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EL 4493

HAMILTON CREEK

FIRST PARTIAL SURRENDER REPORT FOR THE PERIOD 17/5/2010 TO 16/5/2014

Submitted by
Tianda Uranium (Australia) Pty Ltd
2014

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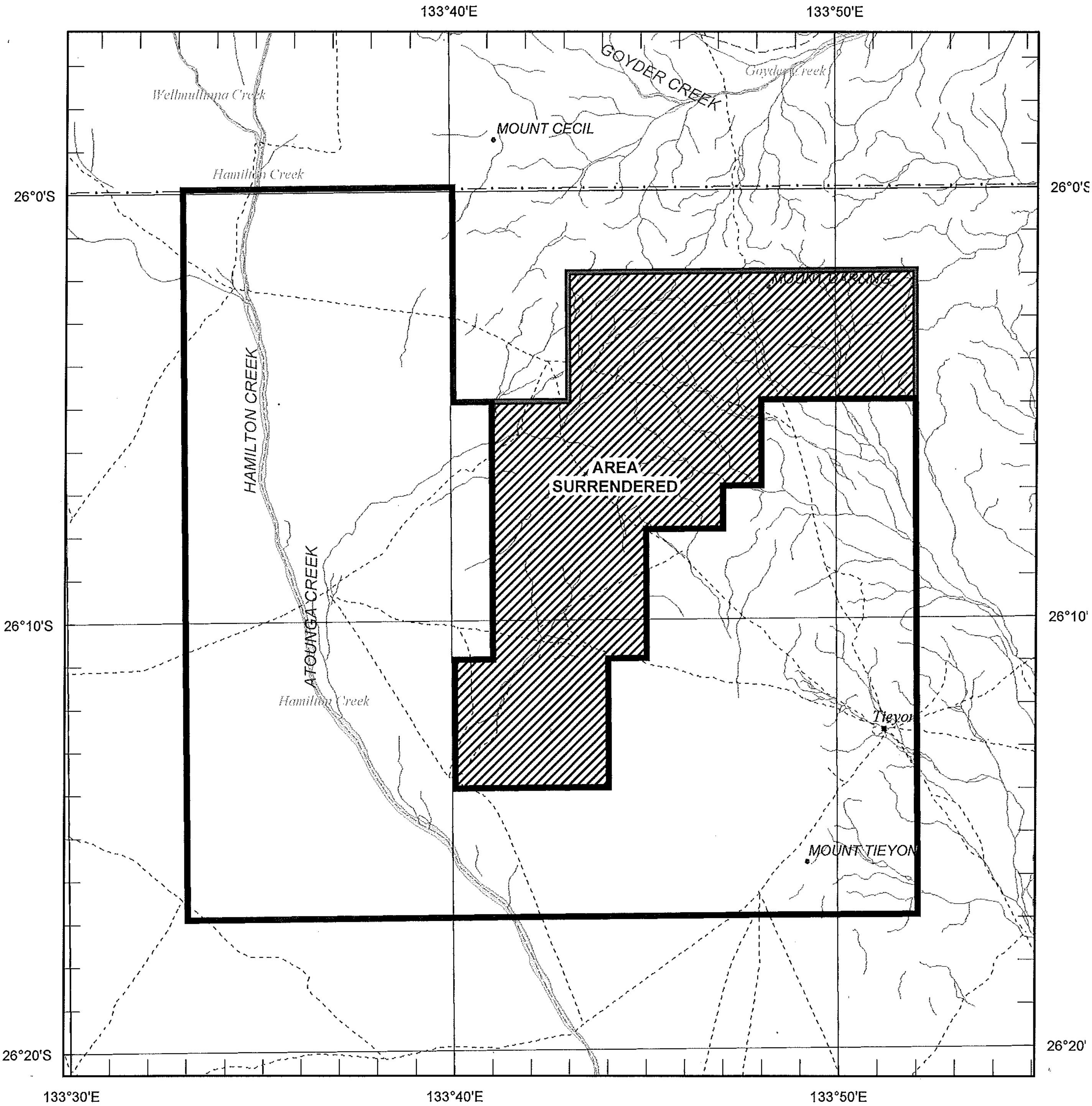
Government of South Australia
Department of State Development

SCHEDULE A



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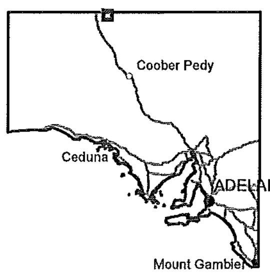

APPLICANT : **TIANDA URANIUM (AUSTRALIA) PTY LTD**

FILE REF : **2009/00336** TYPE : **MINERAL ONLY**

AREA : **674** sq km (approx)

1 : 250 000 MAPSHEETS : **ABMINGA**

LOCALITY : **HAMILTON CREEK AREA - Approximately 120 km north of Marla**

DATE GRANTED: **17-May-2010** DATE EXPIRED: **16-May-2014** EL NO: **4493**

Tenement holder:	Tianda Uranium (Australia) Pty Ltd
Operator:	Terra Search Pty Ltd 12/120 Briggs St Welshpool WA 6106
Title:	Surrender Report for EL4493 Hamilton Creek, 17th May 2010 to 16 May 2014
Commodities:	Uranium
Authors:	Niamh McMunn
Date:	July 2014
Mapsheets:	Abminga 1:250,000 SG 53-10 Tieyon 1:100,000 5645
Datum:	GDA 94 Zone 53
	Longitude and Latitude (AGD 66)

Executive Summary

Exploration License EL4493 lies in the far north of South Australia, abutting the Northern Territory Border and about 30km east of Stuart Highway. It is entirely within Tieyon Station. It was granted on May 17th 2010 and it covered 25 graticular blocks with a total area of 77 km^2.

The tenement is on the eastern margins of the Musgrave Block, represented in the area mostly by adamellite but also dolerite dykes and gneiss. Though the Proterozoic Musgrave Block rocks have widespread outcrop, they are extensively and unconformably overlain by Jurassic-Cretaceous Algebuckina Sandstone. In turn, the Tertiary Cordillo Silcrete overlies the sandstone, as a hard caprock which erodes to a mesa-and-butte landscape.

The Musgrave Block adamellite has high uranium abundance is some areas. Mobilized by weathering, this uranium could form economic deposits in either the Algebuckina Sandstone, or in calcretes that have formed in palaeodrainage channels within the tenement.

Field mapping along Hamilton Creek revealed calcrete deposits at least a metre thick along a considerable length of the bank. These were often overlain by orange-red unconsolidaqted aeolian sand.

During the tenure of the tenement ten rockchip samples were taken at two calcrete roadbase pits, while 22 rockchip and 46 soil samples were taken elsewhere. Eight water bores within the tenement and another seven nearby were sampled and assayed for a suite of elements.

Contents

Figures

1 Introduction

Tianda Uranium (Australia) Pty Ltd holds EL 4493 in the far north of South Australia, bordering the Northern Territory border and about fifty kilometres east of the North Australian (Ghan) Railway line.

EL 4493 includes anomalously radioactive granites of the Musgrave Complex, overlain unconformably by Jurassic-Cretaceous Algebuckina Sandstone and the Cordillo Silcrete. Weathering of the granite is hypothesized to release uranium which may be trapped within redox fronts in the sandstone. Additionally, the existence of calcrete within the tenement may result in formation of Yeeleerie-style uranium deposits.

Exploration of the tenement commenced on May 20th, 2010 with the season's work being completed on July 29th. The work included soil geochemistry, rock chip sampling, water sampling, reconnaissance and mapping over much of the tenement. The exploration license covers 896 square kilometres so much vehicle-based reconnaissance was necessary.

2 Location and access

Access to the exploration license was from Alice Springs, south to Kulgera (270km), then east along the Finke Road (50km) and southeast to Tieyon Homestead (32km).

Figure 1 Tenement Location EL4493

Access to the tenement is obtained from Tiryon Homestead by a track heading north east. From here most of the southern area of the tenement can be accessed.

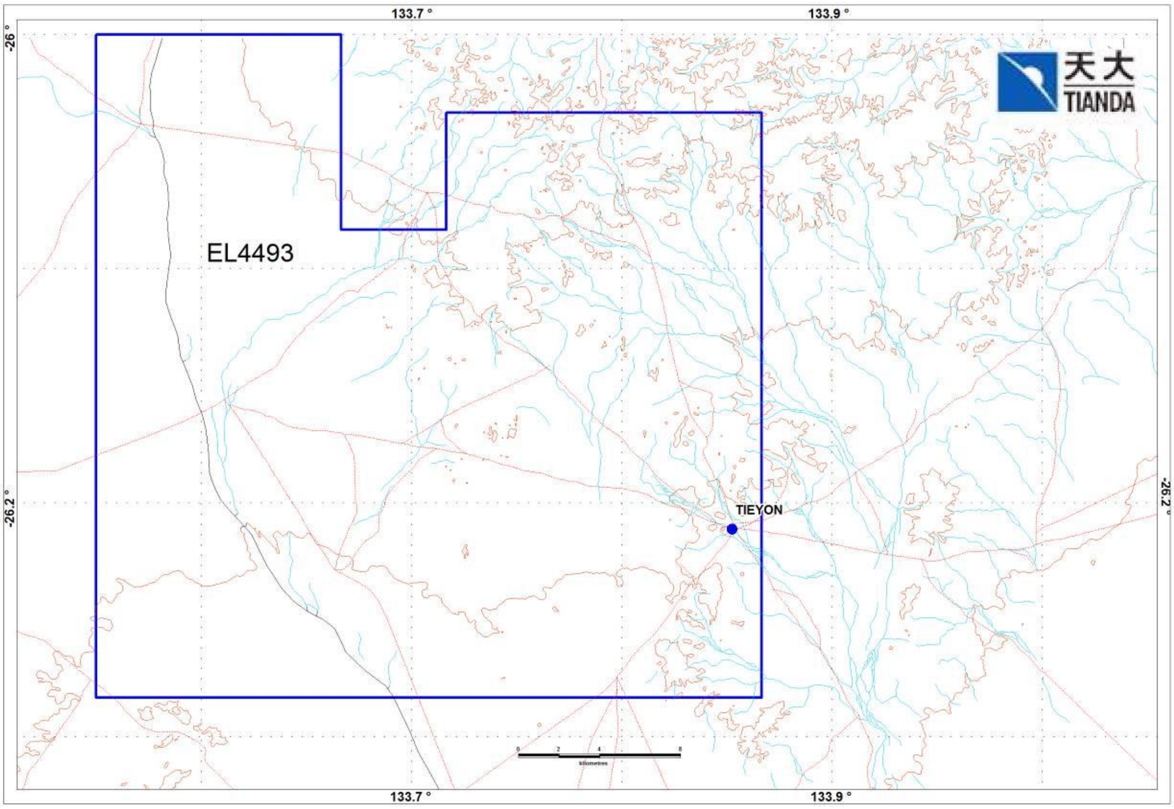

Figure 2 Access to Tenement EL4493

Tieyon Station is managed by:-

Paul and Jo Smith
Tieyon Station
Alice Springs
NT 0870

ph. 08 89560720

3 Work Carried out on EL 4493

Terra Search Pty Ltd were contracted to carry out all the exploration work on EL 4493 on behave of Tianda. Work carried out on this tenement since it was acquired by Tianda in 2010 includes rock chip sampling, soil and water sampling and an EM survey carried out in 2011. The aim of this was to determine if any of the ground was a host for a uranium deposit. A number of rock chip and soil samples were taken over the area in 2010. Any calcrete on the ground was targeted as well as sandstone and ademellite. Some of these came up positive for uranium, with some highs in the rock chips with 34ppm of uranium. The map below shows the location of the rock chips, soil and water samples.

A total of 32 rockchip samples, 46 soil samples and 16 water samples were taken across the entire tenement. Of which one water sample, two soil samples and five rockchip samples were within the relinquished area.

Figure 3 outlies all the surficial exploration that was carried out over the tenement over the past four years. All the assay data for these samples can be found in appendix 1. As well as carrying out this sampling an Electro Magnetic (EM) survey was commissioned in 2011 to cover the tenement on a 3200 spacing using east west flightlines and Geotech's VTEM system. A total of 214 line km was flown over the tenement. The main aim was to define the paleotopography and identify targets for the most likely redox boundary areas with future drilling. The full EM report can be found in appendix 2. Figure 4 shows the lines that were flown with a 3200m spacing.

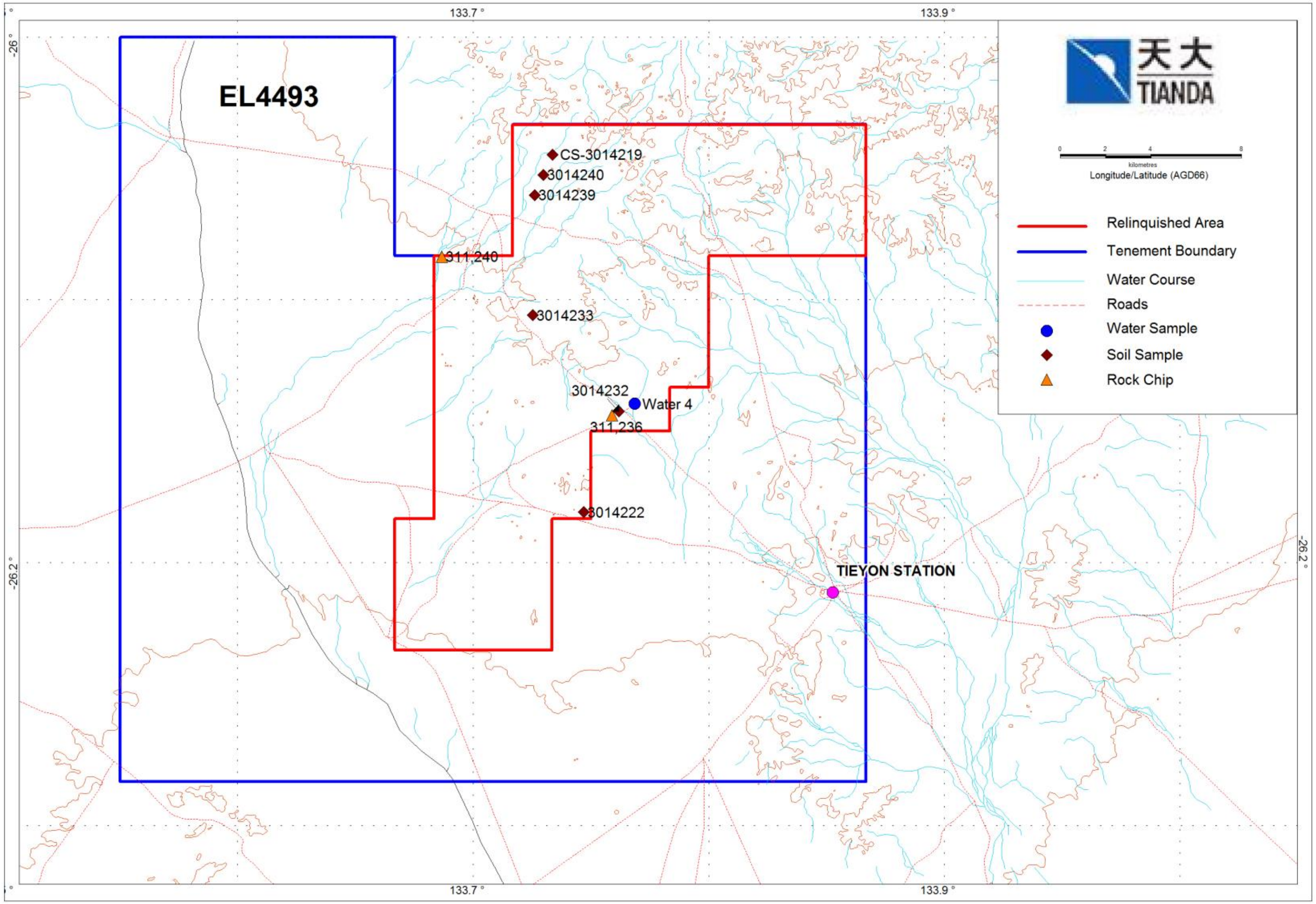

Figure 3 Previous Work Carried out Over EL 4493

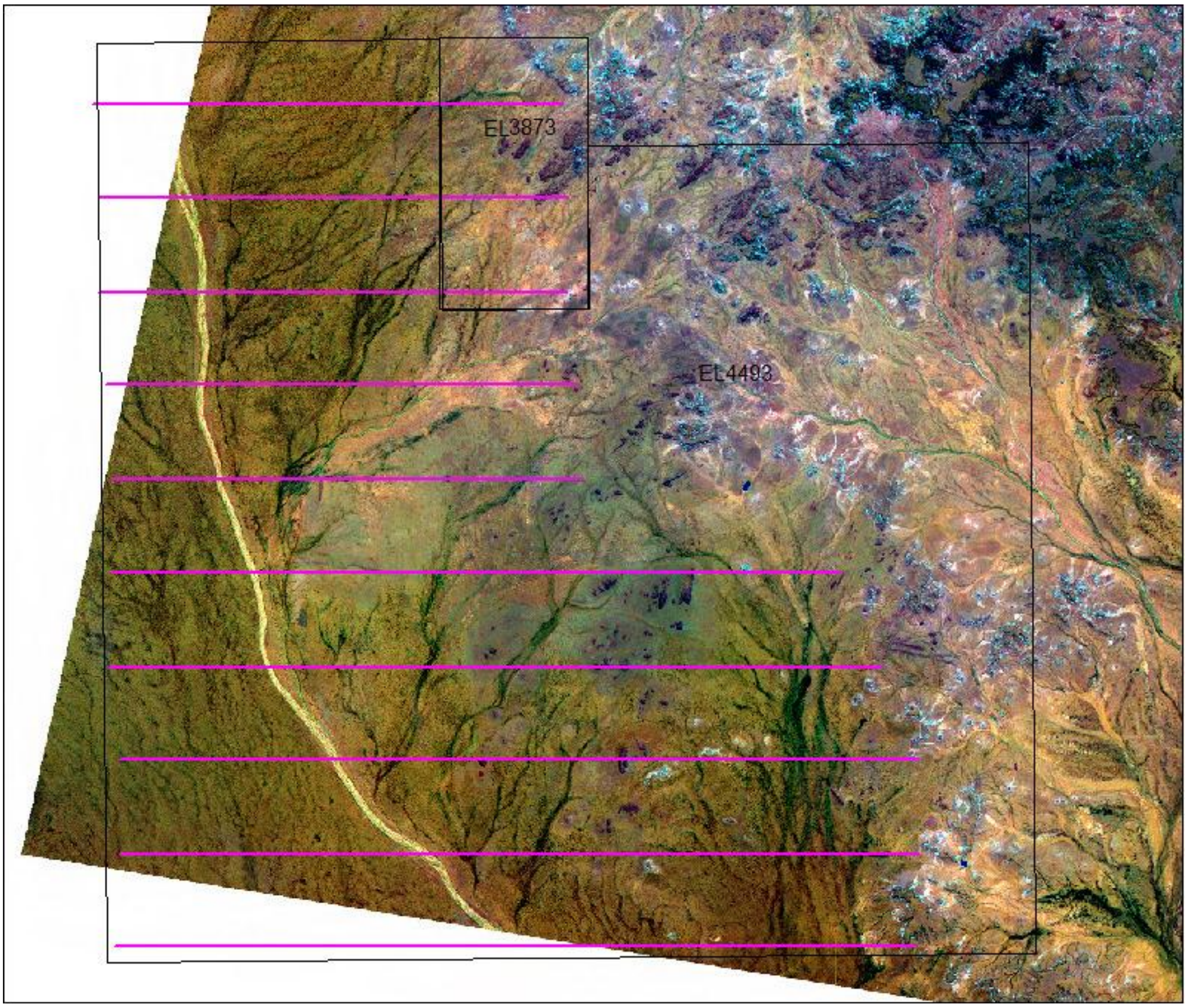

Figure 4 EL4493 EM survey lines 3200m spacings

4 Area Relinquished

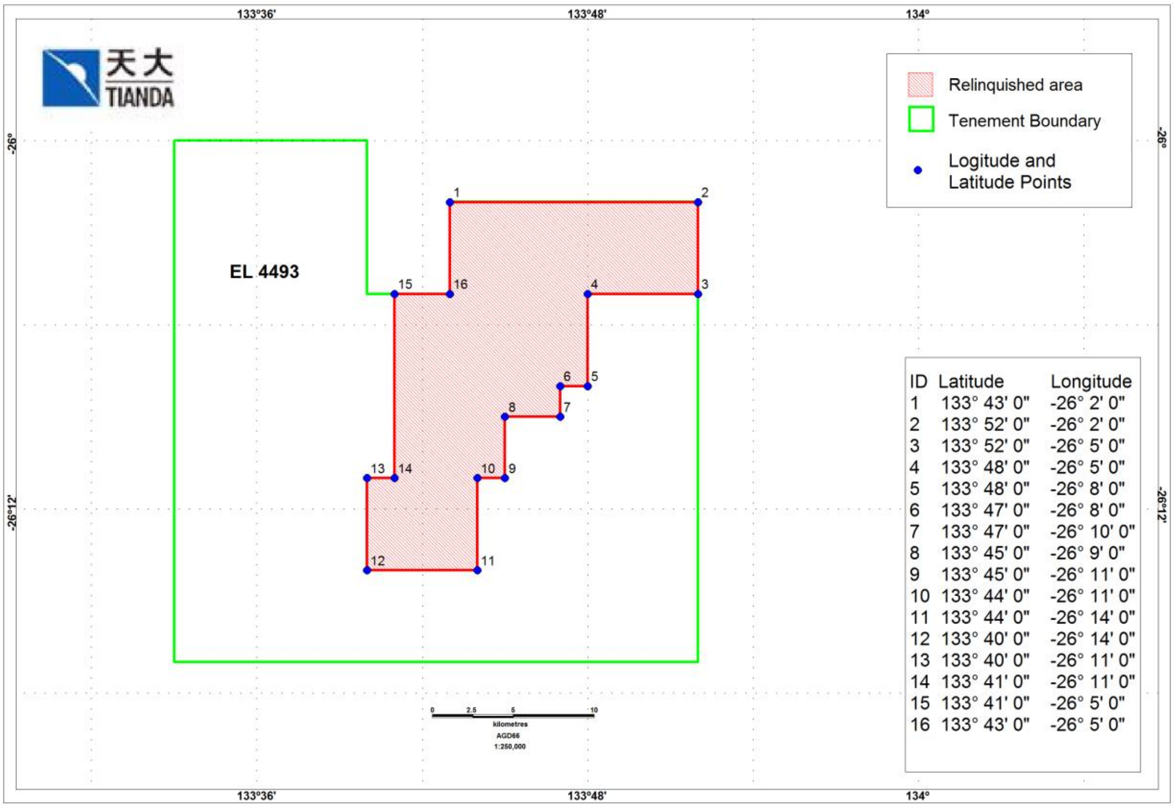

Figure 5 Area Relinquished EL4493

The above picture shows the area that was relinquished in April 2014. Since the tenement was granted in May 2010 much work was completed over the tenement, including mapping rock chipping, water and soil sampling as well as an EM survey. It was felt that by relinquishing this area Tianda will be fully able to concentrate on the rest of the tenement and start to outline potential targets. The results from the EM survey appear to have defined good, roughly north south, channels running down the western side of the tenement as well as shorter channels in the central and eastern portion. This will be the next area to further explore and determine its likelihood of a uranium deposit.

Appendix 1

Geochemistry Files

Rock chip samples

Client Ref: Tianda Resources
Client Name: Terra Search
Date Reported: 21/07/2010

Element	mga_E	mga_N	Ag_MS	Al_OES	As_MS	Ba_OES	Be_MS	Bi_MS
Units			ppm	ppm	ppm	ppm	ppm	ppm
DL			0.01	10	0.5	0.2	0.2	0.1
rockchip sample			MMA04	MMA04	MMA04	MMA04	MMA04	MMA04
3014222	374786.3	7103705.926	0.1	66027	-0.5	1788	1.7	-0.1
3014232	376228.15	7107951.481	0.21	4233	2.8	1009	0.3	-0.1
3014233	372536.96	7111982.097	0.05	15201	3.4	695	0.5	-0.1
3014239	372563.91	7117040.4	0.06	78566	-0.5	779	3.2	-0.1
3014240	372932.43	7117895.182	0.03	13069	1.6	1939	0.3	-0.1

rockchip samples

Element	Ca_OES	Cd_MS	Ce_MS	Co_MS	Cr_OES	Cs_MS	Cu_MS	Dy_R
Units	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm
DL	10	0.05	0.05	0.2	2	0.1	0.2	0.02
rockchip sample	MMA04	MMA04	MMA04	MMA04	MMA04	MMA04	MMA04	MMA04
3014222	11489	0.11	128	5.6	8	0.4	33.6	6.15
3014232	138525	0.07	9.84	3.7	18	0.1	12.7	1.08
3014233	231932	0.06	90.5	4.8	5	0.2	12.4	6.89
3014239	14330	0.08	233	5.9	6	1.4	3	2.66
3014240	280432	0.14	14.9	4.7	12	0.6	6.6	9.63

rockchip samples

Element	Er_R	Eu_R	Fe_OES	Ga_MS	Gd_R	Ge_MS	Hf_MS	Hg_MS
Units	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm
DL	0.05	0.02	100	0.05	0.05	0.05	0.02	0.05
rockchip sample	MMA04	MMA04	MMA04	MMA04	MMA04	MMA04	MMA04	MMA04
3014222	3.6	2	20414	17.8	9.7	1.89	1.85	-0.05
3014232	0.7	0.34	7190	1.55	1.78	0.51	1.95	-0.05
3014233	3.51	1.92	10366	4.38	8.99	0.62	0.22	-0.05
3014239	1.19	1.09	28502	21.4	8.16	1.16	9.57	-0.05
3014240	5.3	3.17	9262	3.99	15.0	0.29	0.48	-0.05

rockchip samples

Element	Ho_R	In_MS	K_OES	La_MS	Li_OES	Lu_R	Mg_OES	Mn_OES
Units	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm
DL	0.02	0.01	10	0.05	0.5	0.02	10	2

rockchip sample	MMA04	MMA04	MMA04	MMA04	MMA04	MMA04	MMA04	MMA04
3014222	1.32	0.04	40766	68.5	9.7	0.52	2792	497
3014232	0.25	0.02	1720	5.47	11.8	0.12	6255	69
3014233	1.36	0.02	8149	30.5	9.7	0.48	30219	137
3014239	0.48	0.02	34303	131	19.4	0.26	3782	506
3014240	2.13	0.01	7756	69	3	0.63	6664	101

rockchip samples

Element	Mo_MS	Na_OES	Nb_MS	Nd_R	Ni_MS	P_OES	Pb_MS	Pr_R
Units	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm
DL	0.1	10	0.5	0.02	2	5	0.2	0.05
rockchip sample	MMA04	MMA04	MMA04	MMA04	MMA04	MMA04	MMA04	MMA04
3014222	0.3	19818	11.2	63.8	6	1714	45.5	16.2
3014232	0.6	551	25.2	5.6	5	396	5.4	1.32
3014233	0.1	470	6.4	51.7	8	353	7.1	11.1
3014239	0.7	29417	4.1	74.6	6	522	63.3	22.9
3014240	0.1	1163	3.7	79.0	9	146	6.2	17.4

Element	Rb_MS	Re_MS	S_OES	Sb_MS	Sc_OES	Se_MS	Sm_R	Sn_MS
Units	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm
DL	0.1	0.01	50	0.1	1	0.05	0.02	0.2
rockchip sample	MMA04	MMA04	MMA04	MMA04	MMA04	MMA04	MMA04	MMA04
3014222	218.5	-0.01	79	-0.1	6	0.28	10.3	1.9
3014232	6	-0.01	465	0.1	6	1.01	1.05	2.3
3014233	37.6	-0.01	344	-0.1	2	2.24	10.5	1
3014239	173.8	-0.01	80	-0.1	27	0.09	8.73	1.2
3014240	30.3	-0.01	790	-0.1	2	0.65	14.0	0.6

rockchip samples

Element	Sr_OES	Ta_MS	Tb_R	Te_MS	Th_MS	Ti_OES	Tl_MS	Tm_R
Units	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm
DL	0.1	0.01	0.02	0.2	0.02	10	0.1	0.05
rockchip sample	MMA04	MMA04	MMA04	MMA04	MMA04	MMA04	MMA04	MMA04
3014222	342	0.1	1.14	-0.2	14.9	2613	1.1	0.62
3014232	220	1.02	0.18	-0.2	2.39	8269	-0.1	0.14
3014233	312	-0.01	1.33	-0.2	2.54	1478	0.2	0.6
3014239	257	-0.01	0.61	-0.2	273	2102	0.9	0.22
3014240	423	0.04	1.83	-0.2	0.37	1485	0.2	0.81

rockchip samples

Element	U_MS	V_OES	W_MS	Y_MS	Yb_R	Zn_MS	Zr_MS
Units	ppm	ppm	ppm	ppm	ppm	ppm	ppm
DL	0.02	2	0.1	0.05	0.05	0.2	1
rockchip sample	MMA04	MMA04	MMA04	MMA04	MMA04	MMA04	MMA04
3014222	0.51	35	-0.1	37.7	3.34	55.4	69
3014232	12.0	36	1.1	6.89	0.9	12.8	77
3014233	1.02	26	-0.1	33.1	3.24	17.6	5
3014239	9.17	50	-0.1	13.2	1.4	55.8	358
3014240	0.54	26	0.1	67.8	4.02	12.1	17

Labwest Minerals Analysis ALW000247
Client Ref: Tianda Resources -80# S **Soil Geochemistry**

Element				Ag_MS	Al_OES	As_MS	Ba_OES	Be_MS
Units				ppm	ppm	ppm	ppm	ppm
DL				0.01	10	0.5	0.2	0.2
soil sample	mgaE	mgaN	elevation	MMA04	MMA04	MMA04	MMA04	MMA04
311236	376079.02	7107953	428	0.1	39083	3.6	662	1.1
311240	368783.92	7114560.3	440	0.11	95209	3.8	445	1.7

Soil Geochemistry

Element	Bi_MS	Ca_OES	Cd_MS	Ce_MS	Co_MS	Cr_OES	Cs_MS	Cu_MS
Units	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm
DL	0.1	10	0.05	0.05	0.2	2	0.1	0.2
soil sample	MMA04	MMA04	MMA04	MMA04	MMA04	MMA04	MMA04	MMA04
311236	0.1	61941	0.07	45.4	8.8	30	1.5	18
311240	0.2	7124	-0.05	50.5	5.7	54	3.2	19.7

Soil Geochemistry

Element	Dy_R	Er_R	Eu_R	Fe_OES	Ga_MS	Gd_R	Ge_MS	Hf_MS
Units	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm
DL	0.02	0.05	0.02	100	0.05	0.05	0.05	0.02
soil sample	MMA04	MMA04	MMA04	MMA04	MMA04	MMA04	MMA04	MMA04
311236	6.36	4.31	1.42	25681	9.44	6.3	1.04	2.03
311240	3.68	2.17	1.04	44802	21.61	4.5	1.71	2.59

Soil Geochemistry

Element	Hg_MS	Ho_R	In_MS	K_OES	La_MS	Li_OES	Lu_R	Mg_OES
Units	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm
DL	0.05	0.02	0.01	10	0.05	0.5	0.02	10
soil sample	MMA04	MMA04	MMA04	MMA04	MMA04	MMA04	MMA04	MMA04
311236	-0.05	1.52	0.03	14746	22.0	17	0.77	9636
311240	-0.05	0.79	0.06	10586	31.4	26.4	0.39	8122

Soil Geochemistry

Element	Mn_OES	Mo_MS	Na_OES	Nb_MS	Nd_R	Ni_MS	P_OES	Pb_MS
Units	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm
DL	2	0.1	10	0.5	0.02	2	5	0.2
soil sample	MMA04	MMA04	MMA04	MMA04	MMA04	MMA04	MMA04	MMA04
311236	349	0.4	3019	14.1	25.1	13	542	13.6
311240	247	0.5	4482	13.8	26.6	19	184	17.1

Soil Geochemistry

Element	Pr_R	Rb_MS	Re_MS	S_OES	Sb_MS	Sc_OES	Se_MS	Sm_R
Units	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm
DL	0.05	0.1	0.01	50	0.1	1	0.05	0.02
soil sample	MMA04	MMA04	MMA04	MMA04	MMA04	MMA04	MMA04	MMA04
311236	5.65	60.8	-0.01	294	0.1	8	0.78	5.37
311240	6.77	57.9	-0.01	249	0.2	13	0.27	4.69

Soil Geochemistry

Element	Sn_MS	Sr_OES	Ta_MS	Tb_R	Te_MS	Th_MS	Ti_OES	Tl_MS
Units	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm
DL	0.2	0.1	0.01	0.02	0.2	0.02	10	0.1
soil sample	MMA04	MMA04	MMA04	MMA04	MMA04	MMA04	MMA04	MMA04
311236	1.8	164.6	0.13	1.06	-0.2	5.96	5539	0.3
311240	2.8	153.9	0.22	0.66	-0.2	14.5	6194	0.4

Soil Geochemistry

Element	Tm_R	U_MS	V_OES	W_MS	Y_MS	Yb_R	Zn_MS	Zr_MS
Units	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm
DL	0.05	0.02	2	0.1	0.05	0.05	0.2	1
soil sample	MMA04	MMA04	MMA04	MMA04	MMA04	MMA04	MMA04	MMA04
311236	0.8	1.15	80	0.6	43.4	4.36	52.7	75
311240	0.41	1.3	122	0.9	20.5	2.33	48.1	98

Water sample

Element				Ag_MS	As_MS	Ba_OES	Ca_OES	Co_MS
Units				ug/L	ug/L	mg/L	mg/L	ug/L
DL				0.05	0.5	0.02	0.05	0.2
Water samp	mgaE	mgaN	Elvation	SOL01	SOL01	SOL01	SOL01	SOL01
Water 4	377026	7108445.483	429	-0.05	1.1	0.14	17.68	0.6

Element	Cu_MS	Fe_OES	K_OES	Li_OES	Mo_MS	Ni_MS	P_OES	Pb_MS
Units	ug/L	mg/L	mg/L	mg/L	ug/L	ug/L	mg/L	ug/L
DL	0.2	0.01	0.05	0.001	0.1	0.2	0.05	0.2
Water sample	SOL01	SOL01	SOL01	SOL01	SOL01	SOL01	SOL01	SOL01
Water 4	3.3	3.26	9.64	0.002	1.0	2.7	0.14	1.3

Element	S_OES	Se_MS	Th_MS	Ti_OES	U_MS	V_OES	Y_MS	Zn_MS
Units	mg/L	ug/L	ug/L	mg/L	ug/L	mg/L	ug/L	ug/L
DL	1	0.05	0.1	0.01	0.05	0.001	0.05	0.2
Water sample	SOL01	SOL01	SOL01	SOL01	SOL01	SOL01	SOL01	SOL01
Water 4	2	1.01	1.2	0.16	0.26	0.009	2.75	8.7

Appendix 2 EM Survey

Geotech Airbourne Pty Ltd

SURVEY AND LOGISTICS REPORT ON A HELICOPTER BORNE VERSATILE TIME DOMAIN ELECTROMAGNETIC (VTEM) SURVEY

on the

KULGERA AREA

AUSTRALIA

for

TIANDA URANIUM PTY LTD (TIANDA)

by

GEOTECH AIRBORNE PTY LIMITED

Unit 1, 29 Mulgul Road,
Malaga, WA, 6090,
Western Australia
Tel: +61 8 9249 8814
Fax: +61 8 9249 8894
www.geotechairborne.com
keith@geotechairborne.com

Project AA1052
May, 2011

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APPENDICES

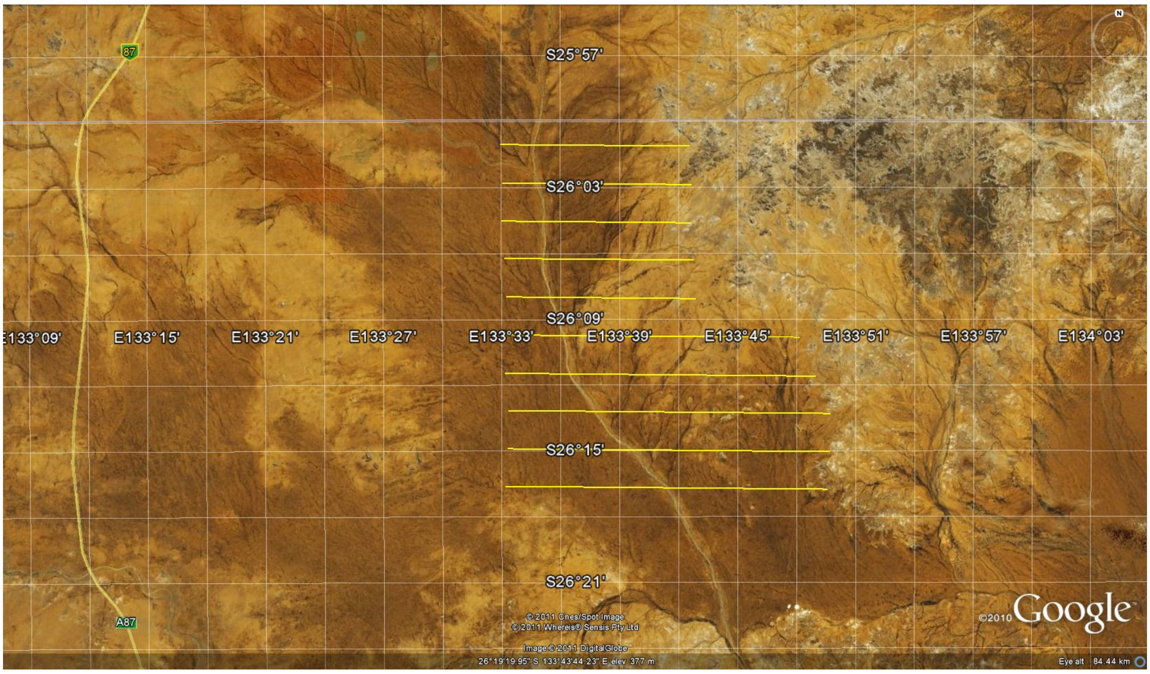
SURVEY AND LOGISTICS REPORT ON A HELICOPTER-BORNE VTEM SURVEY

1. SURVEY SPECIFICATIONS

1.1. General

Job Number	AA1052
Client	Tianda Uranium Pty Ltd
Project Area	Kulgera
Location	Australia
Number of Blocks	1
Total line kilometres	214
Survey date	25 May – 29 May 2011
Client Representative	Dr She Fa Chen, Chief Geologist Suite 37/328 Albany Highway, Victoria Park, WA6100, Australia Tel: +61 8 9472 7447 E-mail: shefachen@tianda.com
Client address	Suite 37/328 Albany Highway, Victoria Park, WA6100, Australia
Client Consultant	N/A

1.2. VTEM flight plan on Google EARTH™ Background



1.3. Survey block coordinates.

Easting UTM53S	Northing UTM53S
KULGERA	
354818.11	7092854.78
354818.11	7121600.00
382980.42	7121600.00
382980.42	7092854.78
354818.11	7092854.78

1.4. Survey block specifications

Survey block	Line spacing (m)	Line-km (contractual)	Line-km (delivered)	Flight direction	Line number
KULGERA	3200	214	214	090°- 270°	L10000 – L10090

1.5. Survey schedule

Date	Flight #	Block	Nominal Production Km flown	Comments
25-May-11	1			VTEM assembly & Tests
26-May-11	2,3			VTEM assembly & Tests
27-May-11	4			Tests
28-May-11	5,6			Production
29-May-11				Demobilization

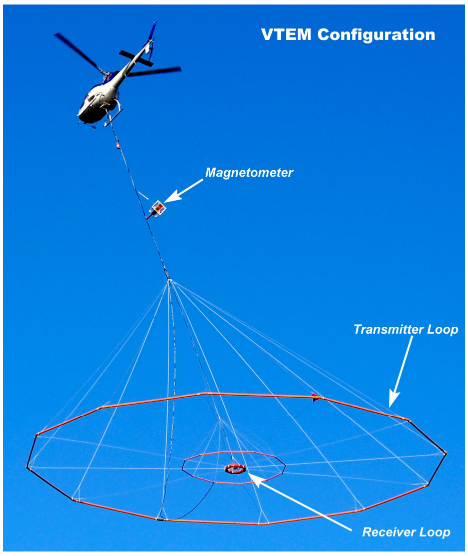
2. SYSTEM SPECIFICATIONS

2.1. Instrumentation

Survey Helicopter	
Model	AS 350 B3
Registration	VH VTX
Operating Company	Air Walser
Nominal survey speed	80 km/h
Nominal terrain clearance	80 m
VTEM Transmitter	
Coil diameter	26 m
Number of turns	4
Pulse repetition rate	25 Hz
Peak current	200 Amp
Duty cycle	36.7%
Peak dipole moment	425,000 NIA
Pulse width	7.35 ms
Nominal terrain clearance	49 m
VTEM Receiver	
Coil diameter	1.2 metre
Number of turns	100
Effective area	113.1 m^2
Sampling interval	0.1 s
Nominal terrain clearance	49 m
Magnetometer	
Type	Geometrics
Model	Optically pumped cesium vapour
Sensitivity	0.02 nT
Sampling interval	0.1 s
Cable length	13.5 m
Nominal terrain clearance	70 m
Radar Altimeter	
Type	Terra TRA 3000/TRI 40
Position	Beneath cockpit
Sampling interval	0.2 s
GPS navigation system	
Type	NovAtel
Model	WAAS enabled OEM4-G2-3151W
Antenna position	Helicopter tail
Sampling interval	0.2 s
Base Station Magnetometer/GPS	
Type	Geometrics
Model	Cesium vapour
Sensitivity	0.001 nT
Sampling interval	1 s

2.2. VTEM Configuration

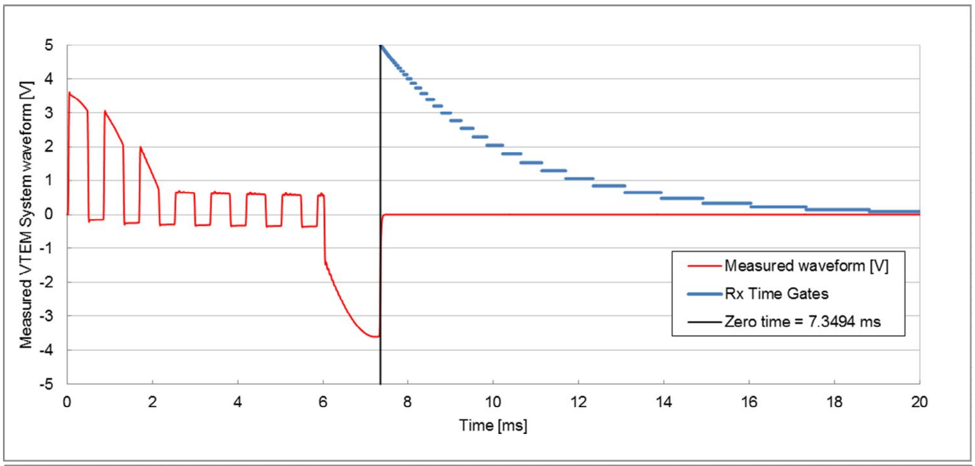
Configuration	
Cable angle with vertical	40 °
Cable length (EM receiver)	40 m
Cable length (Magnetometer)	13.5 m

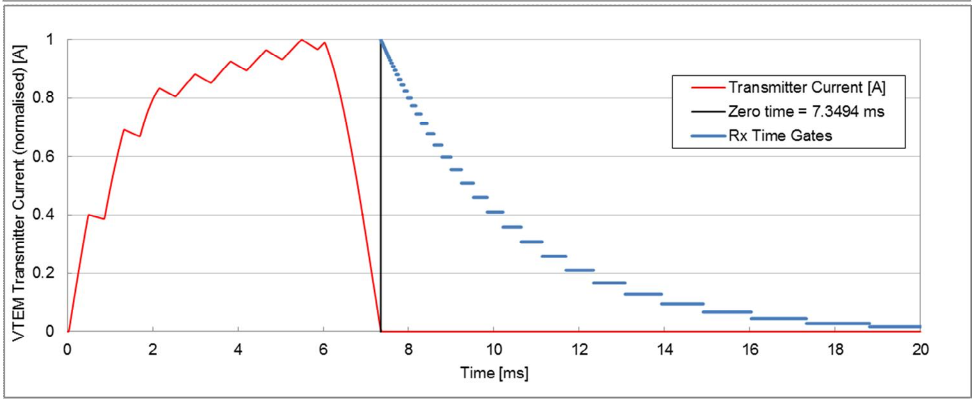


2.3. VTEM decay sampling scheme

VTEM B-field System Decay Sampling scheme				
Array	Microseconds			
Index	Middle	Start	End	Width
13	83	78	90	12
14	96	90	103	13
15	110	103	118	15
16	126	118	136	18
17	145	136	156	20
18	167	156	179	23
19	192	179	206	27
20	220	206	236	30
21	253	236	271	35
22	290	271	312	40
23	333	312	358	46
24	383	358	411	53
25	440	411	472	61
26	505	472	543	70
27	580	543	623	81
28	667	623	716	93
29	766	716	823	107
30	880	823	945	122
31	1010	945	1086	141
32	1161	1086	1247	161
33	1333	1247	1432	185
34	1531	1432	1646	214
35	1760	1646	1891	245
36	2021	1891	2172	281
37	2323	2172	2495	323
38	2667	2495	2865	370
39	3063	2865	3292	427
40	3521	3292	3781	490
41	4042	3781	4341	560
42	4641	4341	4987	646
43	5333	4987	5729	742
44	6125	5729	6581	852
45	7036	6581	7560	979
46	8083	7560	8685	1125
47	9286	8685	9977	1292
48	10667	9977	11458	1482

2.4. VTEM Transmitter Waveform over one half-period (May 2011)





3. PROCESSING

3.1. Processing parameters

Coordinates	
Projection	MGA Z 53
Datum	GDA 94
Spheroid	GDA 94
Spherics rejection (EM and Magnetic data)	
Non-linear filter	4 point
Non-linear filter sensitivity	0.0001
Low-pass filter wavelength	15 fids
Lag correction of other sensors to EM receiver position	
GPS	18 m
Radar	28 m
Magnetometer	17 m

3.2. Flight Path

The flight path, recorded by the acquisition program as WGS 84 latitude/longitude, was converted into the UTM coordinate system in Oasis Montaj. The flight path was drawn using linear interpolation between x,y positions from the navigation system. Positions are updated every second and expressed as UTM eastings (x) and UTM northings (y).

3.3. Electromagnetic Data

A three stage digital filtering process was used to reject major sferic events and to reduce system noise. Local sferic activity can produce sharp, large amplitude events that cannot be removed by conventional filtering procedures. Smoothing or stacking will reduce their amplitude but leave a broader residual response that can be confused with geological phenomena. To avoid this possibility, a computer algorithm searches out and rejects the major sferic events.

The signal to noise ratio was further improved by the application of a low pass linear digital filter. This filter has zero phase shift which prevents any lag or peak displacement from occurring, and it suppresses only variations with a wavelength less than the specified filter wavelength.

VTEM's X-component data produces crossover type anomalies with conductors located beneath the inflection between maxima and minima in the data. This is in contrast to the Z component which shows maxima or minima above conductors. During acquisition the convention is for X-coil data to be positive in the direction of flight. In the processing phase the polarity is adjusted to follow the right hand rule for multi-component transient electromagnetic methods.

For N-S lines the sign convention for the X in-line component crossover is positive-negative pointing south to north for vertical plate conductors perpendicular to the profile. For E-W lines the sign convention for the X in-line component crossover is positive-negative pointing west to east for vertical plate conductors perpendicular to the profile. X-component data for alternating/opposite flight directions are reversed (multiplied by negative one) in the final database to account for this polarity convention.

The Fraser Filter converts crossovers of the correct polarity into peak responses of X component by differencing successive values. It is calculated as $(f_1+f_2)-(f_3+f_4)$ where f_i are data from four consecutive stations. This is a derivative filter and likely to increase any noise in data.

A useful presentation of X-component data is the Staked Fraser Filter. The Stacked Fraser Filter data are calculated as the average value of 16 channels (20 to 35) of Fraser Filtered X-component data. The signal to noise ratio is improved and information from 16 channels are combined into one, which allows easier presentation in grid or map format.

3.4. Magnetic Data

The processing of the magnetic data involved the correction for diurnal variations by using the digitally recorded ground base station magnetic values. The base station magnetometer data was edited and merged into the Geosoft GDB database on a daily basis. The aeromagnetic data was corrected for diurnal variations by subtracting the observed magnetic base station deviations.

A micro-levelling procedure was then applied. This technique is designed to remove persistent low-amplitude components of flight-line noise remaining after tie line levelling.

The corrected magnetic data was interpolated between survey lines using a random point gridding method to yield x-y grid values for a standard grid cell size of a quarter of the line spacing. The Minimum Curvature algorithm was used to interpolate values onto a rectangular regular spaced grid.

3.5. Digital Terrain Model

Subtracting the radar altimeter data from the GPS elevation data creates a digital elevation model. To correct for minor elevation differences that are evident in this data when gridded, Shuttle Radar Topography Mission (SRTM) data have been used.

4. DELIVERABLES

VTEM Survey and logistics report		
Format	PDF	
Copies	2 x Digital (DVD/CD) 2 x Hard copy	
Database		
Format	Digital Geosoft (.GDB)	
Channels	Name	Description
	X_UTM	X positional data (UTM Z53S/ WGS84)
	Y_UTM	Y positional data (UTM Z53S/ WGS84)
	X_MGA	X positional data (MGA Z53/ GDA94)
	Y_MGA	Y positional data (MGA Z53/ GDA94)
	Lon	Longitude data
	Lat	Latitude data
	Z	GPS antenna elevation (metres above sea level)
	Radar	Helicopter terrain clearance from radar altimeter (metres above ground level)
	RxAlt	EM Receiver and Transmitter terrain clearance (metres above ground level)
	DTM	Digital terrain model (metres)
	Gtime1	UTC time (seconds of the day)
	MagTF	Raw Total Magnetic field data (nT)
	MagBase	Magnetic diurnal variation data (nT)
	MagDiu	Total Magnetic field diurnal variation and lag corrected data (nT)
	MagMicL	Microleveled Total Magnetic field data (nT)
	dBdtz [13] - dBdtz[48]	dB/dt, Time Gates 83 µs to 10667 µs (pV/A/m^4)
	BFieldz[13] - BFieldz[48]	B-field, Time Gates 83 µs to10667 µs (pV.ms/A/m^4)
	PLM	Power line monitor
Grids		
Format	Digital Geosoft (.GRD and .GI)[1]	
Grids	Name	Description
	AA1052_Kulgera_Mag	Total Magnetic field (nT)
Maps		
Format	Digital Geosoft (.MAP)	
Scale	1:20 000	
Maps	Name	Description
	AA1052_Kulgera_Mag	Total Magnetic field colour contours
	AA1052_Kulgera_dBdt_Log	VTEM dB/dt profiles, Time Gates 0.667 – 9.286 ms in log-linear scale
	AA1052_Kulgera_Bfield_Log	VTEM B-field profiles, Time Gates 0.667 – 9.286 ms in log-linear scale

[1] A Geosoft .GRD file has a .GI metadata file associated with it, containing grid projection information.

Waveform		
Format	Digital Excel Spreadsheet (AA1052_Kulgera_Waveform.xls)	
Columns	Name	Description
	Time	Sampling rate interval, 5.208 µs
	Volt	Output voltage of the receiver coil (volt)
	Current	Transmitter current (normalised to 1A peak)

Google Earth Flight Path file	
Format	Google Earth AA1052_Kulgera_FlightPath.kmz
	Free version of Google Earth software can be downloaded from, *http://earth.google.com/download-earth.html*

5. PERSONNEL

Geotech Airborne Limited Personnel	
Operator / Crew chief	Jon Lambert
Operator	Steve Stanley
Data Processing (Preliminary)	Pete Hamilton
Data Processing (Final) /Reporting	Joel Mutatavikwa
Final data supervision	Malcolm Moreton Data Processing Manager (malcolm@geotechairborne.com)
Overall project management	Keith Fisk Managing Partner and Director (keith@geotechairborne.com)

APPENDIX A

GENERALIZED MODELING RESULTS OF THE VTEM SYSTEM
(by Roger Barlow and Alexander Prikhodko)

Introduction

The VTEM system is based on a concentric or central loop design, whereby, the receiver is positioned at the centre of a transmitter loop that produces a primary field. The wave form is a bi-polar, modified square wave with a turn-on and turn-off at each end.

During turn-on and turn-off, a time varying field is produced (dB/dt) and an electro-motive force (emf) is created as a finite impulse response. A current ring around the transmitter loop moves outward and downward as time progresses. When conductive rocks and mineralization are encountered, a secondary field is created by mutual induction and measured by the receiver at the centre of the transmitter loop.

Efficient modeling of the results can be carried out on regularly shaped geometries, thus yielding close approximations to the parameters of the measured targets. The following is a description of a series of common models made for the purpose of promoting a general understanding of the measured results.

A set of models has been produced for the Geotech VTEM® system dB/dT Z and X components (see models A-1 to A-16). The Maxwell ™ modeling program (EMIT Technology Pty. Ltd. Midland, WA, AU) used to generate the following responses assumes a resistive half-space. The reader is encouraged to review these models, so as to get a general understanding of the responses as they apply to survey results. While these models do not begin to cover all possibilities, they give a general perspective on the simple and most commonly encountered anomalies.

As the plate dips and departs from the vertical position, the peaks become asymmetrical.

As the dip increases, the aspect ratio (Min/Max) decreases and this aspect ratio can be used as an empirical guide to dip angles from near 90º to about 30º. The method is not sensitive enough where dips are less than about 30º.

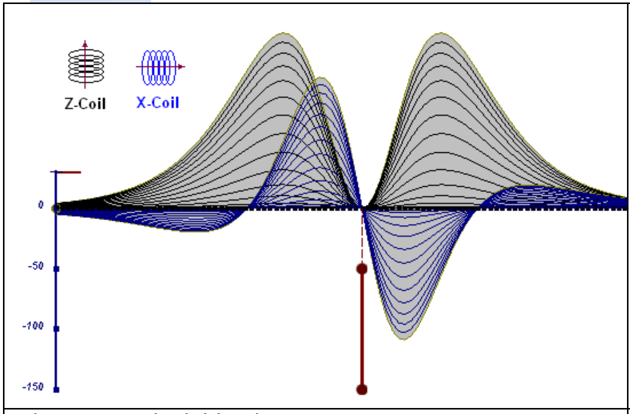


Fig A-1: Vertical thin plate

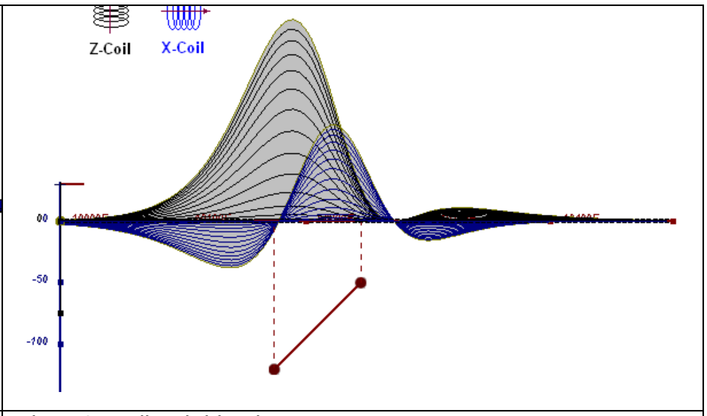


Fig A-2: Inclined thin plate

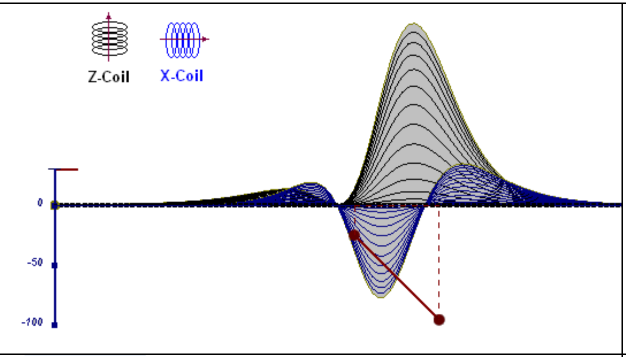


Fig A-3: Inclined thin plate

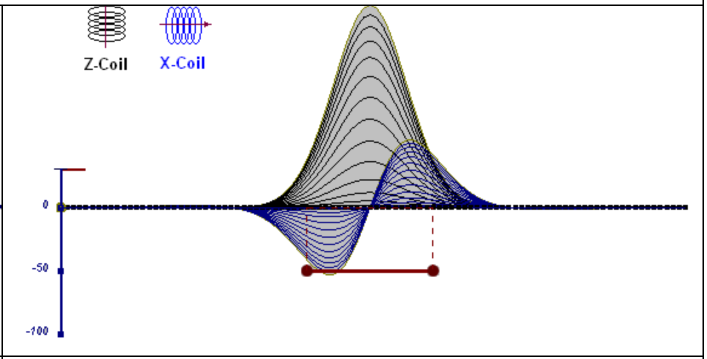


Fig A-4: Horizontal thin plate

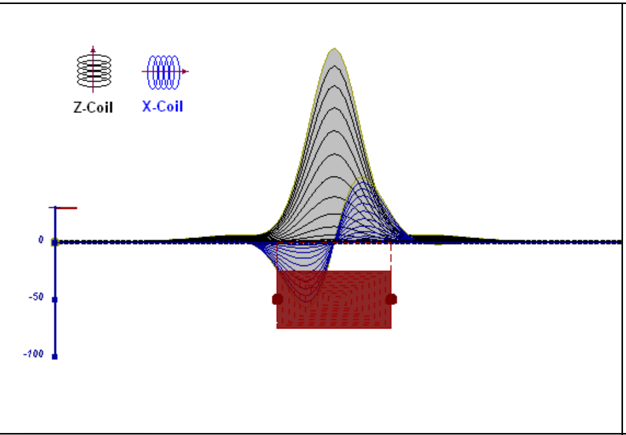


Figure A-5: Horizontal thick plate (linear scale of the response)

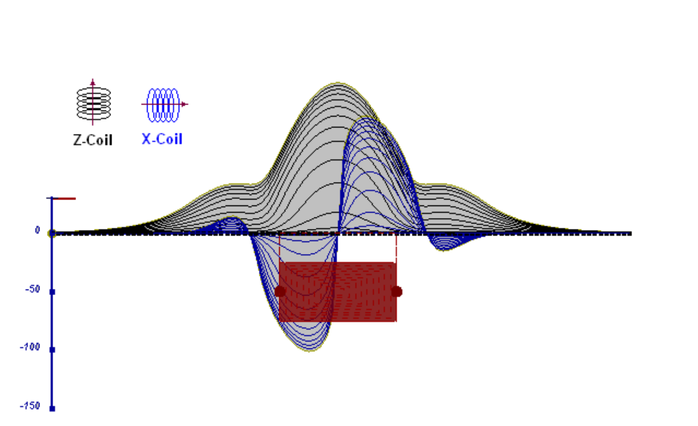


Figure A-6: Horizontal thick plate (log scale of the response)

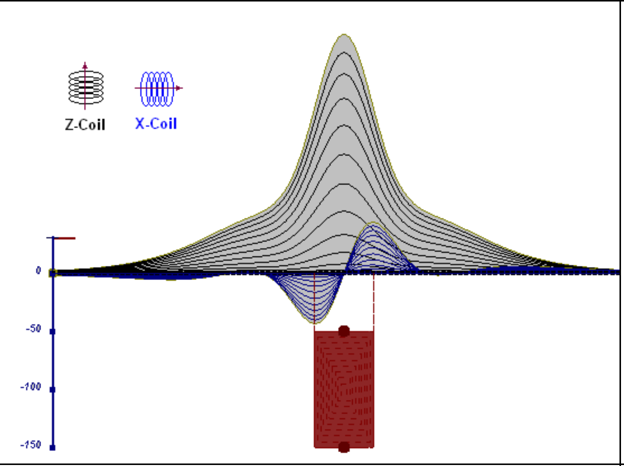


Figure A-7: Vertical thick plate (linear scale of the response). 50 m depth

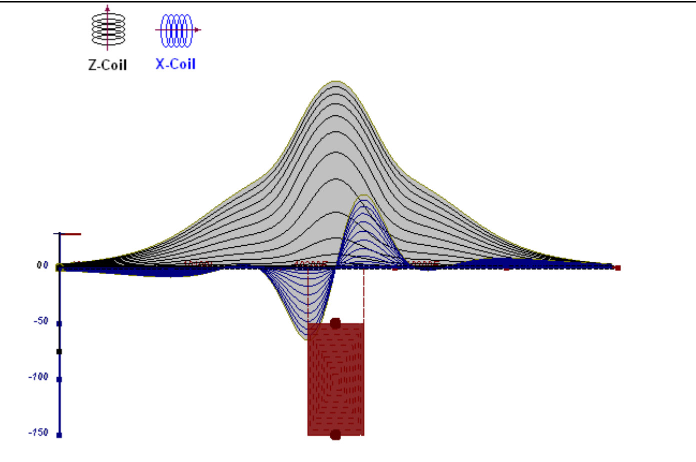


Figure A-8: Vertical thick plate (log scale of the response). 50 m depth

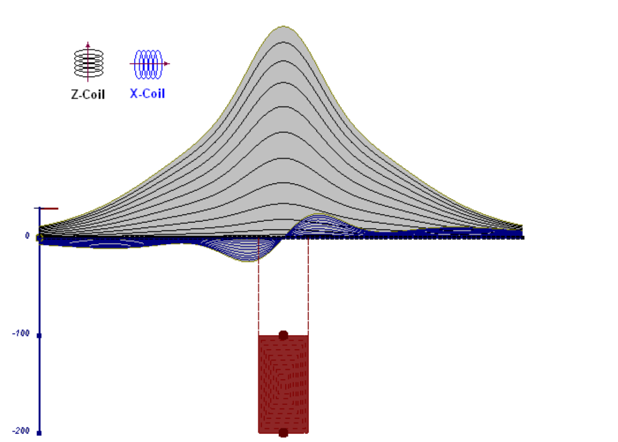


Fig A-9: Vertical thick plate (linear scale of the response). 100 m depth

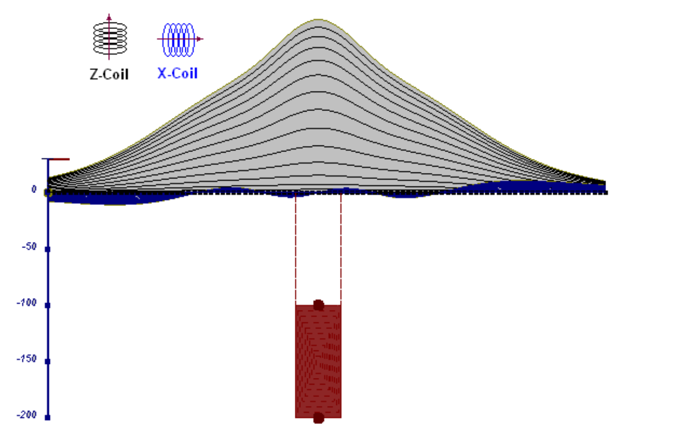


Fig A-10: Vertical thick plate (linear scale of the response). Depth/hor.thickness=2.5

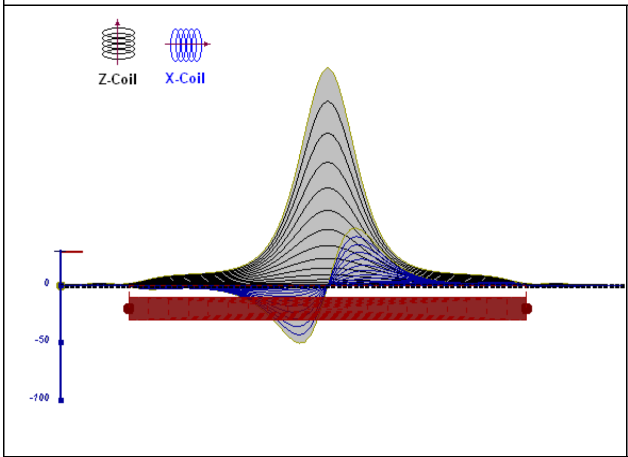


Fig A-10: Horizontal thick plate (linear scale of the response)

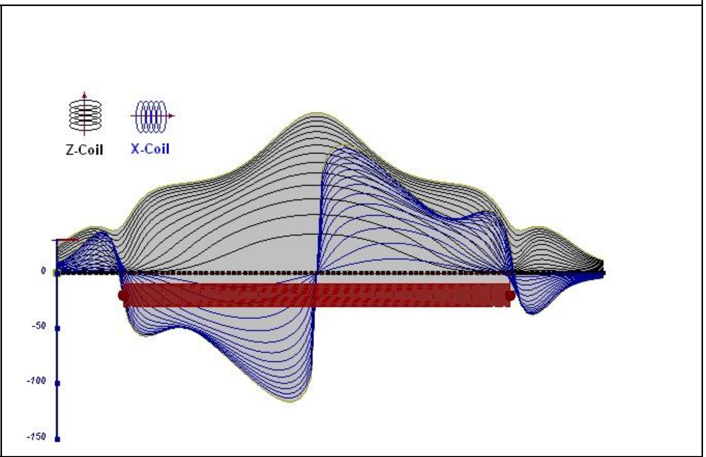


Fig A-11: Horizontal thick plate (log scale of the response)

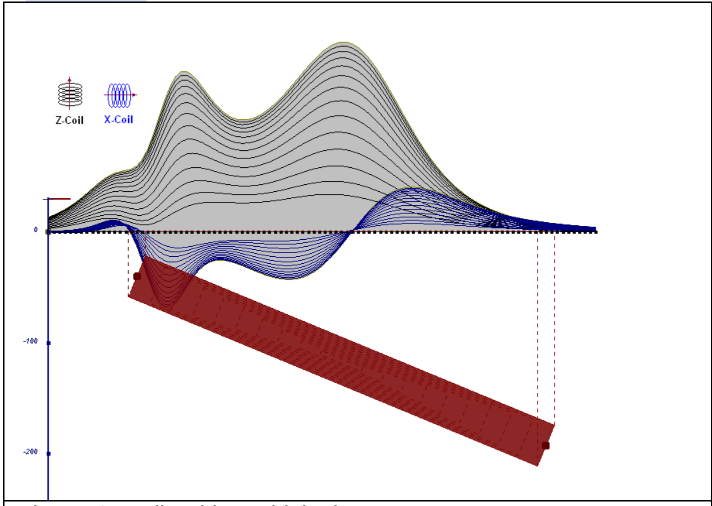


Fig A-12: Inclined long thick plate

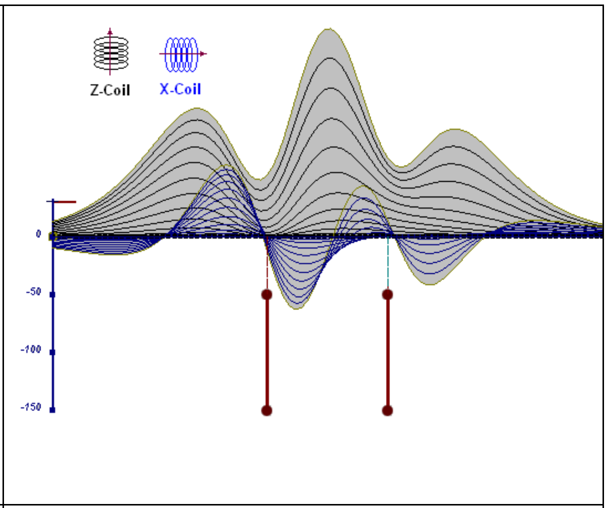


Fig A-13: Two vertical thin plates

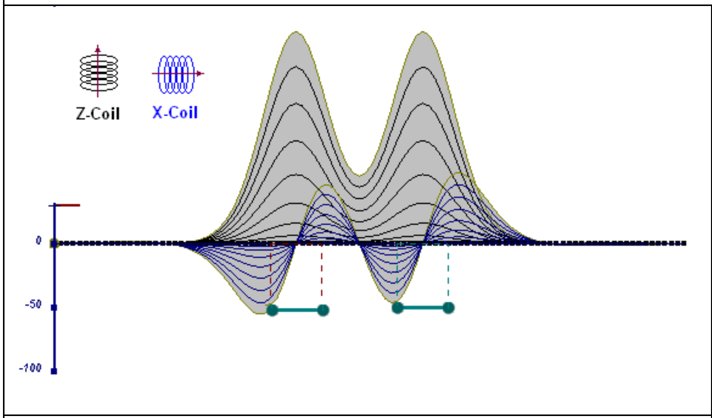


Fig A-14: Two horizontal thin plates

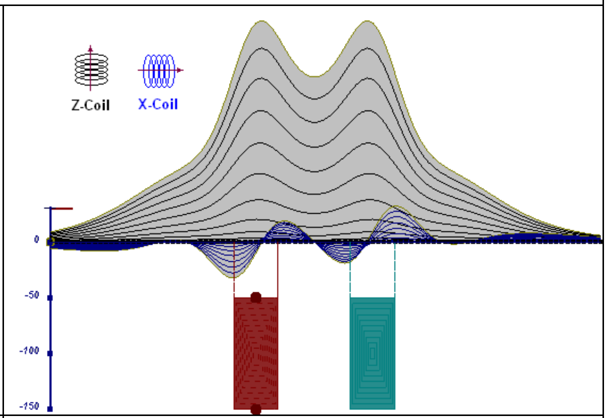


Fig A-15: Two vertical thick plates

The same type of target but with different thickness, for example, creates different form of the response:

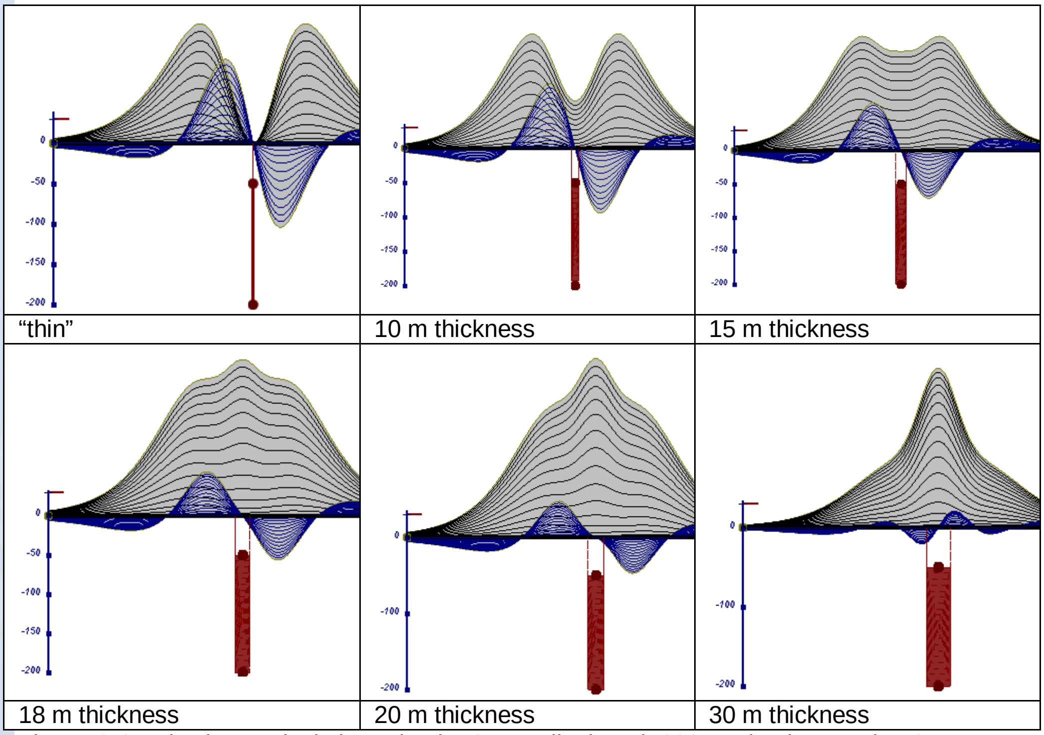


Fig A-16 Conductive vertical plate, depth 50 m, strike length 200 m, depth extend 150 m.

General Interpretation Principals

Magnetics

The total magnetic intensity responses reflect major changes in the magnetite and/or other magnetic minerals content in the underlying rocks and unconsolidated overburden. Precambrian rocks have often been subjected to intense heat and pressure during structural and metamorphic events in their history. Original signatures imprinted on these rocks at the time of formation have, it most cases, been modified, resulting in low magnetic susceptibility values.

The amplitude of magnetic anomalies, relative to the regional background, helps to assist in identifying specific magnetic and non-magnetic rock units (and conductors) related to, for example, mafic flows, mafic to ultramafic intrusives, felsic intrusives, felsic volcanics and/or sediments etc. Obviously, several geological sources can produce the same magnetic response. These ambiguities can be reduced considerably if basic geological information on the area is available to the geophysical interpreter.

In addition to simple amplitude variations, the shape of the response expressed in the wave length and the symmetry or asymmetry, is used to estimate the depth, geometric parameters and magnetization of the anomaly. For example, long narrow magnetic linears usually reflect mafic flows or intrusive dyke features. Large areas with complex magnetic patterns may be produced by intrusive bodies with significant magnetization, flat lying magnetic sills or sedimentary iron formation. Local isolated circular magnetic patterns often represent plug-like igneous intrusives such as kimberlites, pegmatites or volcanic vent areas.

Because the total magnetic intensity (TMI) responses may represent two or more closely spaced bodies within a response, the second derivative of the TMI response may be helpful for distinguishing these complexities. The second derivative is most useful in mapping near surface linears and other subtle magnetic structures that are partially masked by nearby higher amplitude magnetic features. The broad zones of higher magnetic amplitude, however, are severely attenuated in the vertical derivative results. These higher amplitude zones reflect rock units having strong magnetic susceptibility signatures. For this reason, both the TMI and the second derivative maps should be evaluated together.

Theoretically, the second derivative, zero contour or colour delineates the contacts or limits of large sources with near vertical dip and shallow depth to the top. The vertical gradient map also aids in determining contact zones between rocks with a susceptibility contrast, however, different, more complicated rules of thumb apply.

Concentric Loop EM Systems

Concentric systems with horizontal transmitter and receiver antennae produce much larger responses for flat lying conductors as contrasted with vertical plate-like conductors. The amount of current developing on the flat upper surface of targets having a substantial area in this dimension, are the direct result of the effective coupling angle, between the primary magnetic field and the flat surface area. One therefore, must not compare the amplitude/conductance of responses generated from flat lying bodies with those derived from near vertical plates; their ratios will be quite different for similar conductances.

Determining dip angle is very accurate for plates with dip angles greater than 30º. For angles less than 30º to 0º, the sensitivity is low and dips can not be distinguished accurately in the presence of normal survey noise levels.

A plate like body that has near vertical position will display a two shoulder, classic **M** shaped response with a distinctive separation distance between peaks for a given depth to top.

It is sometimes difficult to distinguish between responses associated with the edge effects of flat lying conductors and poorly conductive bedrock conductors. Poorly conductive bedrock conductors having low dip angles will also exhibit responses that may be interpreted as surfacial overburden conductors. In some situations, the conductive response has line to line continuity and some magnetic correlation providing possible evidence that the response is related to an actual bedrock source.

The EM interpretation process used, places considerable emphasis on determining an understanding of the general conductive patterns in the area of interest. Each area has different characteristics and these can effectively guide the detailed process used.

The first stage is to determine which time gates are most descriptive of the overall conductance patterns. Maps of the time gates that represent the range of responses can be very informative. Next, stacking the relevant channels as profiles on the flight path together with the second vertical derivative of the TMI is very helpful in revealing correlations between the EM and Magnetics. Key lines can be profiled as single lines to emphasize specific characteristics of a conductor or the relationship of one conductor to another on the same line.

Resistivity Depth sections can be constructed to show the relationship of conductive overburden or conductive bedrock with the conductive anomaly.

APPENDIX B

GEOPHYSICAL MAP IMAGES
(not to scale)