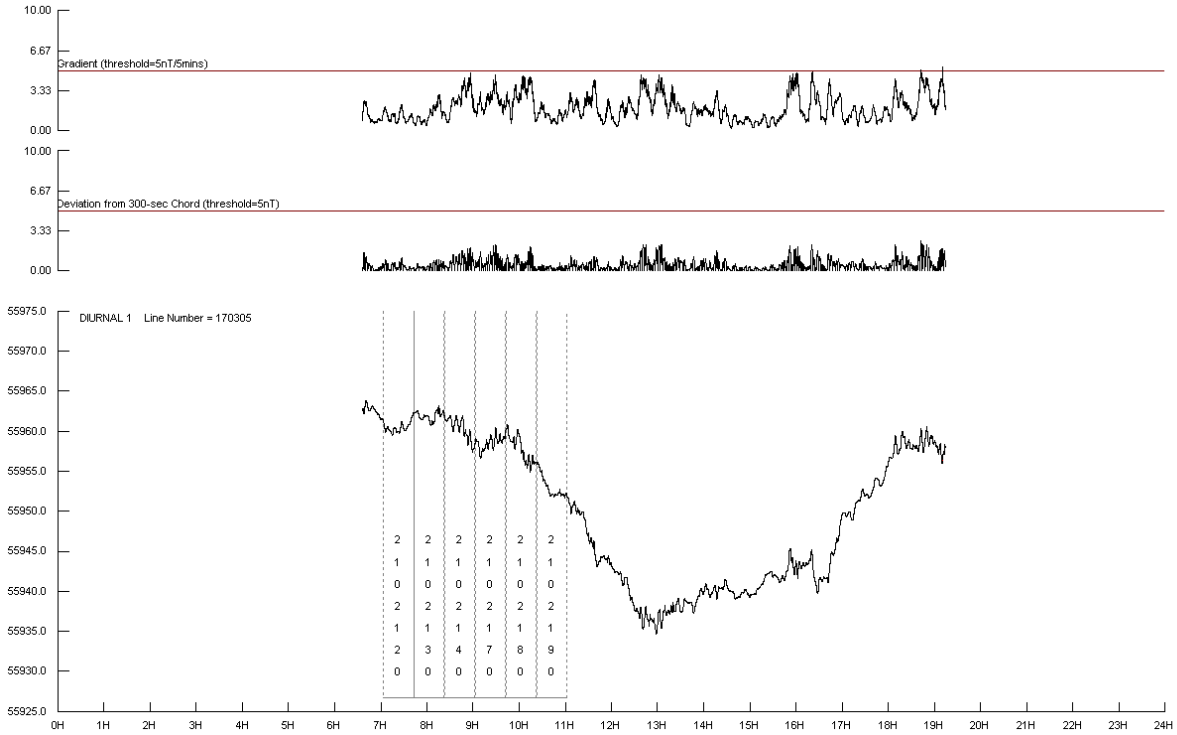
Deviation from 300-sec Chord (threshold=5nT)
DIURNAL 1 Line Number = 170303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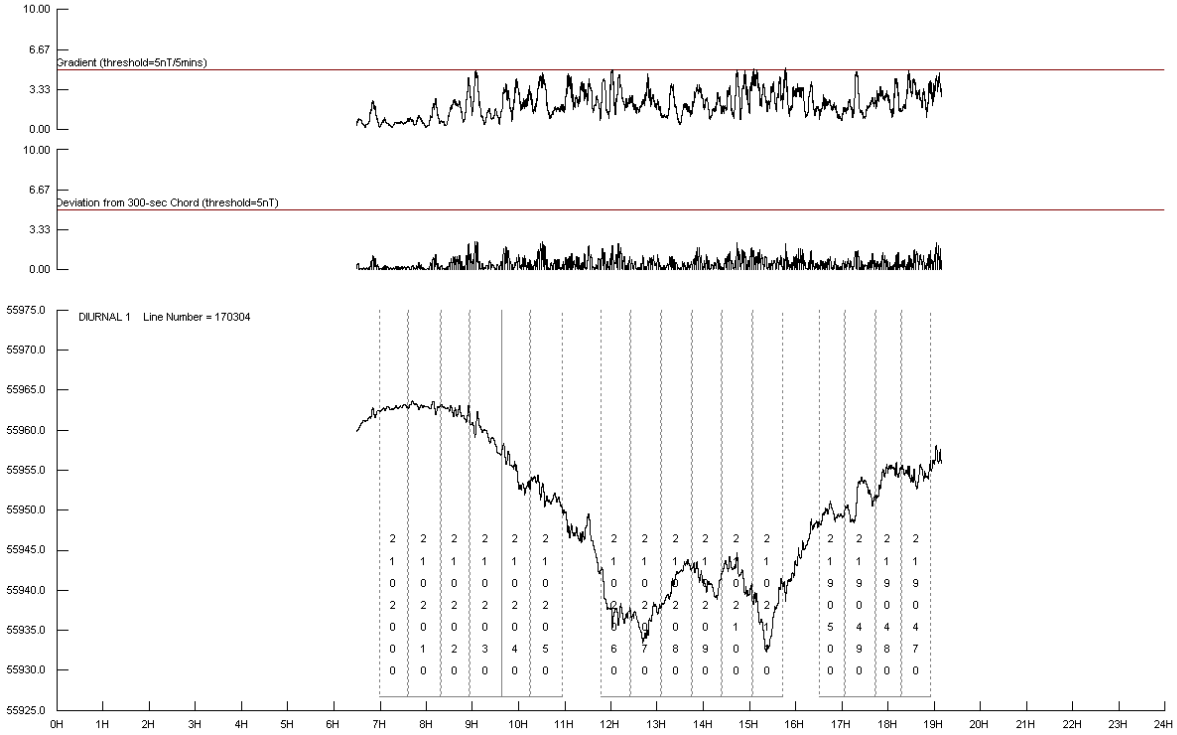
Deviation from 300-sec Chord (threshold=5nT)
DIURNAL 1 Line Number = 170305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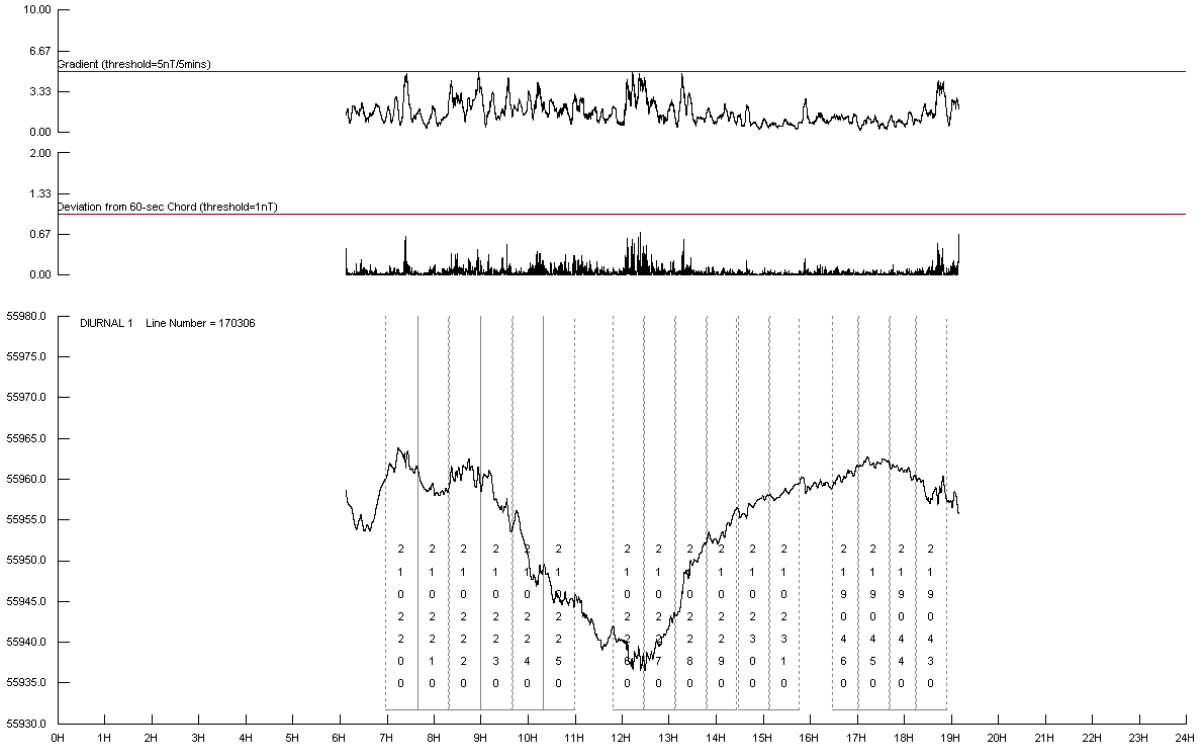
Deviation from 300-sec Chord (threshold=5nT)
DIURNAL 1 Line Number = 170304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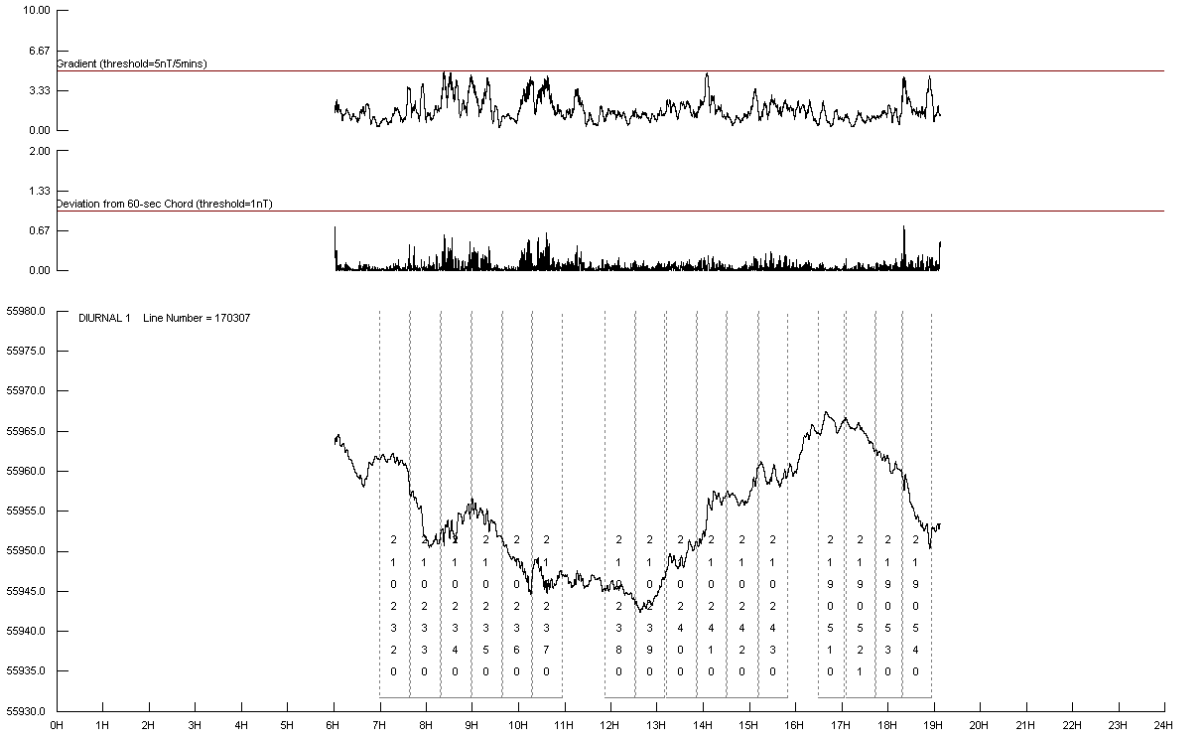
Deviation from 60-sec Chord (threshold=1nT)
DIURNAL 1 Line Number = 170306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Deviation from 60-sec Chord (threshold=1nT)
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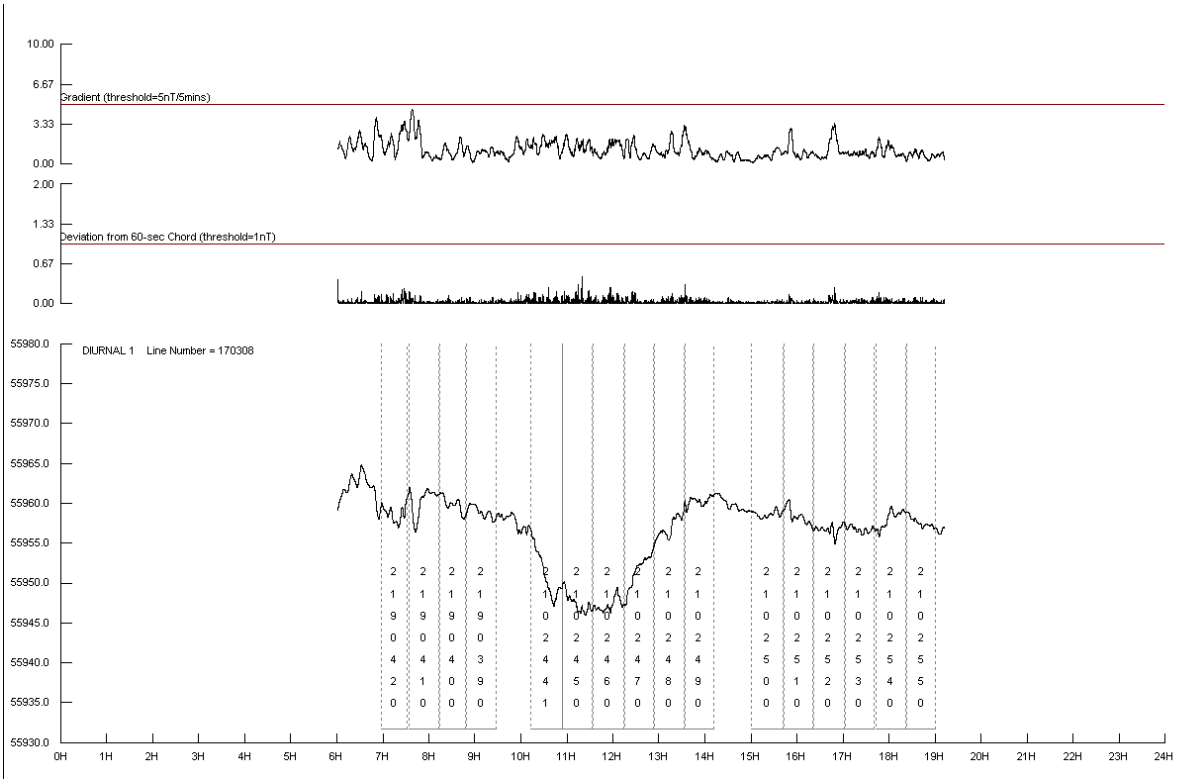
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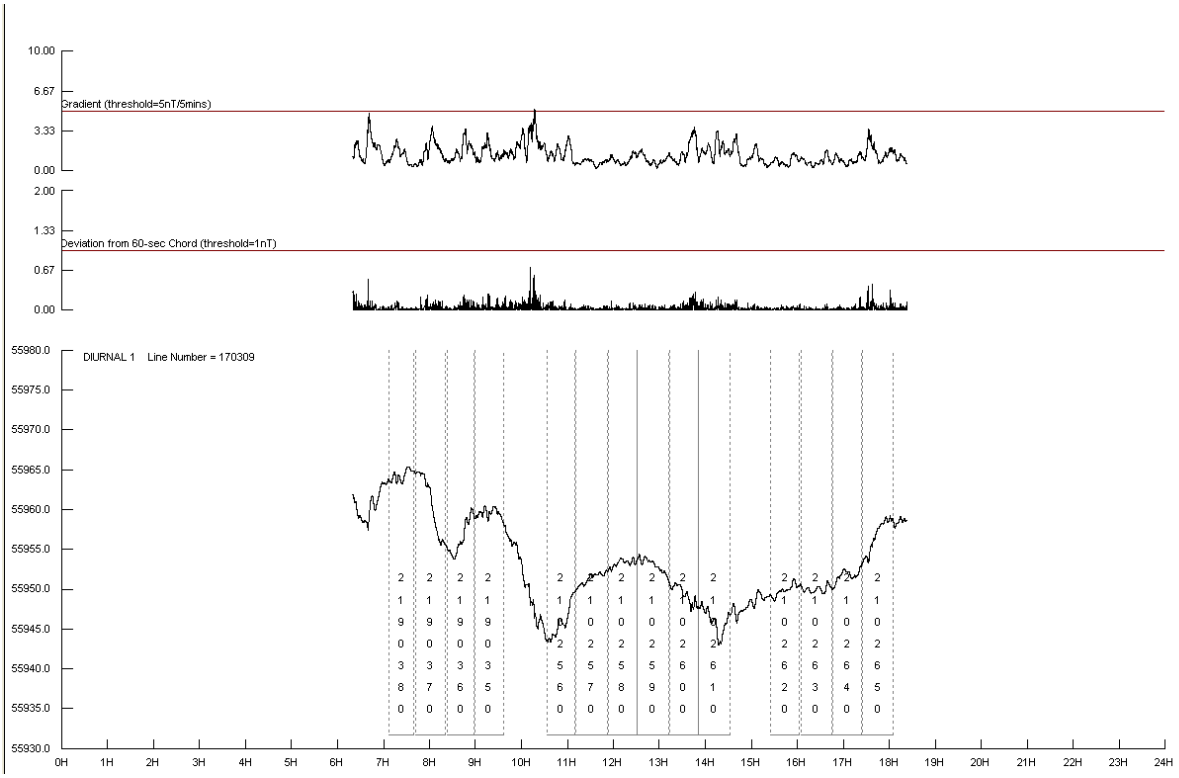
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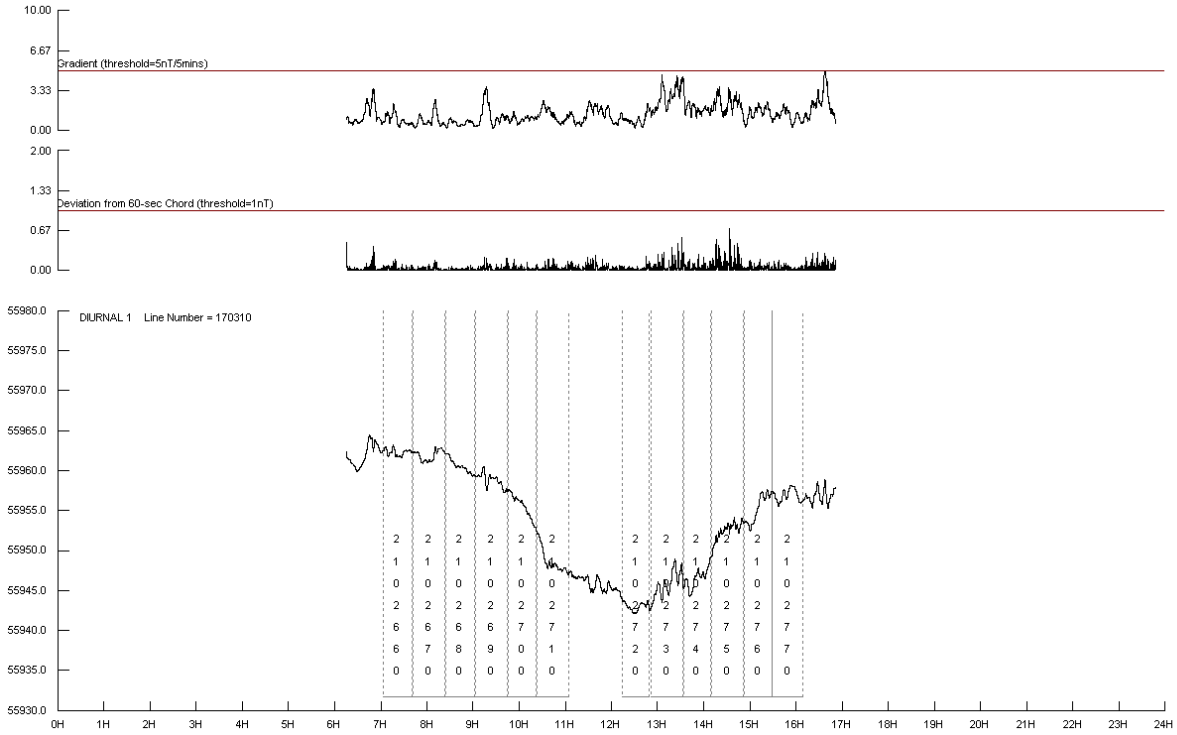
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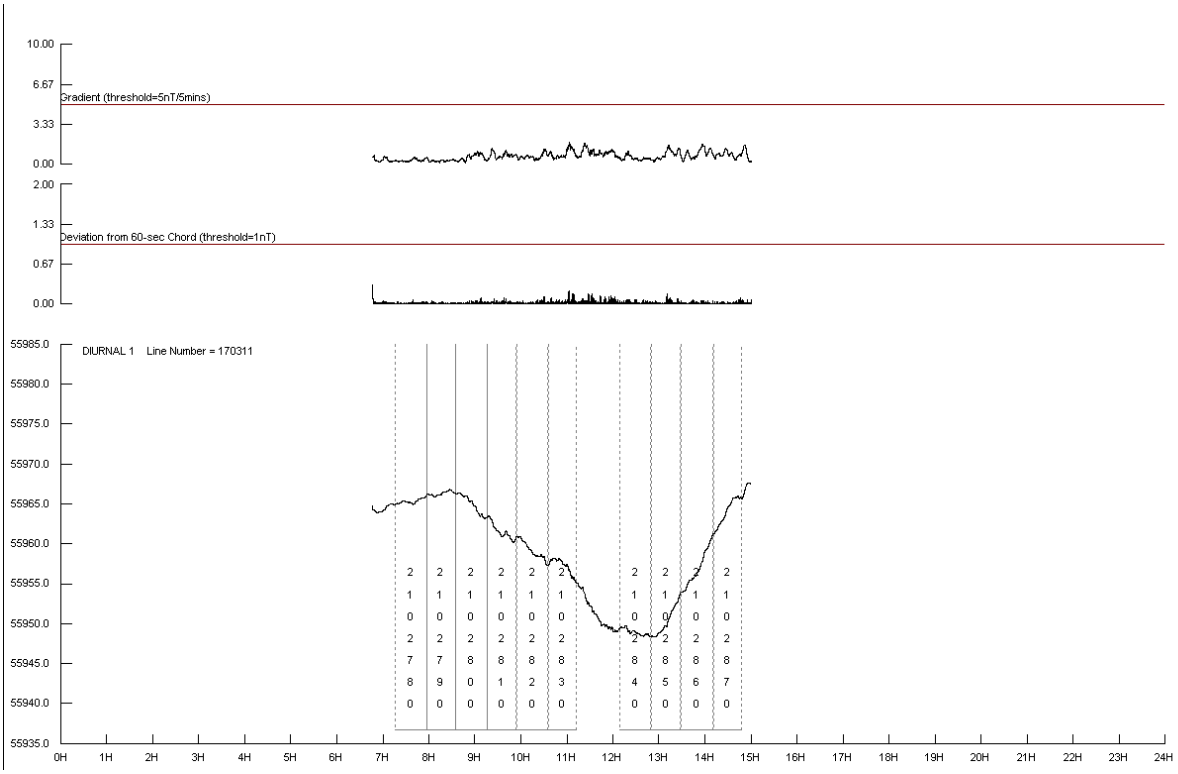
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Deviation from 60-sec Chord (threshold=1nT)
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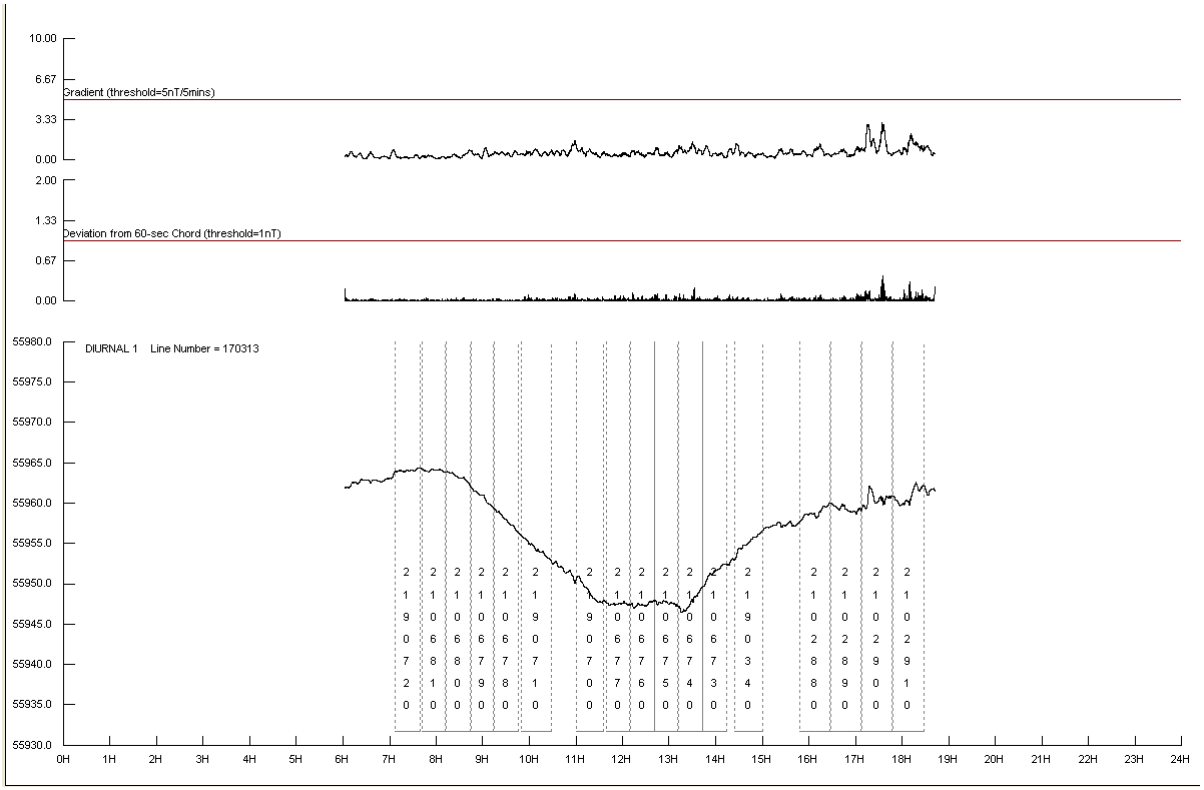
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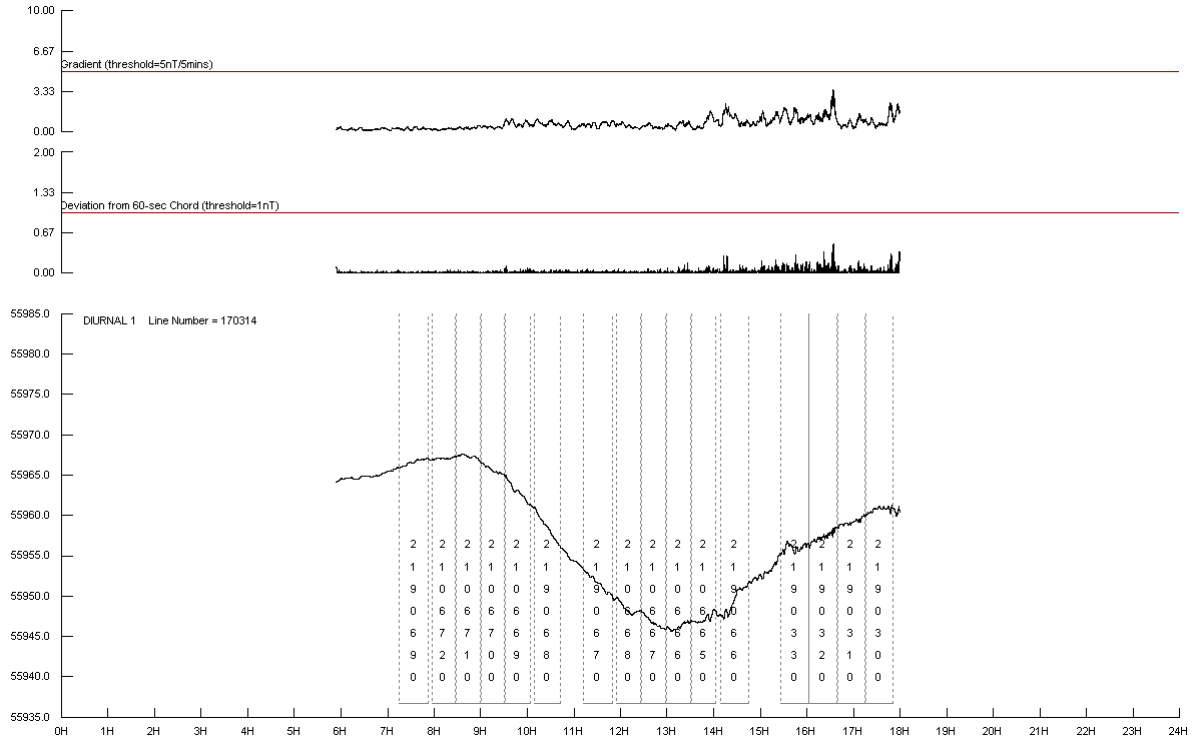
Deviation from 60-sec Chord (threshold=1nT)
DIURNAL 1 Line Number = 170313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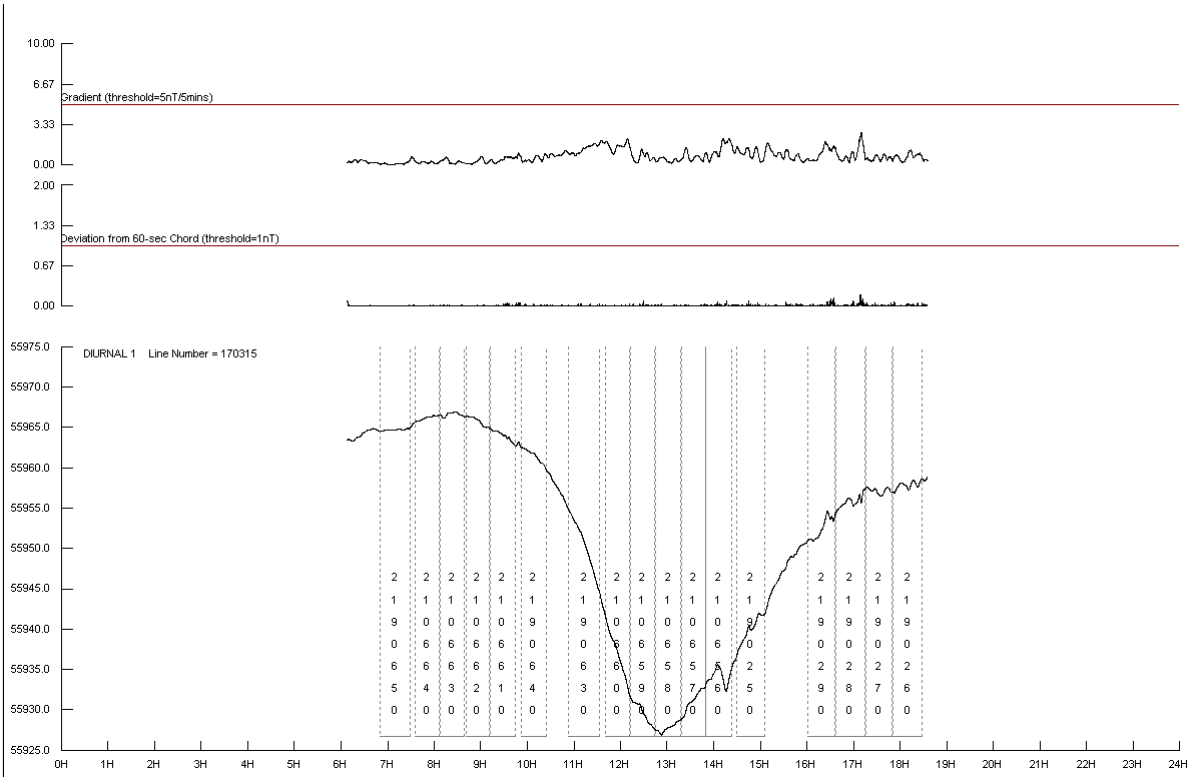
Deviation from 60-sec Chord (threshold=1nT)
DIURNAL 1 Line Number = 170314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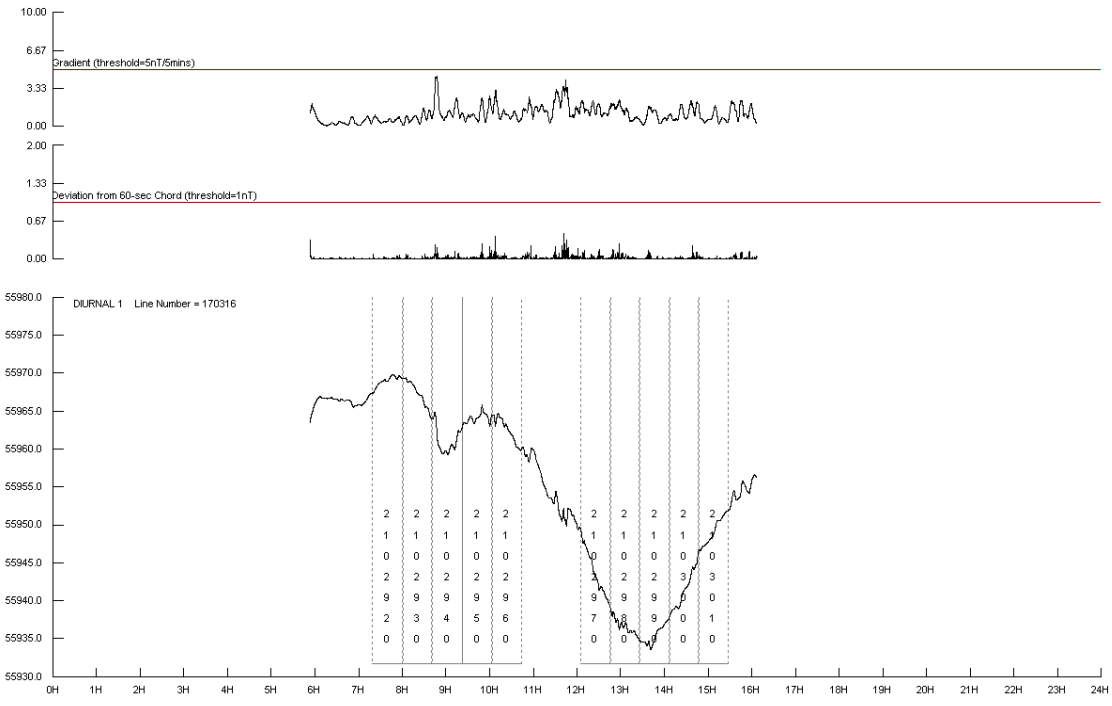
DIURNAL 1 Line Number = 170315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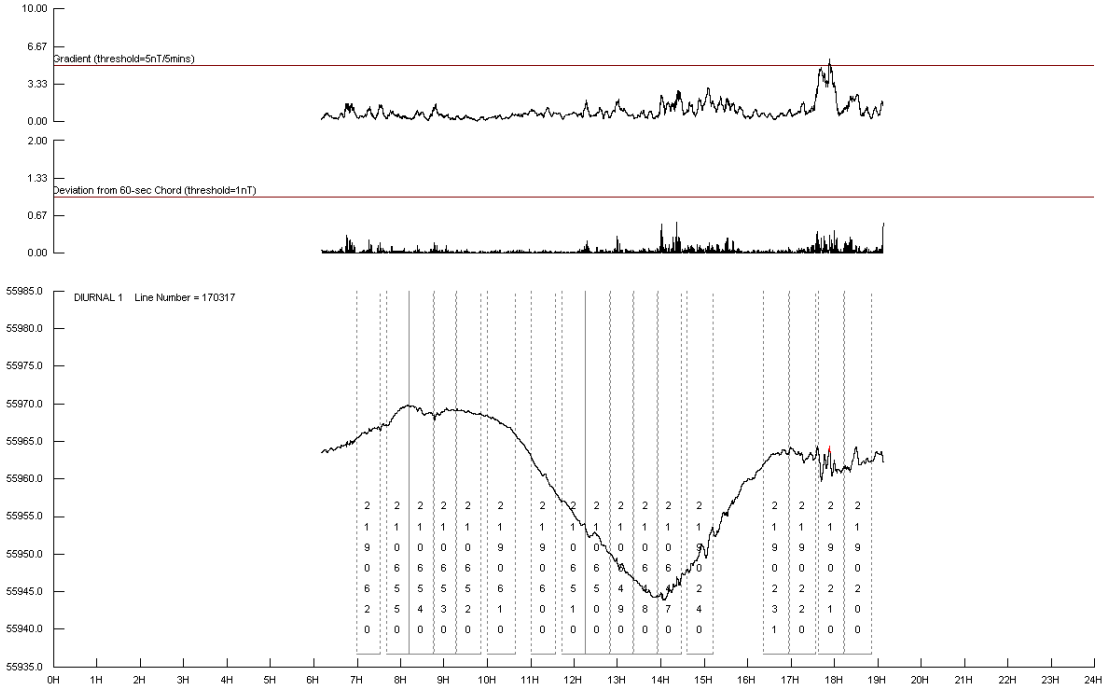
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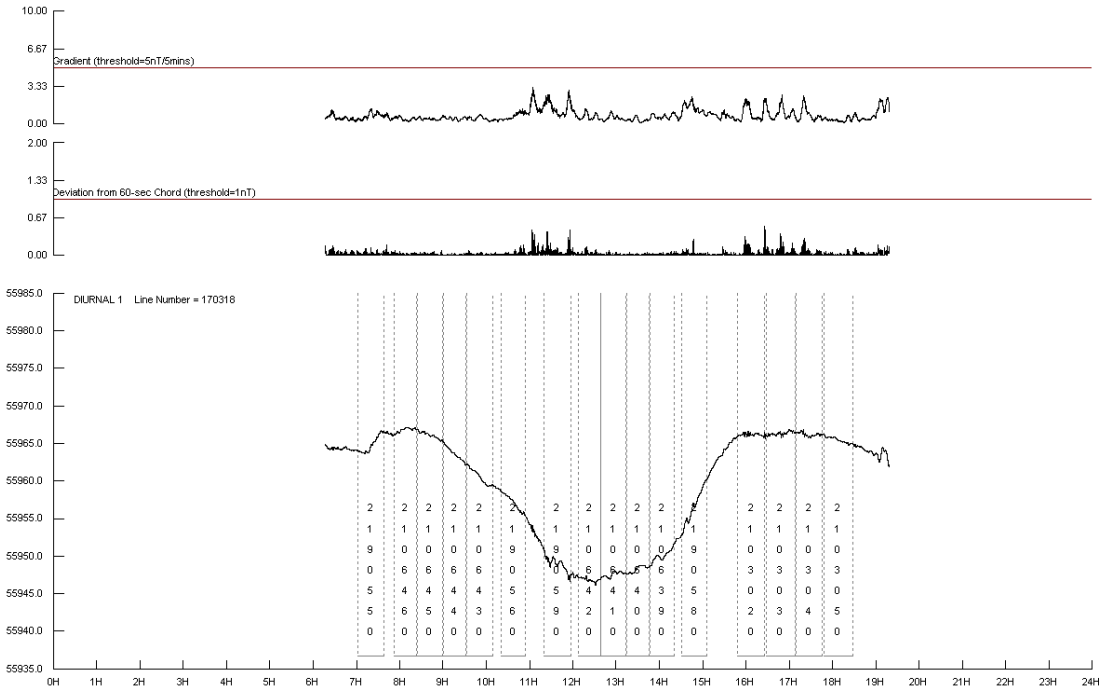
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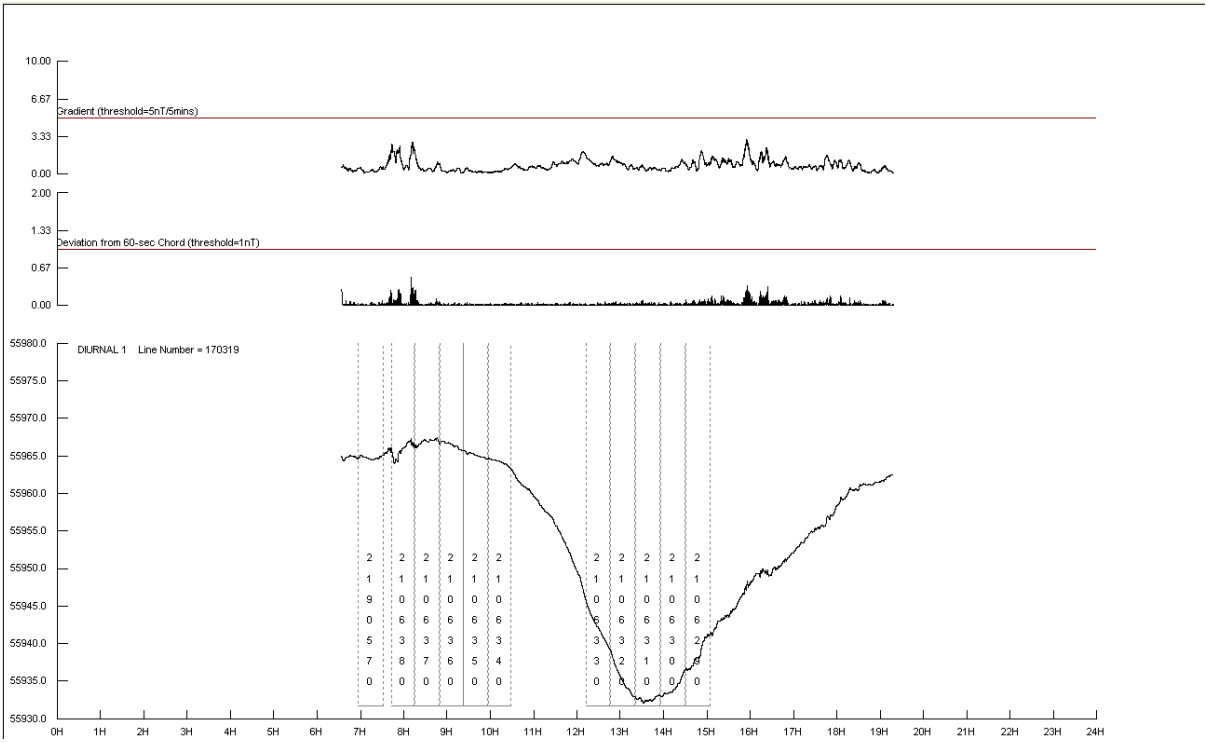
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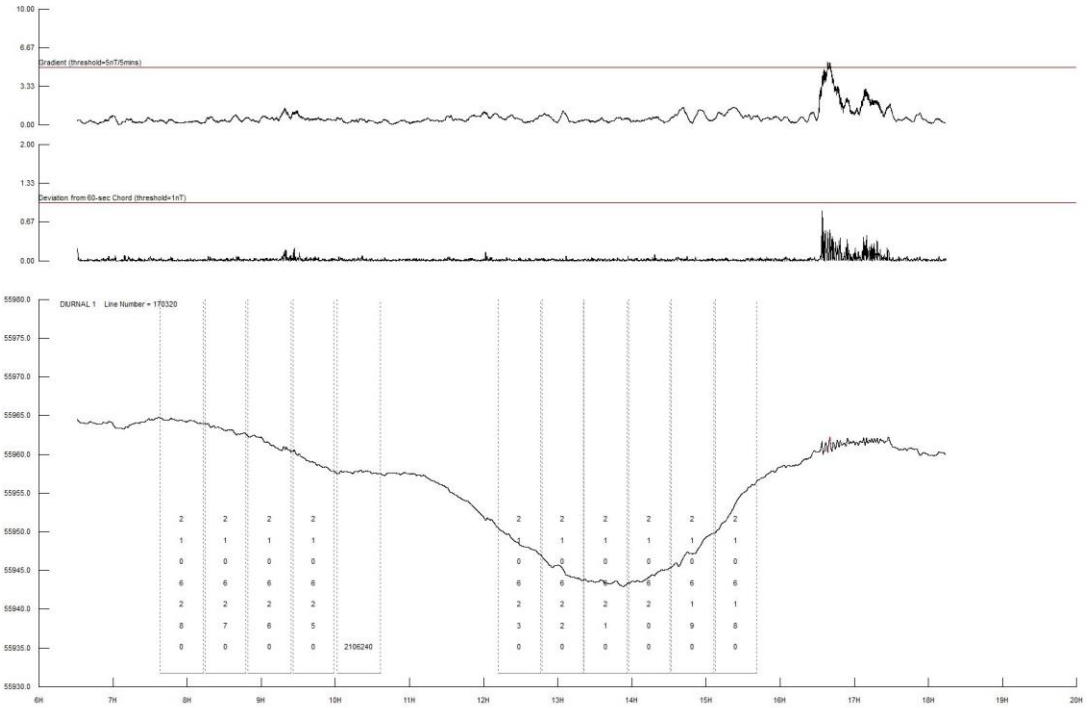
DIURNAL 1 Line Number = 170319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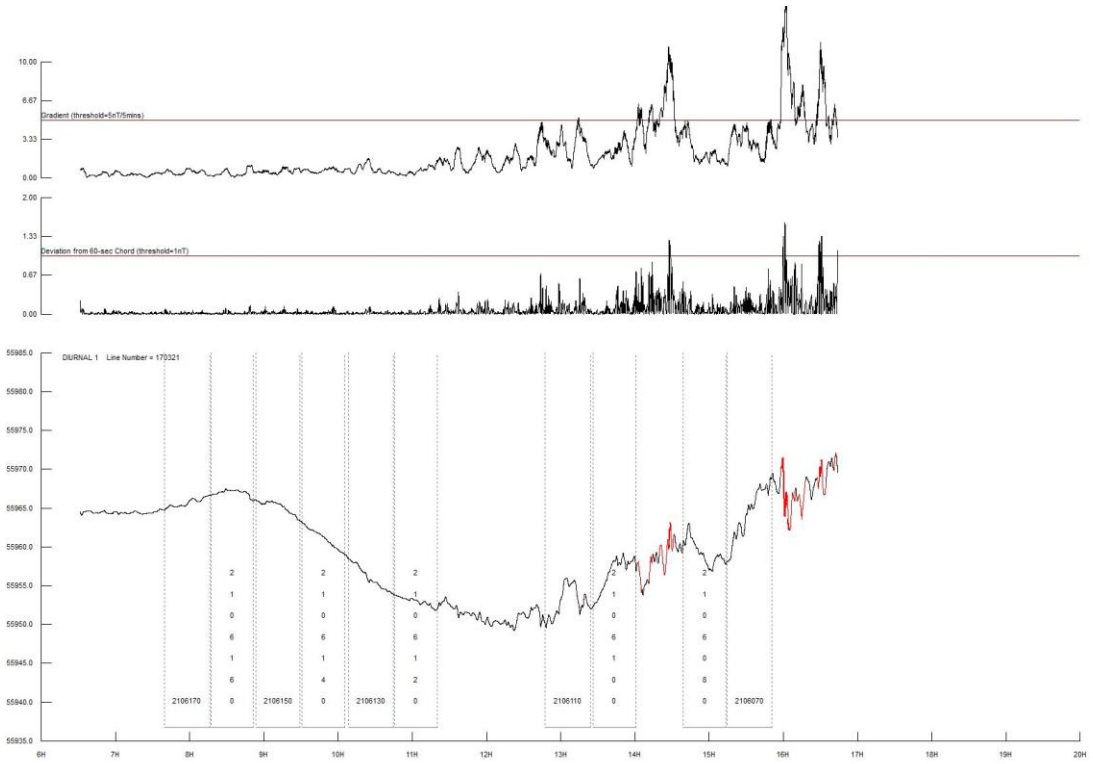
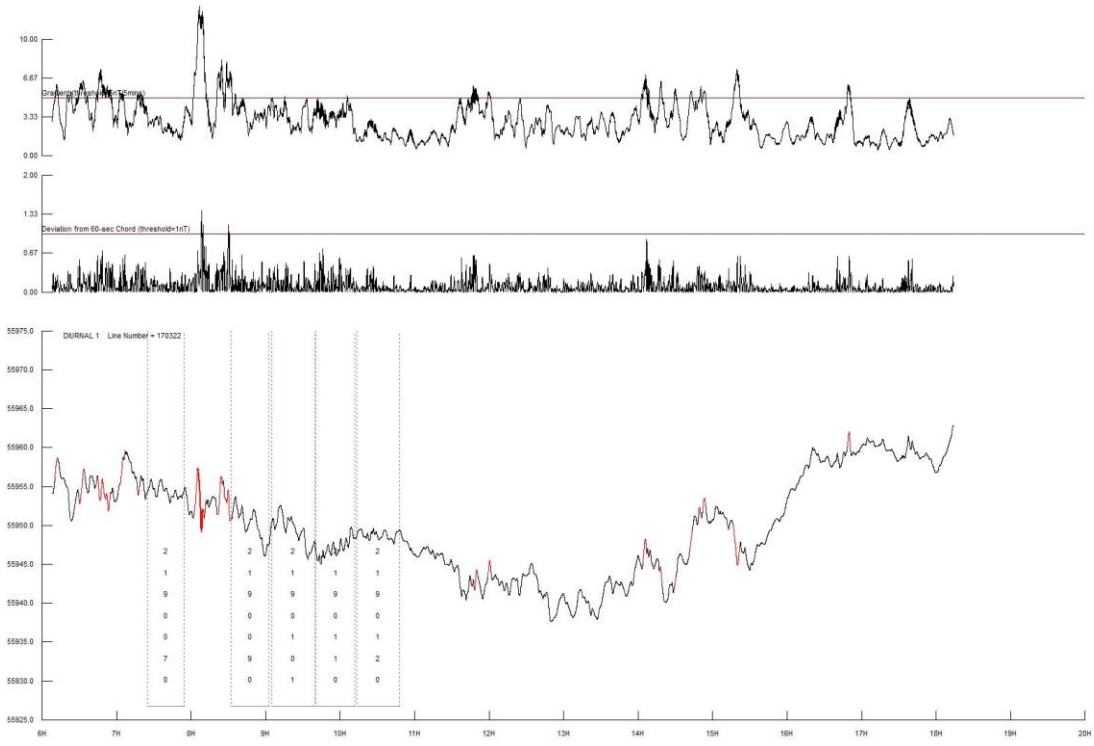
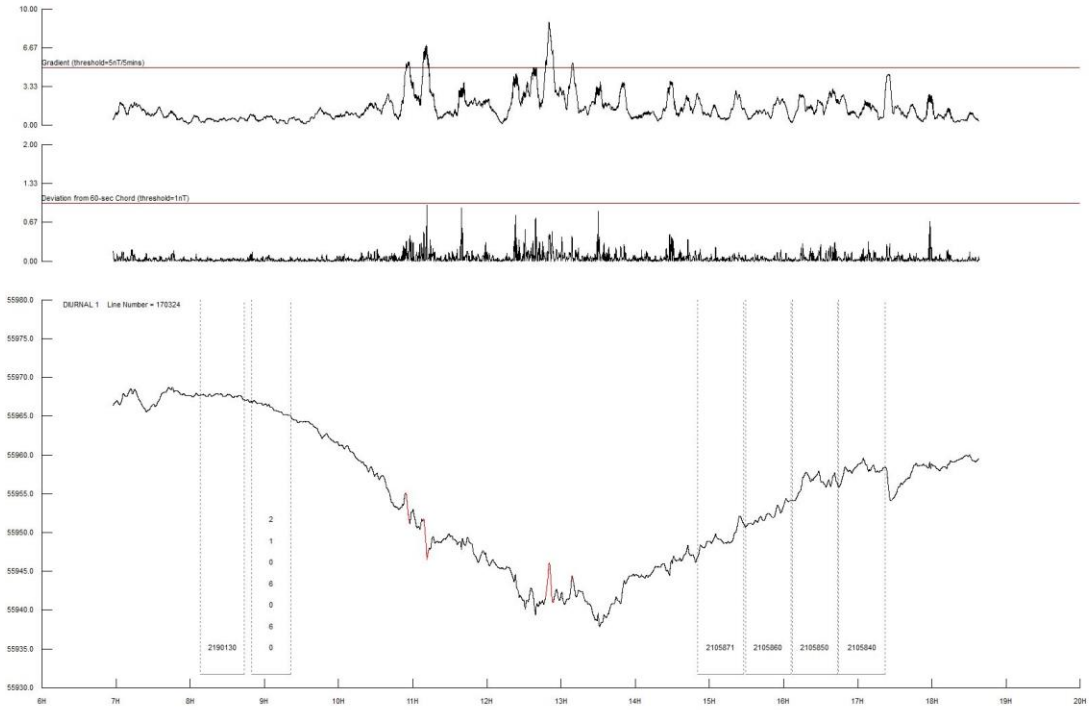
DIURNAL 1 Line Number = 170320


Gradient (threshold=5nT/5mins)
Deviation from 60-sec Chord (threshold=1nT)
DIURNAL 1 Line Number = 170321
2106170
2106150
2106130
2106110
2106070
6H
7H
8H
9H
10H
11H
12H
13H
14H
15H
16H
17H
18H
19H
20H


Deviation from 60-sec Chord (threshold=1nT)
DIURNAL 1 Line Number = 170322
6H
7H
8H
9H
10H
11H
12H
13H
14H
15H
16H
17H
18H
19H
20H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Deviation from 60-sec Chord (threshold=1nT)
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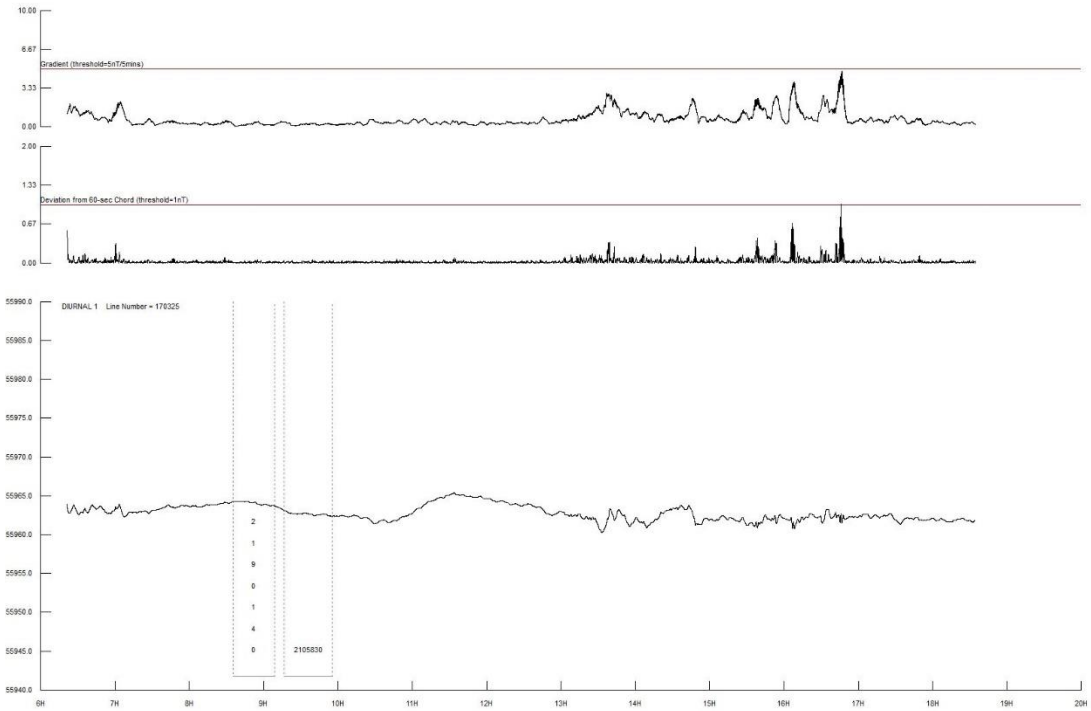
2105850
2105840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Deviation from 60-sec Chord (threshold=1nT)
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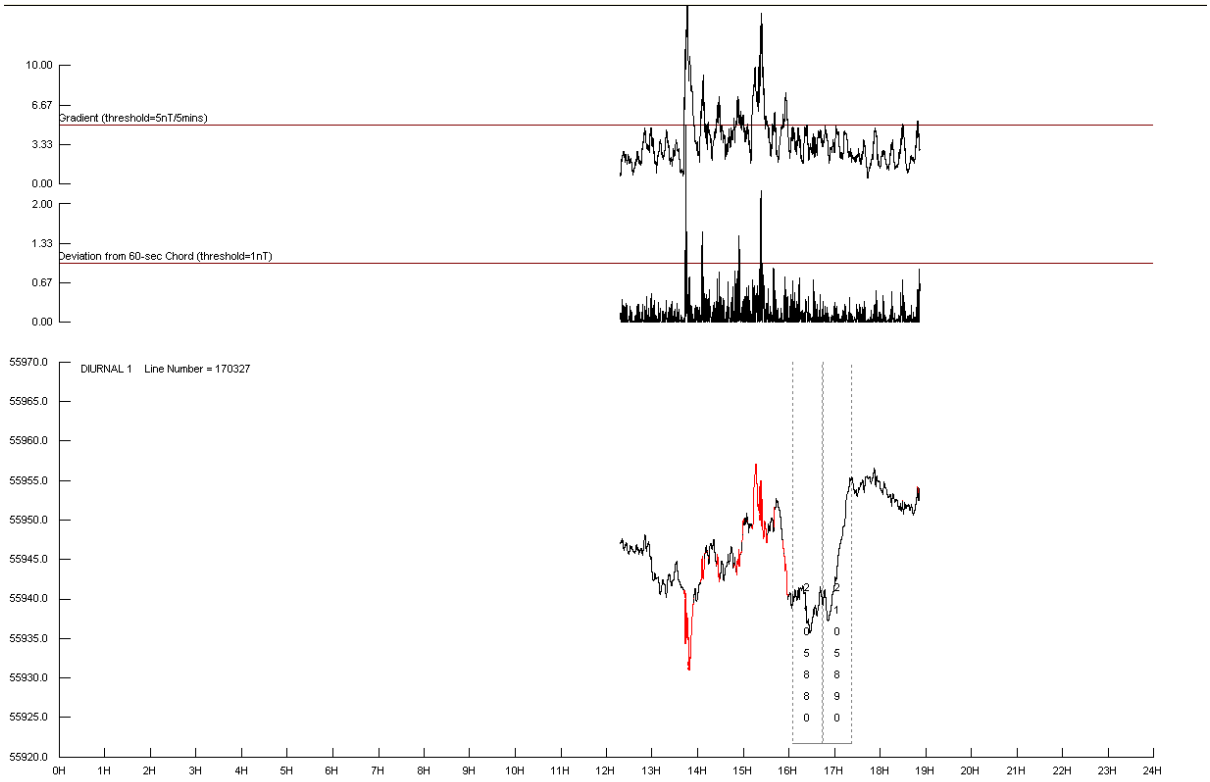
2105830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Gradient (threshold=5nT/5mins)
3.33
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2.00
1.33
Deviation from 60-sec Chord (threshold=1nT)
0.67
0.00
55970.0
DIURNAL 1 Line Number = 170327
55965.0
55960.0
55955.0
55950.0
55945.0
55940.0
55935.0
55930.0
55925.0
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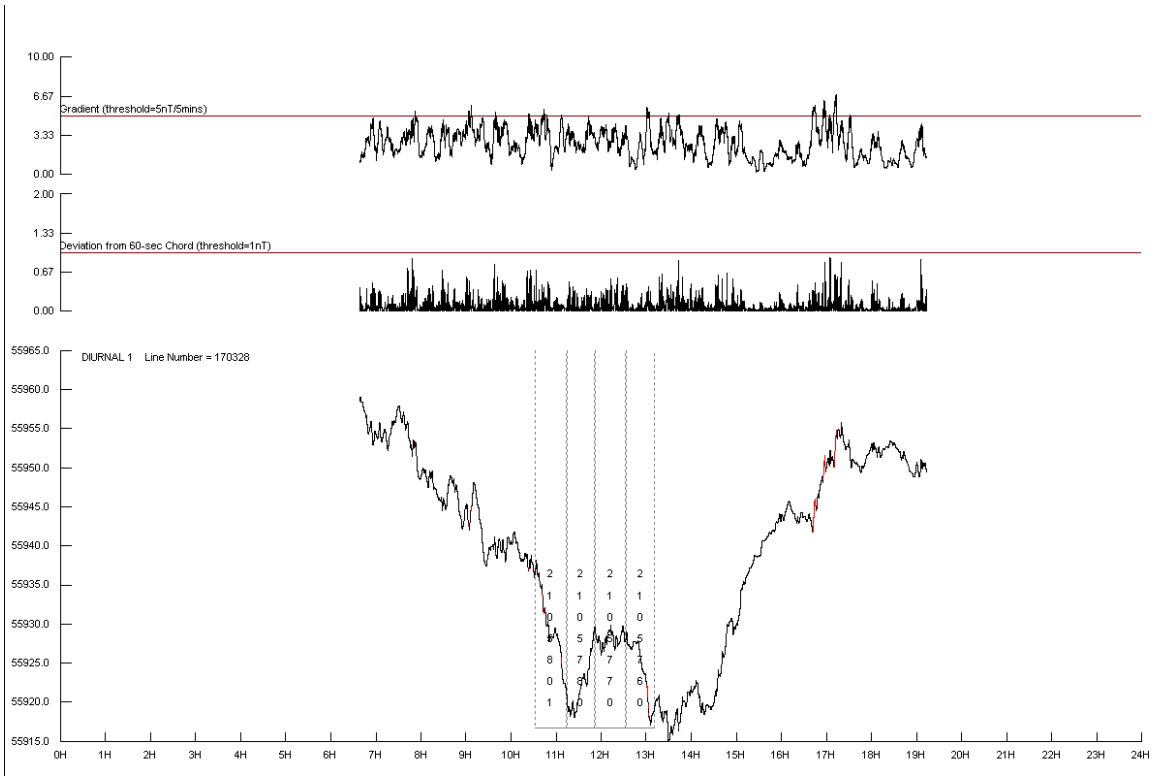
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Gradient (threshold=5nT/5mins)
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0.00
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Deviation from 60-sec Chord (threshold=1nT)
0.67
0.00
55965.0
DIURNAL 1 Line Number = 170328
55960.0
55955.0
55950.0
55945.0
55940.0
55935.0
55930.0
55925.0
55920.0
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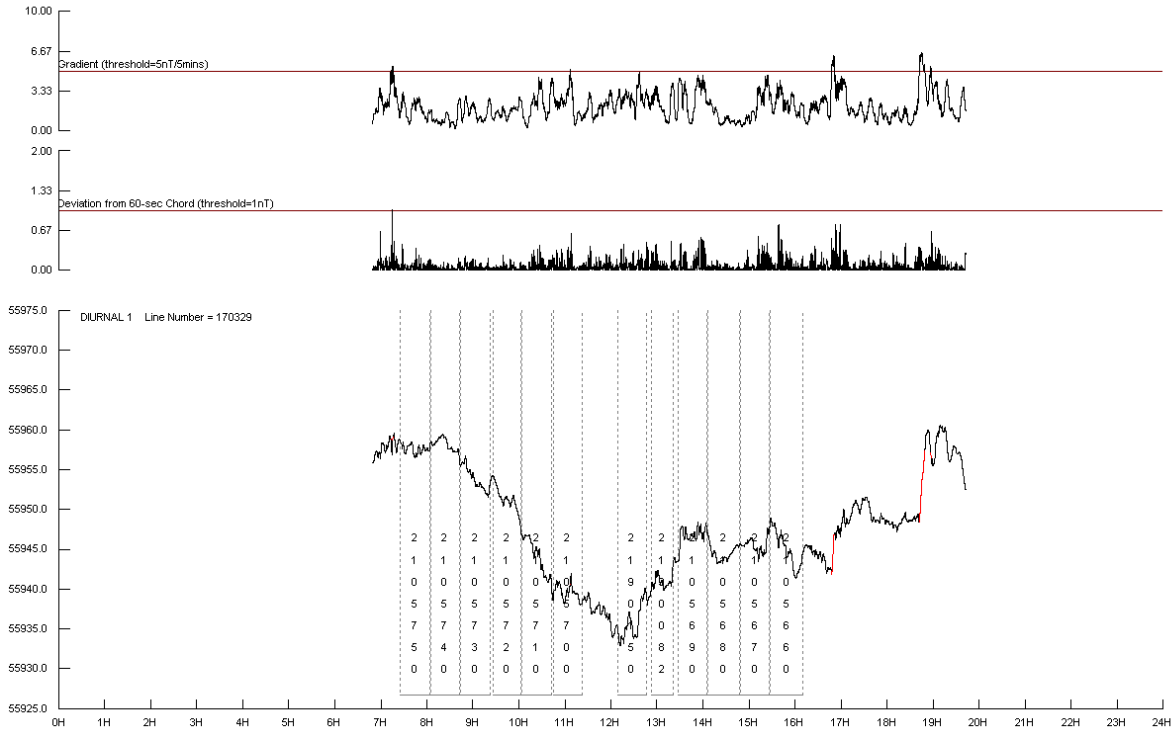
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Deviation from 60-sec Chord (threshold=1nT)
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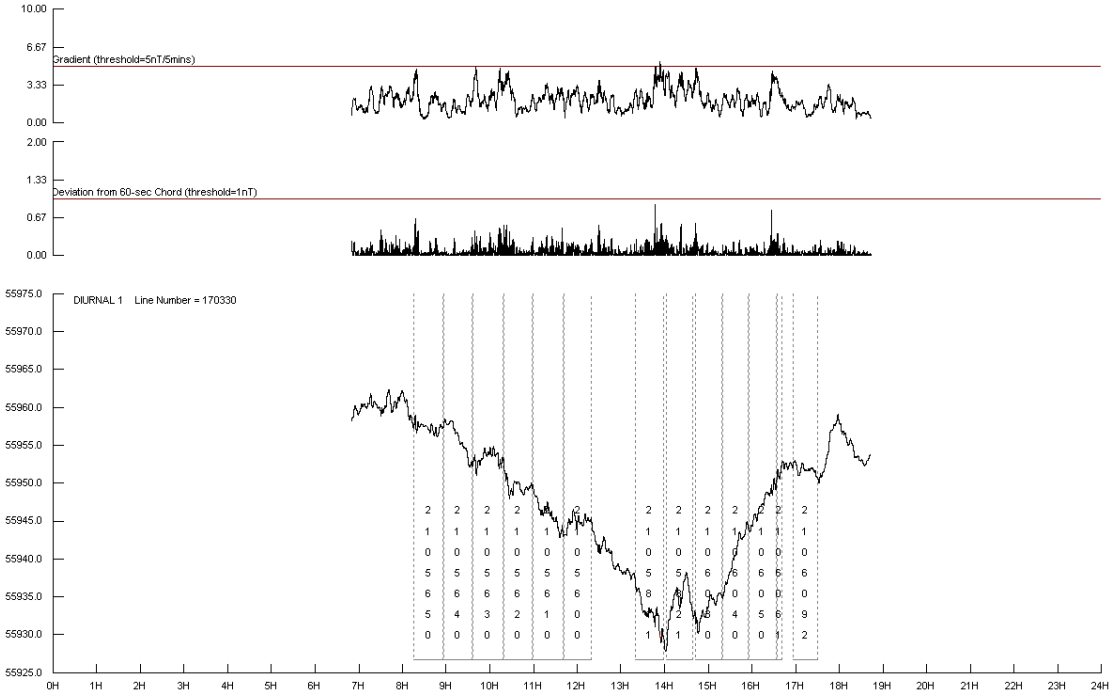
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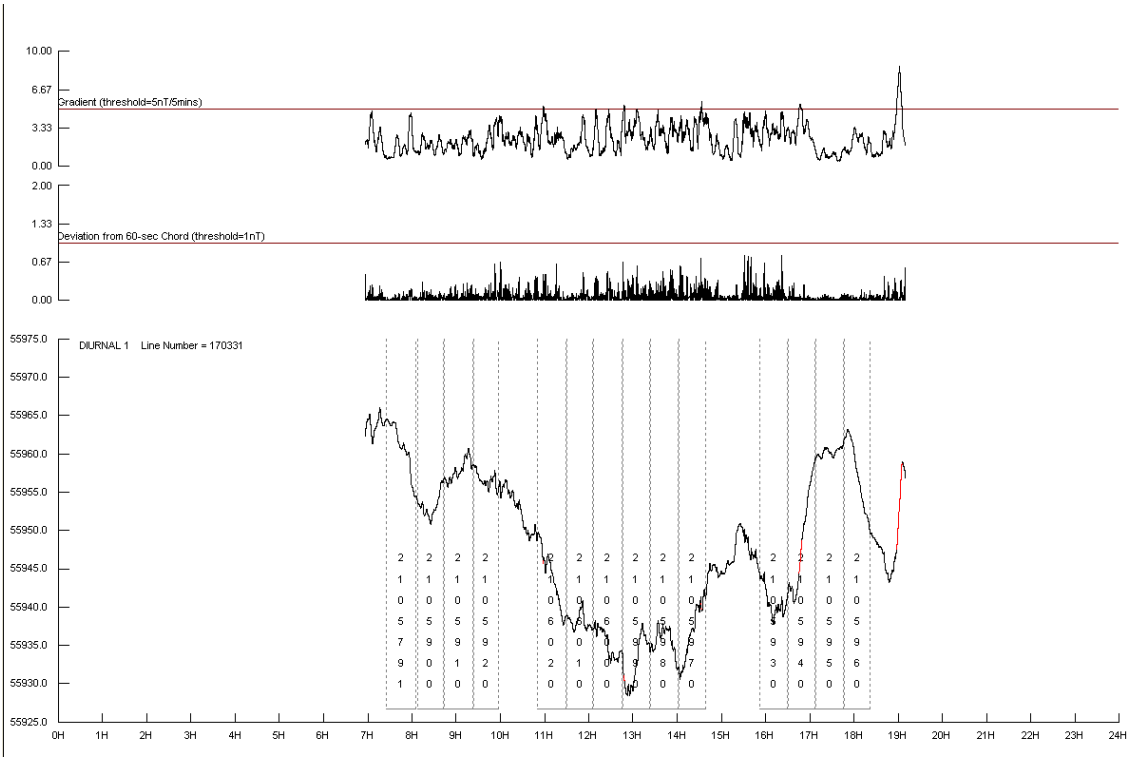
Deviation from 60-sec Chord (threshold=1nT)
DIURNAL 1 Line Number = 170330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Gradient (threshold=5nT/5mins)
3.33
0.00
2.00
1.33
Deviation from 60-sec Chord (threshold=1nT)
0.67
0.00
55975.0
DIURNAL 1 Line Number = 170331
55970.0
55965.0
55960.0
55955.0
55950.0
55945.0
55940.0
55935.0
55930.0
55925.0
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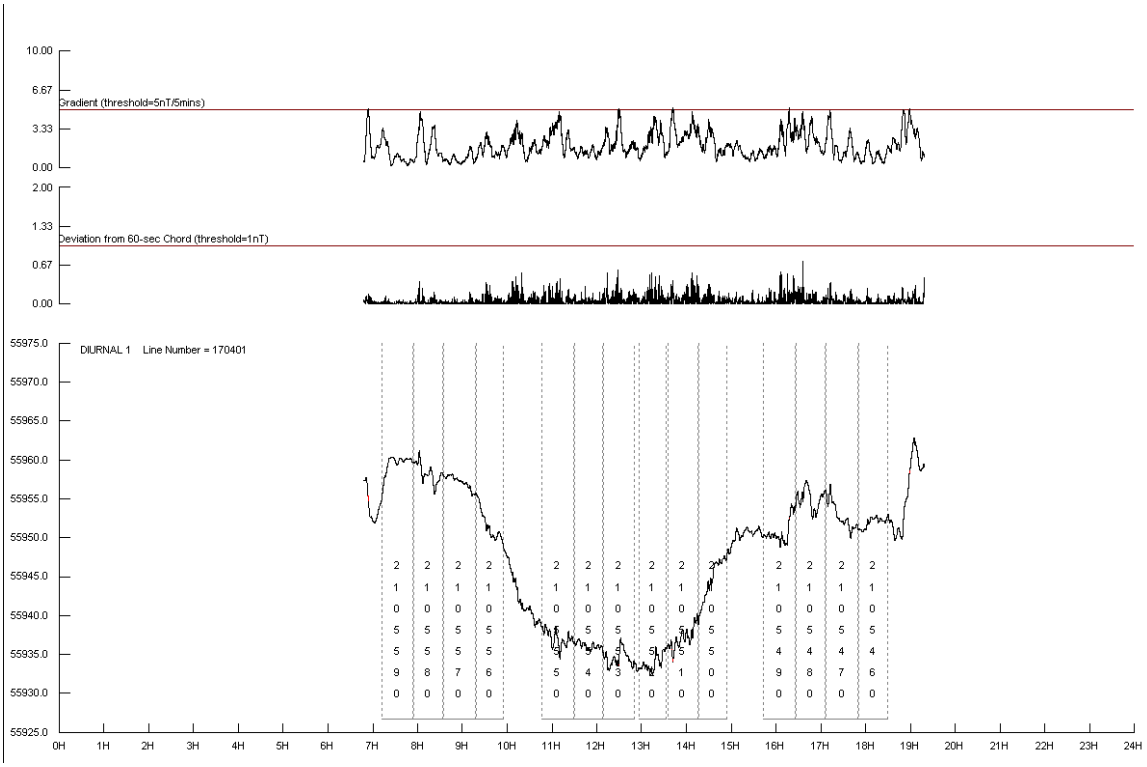
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Gradient (threshold=5nT/5mins)
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0.00
2.00
1.33
Deviation from 60-sec Chord (threshold=1nT)
0.67
0.00
55975.0
DIURNAL 1 Line Number = 170401
55970.0
55965.0
55960.0
55955.0
55950.0
55945.0
55940.0
55935.0
55930.0
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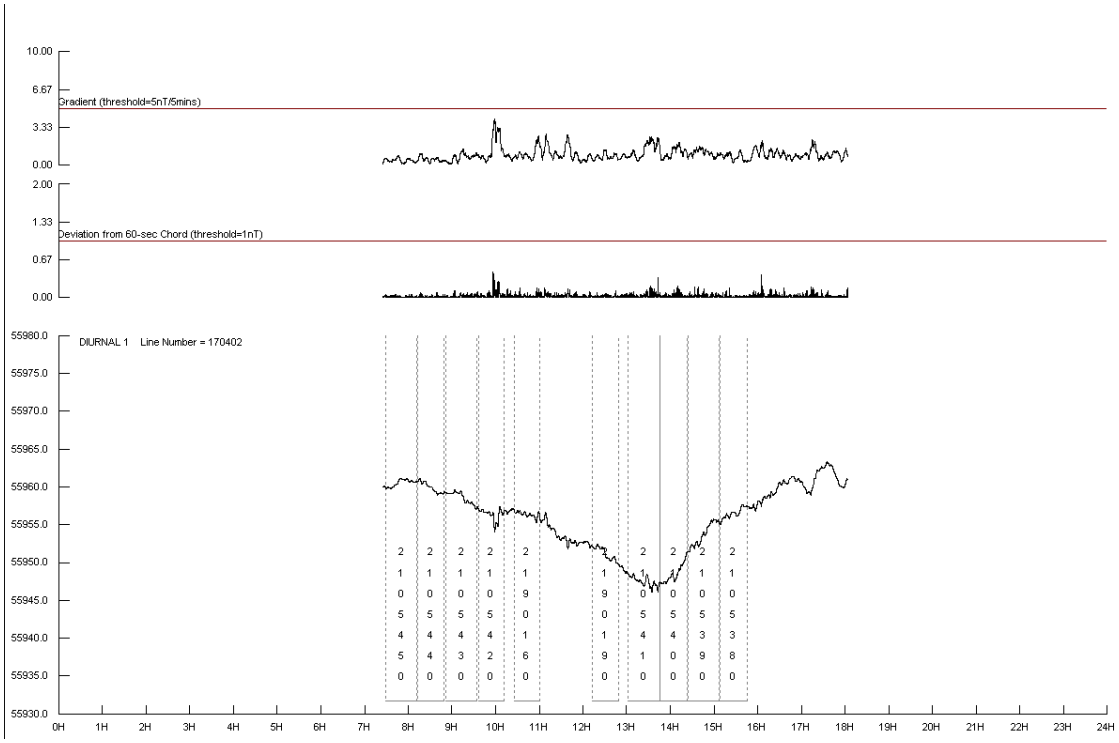
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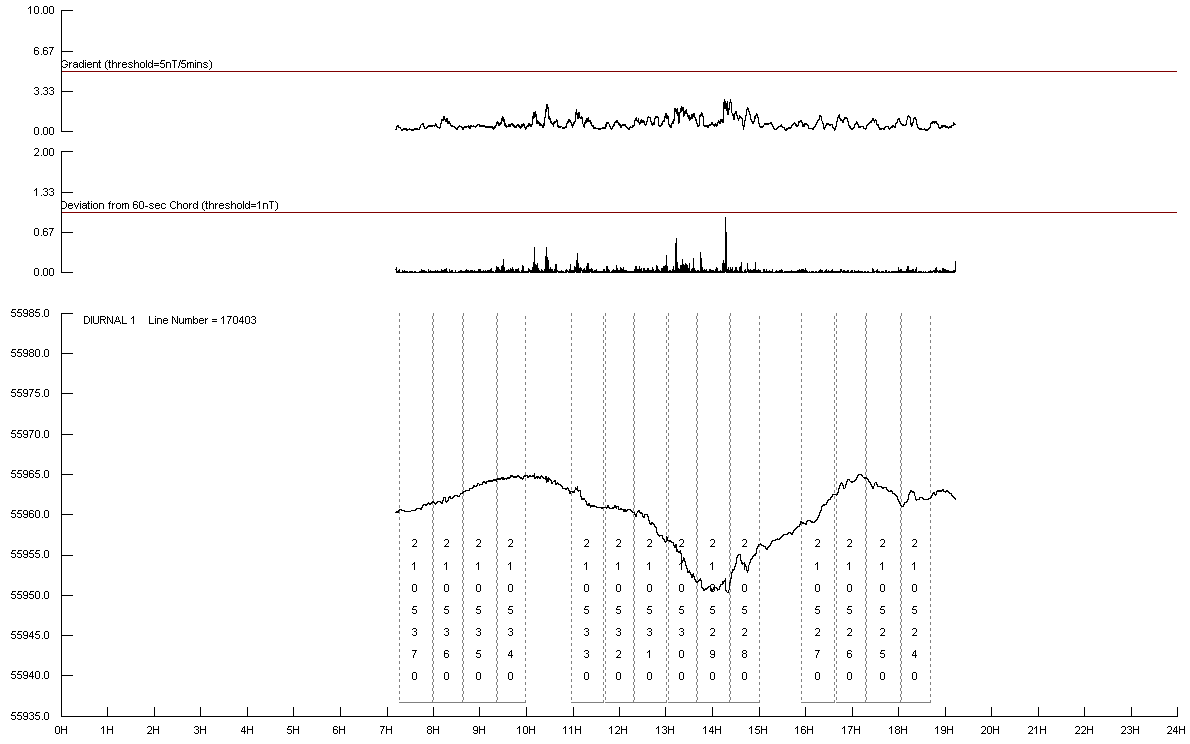
Deviation from 60-sec Chord (threshold=1nT)
DIURNAL 1 Line Number = 170402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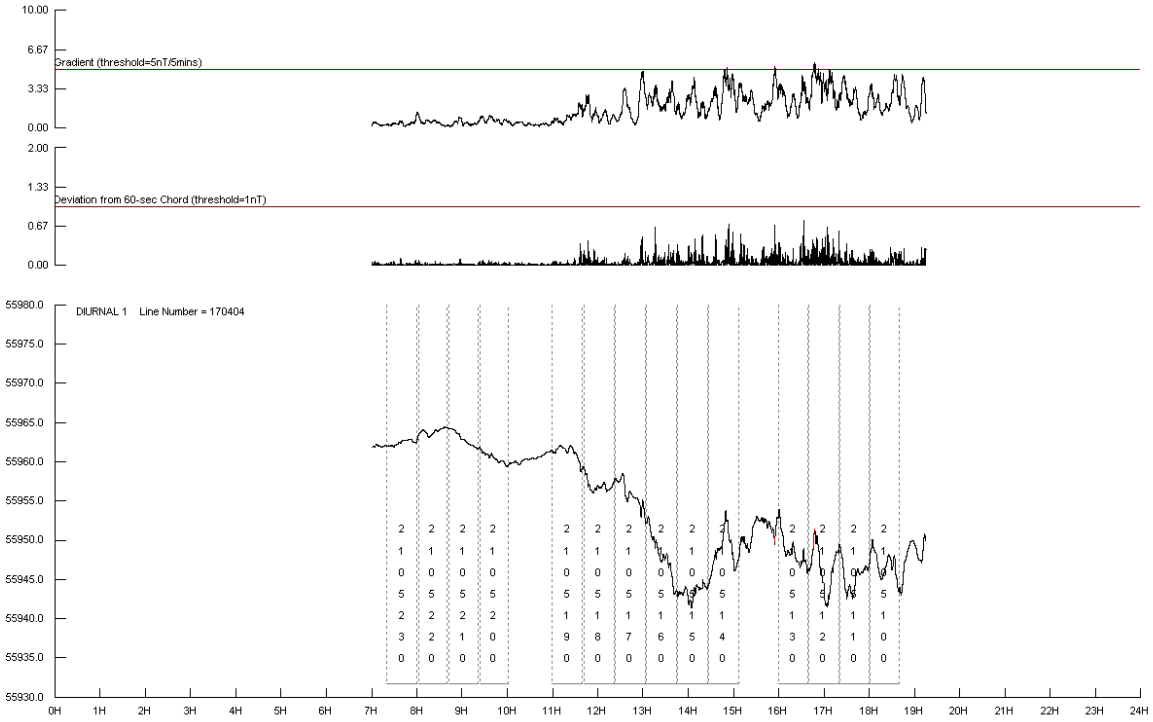
Deviation from 60-sec Chord (threshold=1nT)
DIURNAL 1 Line Number = 170403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Deviation from 60-sec Chord (threshold=1nT)
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0.00
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DIURNAL 1 Line Number = 170404
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55970.0
55965.0
55960.0
55955.0
55950.0
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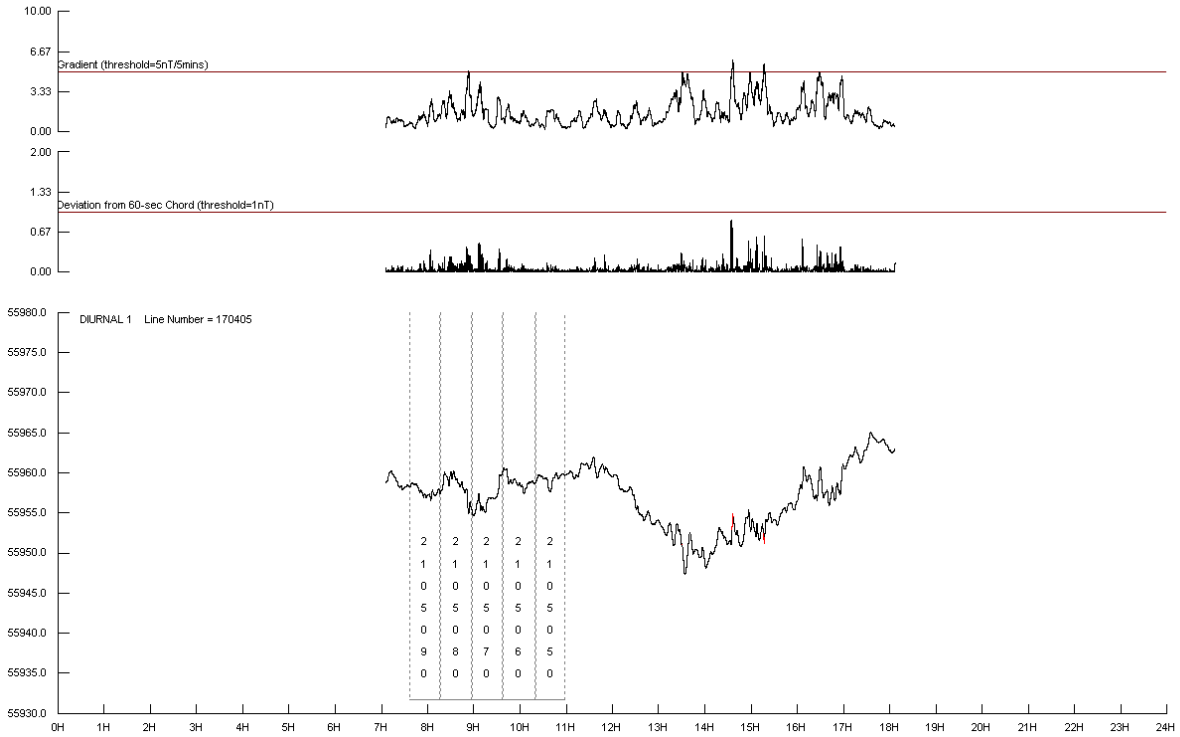
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Gradient (threshold=5nT/5mins)
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0.00
2.00
1.33
Deviation from 60-sec Chord (threshold=1nT)
0.67
0.00
55980.0
DIURNAL 1 Line Number = 170405
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55970.0
55965.0
55960.0
55955.0
55950.0
55945.0
55940.0
55935.0
55930.0
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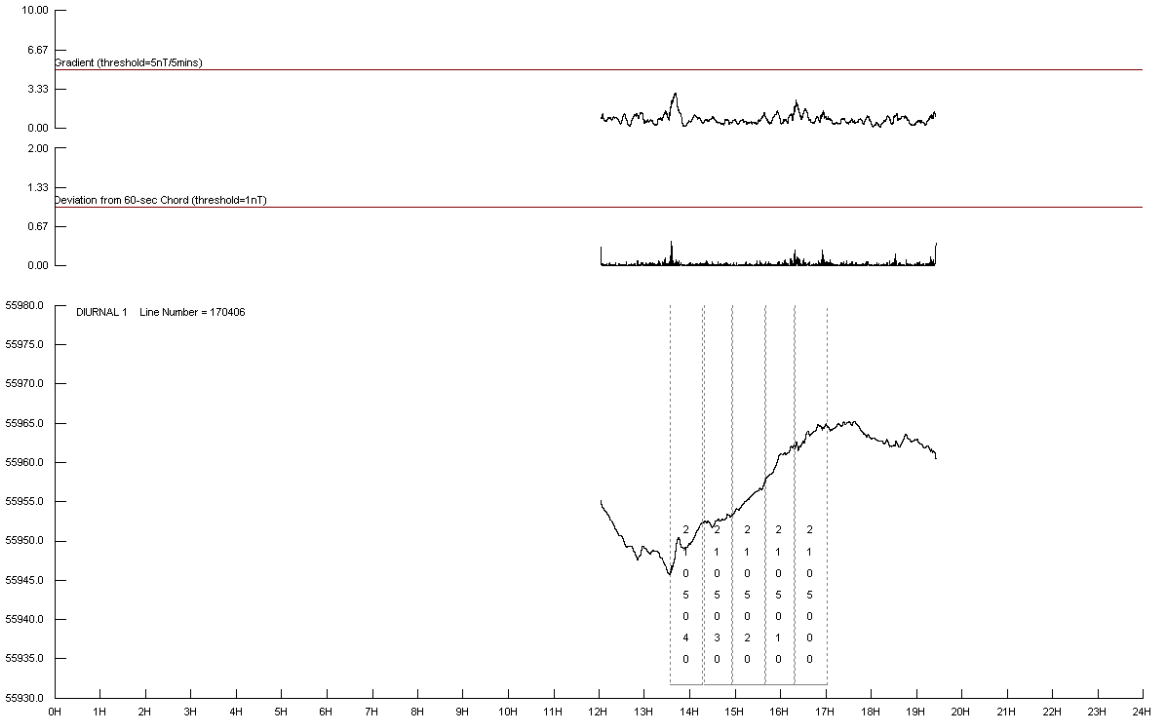
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Gradient (threshold=5nT/5mins)
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0.00
2.00
1.33
Deviation from 60-sec Chord (threshold=1nT)
0.67
0.00
55980.0
DIURNAL 1 Line Number = 170406
55975.0
55970.0
55965.0
55960.0
55955.0
55950.0
55945.0
55940.0
55935.0
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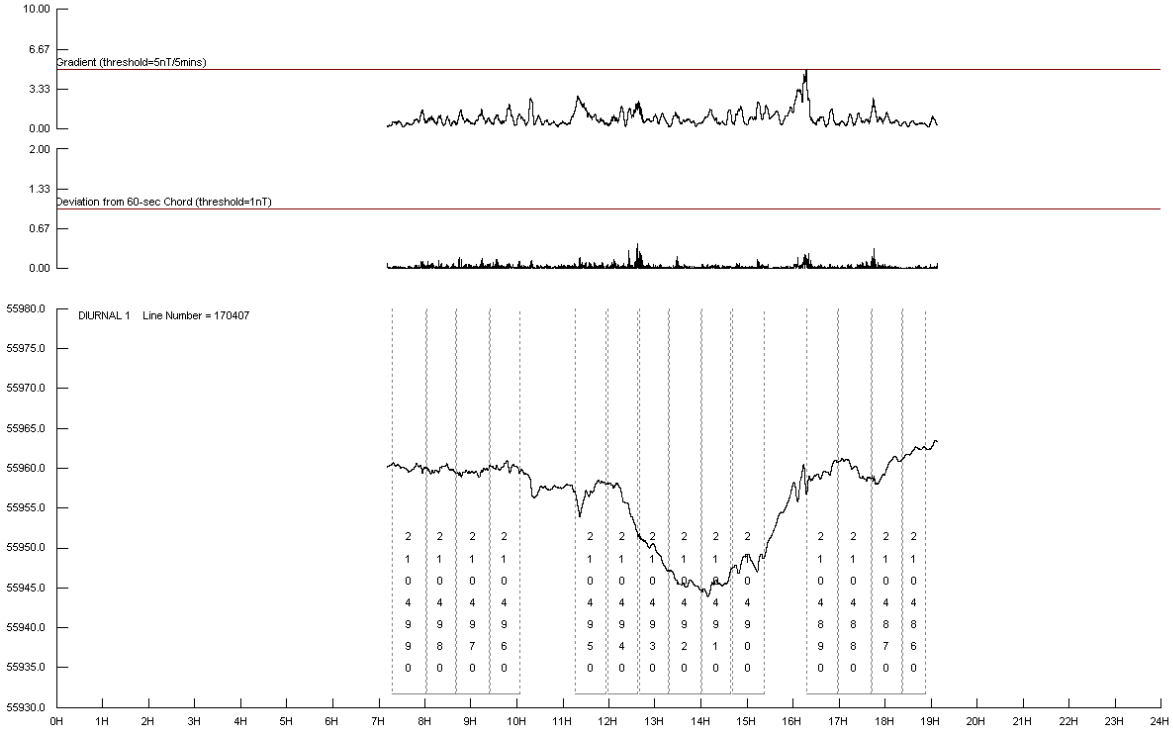
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Gradient (threshold=5nT/5mins)
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0.00
2.00
1.33
Deviation from 60-sec Chord (threshold=1nT)
0.67
0.00
55980.0
DIURNAL 1 Line Number = 170407
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55965.0
55960.0
55955.0
55950.0
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55940.0
55935.0
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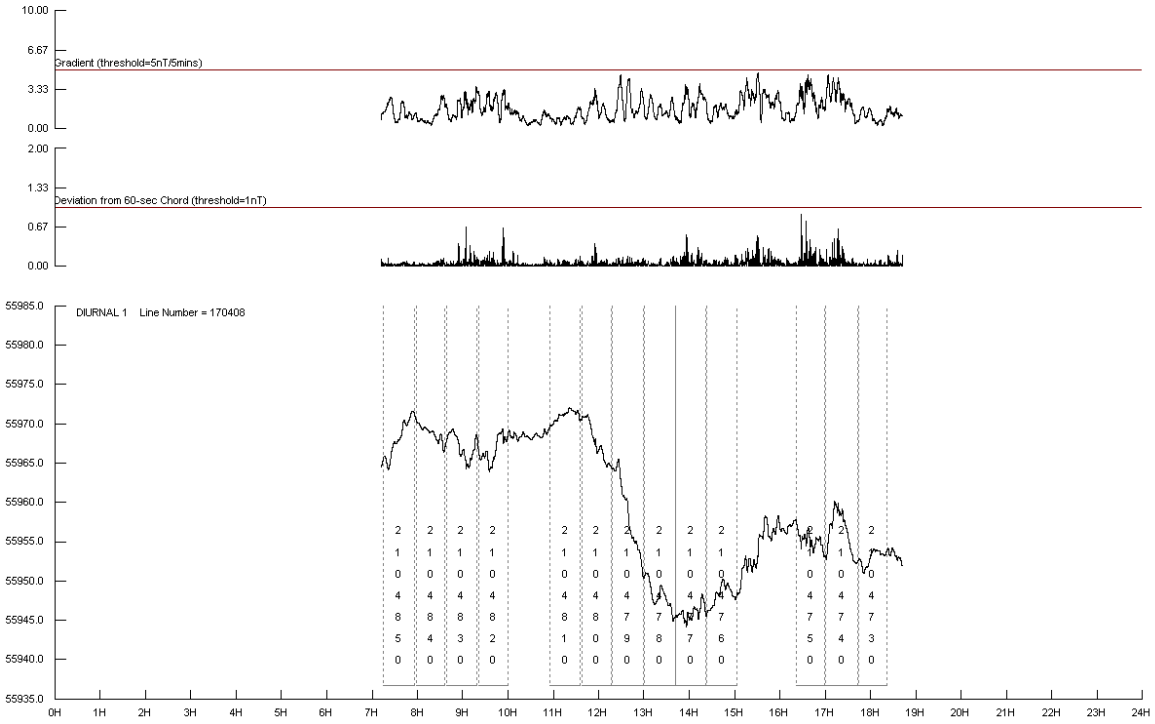
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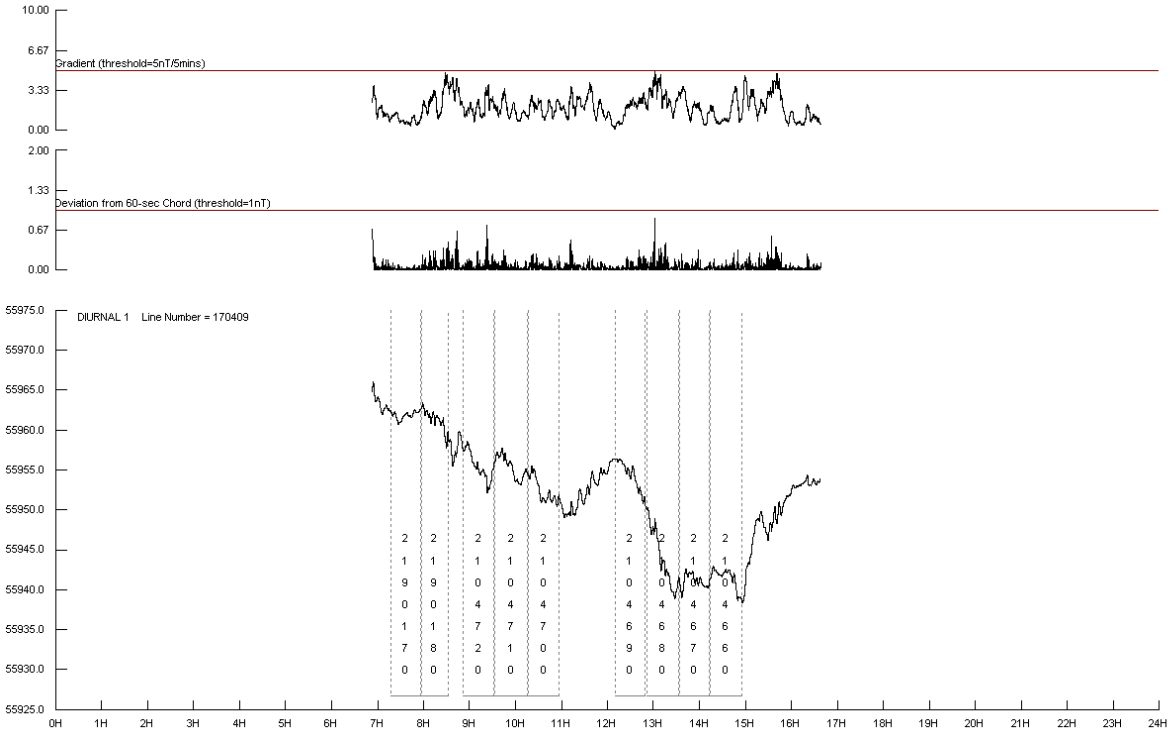
Deviation from 60-sec Chord (threshold=1nT)
DIURNAL 1 Line Number = 170408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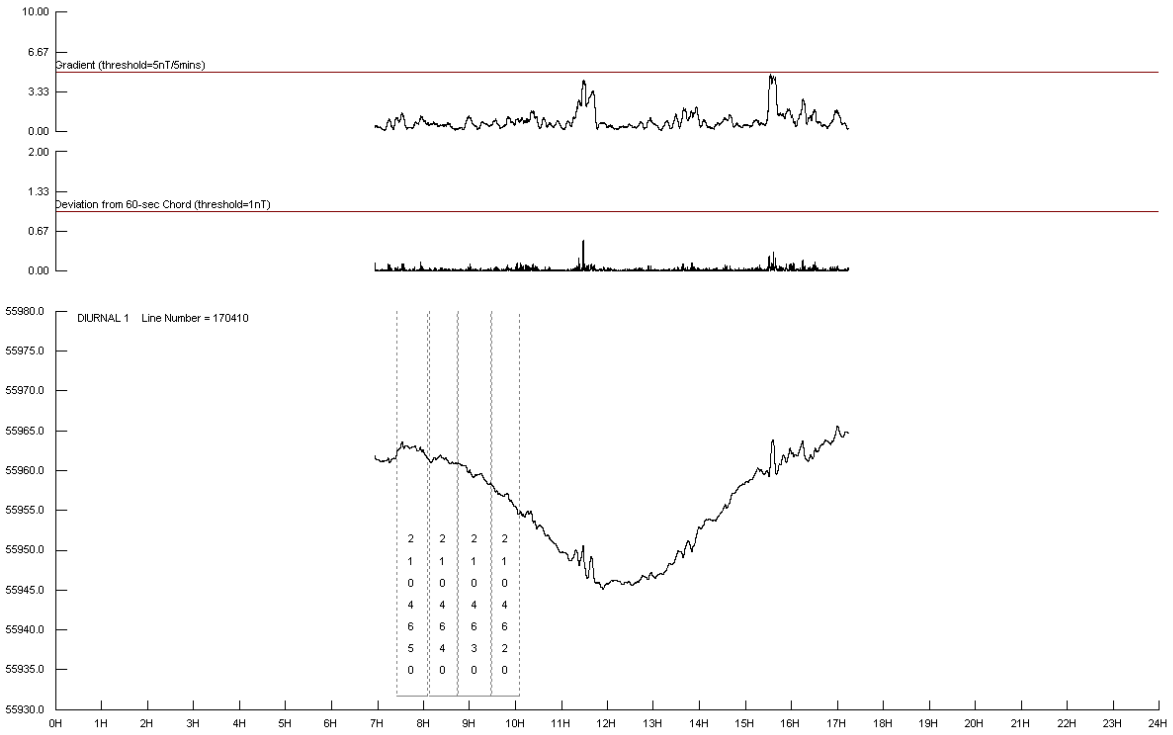
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0.00
2.00
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Deviation from 60-sec Chord (threshold=1nT)
0.67
0.00
55980.0
DIURNAL 1 Line Number = 170410
55975.0
55970.0
55965.0
55960.0
55955.0
55950.0
55945.0
55940.0
55935.0
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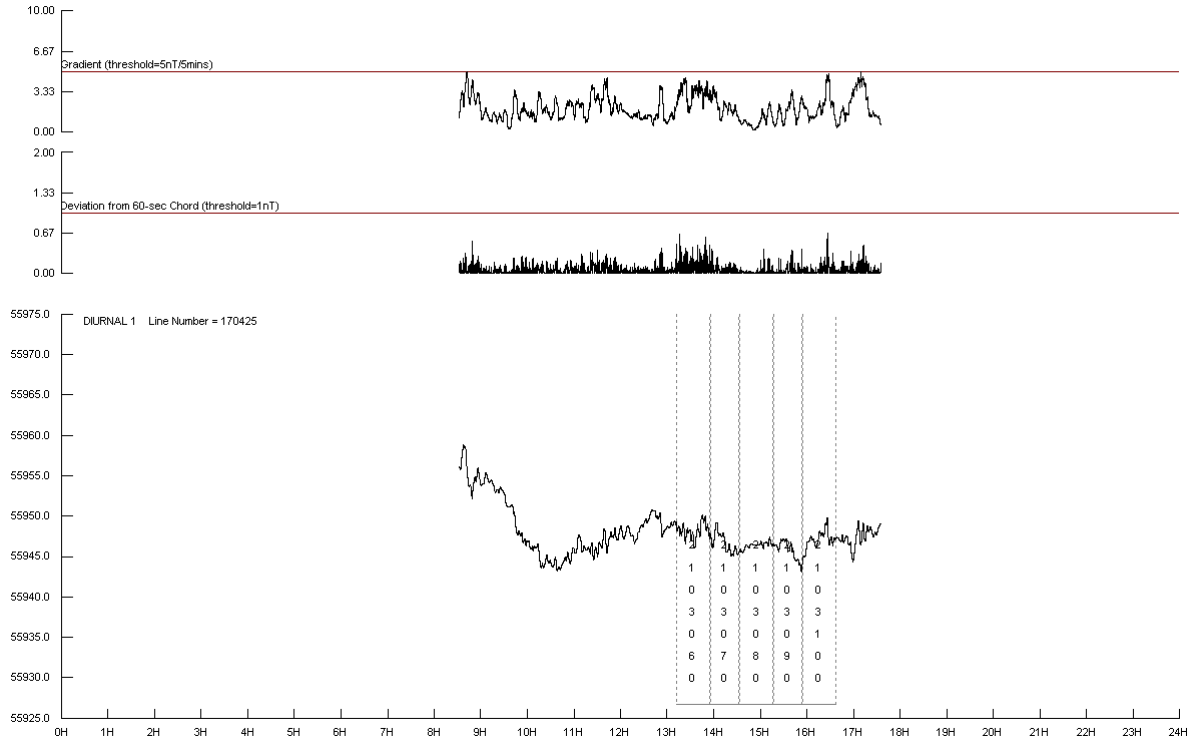
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Gradient (threshold=5nT/5mins)
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0.00
2.00
1.33
Deviation from 60-sec Chord (threshold=1nT)
0.67
0.00
55975.0
DIURNAL 1 Line Number = 170425
55970.0
55965.0
55960.0
55955.0
55950.0
55945.0
55940.0
55935.0
55930.0
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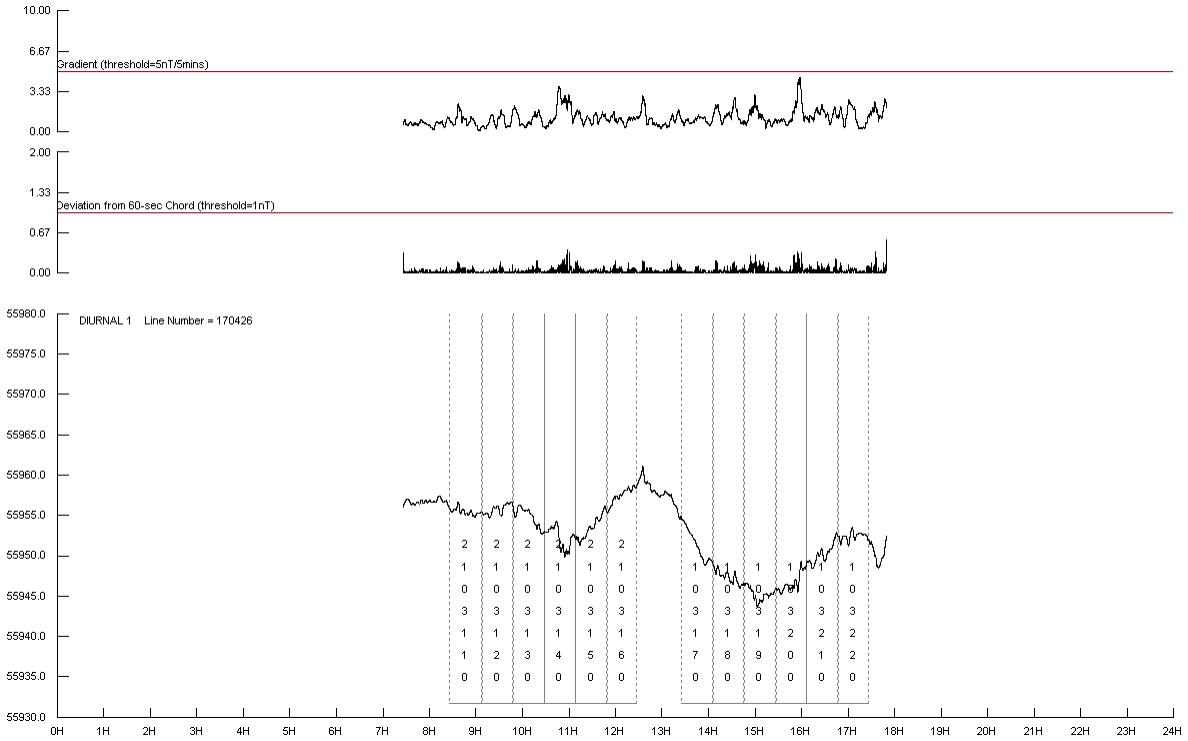
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Deviation from 60-sec Chord (threshold=1nT)
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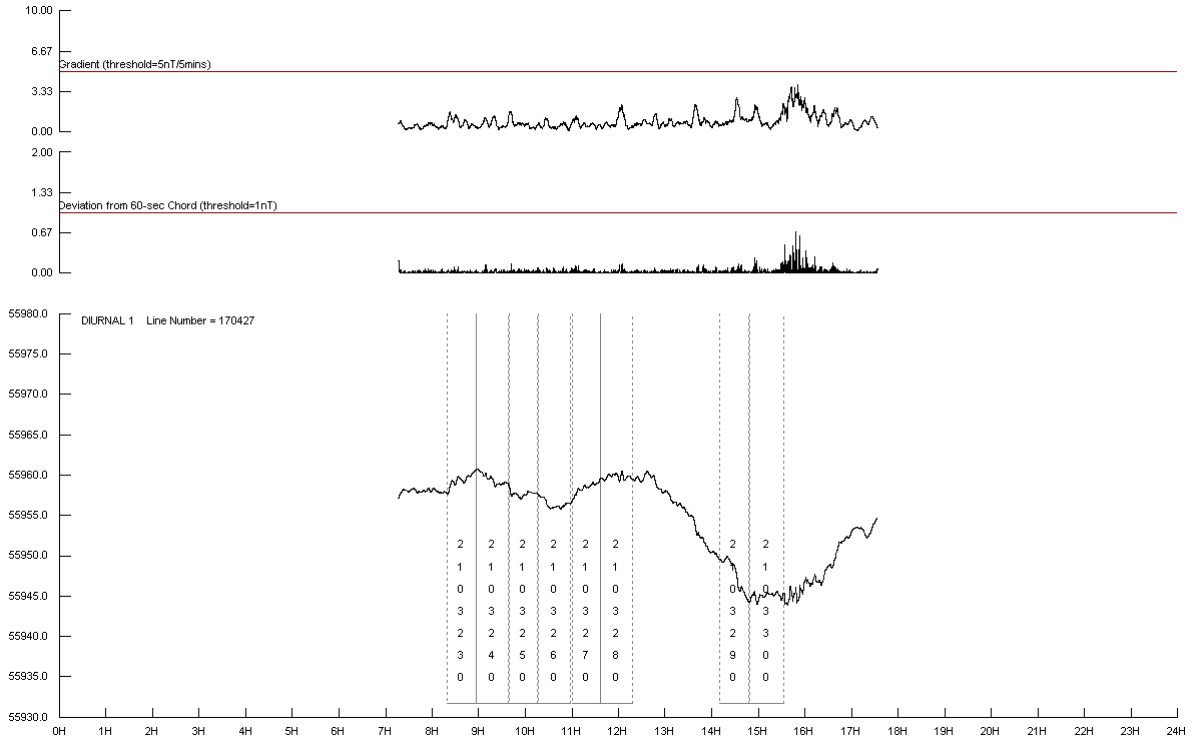
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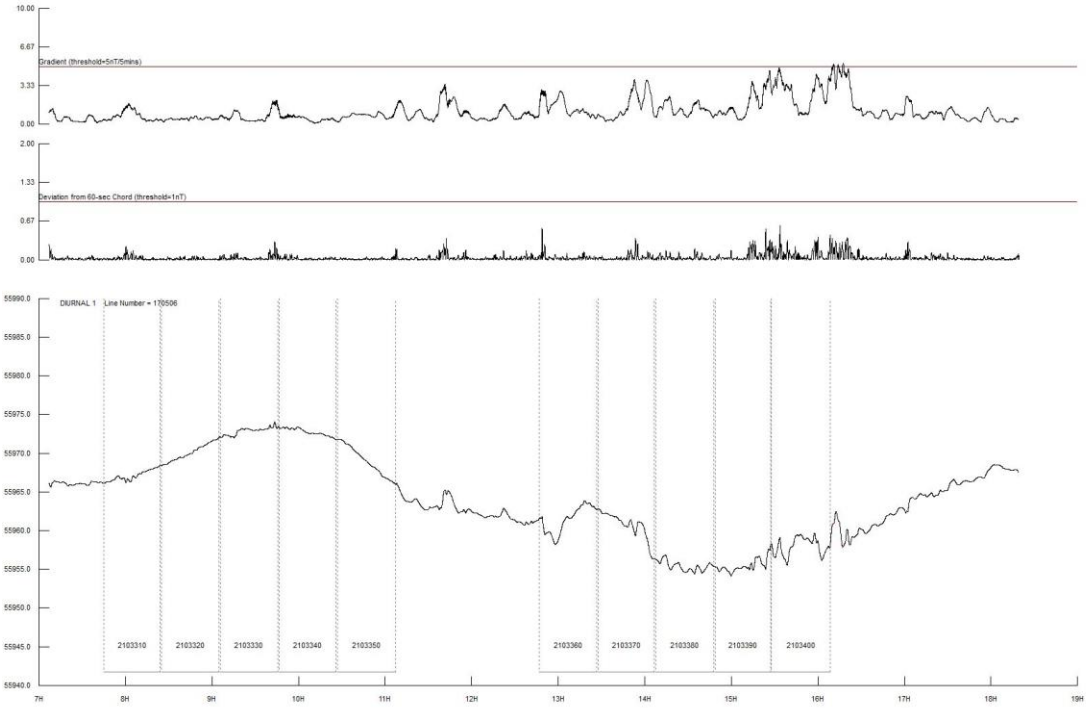
Deviation from 60-sec Chord (threshold=1nT)
DIURNAL 1 Line Number = 170427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Deviation from 60-sec Chord (threshold=1nT)
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2103360
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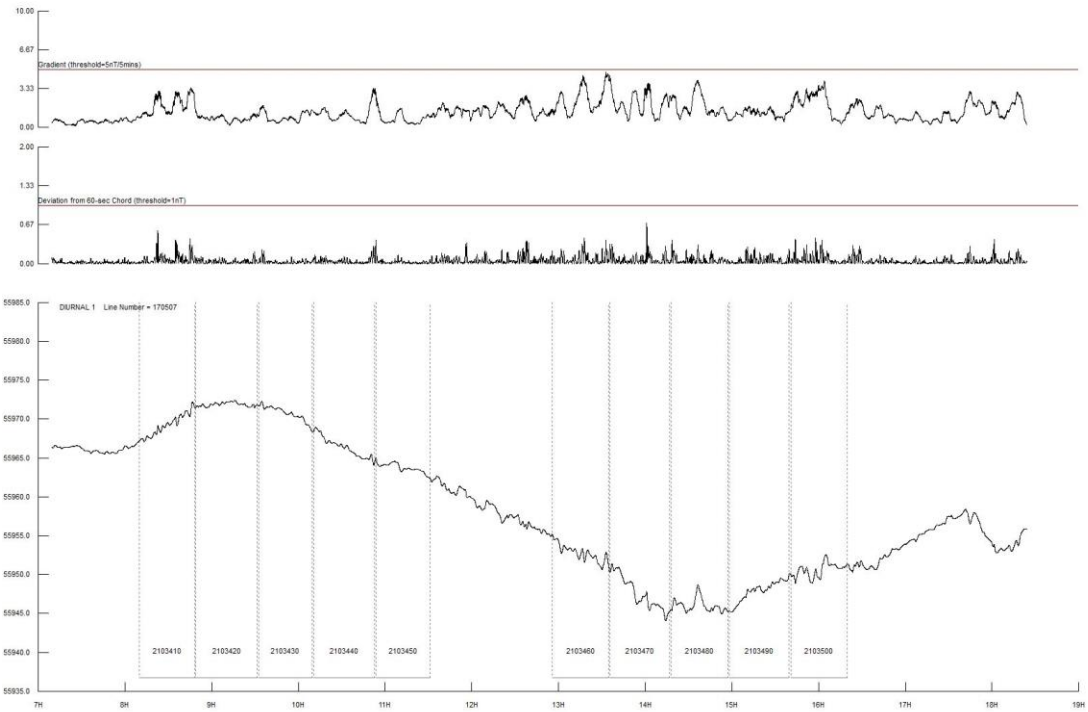
2103390
2103400


Gradient (threshold=5nT/5mins)
Deviation from 60-sec Chord (threshold=1nT)
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2103460
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2103480
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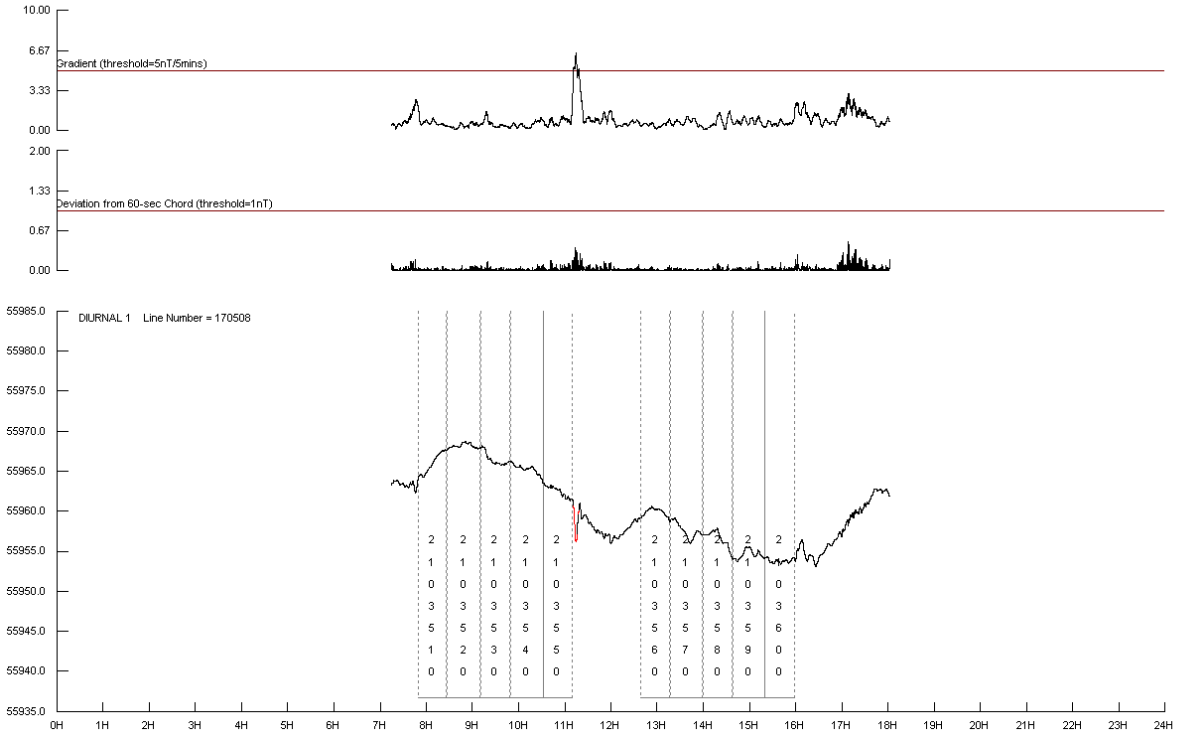
2103500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Gradient (threshold=5nT/5mins)
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0.00
2.00
1.33
Deviation from 60-sec Chord (threshold=1nT)
0.67
0.00
55985.0
DIURNAL 1 Line Number = 170508
55980.0
55975.0
55970.0
55965.0
55960.0
55955.0
55950.0
55945.0
55940.0
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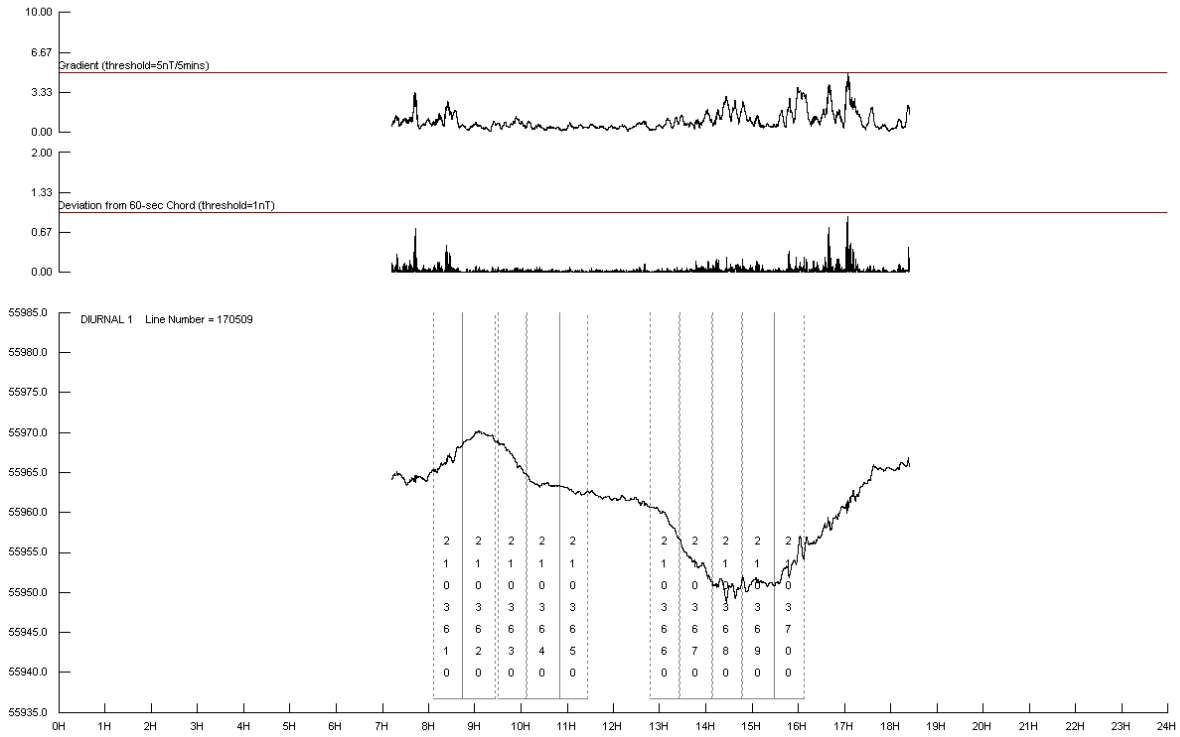
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Gradient (threshold=5nT/5mins)
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0.00
2.00
1.33
Deviation from 60-sec Chord (threshold=1nT)
0.67
0.00
55985.0
DIURNAL 1 Line Number = 170509
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55975.0
55970.0
55965.0
55960.0
55955.0
55950.0
55945.0
55940.0
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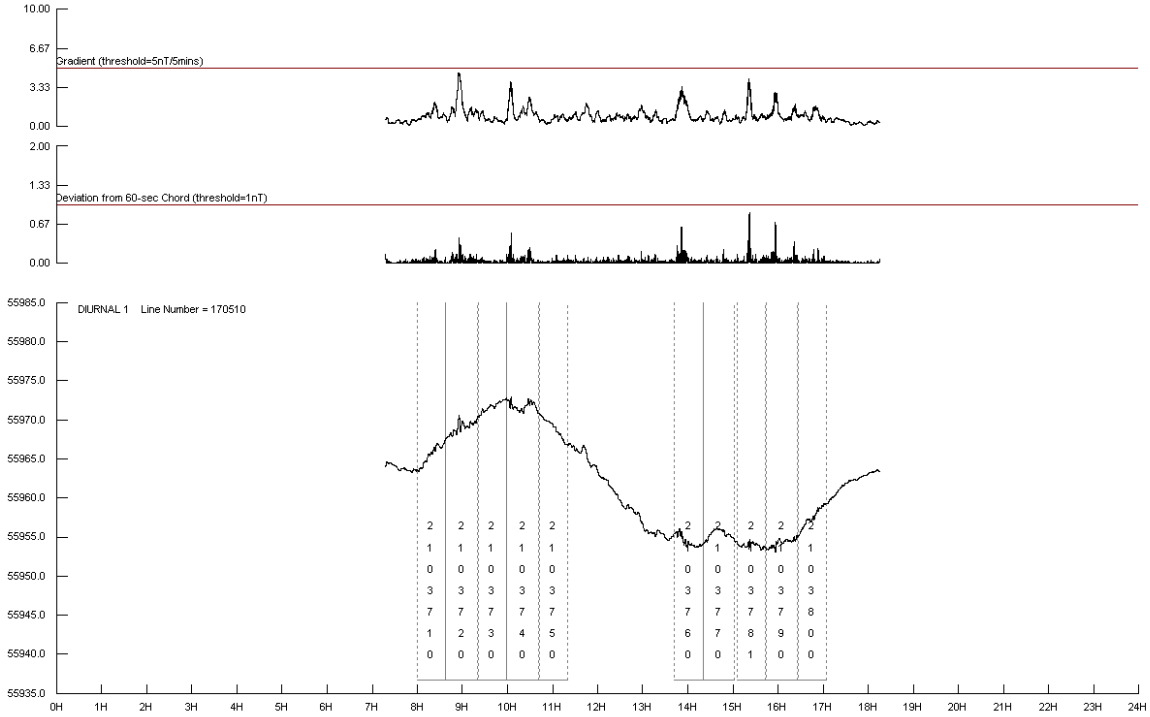
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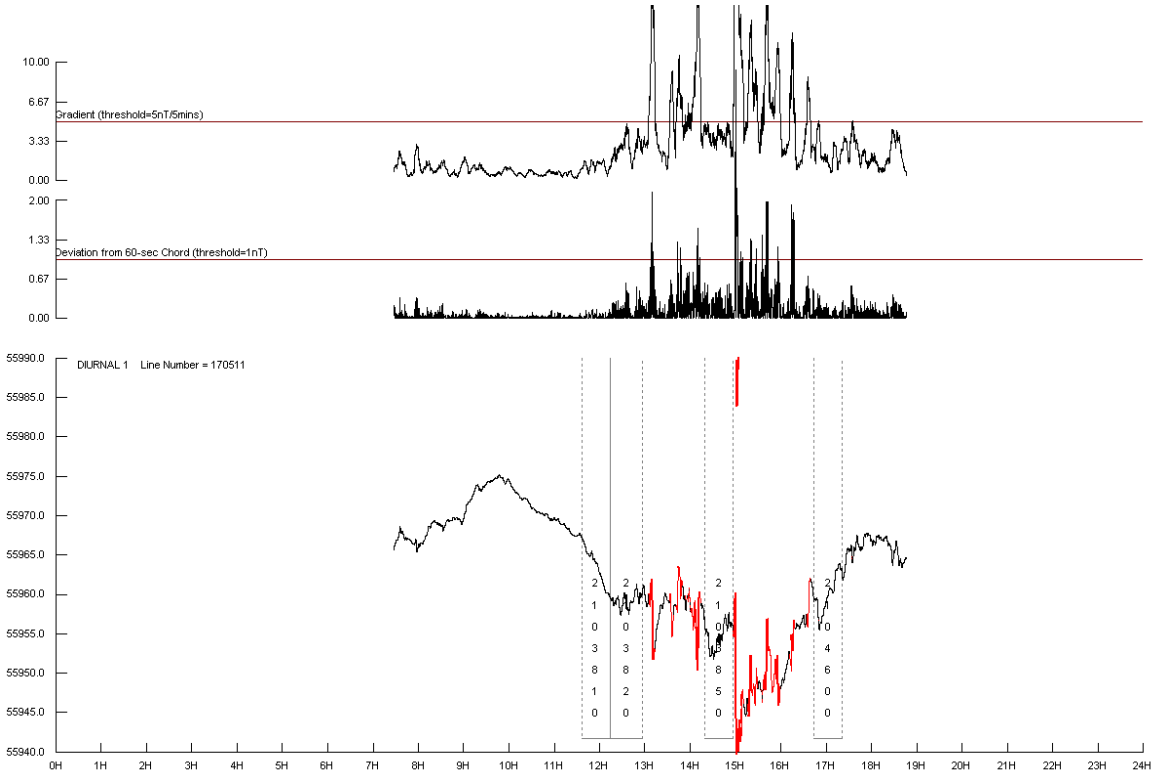
Deviation from 60-sec Chord (threshold=1nT)
DIURNAL 1 Line Number = 170510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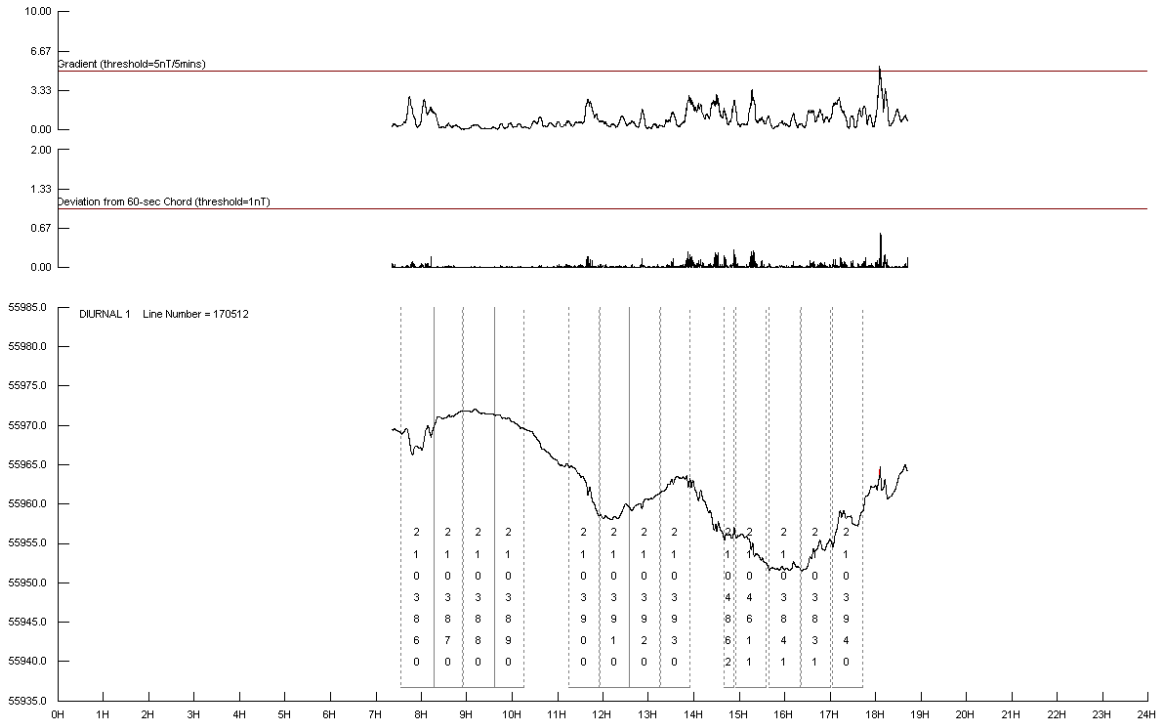
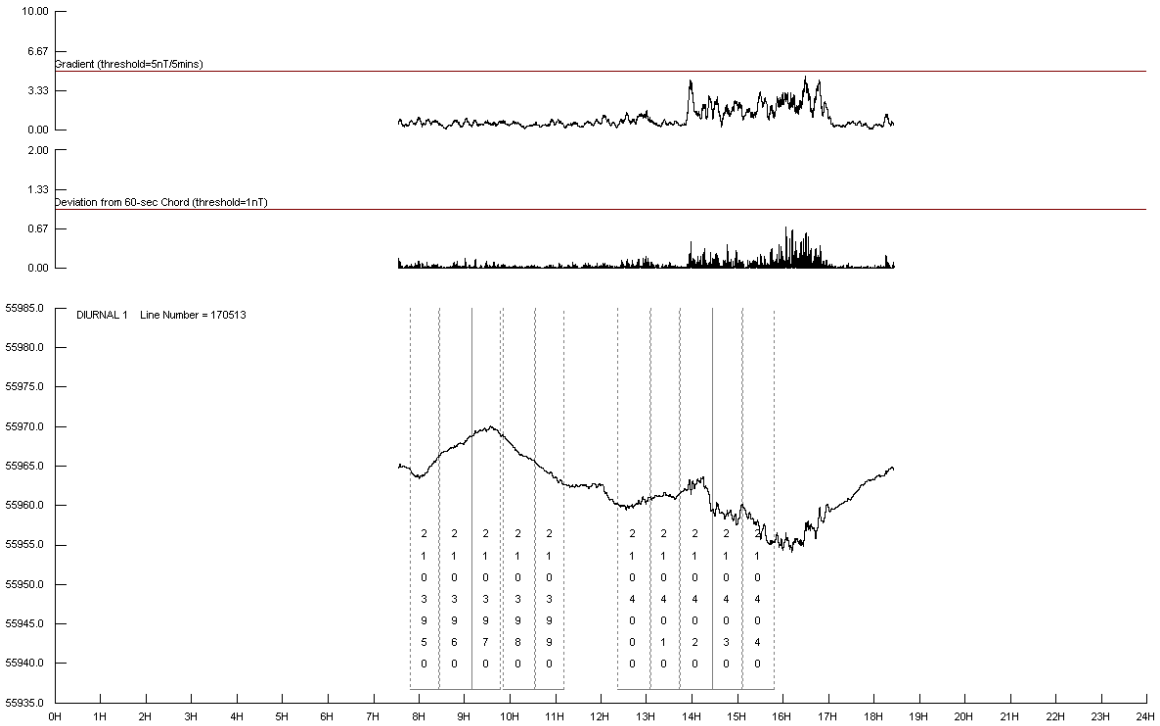
Deviation from 60-sec Chord (threshold=1nT)
DIURNAL 1 Line Number = 170511


Gradient (threshold=5nT/5mins)
Deviation from 60-sec Chord (threshold=1nT)
DIURNAL 1 Line Number = 170512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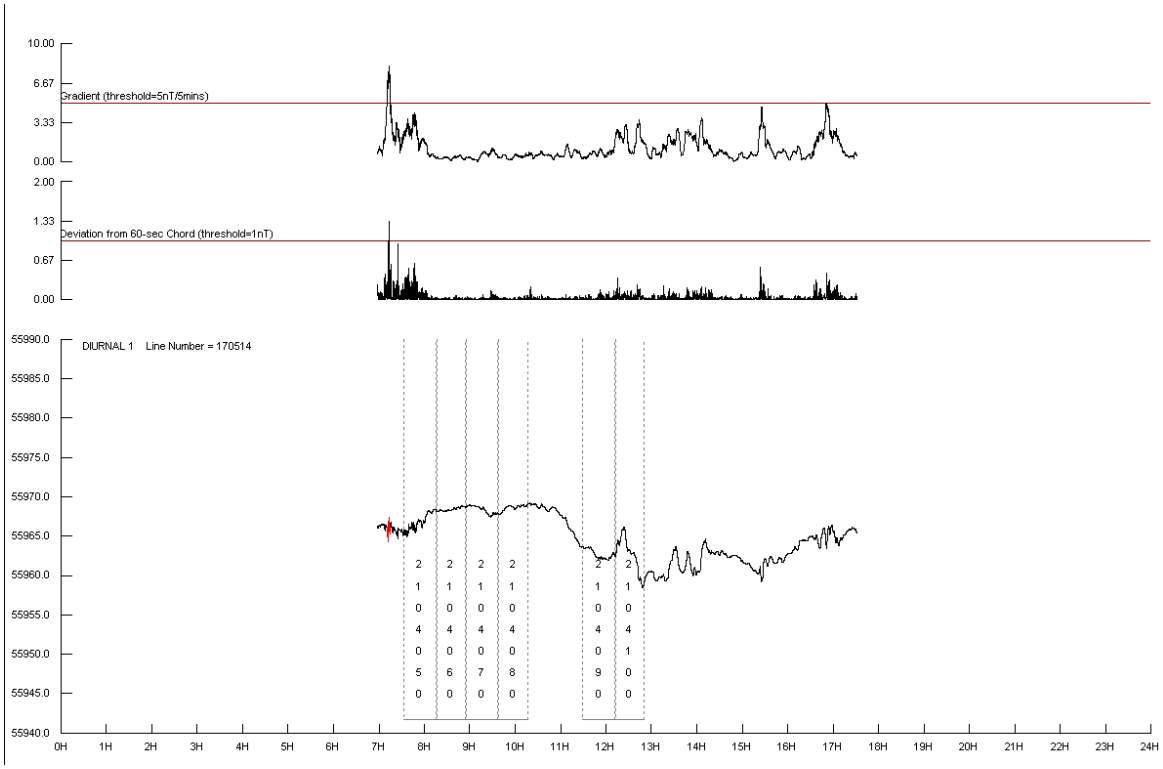
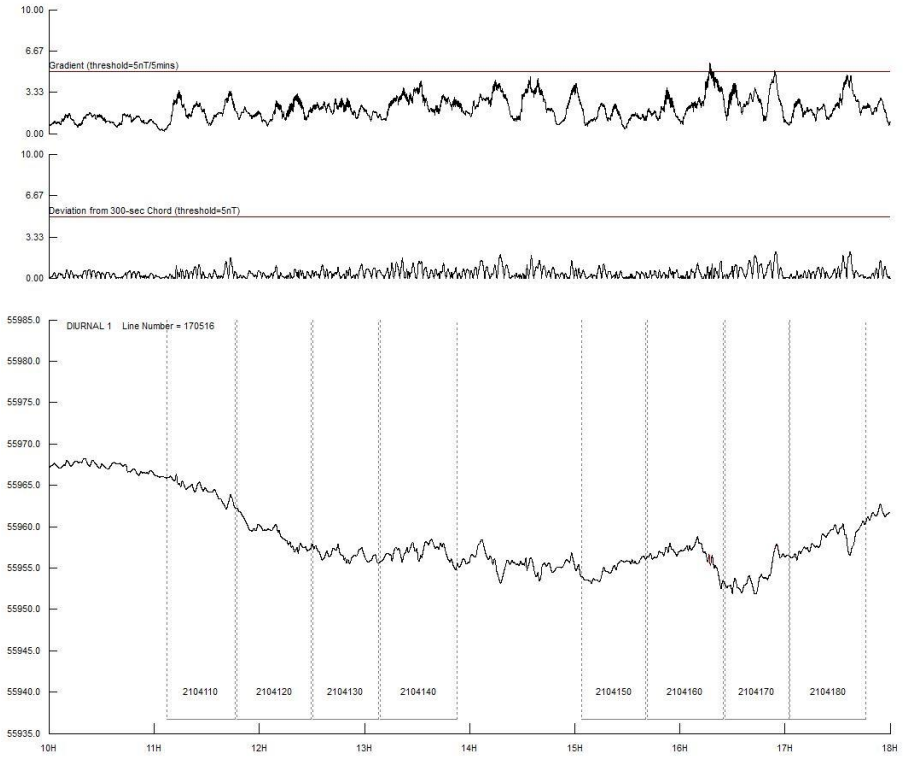
Deviation from 60-sec Chord (threshold=1nT)
DIURNAL 1 Line Number = 170513


Gradient (threshold=5nT/5mins)
Deviation from 60-sec Chord (threshold=1nT)
DIURNAL 1 Line Number = 170514


Gradient (threshold=5nT/5mins)
Deviation from 300-sec Chord (threshold=5nT)
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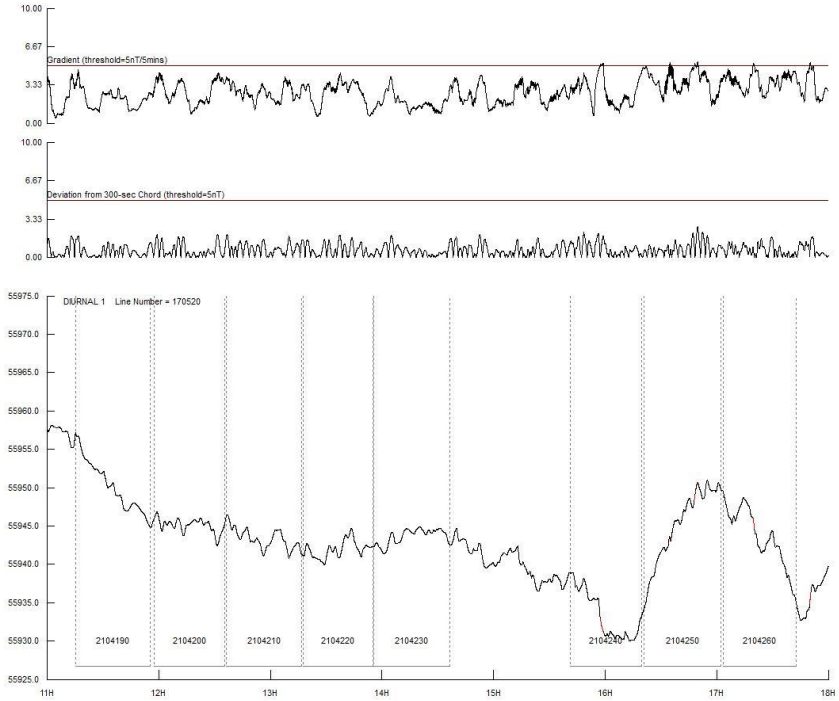
2104130
2104140
2104150
2104160
2104170
2104180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Deviation from 300-sec Chord (threshold=5nT)
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2104220
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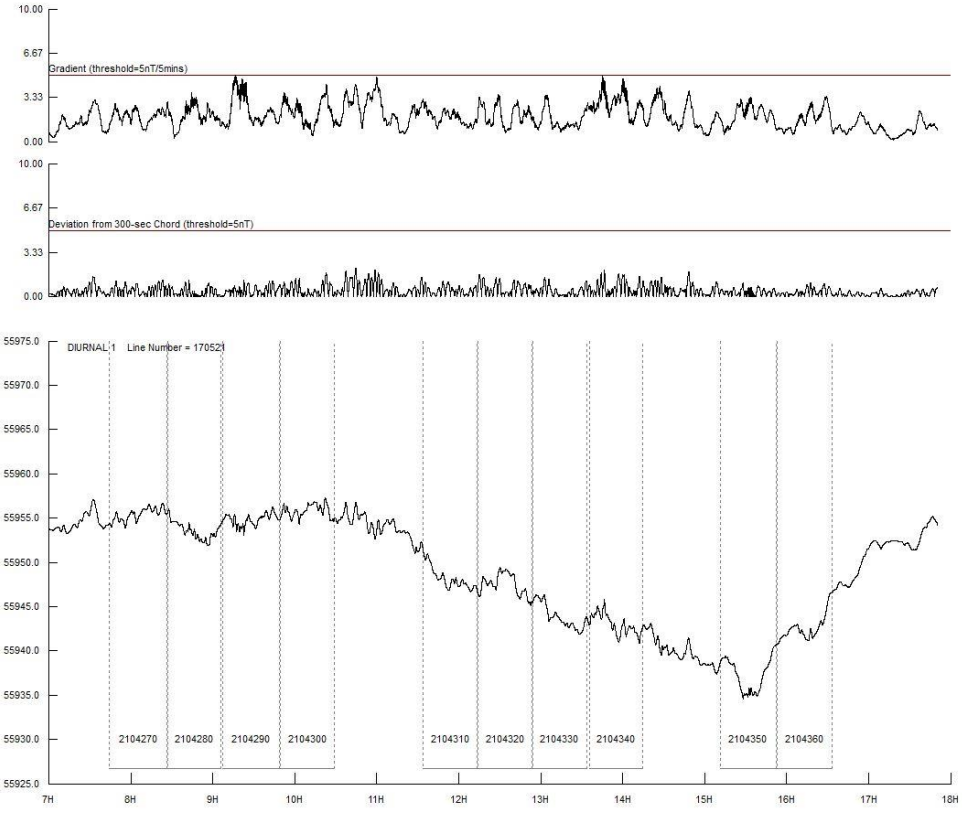
2104260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Deviation from 300-sec Chord (threshold=5nT)
DIURNAL 1 Line Number = 170521
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2104290
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2104320
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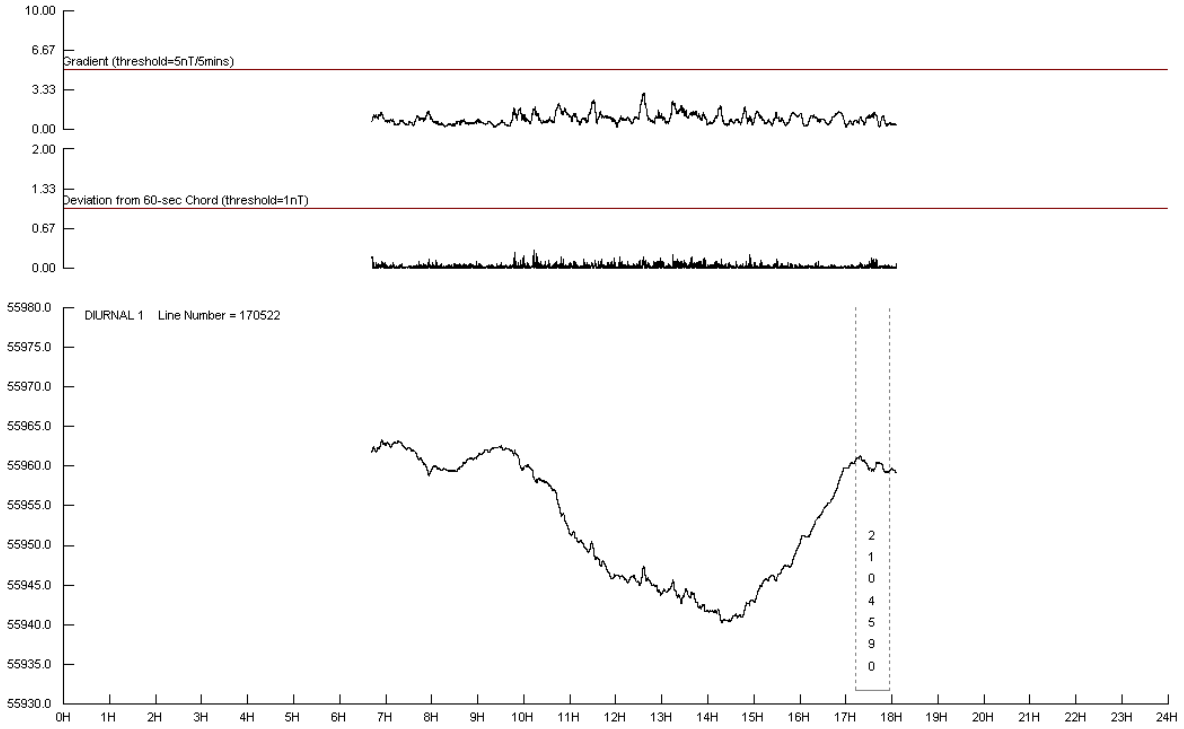
2104340
2104350
2104360


10.00
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Gradient (threshold=5nT/5mins)
3.33
0.00
2.00
1.33
Deviation from 60-sec Chord (threshold=1nT)
0.67
0.00
55980.0
55975.0
55970.0
55965.0
55960.0
55955.0
55950.0
55945.0
55940.0
55935.0
55930.0
DIURNAL 1 Line Number = 170522
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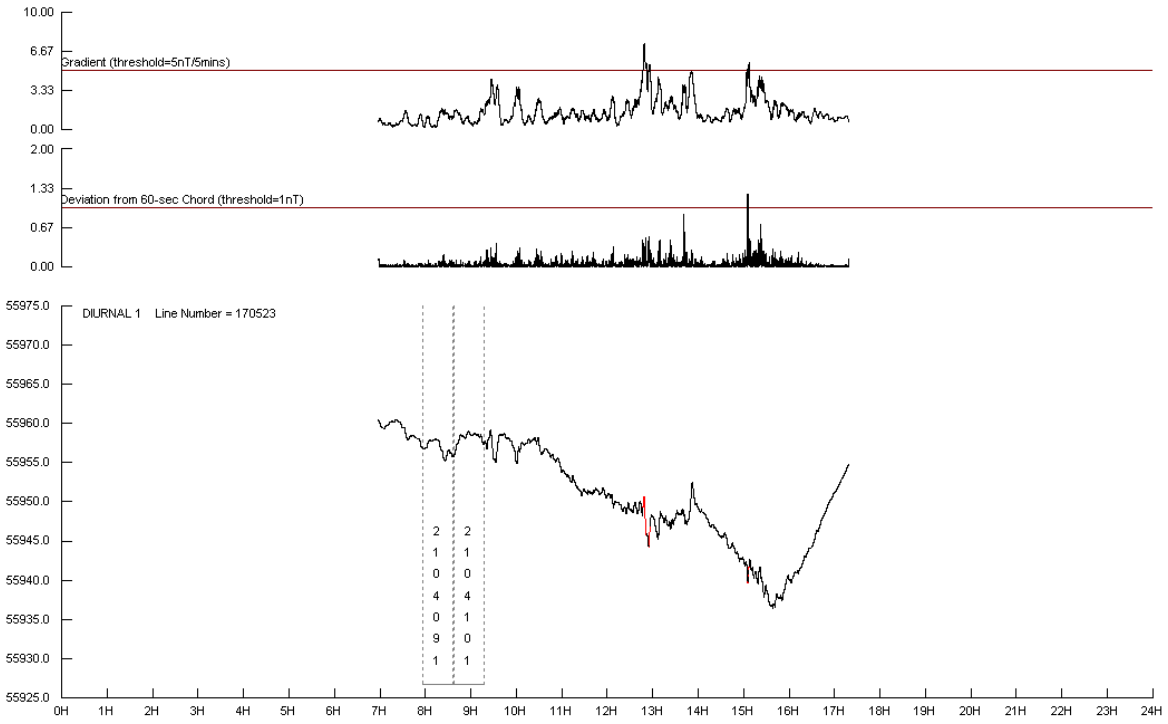
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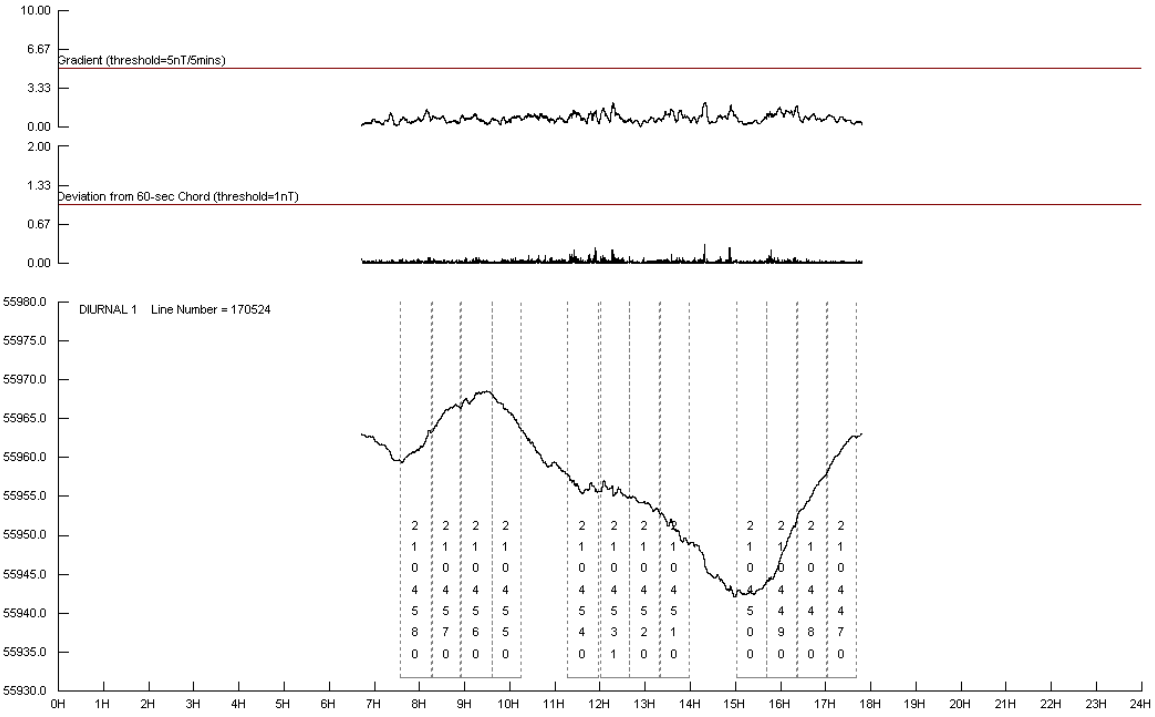
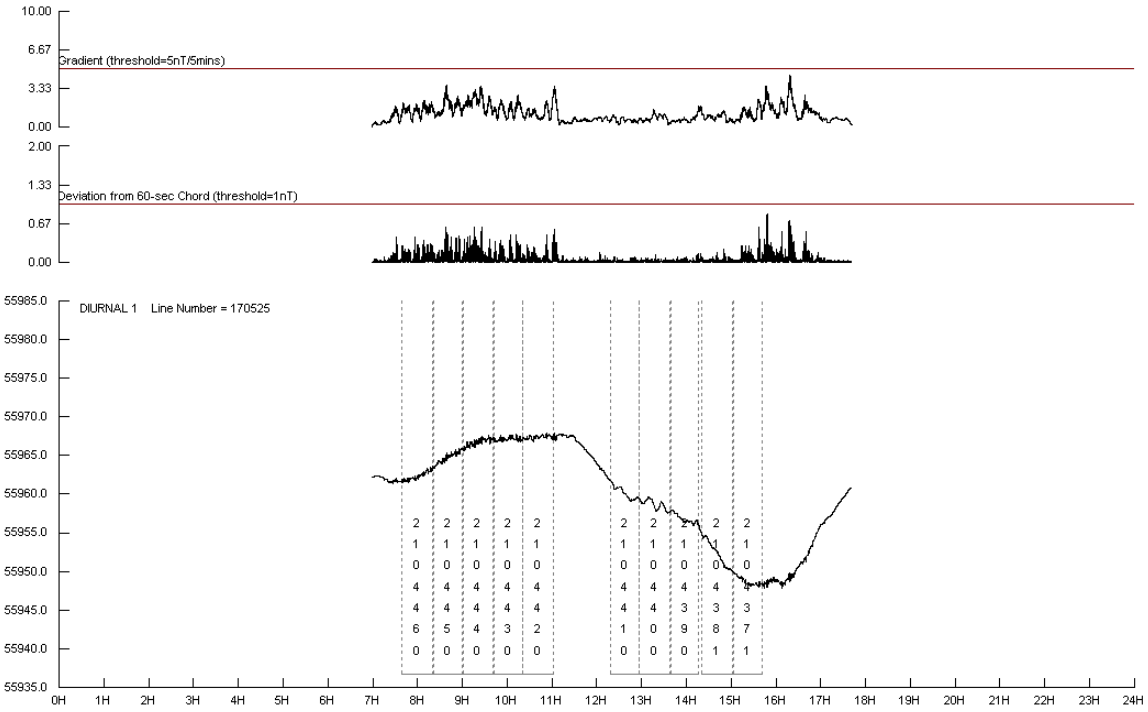
Gradient (threshold=5nT/5mins)
3.33
0.00
2.00
1.33
Deviation from 60-sec Chord (threshold=1nT)
0.67
0.00
55975.0
55970.0
55965.0
55960.0
55955.0
55950.0
55945.0
55940.0
55935.0
55930.0
55925.0
DIURNAL 1 Line Number = 170523
2104091
2104101
0H 1H 2H 3H 4H 5H 6H 7H 8H 9H 10H 11H 12H 13H 14H 15H 16H 17H 18H 19H 20H 21H 22H 23H 24H


Gradient (threshold=5nT/5mins)
Deviation from 60-sec Chord (threshold=1nT)
DIURNAL 1 Line Number = 170524


Gradient (threshold=5nT/5mins)
Deviation from 60-sec Chord (threshold=1nT)
DIURNAL 1 Line Number = 170525

APPENDIX 4 PROCESSING PARAMETERS AND DELIVERABLES

Magnetics

Average Diurnal 55,956 nT

IGRF Correction Parameters

Year:	2017.25
Zone:	53
Hemisphere:	South
Latitude:	-28.3969207 °
Longitude:	134.2655792 °
Total Field:	55,946.19 nT
Declination:	5.2728 °
Inclination:	-60.7408 °

Radiometrics

Radiometric Correction Parameters

Height Attenuation Coefficients

Total Count:	-0.0074
Potassium:	-0.0094
Uranium:	-0.0084
Thorium:	-0.0074

Aircraft Background Coefficients

Total Count:	22.138
Potassium:	10.034
Uranium:	0.000
Thorium:	0.000

Cosmic Correction Coefficients

Total Count:	1.0939
Potassium:	0.0624
Uranium:	0.0503
Thorium:	0.0611

Radiometric Stripping Coefficients

Alpha:	0.2670
Beta:	0.4010
Gamma:	0.7450
a:	0.0450

Radiometric Concentration Coefficients

Total Count:	39.0
Potassium:	129.5
Uranium:	15.1
Thorium:	7.4

Located and Gridded Data

ASCII Located data were supplied in ASEG-GDF format. Gridded data were supplied in ERMapper format.

ASCII Located Data File Formats and Channels

Magnetics

survey:I4:NULL=999
flight:I4:NULL=999
LINE:I10:NULL=99999
FID:I10:NULL=9999999
dateCode:I9:NULL=99999999:UNIT=YYYYMMDD
Bearing:I4:NULL=999:UNIT=deg
longitude_gda94:F13.7:NULL=9999.999999:UNIT=deg
latitude_gda94:F13.7:NULL=9999.999999:UNIT=deg
easting_gda94:F12.2:NULL=99999999.99:UNIT=m
northing_gda94:F12.2:NULL=99999999.99:UNIT=m
gps_height:F7.1:NULL=9999.9:UNIT=m
Zone:I3:NULL=99
radar_alt:F8.2:NULL=9999.99:UNIT=m
laser_alt:F8.2:NULL=9999.99:UNIT=m
dem_laser:F8.2:NULL=9999.99:UNIT=m
dem_radar:F8.2:NULL=9999.99:UNIT=m
magnetics_final_tielevelled:F10.3:NULL=99999.999:UNIT=nT
magnetics_final_microlevelled:F10.3:NULL=99999.999:UNIT=nT
magnetics_final_microlevelled_1vd:F11.6:NULL=999.999999:UNIT=nT/m
magnetic_diurnal:F10.3:NULL=99999.999:UNIT=nT
magnetic_igrf:F10.3:NULL=99999.999:UNIT=nT

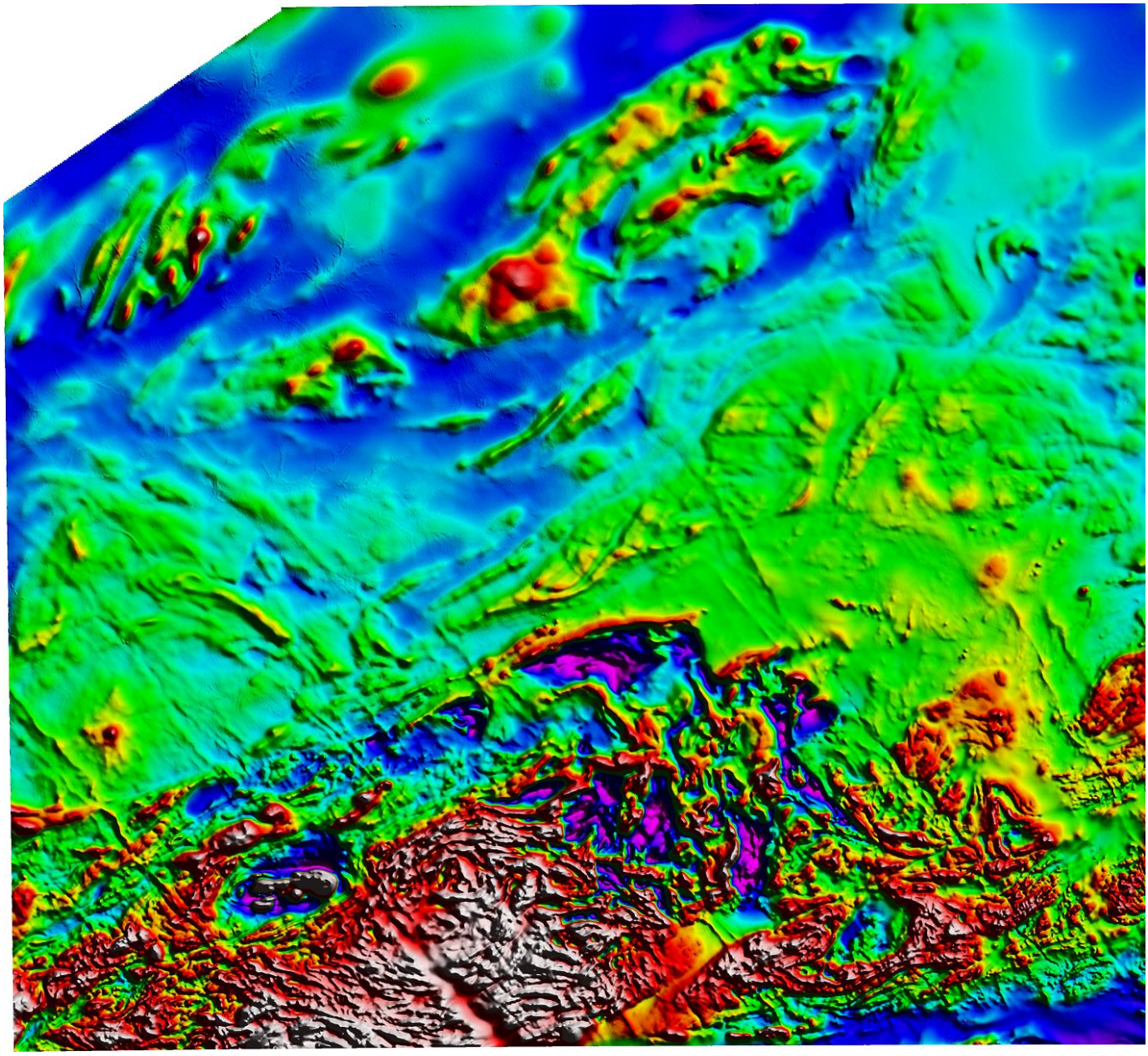
Radiometrics

survey:I4:NULL=999
flight:I4:NULL=999
LINE:I10:NULL=999999999
FID:I10:NULL=9999999
dateCode:I9:NULL=99999999:UNIT=YYYYMMDD
bearing:I4:NULL=999:NAME=Bearing
longitude_gda94:F13.7:NULL=9999.9999999:UNIT=deg
latitude_gda94:F13.7:NULL=9999.9999999:UNIT=deg
easting_gda94:F12.2:NULL=99999999.99:UNIT=m
northing_gda94:F12.2:NULL=99999999.99:UNIT=m
gps_height:F7.1:NULL=9999.9:UNIT=m
radar_alt_raw_edited:F8.2:NULL=9999.99:UNIT=m
laser_alt_raw_edited:F8.2:NULL=9999.99:UNIT=m
dem_laser:F8.2:NULL=9999.99:UNIT=m
dem_radar:F8.2:NULL=9999.99:UNIT=m
Baro_pres:F9.2:NULL=99999.99:UNIT=mbar
Temperature:F7.1:NULL=9999.9:UNIT=degrees C
dose_no_nasvd:F10.3:NULL=99999.999:UNIT=nGy/hr
k_percent_no_nasvd:F9.3:NULL=9999.999:UNIT=percent
u_ppm_no_nasvd:F9.3:NULL=9999.999:UNIT=ppm
th_ppm_no_nasvd:F9.3:NULL=9999.999:UNIT=ppm
dose_nasvd:F10.3:NULL=99999.999:UNIT=nGy/hr
k_percent_nasvd:F9.3:NULL=9999.999:UNIT=percent
u_ppm_nasvd:F9.3:NULL=9999.999:UNIT=ppm
th_ppm_nasvd:F9.3:NULL=9999.999:UNIT=ppm

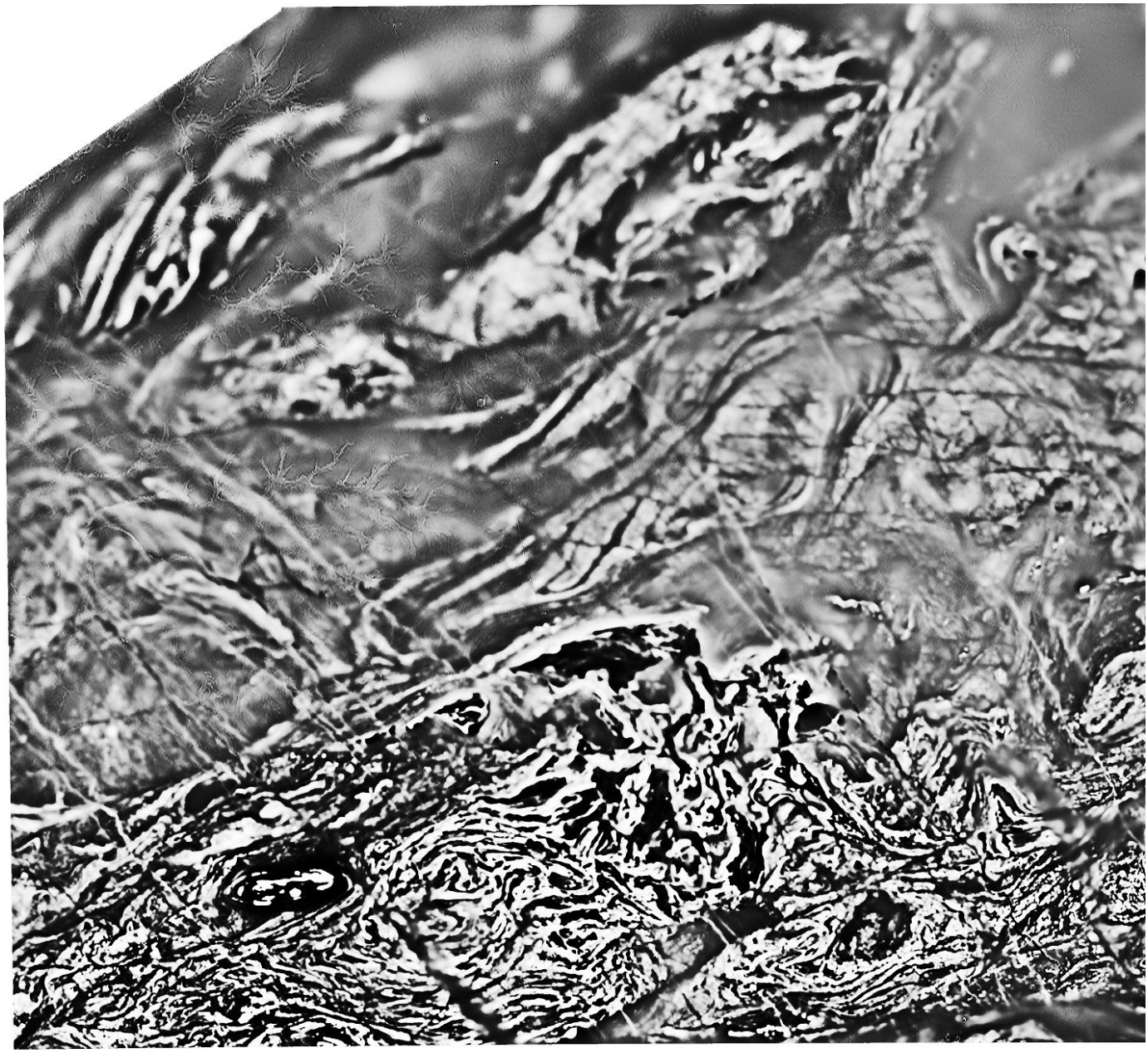
Elevation

survey:I4:NULL=999
flight:I4:NULL=999
LINE:I10:NULL=999999999
FID:I10:NULL=9999999
dateCode:I9:NULL=99999999:UNIT=YYYYMMDD
bearing:I4:NULL=999:UNIT=deg
longitude_gda94:F13.7:NULL=9999.9999999:UNIT=deg
latitude_gda94:F13.7:NULL=9999.9999999:UNIT=deg
easting_gda94:F12.2:NULL=99999999.99:UNIT=m
northing_gda94:F12.2:NULL=99999999.99:UNIT=m
zone:I3:NULL=99
radar_alt:F8.2:NULL=9999.99:UNIT=m
laser_alt:F8.2:NULL=9999.99:UNIT=m
Gps_height:F8.2:NULL=9999.99:UNIT=m
Dem_laser:F8.2:NULL=9999.99:UNIT=m
Dem_radar:F8.2:NULL=9999.99:UNIT=m

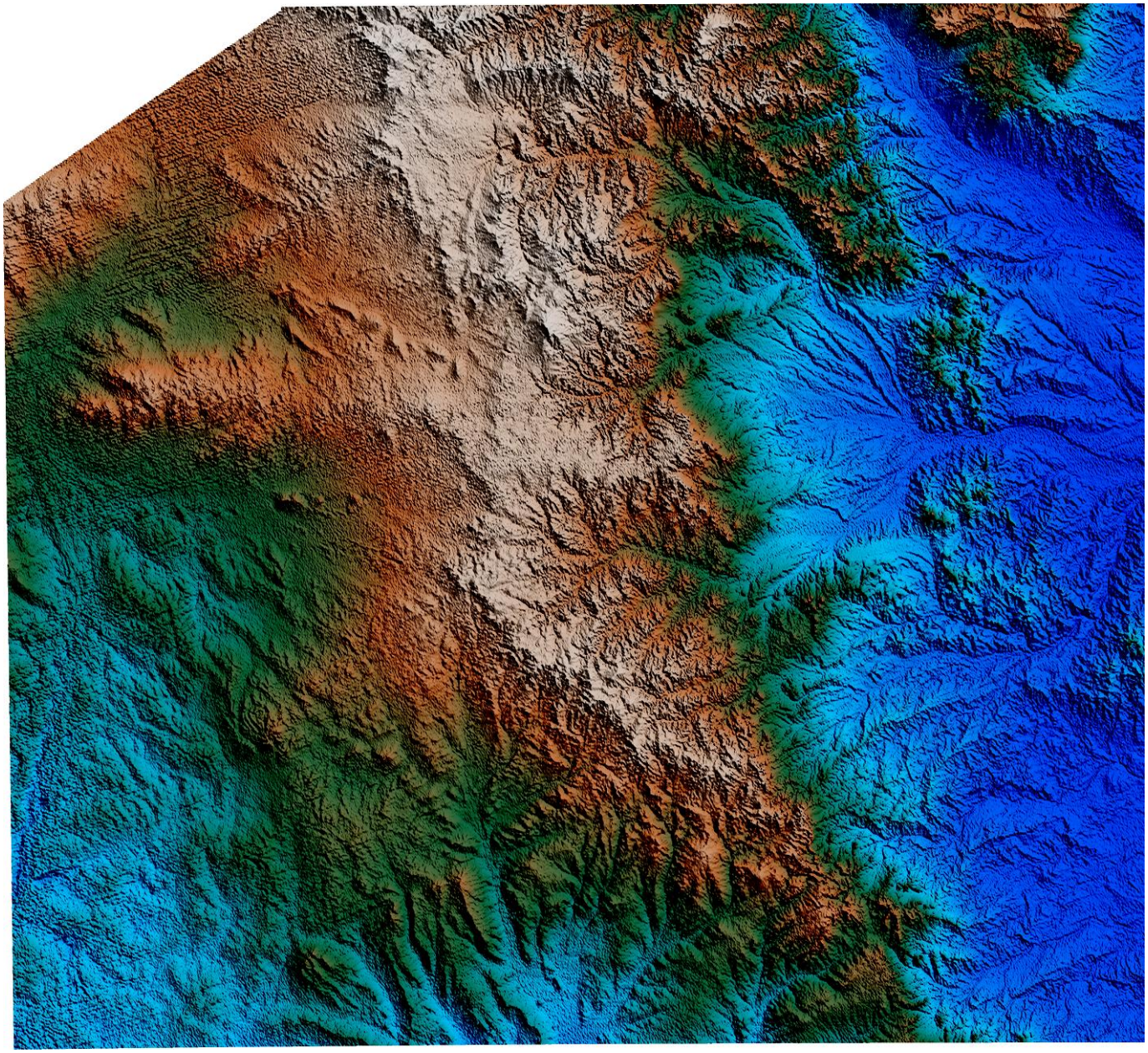
APPENDIX 5 VERIFICATION IMAGES



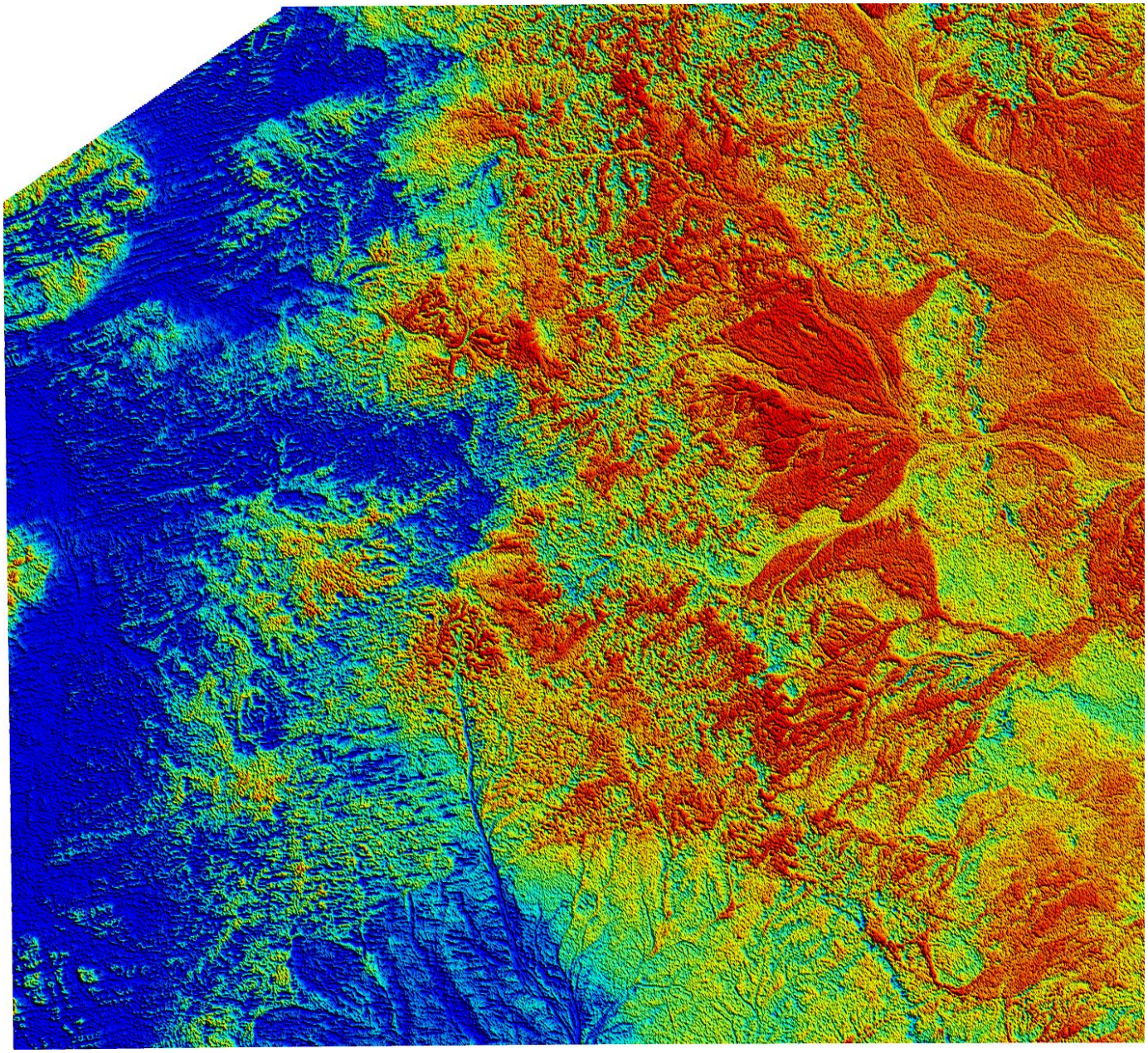
Colour Total Magnetic Intensity



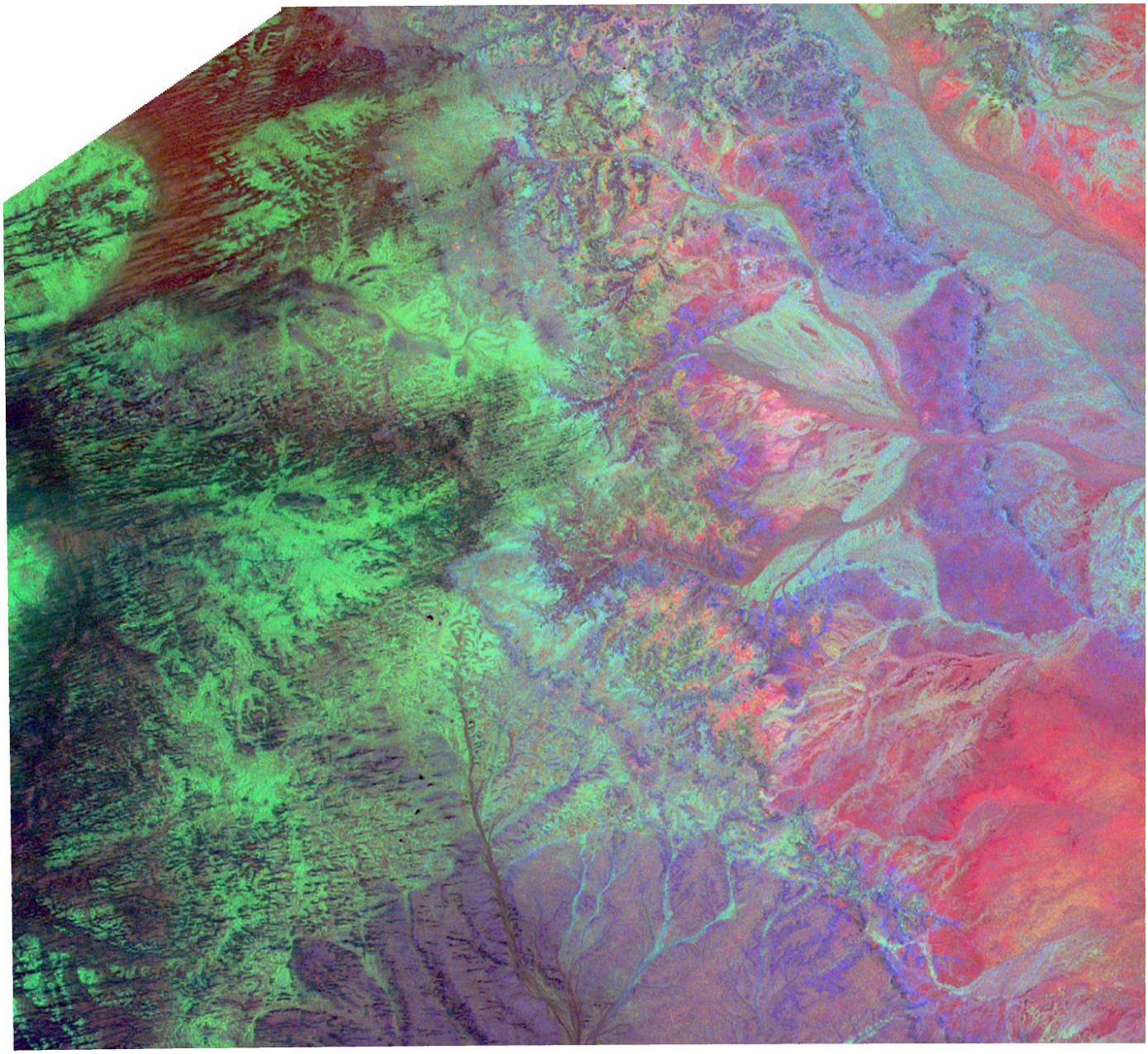
Grey Total Magnetic Intensity First Vertical Derivative



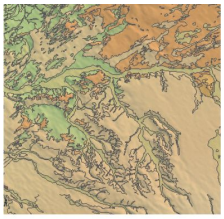
Colour Digital Elevation Model

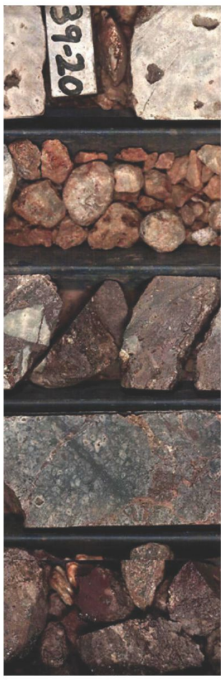


Colour Total Count



Radiometric Ternary

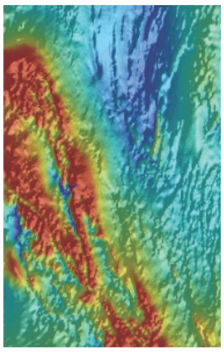




Department of State Development

Metadata: PACE Copper Gawler Craton Airborne Survey, Region 2A, P1280, Murloocoppie, 2017SA001

Date Printed: 17/10/2017



Government of South Australia

Department of State Development

Dataset

Title: PACE Copper Gawler Craton Airborne Survey, Region 2A, P1280, Murloocoppie, 2017SA001

Custodian: Department of the Premier and Cabinet

Jurisdiction: SA

Description

Abstract:

The Gawler Craton Airborne Survey The survey will capture approximately 1,800,000 line kilometres of new geophysical data (magnetic, radiometric and digital elevation data) over an area of approximately 324,000 square kilometres. Magnetic data includes TMI, TMI reduced to pole and 1VD of RTP TMI; elevation data includes models derived from radar altimeter and laser altimeter subtracted from differential GPS heights; spectrometer data includes dose rate, uranium, thorium, potassium and ternary (RGB) radiometrics.

ANZLIC Search Terms:

GEOSCIENCES Geophysics BOUNDARIES Surveys

GEN Category: GAWLER PROVINCE

GEN Custodial Jurisdiction: South Australia

GEN Name: Murloocoppie Map Sheet, Gawler Craton

Geographic Extent Polygon: -29.024, 135.0271, -27.7517, 133.4583

North bounding latitude: -29.024

South bounding latitude: -27.7517

East bounding longitude: 135.0271

West bounding longitude: 133.4583

Data Currency

Beginning Date: 01/02/2017

End Date: 18/10/2017

Dataset Status

Progress: Complete

Maintenance: As required

Version Number: 1

Access

Stored format: DIGITAL data are stored as located data (ascii), ERMapper grids, tif images.

Available format(s): DIGITAL

Access constraint(s): Data is released under Creative Commons CC-BY.

SARIG Layer(s): Gawler Craton Airborne Survey\Region 2A

Data Quality

Lineage: The data was originally collected by government, released as located data and processed into grid and image products.

Positional accuracy: Original data were located using GPS. GPS units are accurate to less than 10 metres.

Attribute accuracy: Not Known

Logical consistency: All data have been quality controlled by the Geological Survey of South Australia.

Completeness: This survey is complete

Contact Information

Contact organisation: Department of the Premier and Cabinet

Contact position: Customer Service Centre

Contact mail address: GPO box 320 Adelaide SA 5001

Contact telephone: 08 8463 3000

Contact email: Resources.CustomerServices@sa.gov.au

Metadata Dates

Add date: 2017-10-06

Change date: 2017-10-17

Responsible Party

Responsible party: Director, Geological Survey of South Australia

Responsible party function: Custodian/Steward

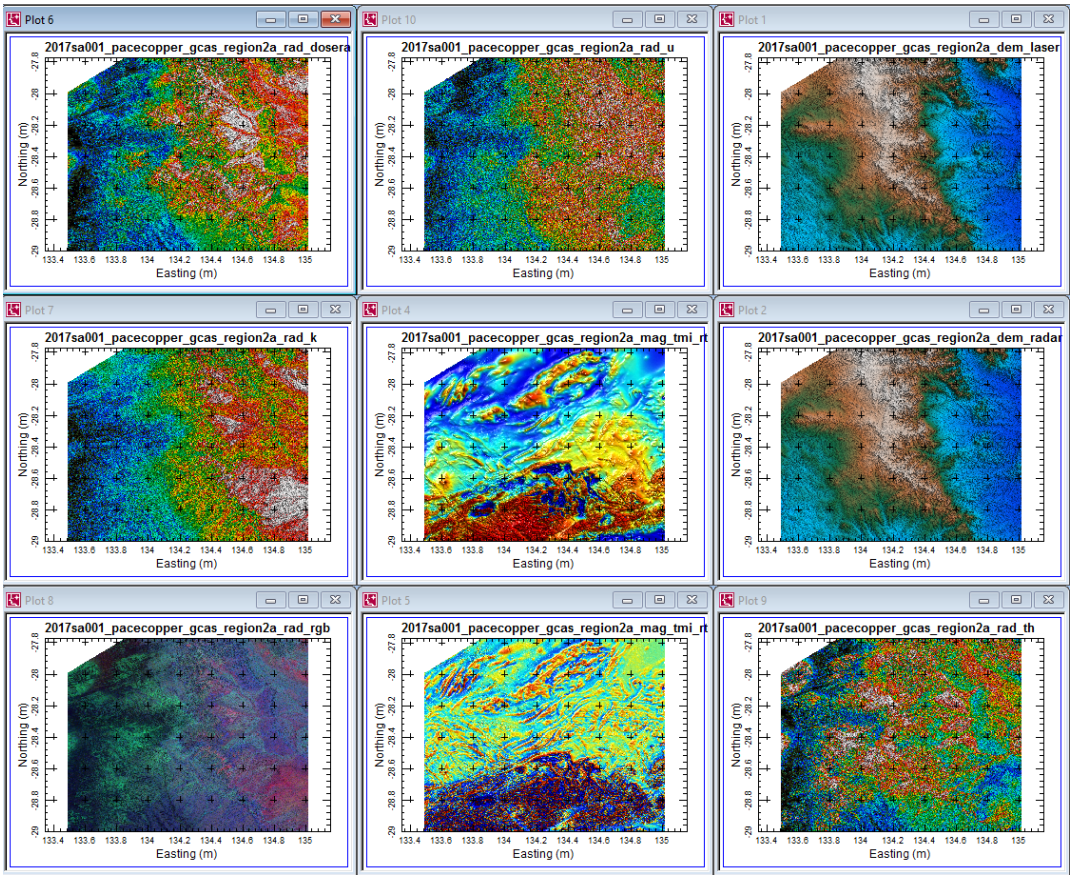
Description

Dataset classification: Principal version

Spatial representation type: Matrix

Dimension: Other

Sample Graphic(s)



GCAS 2A

Usage

Purpose: This set of data is designed as an aid to geological exploration.

Use: Used to supply industry, government and the general public with geophysical information, primarily used for mineral exploration.

Usage limitations: Grid data has been gridded at one fifth of line spacing and interpretations should not be made at scales less than this.

Dataset Associations

Dependant datasets: Airborne Magnetic Surveys of South Australia.

Origin

Dataset size: 11.7Gb

Projection: Geographical

Datum: GDA94

Dataset Management

Authorised by: Director, Geological Survey of South Australia

Attributes