



OUTER-RIM EXPLORATION SERVICES

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(PO Box 3323)
NORMAN PARK, QLD. 4170

Geophysical Contracting Services

100% Australian Owned

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Email: mail@outer-rim.com.au

Volume 1 of 1

Client : Zinifex Ltd

Prospect : White Spur and South Creek

Area : Rosebery, Tas.

Survey : Borehole PEM Survey

Survey Period : 23rd to 29th April, 2006

Operator : Muhamad Humam

Components :Z,X,Y

1 Survey day \$2000.00

1 Field Assist. day \$ 300.00

25-04-06 We drove from the office to the transmitter location at 7.15am, arriving around 8.00am. We set up the transmitter, then walked down to the hole with the receiver and probes. We read the Z component, finishing about 12.20pm and, based on the results, Jovan (geophysicist) decided the X-Y was not necessary. We packed up all the gear into the net for the helicopter to sling back and walked back to the transmitter. We packed up, drove back to the helipad, collected the bore hole gear and returned to the office at 4.00pm.

SURVEY PARAMETERS

Loop WSP15 :400 x 400m

376140E, 5363610N; 376600E, 5363610N

376240E, 5363230N; 376610E, 5363230N.

Current :18 Amps

Time Base :20 ms

Ramp Time :1.0 ms

Sync :Cable

Hole No. :WSP-015

376475E, 5363430N

Depth :400m (at 25m spacing and 2048 stacks)

Channels :20

Components :Z

1 Survey day \$2000.00

1 Field Assist. day \$ 300.00

26-04-06 We left from the office around 7.30am, drove to South Creek (about one hour's drive) along a very muddy track. We got bogged just before we arrived at the transmitter position. We couldn't get any further without the assistance of another 4WD so, while we waited, we unloaded the transmitter gear and laid out the loop. When the backup vehicle arrived, we transferred the borehole gear and drove to the hole. We set up, dummied the hole and read the Z component while the Toyota was being recovered. We finished the survey around 4.00pm, packed up and returned to Rosebery by 6.00pm.

SURVEY PARAMETERS

Loop SCS5 :400 x 400m

384579E, 5391244N; 384847E, 5390992N

384302E, 5390950N; 384586E, 5390708N.

Current :19 Amps

Time Base :20 ms

Ramp Time :1.0 ms

Sync :Cable

Hole No. :SCS-005
384525E, 5390970N
Depth :520m (at 25m spacing and 2048 stacks)
Channels :20
Components :Z

1 Survey day \$2000.00
1 Field Assist. day \$ 300.00

27-04-06 to 28-04-06 We worked for another client.

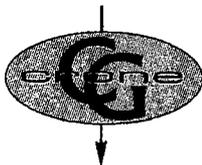
29-04-06 We drove out to site at 7.30am, recovered the loop from the test site and finished at 11.00am. We returned to Rosebery, washed the truck, picked up all our personal gear and drove back to Davenport to catch the Spirit of Tasmania.

½ Survey day \$1000.00
½ Field Assist. day \$ 150.00
½ Mob. day \$ 500.00

30-04-06 We sailed to Melbourne and started the trip back to Queensland.

1 Mob. day \$1000.00

Appendix



CRONE GEOPHYSICS & EXPLORATION LTD.

3607 WOLFEDALE ROAD, MISSISSAUGA, ONTARIO, CANADA, L5C 1V8
Phone: (905) 270-0096 Fax: (905) 270-3472 www.cronegeophysics.com

3-D PULSE EM - SYSTEM DESCRIPTION

Name of System: Crone Pulse EM (PEM).

Method Employed: TDEM (Time-domain electromagnetics) or TEM (Transient EM).

Survey Types:

- **Surface** - DEEPEM, Large In-Loop, Moving Loop, Moving Coil - 3 components.
- **Borehole** - 3D Borehole PEM - 3 components are measured and oriented.
- **Underground** - 3D Borehole PEM - including flat or up-dipping holes.

Measured Quantity: Rate of change of magnetic field in nanoTesla/second (same as nV/m²).

Receiver: Fully digital (input is digitized before stacking) with 24 bit dynamic range.

Channels (Gates):

- Typically 20 logarithmic channels in off-time and 1 during ramp (PP).
- Operator can select from several built-in tables including:
 - 10, 20, or 30 channel system (single, double, triple density)
 - 45 channels 4.5 usec wide covering the end of ramp and start of off-time.
 - 42 channels and PP for 150 msec time base.
 - full sampling of ramp and off-time (8 on ramp and full off-time starting at 0 usec).
- Programmable channel positions in the field.

Stacking: 512 to 65536 stacks with spike rejection.

Gain Control: Automatic software control (no selection or correction required).

Rx Operation: Menu-driven software. Large 16x40 character LCD. Full alphanumeric keyboard.

Display: 256 x 128 pixel scrollable graphic LCD for decay curves and profiles in the field.

Data Handling: Solid state storage; multiple files; all files can be appended at any time. Plot, list, sort, delete data. RS232 transmission of all data or only certain files.

Synchronization: Radio, cable, or crystal clock

Current Waveform: Bipolar on-off square waveform with exponential turn-on and ramp off.

Time Base: Off-time plus ramp time.

- 8.33, 16.66, 50, 100 and 150 msec for 60 Hz noise rejection (equivalent base frequencies of 30, 15, 5, 2.5, 1.67 Hz.)
- 10.0, 20.0, 50.0, 100.0 and 150 msec for 50 Hz noise rejection (equivalent base frequencies of 25, 12.5, 5, 2.5, 1.67 Hz.)

Ramp Time: The time required for the current to turn off.

- 500, 1000, or 1500 usec selections for precisely controlled linear turn-off ramps.
- "fast ramp" option turns current off as quickly as possible for a given loop size and current (2 usec or less to a few hundred usec).

Transmit Loop:

- Single turn loop of any dimension (less than 100m x 100m to greater than 2km x 2km).
- Multi-turn 14m diameter loop for near-surface Moving Coil surveys.

Tx Output Current:

- 30 Amps maximum at 160 Volts for 4.8 kWatt system.
- 20 Amps maximum at 120 Volts for 2.4 kWatt system.

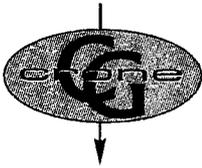
Tx Output Voltage:

- 48 to 240 Volts continuously adjustable for 4.8 kWatt system.
- 24 to 120 Volts continuously adjustable for 2.4 kWatt system.

Tx Safety features: Transmitter automatically shuts off when loop is opened. Also shuts off with high instrument temperature and overload. Fuse and circuit breaker overload protection.

Borehole Probes: 32 mm diameter.
Pressure-tested for depths of 2500m or more.

Operating Temperature: -40°C to 50°C



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3-D PULSE EM - SPECIAL FEATURES

High Power: A new 4.8 kWatt transmitter allows very large loops to be used while maintaining a high current.

Precise Current Ramps: Precisely- controlled linear ramps of fixed duration allow for proper comparisons to be made between data from different loop sizes, and also allows for the step response transformation.

Long Time Base (Low Frequency): A new long time base of 150 msec (1.67 Hz) ensures that very long time constant conductors can be seen in complicated environments.

Step Response: A new step response transformation allows even longer time-constant conductors to be seen by reproducing the response that would be seen in a direct measurement of the step response. Our controlled linear ramps and our standard Primary Pulse (PP) measurement on the ramp are necessary for this calculation.

Fast Ramp Option: A new "fast ramp" option duplicates the response seen from other pulse-type systems, but this does not allow for the step response calculation. We do not recommend fast ramps because they are not as linear as our controlled ramps, they drift in duration as the loop warms up, and there is no advantage in terms of power put into the ground since the *area* under the dB/dt pulse produced by the ramp is the same.

Calculation of Impulse Response: The "fast ramp" response can be calculated (as well as the true impulse response) from our standard linear ramp data.

True Digital Receiver: The Crone receiver is a true digital receiver in that the input is immediately digitized before stacking and binning. This produces the following feature (programmable gate positions).

Programmable Gate Positions: There is complete freedom of channel (or gate) positions and widths,

which can be programmed in the field. There are also numerous built-in tables.

Full Sampling: The entire ramp and off-time can be sampled with contiguous channels if desired.

Current Ramp always Sampled: A Primary Pulse (PP) measurement is always made on the current ramp, which is of great help to ensure proper polarities, and also is crucial for the step response transformation.

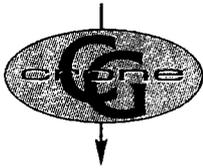
High Quality LCD Display: The 256 x 128 pixel LCD on the receiver allows for accurate plots of decay curves and line or borehole profiles on the receiver, and is of great assistance to the operator to monitor noise and anomaly build-up.

No Data Reduction: There is no data reduction for surface surveys and Z-component borehole surveys, so that what is seen on the receiver is what will be seen in the final plots. For 3-D borehole surveys, there is only the correction applied to the direction of the X and Y components to aid interpretation. Gain controls are automatic, so that the output is always in nanoTeslas/sec (= nV/m²).

Slim-line Probes: A 32 mm probe diameter ensures that virtually all holes can be surveyed with 3-component measurements.

Oriented X and Y Components: X-Y orientation tools accurately orient the X and Y components. This helps tremendously with giving direction to off-hole conductors and to the centre of in-hole conductors.

Reliable, Durable and Portable Equipment: The PEM system has been in use since the early 1970's under temperature extremes of -40°C to +50°C, in desert, jungle, arctic, mountainous, and underground mining conditions.



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3-D PULSE EM - APPLICATIONS

- **Base metals** ⇒ direct detection of:
 - ◊ volcanogenic massive sulphide (VMS) deposits
 - ◊ magmatic sulphide deposits
 - ◊ sedex massive sulphide deposits
 - ◊ higher grade ore within disseminated zones⇒ indirect detection of :
 - ◊ sphalerite and other non-conductors
 - ◊ galena and other poorly connected minerals through detection of associated well-connected conductors.⇒ detection of conductive marker zones related to deposits
- **Gold** ⇒ detection of associated conductors - e.g. pyrite/pyrrhotite
⇒ detection of the host - e.g. banded iron formations
- **Uranium** ⇒ detection of associated graphitic basement conductors
⇒ detection of associated conductive alteration zones
- **Diamonds** ⇒ detection and definition of clay-rich layer overlying kimberlites
⇒ locating kimberlites under locally thinned conductive cover

In the ore definition, delineation and production stages of a mining operation, Pulse EM can still be highly effective to:

- Define the boundaries of conductive ore
- Determine the size of intersected conductors and thereby determine whether they are connected to main ore zones.
- Reduce the number of necessary drillholes by exploring between holes.
- Survey underground drillholes - even flat or inclined holes.

Pulse EM can also be used for:

- General geological mapping of conductive structures
 - ⇒ shears, fractures, lineaments
 - ⇒ hydrothermal alteration
 - ⇒ graphite-rich rocks, including graphitic schist, shale, slate, and argillite
 - ⇒ clay alteration and zeolites
 - ⇒ differential and clay weathering
 - ⇒ conductive weathered layer at surface
- Groundwater exploration
- Mapping groundwater contamination plumes and freshwater-saltwater interface
- Geothermal exploration
- Mapping depth and thickness of horizontal strata
- Mapping permafrost thickness

PLOTS

CONTENTS

Plan No.	Plan Type	ID.	Description	Scale
1	Plan	YWS-001	Hole location plan	1:5000
2	Section		Primary Field plot	1:5000
3	Header	YWS-001	Header information	N/A
4	Profile	(Y1)	Z - Log plot	1:2500
5			- Linear, Ch1-10, 1:2000	1:2500
6			- Linear, Ch10-15, 1:150	1:2500
7			- Linear, Ch15-20, 1:2	1:2500
8			X - Log plot	1:2500
9			- Linear, Ch1-10, 1:1000	1:2500
10			- Linear, Ch10-15, 1:50	1:2500
11			- Linear, Ch15-20, 1:2	1:2500
12			Y - Log plot	1:2500
13			- Linear, Ch1-10, 1:1000	1:2500
14			- Linear, Ch10-15, 1:50	1:2500
15			- Linear, Ch15-20, 1:2	1:2500
16			Total Field plot	1:2500
17	Plan	SCS-005	Hole location plan	1:5000
18	Section		Primary Field plot	1:5000
19	Header	SCS-005	Header information	N/A
20	Profile	(S5)	Z - Log plot	1:3000
21			- Linear, Ch1-10, 1:1000	1:3000
22			- Linear, Ch10-15, 1:5	1:3000
23			- Linear, Ch15-20, 1:2	1:3000
24	Plan	WSP-015	Hole location plan	1:5000
25	Section		Primary Field plot	1:5000
26	Header	WSP-015	Header information	N/A
27	Profile	(WS15)	Z - Log plot	1:2500
28			- Linear, Ch1-10, 1:2500	1:2500
29			- Linear, Ch10-15, 1:5	1:2500
30			- Linear, Ch15-20, 1:2	1:2500

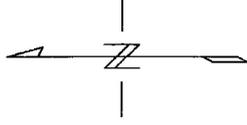
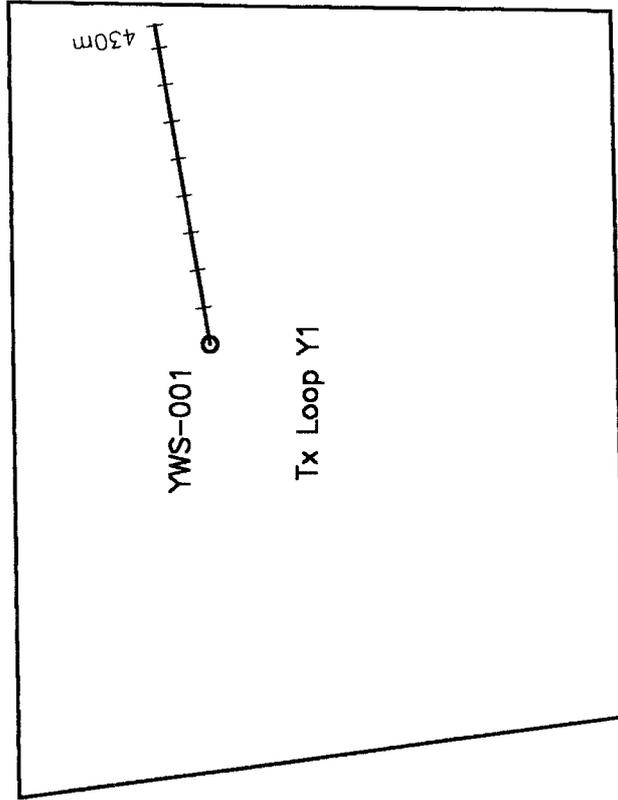
377000E 377100E 377200E 377300E 377400E

5360100N -

5360000N -

5359900N -

5359800N -



Scale 1:5000
50 0 50 100
(metres)

Zinifex Ltd
White Spur

**3-D Borehole Pulse EM Survey
Borehole & Loop Location Map**

Hole: YWS-001

Survey Date: Apr 24, 2006

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Borehole Pulse EM Survey

Client : Zinifex Ltd	Hole : YWS-001
Grid : White Spur	Tx Loop : Y1
Date : Apr 24, 2006	File name : YWS1Z.PEM
Time Base : 20.00 ms	# Readings: 9
Ramp Time : 1.00 ms	Stn Units : Metric
# Channels: 20	Coil Area : 6500 sq m
Sync Type : Cable	Polarity : +
Loop Size : 400m X 400m	Receiver : Digital #109
Current : 20 Amps	Operator : Humam

Loop Coordinates (X,Y,Z)

1. 376926m, 5.36019e+06m, 600m	2. 376980m, 5.35979e+06m, 590m
3. 377448m, 5.3598e+06m, 512m	4. 377454m, 5.3602e+06m, 510m

Hole Coordinates (X,Y,Z) or (Azimuth,Dip,Length)

1. 377227m, 5.36006e+06m, 534m	2. 80deg, 60deg, 430m
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Channel Times (usec)

Ch	Start	End	Center	Ch	Start	End	Center	Ch	Start	End	Center	
PP	-198	-99	-149	1	50	63	56	2	63	86	74	
	3	86	112	99	4	112	153	133	5	153	203	178
	6	203	270	236	7	270	360	315	8	360	482	421
	9	482	639	560	10	639	850	745	11	850	1129	990
	12	1129	1498	1314	13	1498	1993	1746	14	1993	2646	2320
	15	2646	3514	3080	16	3514	4666	4090	17	4666	6192	5429
	18	6192	8221	7206	19	8221	10910	9566	20	10910	14490	12700

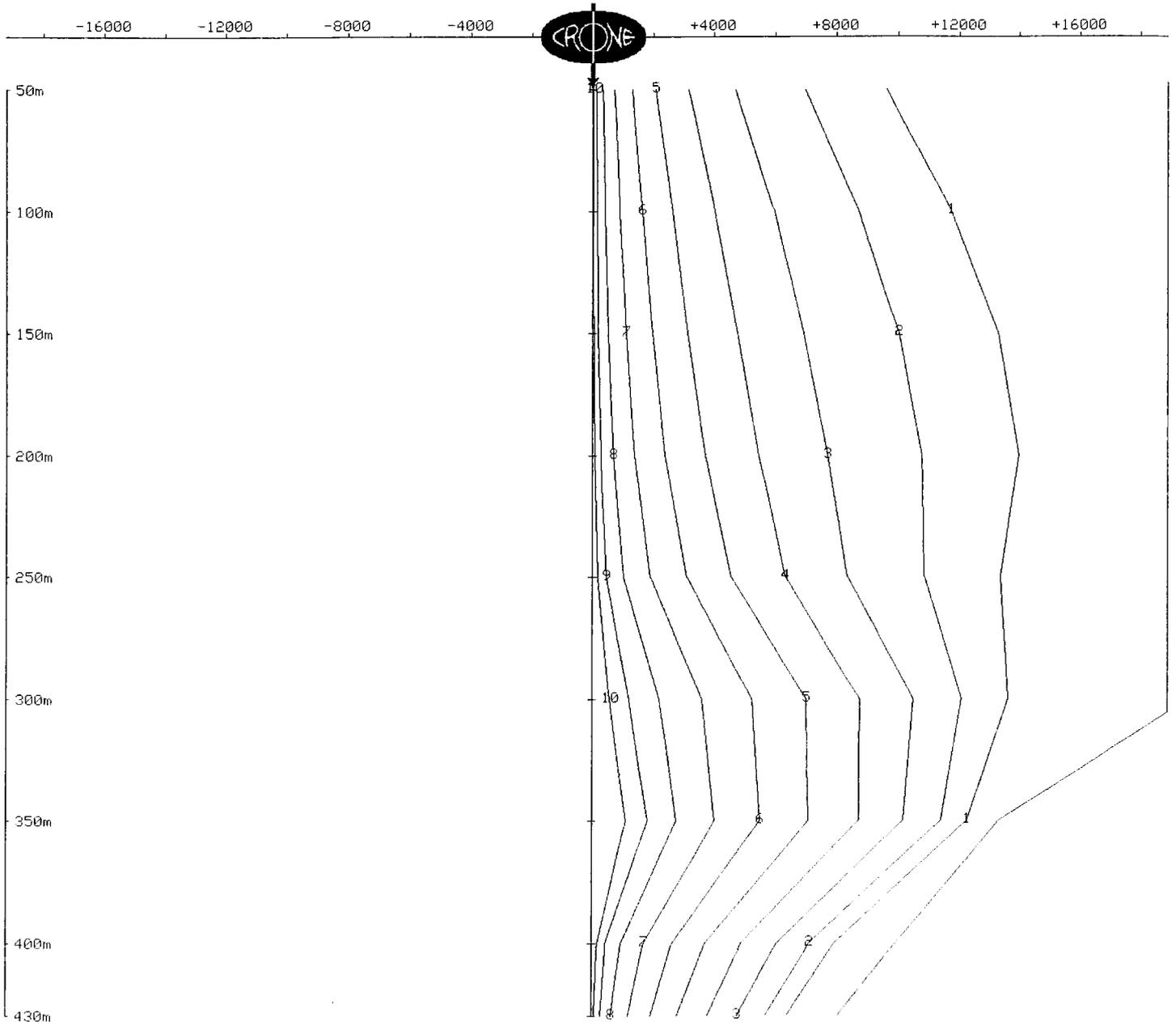
OUTER-RIM EXPLORATION SERVICES

Borehole Pulse EM Survey

Client : Zinifex Ltd
Grid : White Spur
Date : Apr 24, 2006

Hole : YWS-001
Tx Loop : Y1
File name : YWS1Z.PEM

Z COMPONENT dBz/dt nanoTesla/sec - 10 of 20 channels and PP
Scale: 1:2500 Unit Scale: 1cm = 2000 nT/s



OUTER-RIM EXPLORATION SERVICES

Borehole Pulse EM Survey

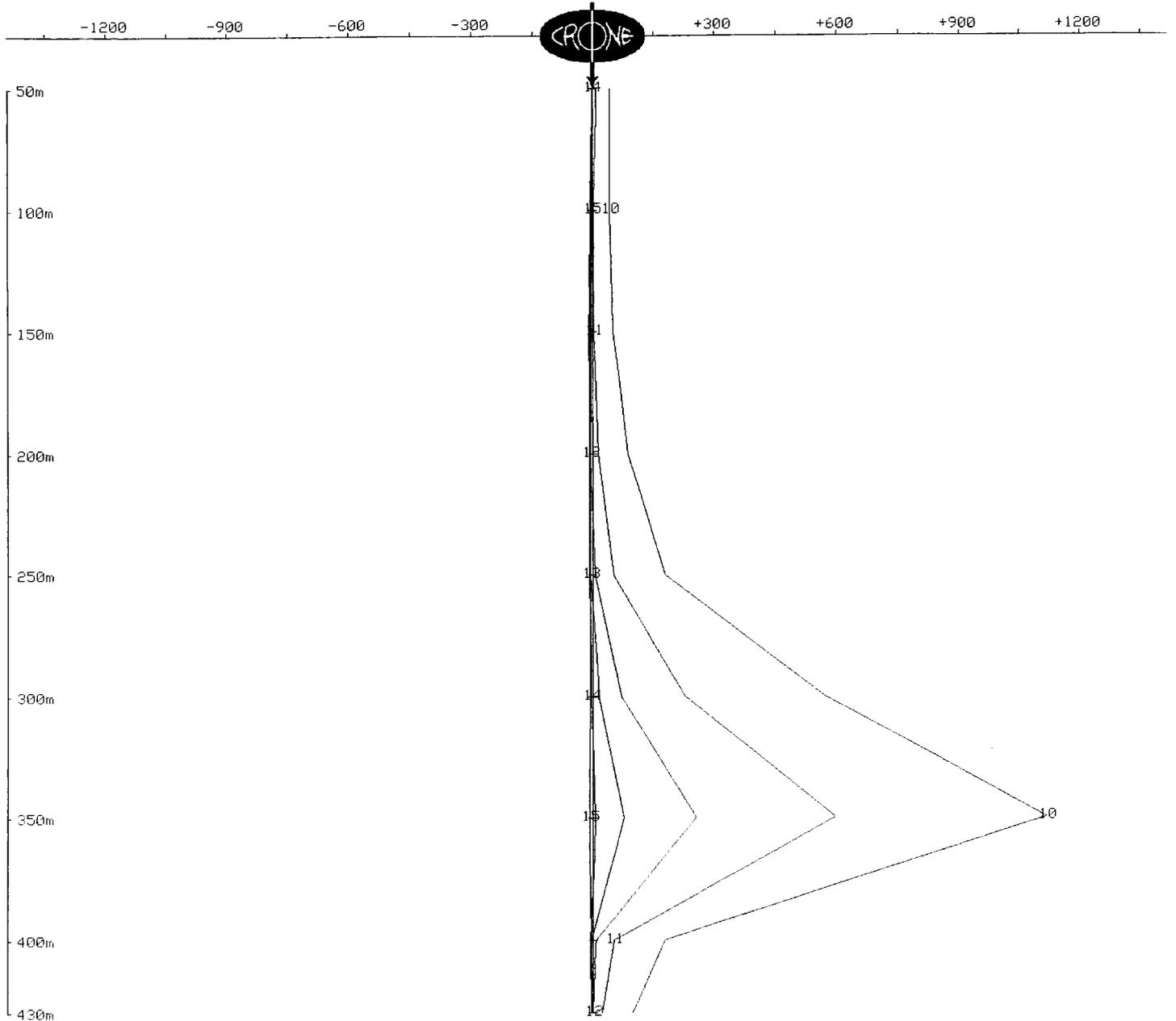
Client : Zinifex Ltd
Grid : White Spur
Date : Apr 24, 2006

Hole : YWS-001
Tx Loop : Y1
File name : YWS1Z.PEM

Z COMPONENT dBz/dt nanoTesla/sec - 6 of 20 channels

Scale: 1:2500

Unit Scale: 1cm = 150 nT/s



OUTER-RIM EXPLORATION SERVICES

Borehole Pulse EM Survey

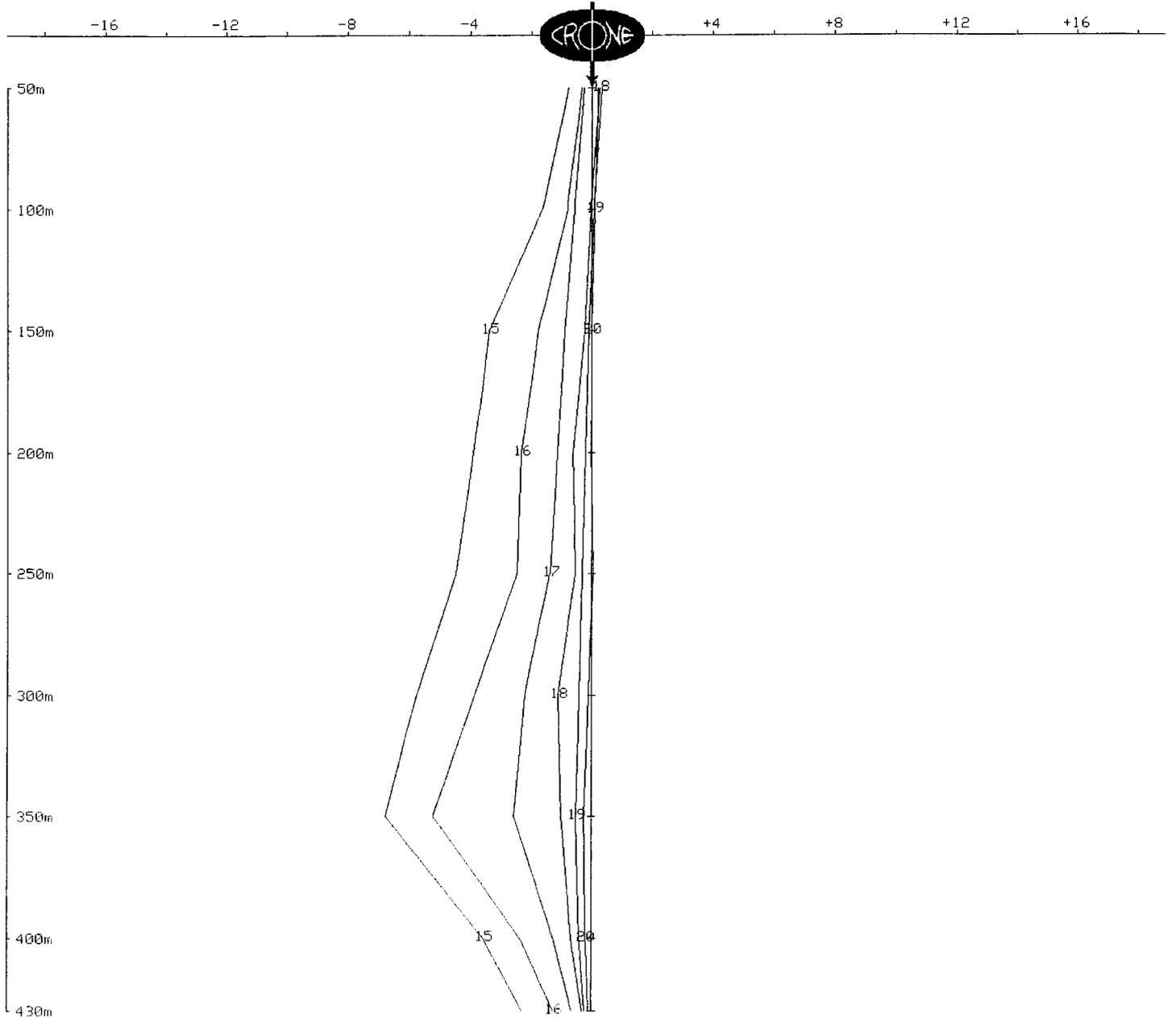
Client : Zinifex Ltd
Grid : White Spur
Date : Apr 24, 2006

Hole : YWS-001
Tx Loop : Y1
File name : YWS1Z.PEM

Z COMPONENT dBz/dt nanoTesla/sec - 6 of 20 channels

Scale: 1:2500

Unit Scale: 1cm = 2 nT/s



OUTER-RIM EXPLORATION SERVICES

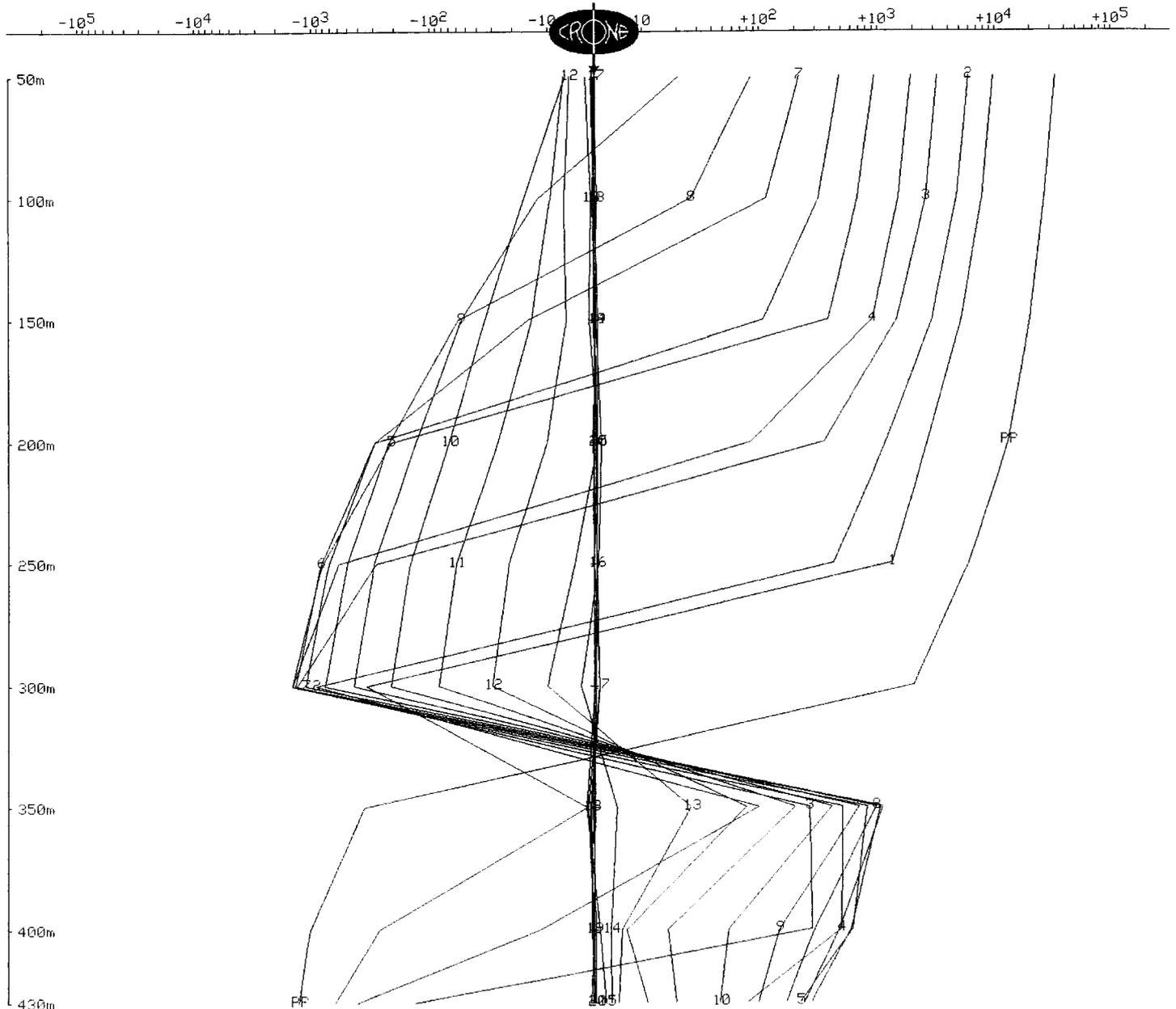
Borehole Pulse EM Survey

Client : Zinifex Ltd
Grid : White Spur
Date : Apr 24, 2006

Hole : YWS-001
Tx Loop : Y1
File name : YWS1XY.PEM

Data Corrected for Probe Rotation using Orientation Tool #5
X COMPONENT dBx/dt nanoTesla/sec - 20 of 20 channels and PP

Scale: 1:2500



OUTER-RIM EXPLORATION SERVICES

Borehole Pulse EM Survey

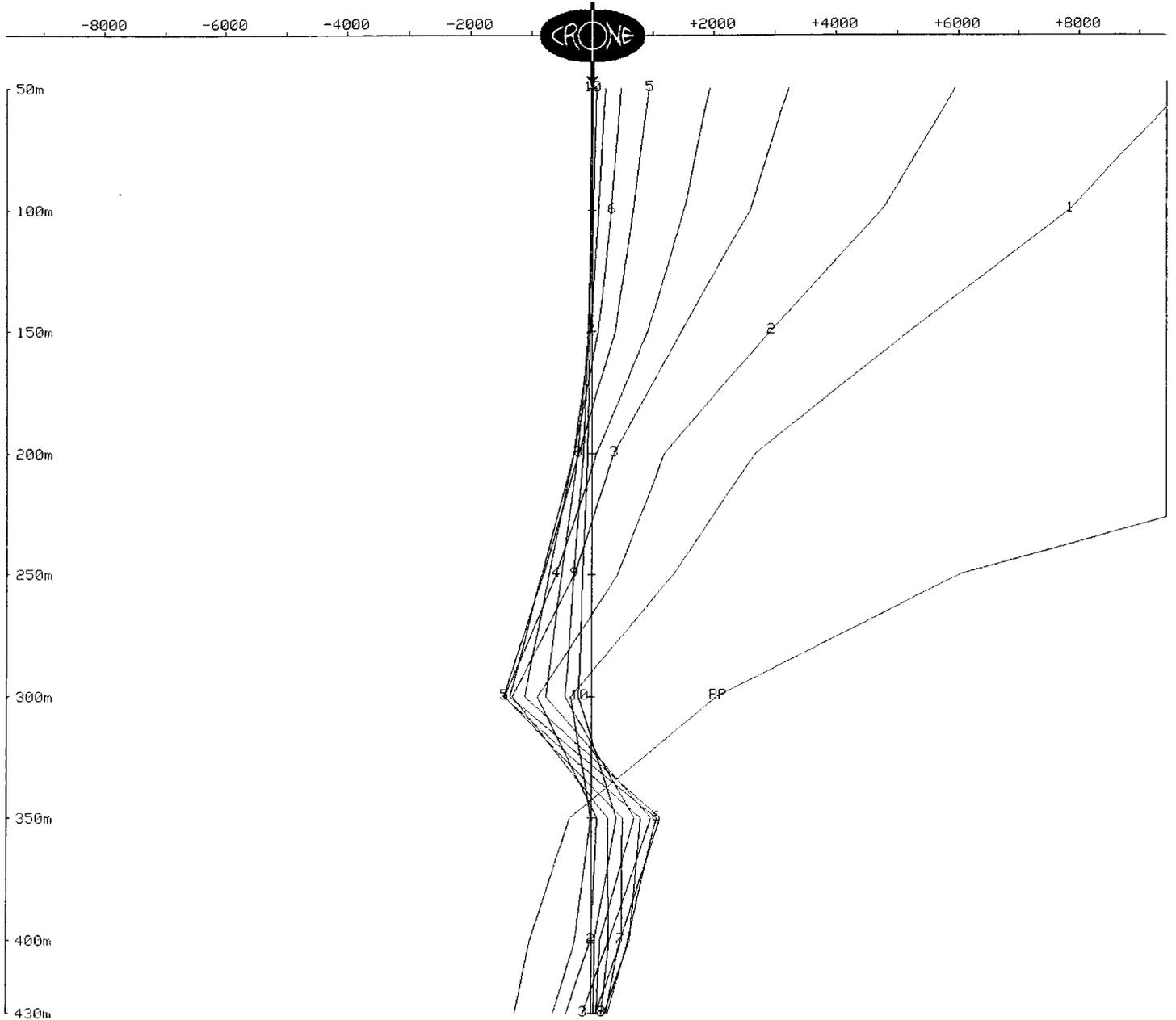
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Grid : White Spur
Date : Apr 24, 2006

Hole : YWS-001
Tx Loop : Y1
File name : YWS1XY.PEM

Data Corrected for Probe Rotation using Orientation Tool #5
X COMPONENT dBx/dt nanoTesla/sec - 10 of 20 channels and PP

Scale: 1:2500

Unit Scale: 1cm = 1000 nT/s



OUTER-RIM EXPLORATION SERVICES

Borehole Pulse EM Survey

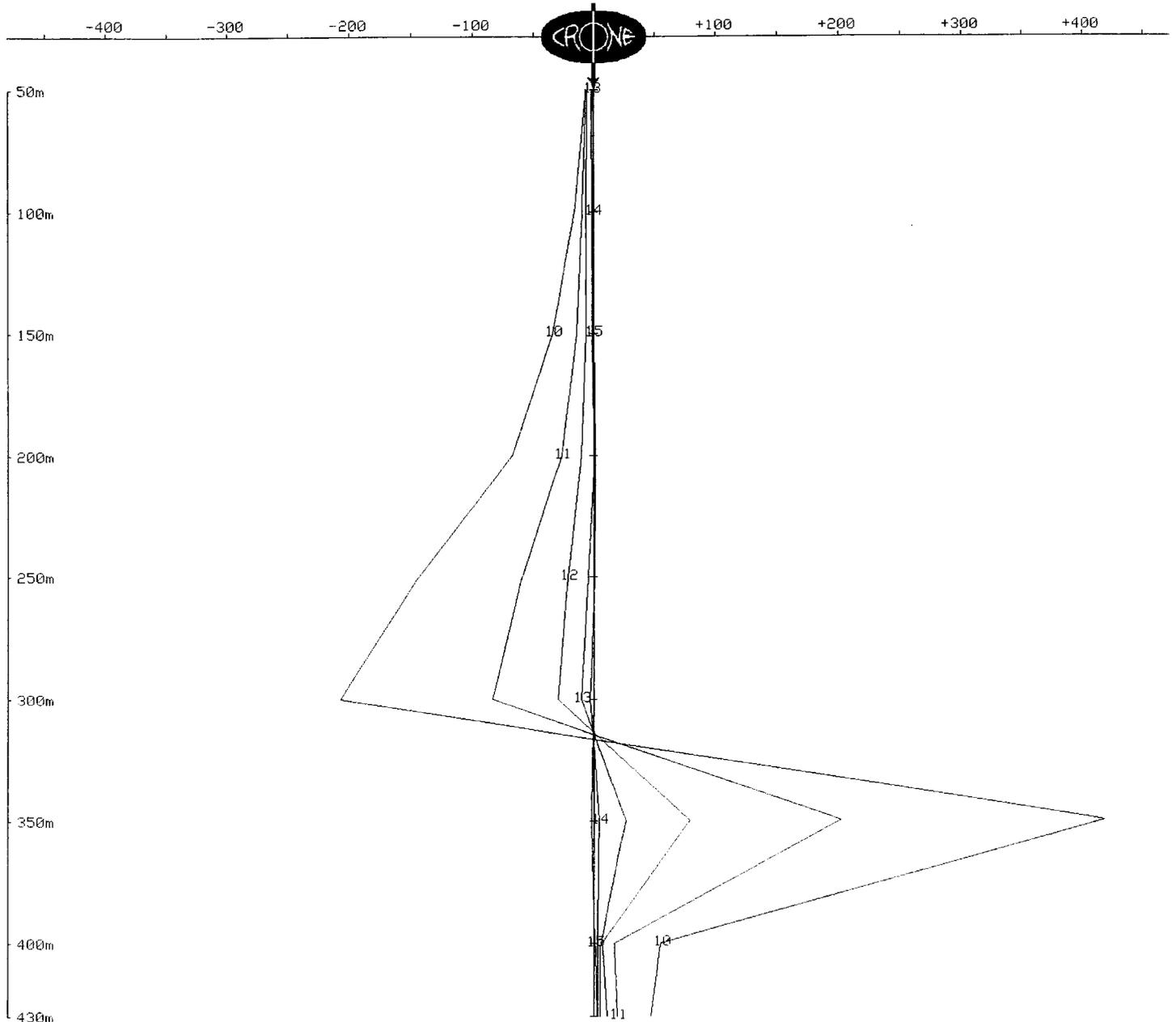
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Grid : White Spur
Date : Apr 24, 2006

Hole : YWS-001
Tx Loop : Y1
File name : YWS1XY.PEM

Data Corrected for Probe Rotation using Orientation Tool #5
X COMPONENT dBx/dt nanoTesla/sec - 6 of 20 channels

Scale: 1:2500

Unit Scale: 1cm = 50 nT/s



OUTER-RIM EXPLORATION SERVICES

Borehole Pulse EM Survey

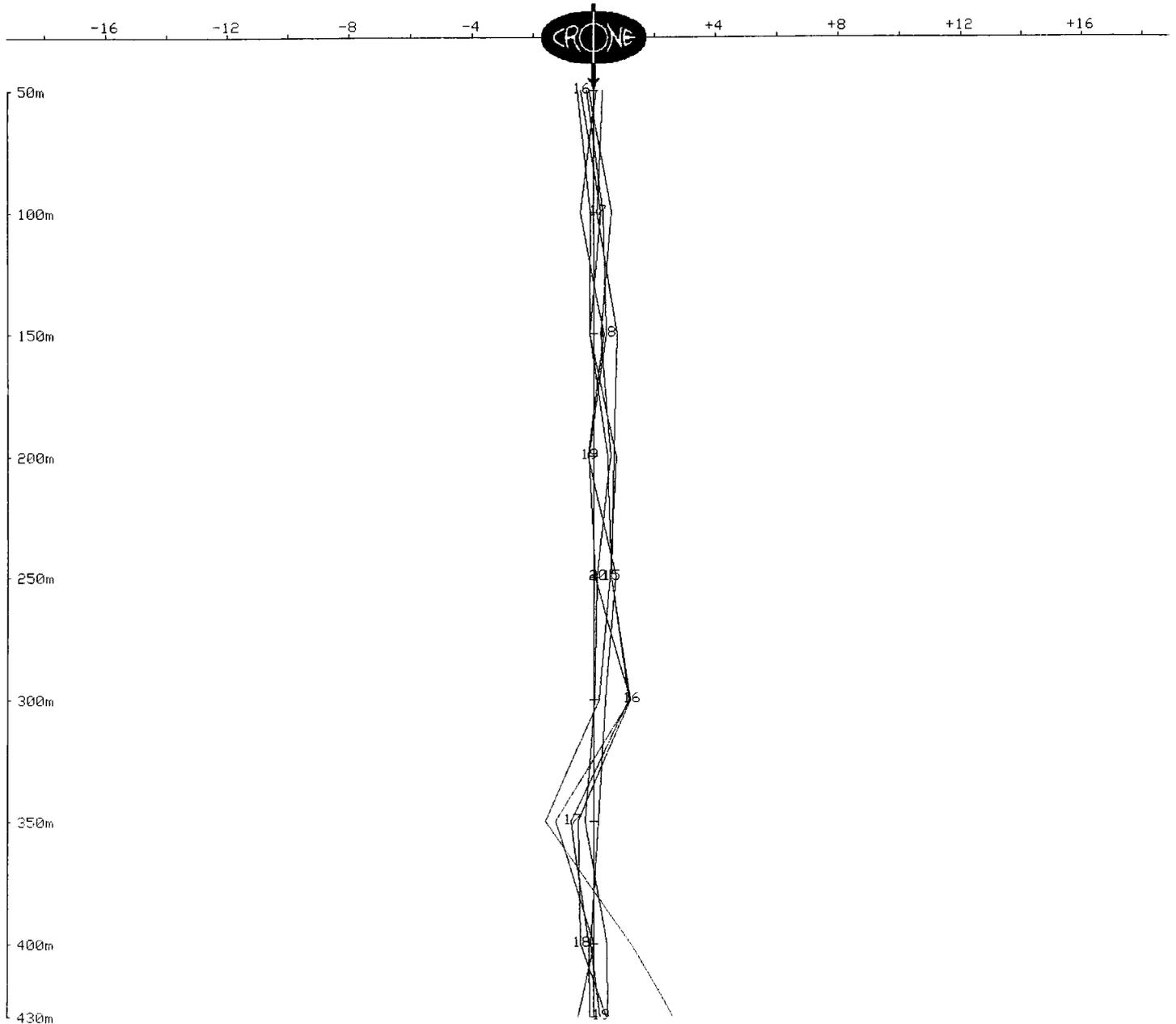
Client : Zinifex Ltd
Grid : White Spur
Date : Apr 24, 2006

Hole : YWS-001
Tx Loop : Y1
File name : YWS1XY.PEM

Data Corrected for Probe Rotation using Orientation Tool #5
X COMPONENT dBx/dt nanoTesla/sec - 6 of 20 channels

Scale: 1:2500

Unit Scale: 1cm = 2 nT/s



OUTER-RIM EXPLORATION SERVICES

Borehole Pulse EM Survey

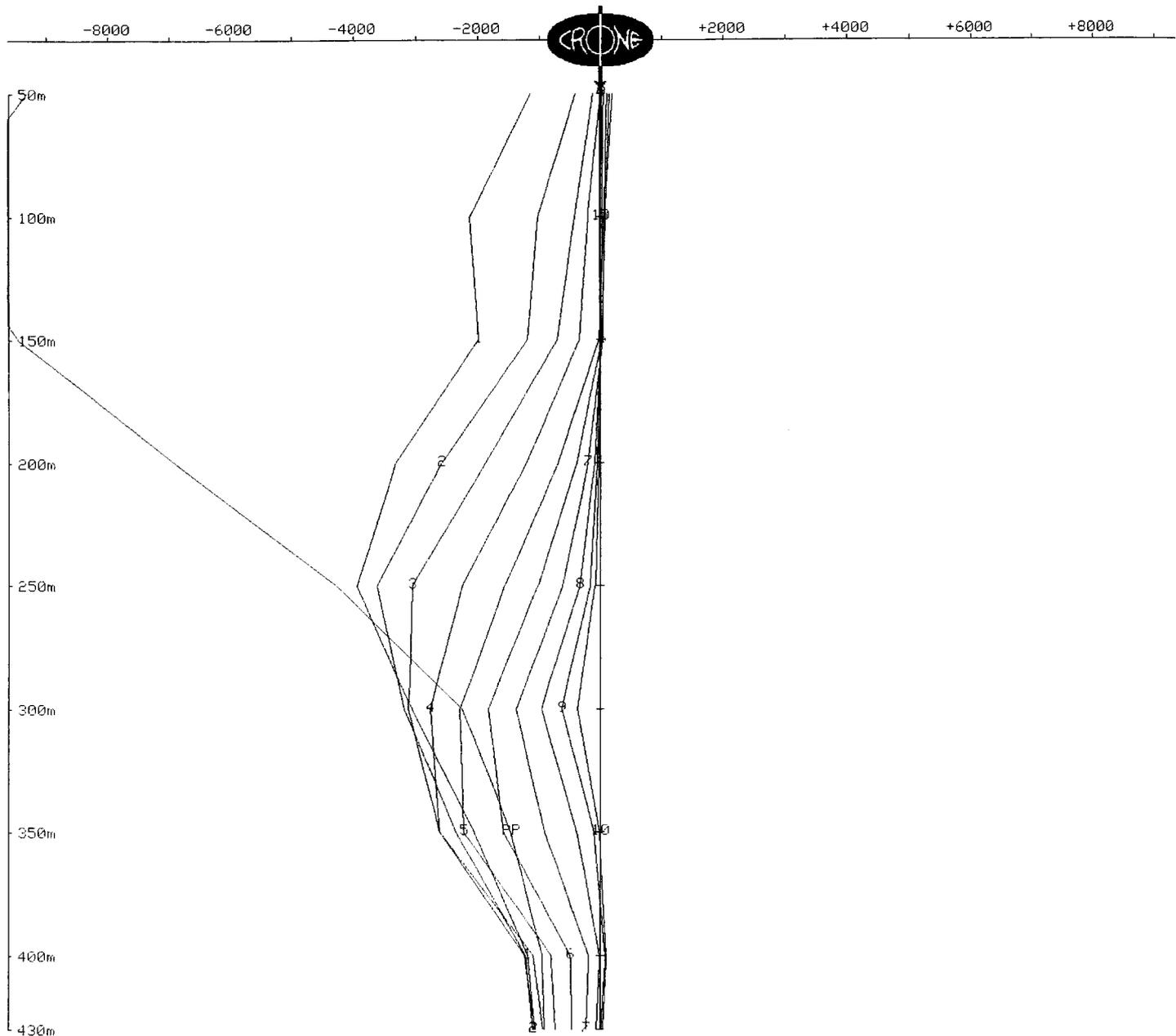
Client : Zinifex Ltd
Grid : White Spur
Date : Apr 24, 2006

Hole : YWS-001
Tx Loop : Y1
File name : YWS1XY.PEM

Data Corrected for Probe Rotation using Orientation Tool #5
Y COMPONENT dBy/dt nanoTesla/sec - 10 of 20 channels and PP

Scale: 1:2500

Unit Scale: 1cm = 1000 nT/s



OUTER-RIM EXPLORATION SERVICES

Borehole Pulse EM Survey

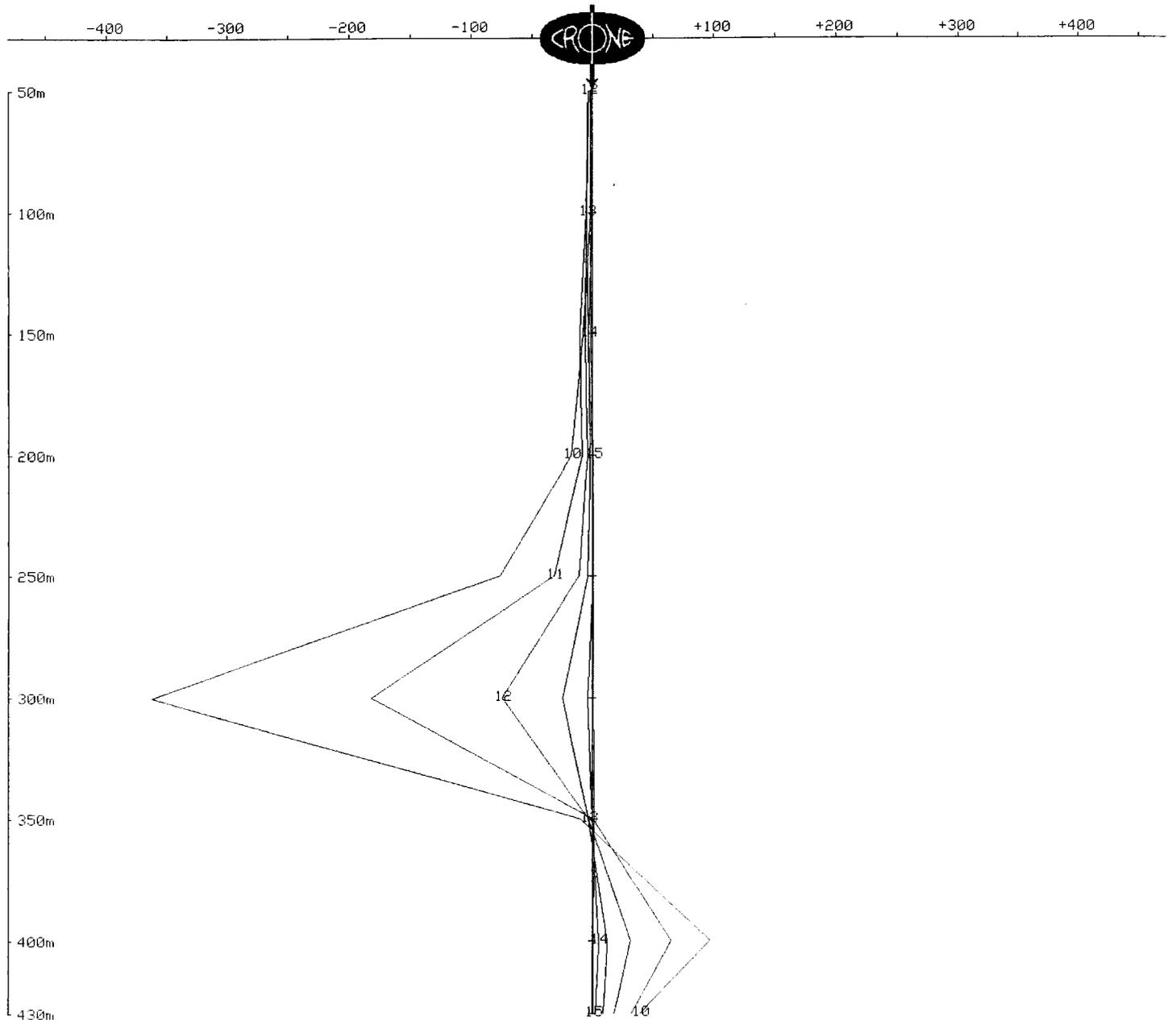
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Grid : White Spur
Date : Apr 24, 2006

Hole : YWS-001
Tx Loop : Y1
File name : YWS1XY.PEM

Data Corrected for Probe Rotation using Orientation Tool #5
Y COMPONENT dBy/dt nanoTesla/sec - 6 of 20 channels

Scale: 1:2500

Unit Scale: 1cm = 50 nT/s



OUTER-RIM EXPLORATION SERVICES

Borehole Pulse EM Survey

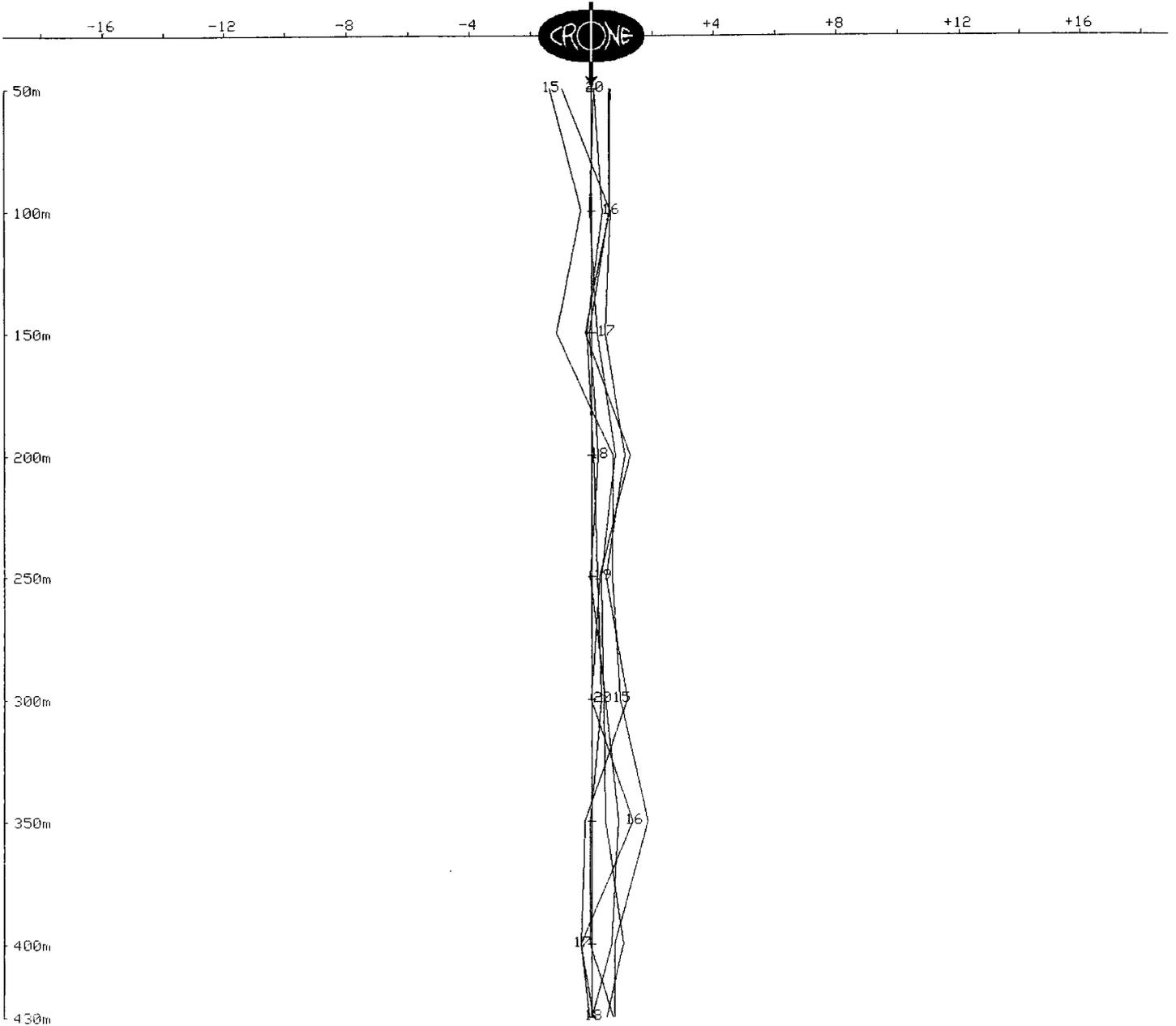
Client : Zinifex Ltd
Grid : White Spur
Date : Apr 24, 2006

Hole : YWS-001
Tx Loop : Y1
File name : YWS1XY.PEM

Data Corrected for Probe Rotation using Orientation Tool #5
Y COMPONENT dBy/dt nanoTesla/sec - 6 of 20 channels

Scale: 1:2500

Unit Scale: 1cm = 2 nT/s



OUTER-RIM EXPLORATION SERVICES

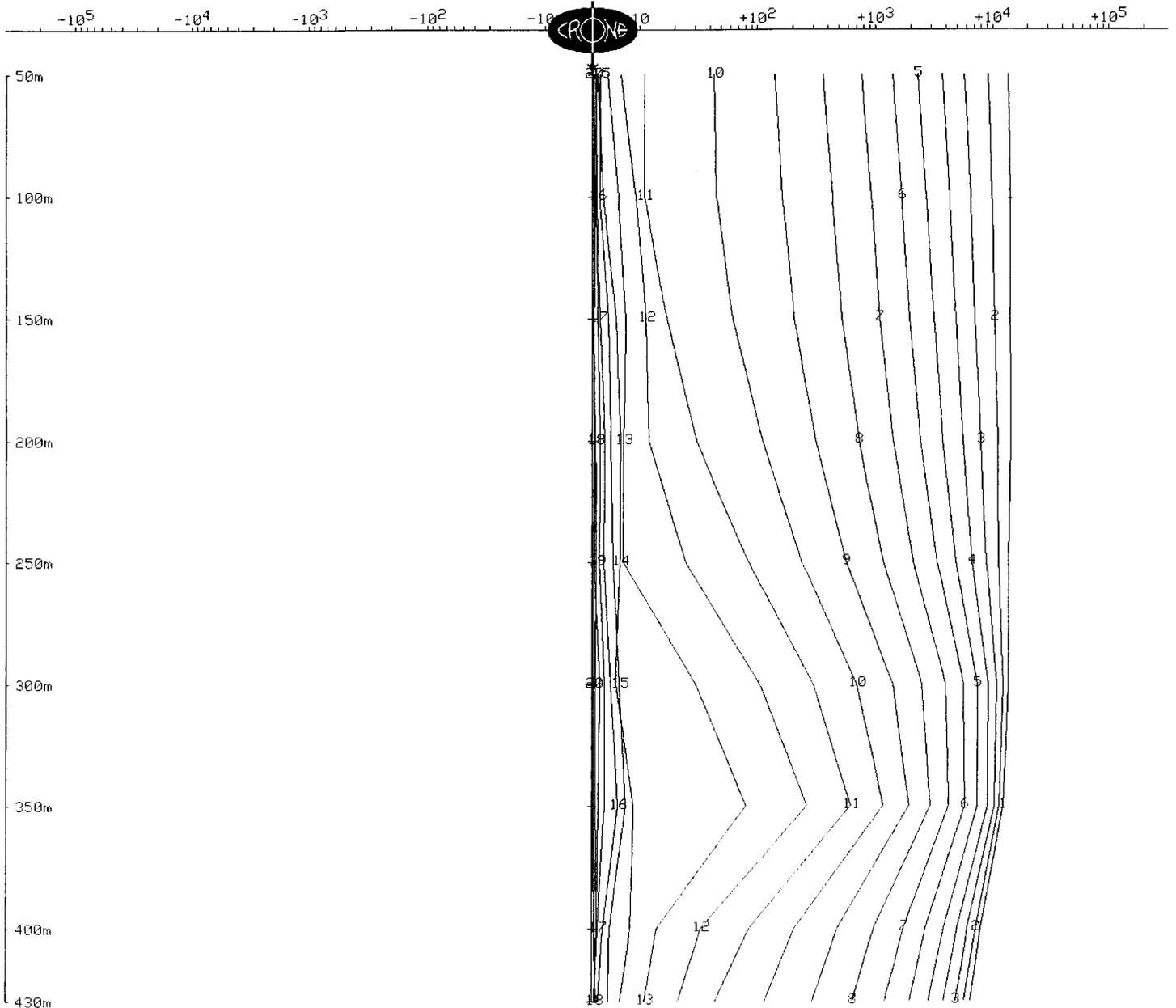
Borehole Pulse EM Survey

Client : Zinifex Ltd
Grid : White Spur
Date : Apr 24, 2006

Hole : YWS-001
Tx Loop : Y1
File name : YWS1XYZ.PEM

TOTAL FIELD dBxyz/dt nanoTesla/sec - 20 of 20 channels

Scale: 1:2500



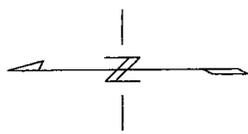
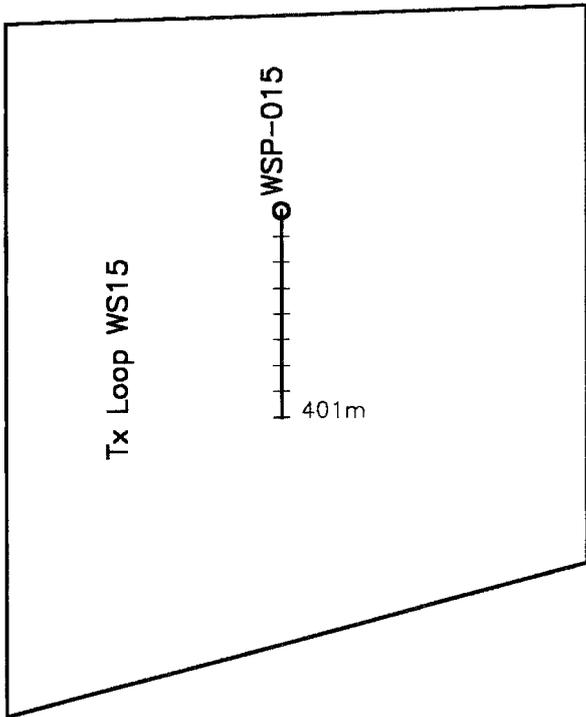
376200E 376300E 376400E 376500E 376600E

5363600N -

5363500N -

5363400N -

5363300N -



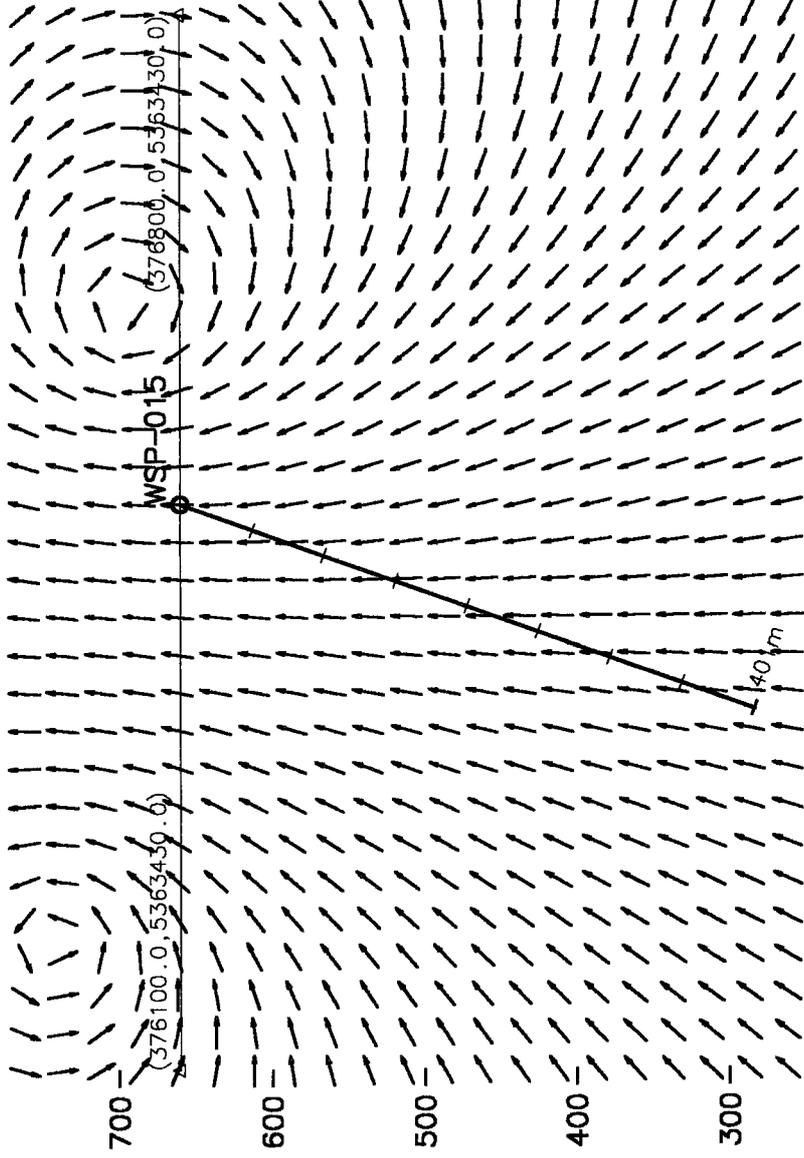
Scale 1:5000
50 0 50 100
(metres)

Zinifex Ltd
White Spur

3-D Borehole Pulse EM Survey
Borehole & Loop Location Map

Hole: WSP-015
Survey Date: Apr 25, 2006

Outer-Rim Exploration Services



Zinifex Ltd
White Spur

3-D Borehole Pulse EM Survey
Hole Section with Primary Field

Hole: WSP-015
Survey Date: Apr 25, 2006

Outer-Rim Exploration Services

OUTER-RIM EXPLORATION SERVICES

Borehole Pulse EM Survey

Client : Zinifex Ltd	Hole : WSP-015
Grid : White Spur	Tx Loop : WS15
Date : Apr 25, 2006	File name : WSP15Z.PEM
Time Base : 20.00 ms	# Readings: 18
Ramp Time : 1.00 ms	Stn Units : Metric
# Channels: 20	Coil Area : 6500 sq m
Sync Type : Cable	Polarity : +
Loop Size : 400m X 400m	Receiver : Digital #109
Current : 18 Amps	Operator : Human

Loop Coordinates (X,Y,Z)

1. 376140m, 5.36361e+06m, 762m	2. 376240m, 5.36323e+06m, 720m
3. 376610m, 5.36323e+06m, 670m	4. 376600m, 5.36361e+06m, 715m

Hole Coordinates (X,Y,Z) or (Azimuth,Dip,Length)

1. 376475m, 5.36343e+06m, 660m	2. 270deg, 70deg, 401m
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Channel Times (usec)

Ch	Start	End	Center	Ch	Start	End	Center	Ch	Start	End	Center	
PP	-198	-99	-149	1	50	63	56	2	63	86	74	
	3	86	112	99	4	112	153	133	5	153	203	178
	6	203	270	236	7	270	360	315	8	360	482	421
	9	482	639	560	10	639	850	745	11	850	1129	990
	12	1129	1498	1314	13	1498	1993	1746	14	1993	2646	2320
	15	2646	3514	3080	16	3514	4666	4090	17	4666	6192	5429
	18	6192	8221	7206	19	8221	10910	9566	20	10910	14490	12700

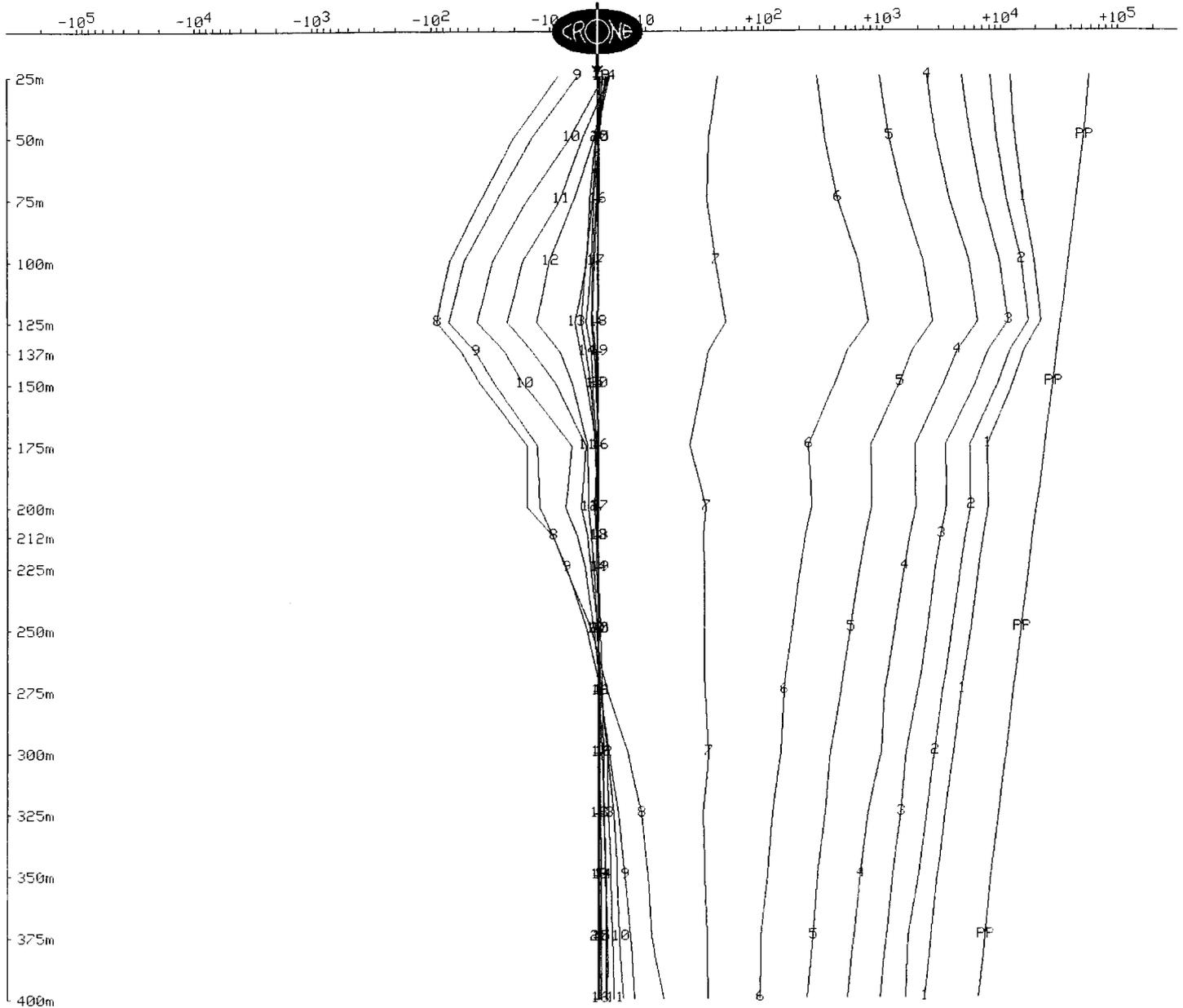
OUTER-RIM EXPLORATION SERVICES

Borehole Pulse EM Survey

Client : Zinifex Ltd
Grid : White Spur
Date : Apr 25, 2006

Hole : WSP-015
Tx Loop : WS15
File name : WSP15Z.PEM

Z COMPONENT dBz/dt nanoTesla/sec - 20 of 20 channels and PP
Scale: 1:2500



OUTER-RIM EXPLORATION SERVICES

Borehole Pulse EM Survey

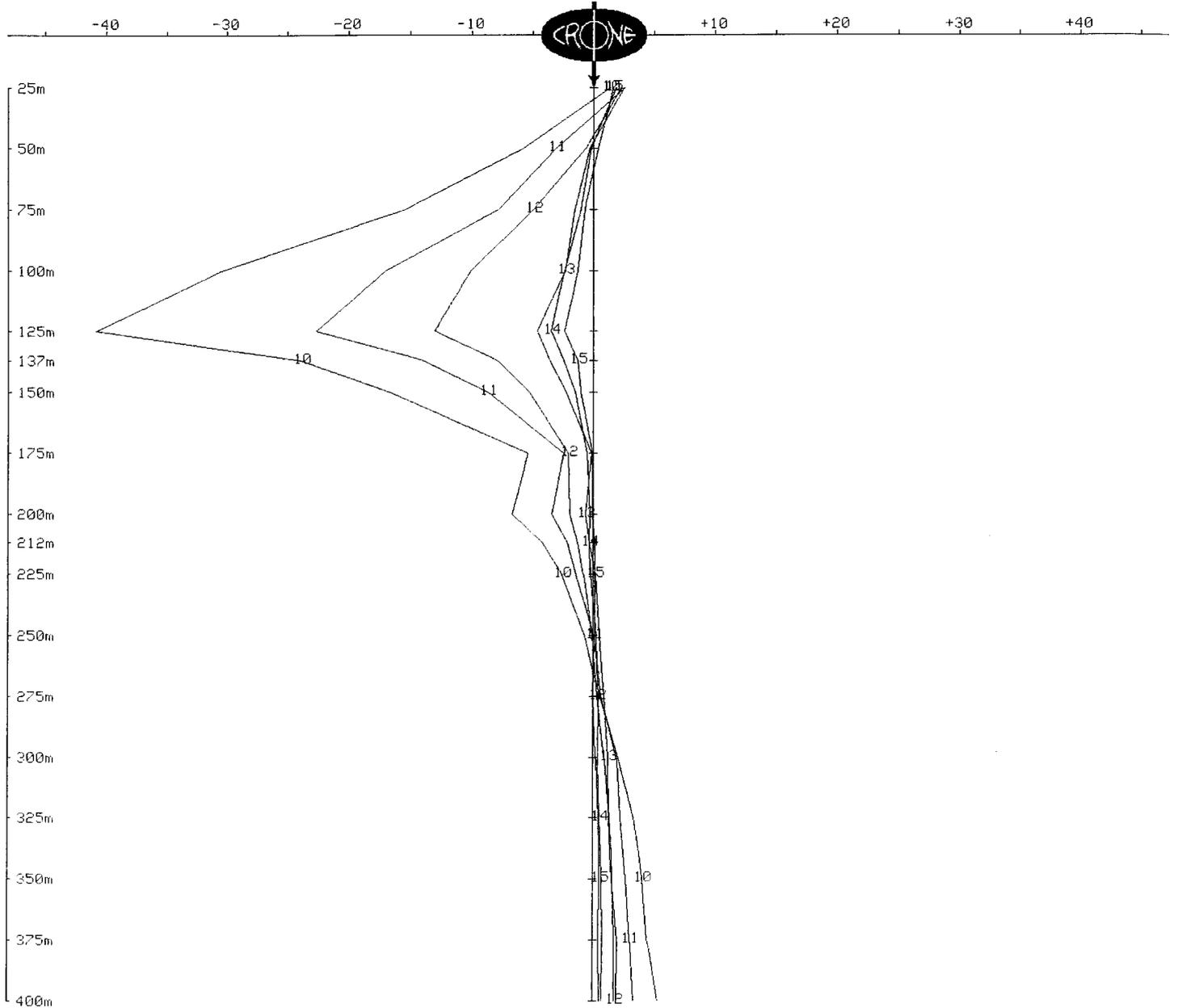
Client : Zinifex Ltd
Grid : White Spur
Date : Apr 25, 2006

Hole : WSP-015
Tx Loop : WS15
File name : WSP15Z.PEM

Z COMPONENT dBz/dt nanoTesla/sec - 6 of 20 channels

Scale: 1:2500

Unit Scale: 1cm = 5 nT/s



OUTER-RIM EXPLORATION SERVICES

Borehole Pulse EM Survey

Client : Zinifex Ltd
Grid : White Spur
Date : Apr 25, 2006

Hole : WSP-015
Tx Loop : WS15
File name : WSP15Z.PEM

Z COMPONENT dBz/dt nanoTesla/sec - 6 of 20 channels

Scale: 1:2500

Unit Scale: 1cm = 2 nT/s

