

**Interpretation of Surface and Downhole
EM Surveys at Boco Siding, White Spur
and Silver Falls Prospects**

for

**PASMINCO LIMITED
ROSEBERY MINE**

By

Jovan Silic Ph. D.

Flagstaff Geoconsultants

(JSA Pty Ltd)

March 2003

DISCLAIMER

Confidentiality

This document and its contents are confidential and may not be disclosed or published in any manner (except in its entirety to a government department as part of the statutory reporting requirements and as may otherwise be required by law) unless Flagstaff GeoConsultants Pty Ltd ["Flagstaff"] has given its prior written consent to the form and context of the disclosure or publication.

Disclaimer

Flagstaff has prepared this report based upon information believed to be accurate at the time of completion, but which is not guaranteed. Flagstaff makes no representation or warranty as to the accuracy, reliability or completeness of the information contained in this report and will not accept liability to any person for any errors or omissions or for losses or damages claimed as a result, directly or indirectly, or items discussed, opinions rendered or recommendations made in this report, except for statutory liability which may not be excluded.

LIST OF CONTENTS

DISCLAIMER	1
LIST OF CONTENTS	2
LIST OF FIGURES	3
SUMMARY	4
INTRODUCTION	5
SURVEY PARAMETERS	5
DATA QUALITY	7
INTERPRETATION OF DATA	7
1. BOCO SIDING SURFACE EM SURVEY	7
2. WHITE SPUR DHEM SURVEYS.	15
a. <i>WSP10</i>	16
b. <i>YWS1</i>	17
c. <i>WSP6</i>	20
d. <i>YWS1 and WSP6 data</i>	23
3. SILVER FALLS	23
5. CONCLUSIONS	25

LIST OF FIGURES

Figure 1.	Boco Siding EL 4/00 1986 UTEM Survey Location Diagram.....	6
Figure 2.	Boco Siding Anomaly 1 UTEM response: Target dip 50 deg, sigt=100 siemens.....	8
Figure 2a.	Boco Siding Anomaly 1 UTEM response: Target dip 50 deg, sigt=100 siemens.....	8
Figure 3.	Boco Siding Anomaly 2 UTEM response: Target dip 30 deg, sigt=100 siemens.....	9
Figure 3a.	Boco Siding Anomaly 2 UTEM response: Target dip 40 deg, sigt=100 siemens.....	9
Figure 3b.	Boco Siding Anomaly 2 UTEM response: Target dip 50 deg, sigt=100 siemens.....	10
Figure 3c.	Boco Siding Anomaly 2 UTEM response: Target dip 50 deg, sigt=50 siemens.....	10
Figure 3d.	Boco Siding Anomaly 2 UTEM response: Target dip 60 deg, sigt=100 siemens.....	11
Figure 3e.	Boco Siding Anomaly 2 UTEM response: Target dip 70 deg, sigt=100 siemens.....	11
Figure 4.	Boco Siding EL4100 : 2002 Crone Pulse EM Survey lines and loop	12
Figure 5.	Surface EM Boco Siding: Line 3400 E Vertical Component.....	12
Figure 5a.	Surface EM Boco Siding: Line 3550 E Vertical Component.....	13
Figure 5b.	Surface EM Boco Siding: Line 3850 E Vertical Component.....	13
Figure 5c.	Surface EM Boco Siding: Line 4000 E Vertical Component.....	14
Figure 5d.	Surface EM Boco Siding: Line 4300 E Vertical Component.....	14
Figure 6.	White Spur 2002 DHEM: Survey Loops and drillhole locations.....	15
Figure 7.	DHEM White Spur: WSP10 Alonghole component.	16
Figure 7a.	DHEM White Spur: WSP10 Crosshole (X) component.	16
Figure 7b.	DHEM White Spur: WSP10 Crosshole (Y) component.	17
Figure 8.	DHEM White Spur: YWS1 Alonghole (Z) component.....	18
Figure 8a.	DHEM White Spur: YWS1 Crosshole (X) component.....	18
Figure 8b.	DHEM White Spur: YWS1 Crosshole (Y) component.....	19
Figure 9.	White Spur YWS1: Modelled and Observed data Alonghole component.	19
Figure 10.	DHEM White Spur: WSP6 Alonghole (Z) component.....	21
Figure 10a.	DHEM White Spur: WSP6 Crosshole (X) component.....	21
Figure 10b.	DHEM White Spur: WSP6 Crosshole (Y) component.....	22
Figure 11.	White Spur WSP6: Modelled and Observed data Alonghole component.....	22
Figure 12.	Target area from YWS1 and WSP6 DHEM data.	23
Figure 13.	Silver Falls DHEM Survey Loop and drillhole location.....	24
Figure 14.	DHEM Silver Falls: HRD1 Alonghole component.....	25

SUMMARY

Surface and Downhole EM surveys at the Boco Siding, White Spur and Silver Falls prospects have not defined any targets that would be clearly associated with significant conductive sulphide accumulations at the prospective time horizons. At Boco Siding and Silver Falls, no conductors of any significance were detected.

The three holes DHEM White Spur data set defined a number of conductors, with the intersected shale unit characterized by short time constant responses. From drillhole YWS1 data an offhole conductor with a late time response can be interpreted as associated with the projected location of the intersected shale sequence, and above the central volcanic sequence contact. As well a conductor to the west of the YWS1 and WSP6 drillhole collars appears to be affecting the data set. The precise location for this conductive target cannot be determined, because neither the YWS1 nor WSP6 drillholes traverse across the target.

INTRODUCTION

From Dec 8 – Dec 18, 2002, Surface and Down Hole Electromagnetic (DHEM) Time Domain (TDEM) Surveys were carried out at a number of prospects in areas to the north and north west of the Rosebery mine.

At Boco Siding a single loop surface EM survey was carried out to define any possible conductive mineralisation that may be associated with the already defined surface geochemical anomaly.

The one hole DHEM Survey at Silver Falls and the three hole DHEM surveys at the White Spur prospects, were carried out, to define any conductive targets that may be close to or at the contact between Central Volcanic Sequence shale and the volcanoclastic Central volcanic sequence time horizon.

The purpose of this report is to discuss the interpretation of the TDEM survey results and to recommend future exploration strategies at the Boco Siding, Silver Falls and White Spur prospects.

SURVEY PARAMETERS

Both the surface and downhole EM data sets were collected using the CRONE Pulse EM system, operated by Outer Rim Exploration Services from Townsville, Queensland.

Surface data measurements were restricted to obtaining vertical component data whereas the DHEM measurements depending on the complexity of the EM response were obtained for the alonghole component or the three downhole orthogonal components.

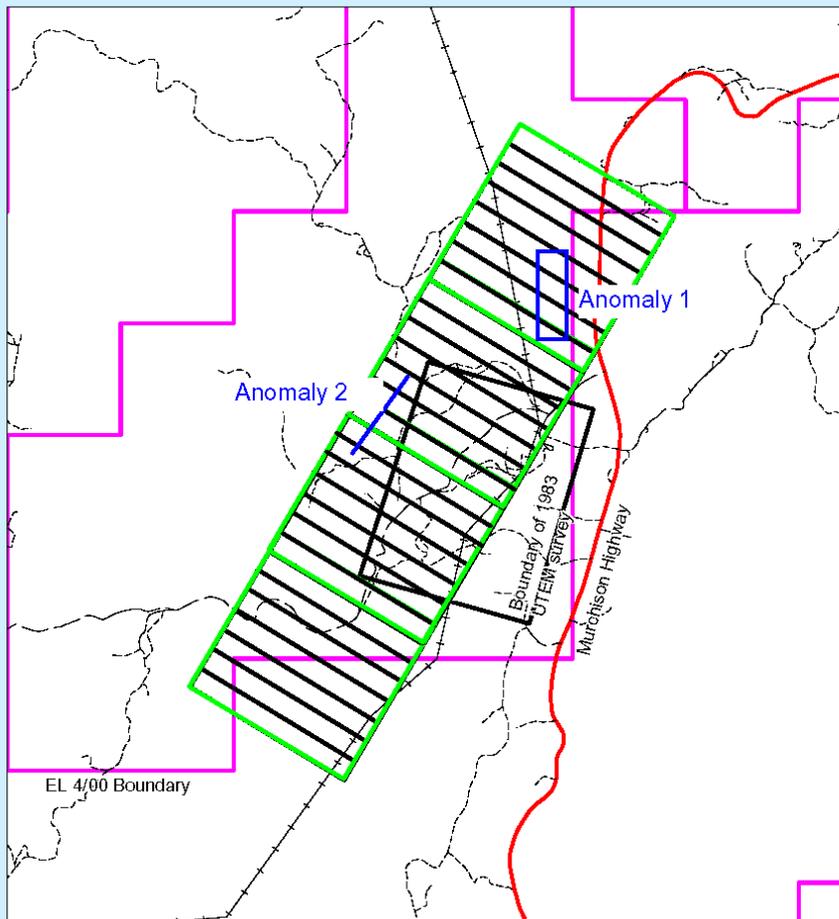
All data was collected with the Crone Pulse EM system operating at a 20 millisecond time base and 1 millisecond transmitter turn off (ramp time). As such the channel times or time sampling scheme in milliseconds was as follows.

Channel No	Time (ms)	Channel No	Time (ms)
1	0.056	11	0.990
2	0.074	12	1.314
3	0.099	13	1.746
4	0.133	14	2.320
5	0.178	15	3.080
6	0.236	16	4.090
7	0.315	17	5.479
8	0.421	18	7.206
9	0.560	19	9.566
10	0.745	20	12.700



PASMINCO
EXPLORATION

**Figure 3.
Boco Siding EL 4/00
1986 UTEM Survey
Location Diagram**



Scale 1:50,000

Compiled by C Dauth Mar 2001

Figure 1. Boco Siding EL 4/00 1986 UTEM Survey Location Diagram

DATA QUALITY

Data quality in any TDEM Survey is largely dependent on the electromagnetic noise levels within the survey area. This supposedly random background noise is invariably alleviated or “stacked out” within a single reading by averaging data over many numbers of the transmitting cycles. As such, during the survey the data quality was invariably monitored and stacking times (number of transmitter cycles within the reading) adjusted so that the data uncertainty in the “late” time channels rarely exceeded ± 0.2 nT/s, at least for the vertical and the alonghole components of the measured EM response.

The EM Survey however was initially slowed down by having to track down cabling and connector problems for both the surface and downhole coils. Very rudimentary tests performed on site appeared to confirm that the system was functioning “normally” after the repair to cable head connections.

INTERPRETATION OF DATA

1. *Boco Siding Surface EM Survey*

At the Boco Siding (Sawyers Creek) prospect two anomalous geochemical trends exist in an area previously surveyed by PanCon using the UTEM system in 1986 (Figure 1). Initially the design of the 1986 survey was performed on the understanding that dips in the area are relatively flat. As such the prospective geology was surveyed with a lines placed inside the energizing loop. If this assumption was not correct could have resulted in “steeply” dipping targets not detected by the UTEM survey.

On examination of 1986 UTEM data, considering that only continuous normalized data is currently available, it was concluded that some “subtle” targets near the edges of the loop might not be identifiable in the old UTEM data as presented in various reports.

Modelling of possible UTEM responses for 1986 loops, as shown in Figures 2 and 3, (point norm data) confirms this assertion. It is evident that even the more steeply dipping targets in the area of anomaly 1 (Figure 2) would have been detected by the UTEM survey and obvious even in continuously normalized data as presented in 1986 reports.

In target area 2, however there could have been some ambiguity in detecting the more steeply dipping targets (eg. Figures 3d and 3e), particularly in the continuous normalized plots of the data. The latter is true because the ever-increasing primary field toward the edge of the loop obliterates any “subtle” response near the loop edge in the continuous normalized response profiles. It is because of these ambiguities that the decision was reached to resurvey the area encompassing Boco Siding geochemical anomaly 2, with the loop location guaranteeing good coupling with the targets having interpreted dips in the area (i.e. 45° and greater from the west) (Figure 4).

Boco Siding Anomaly 1 UTEM response : Target dip 50 deg ,sigt =100 siemens

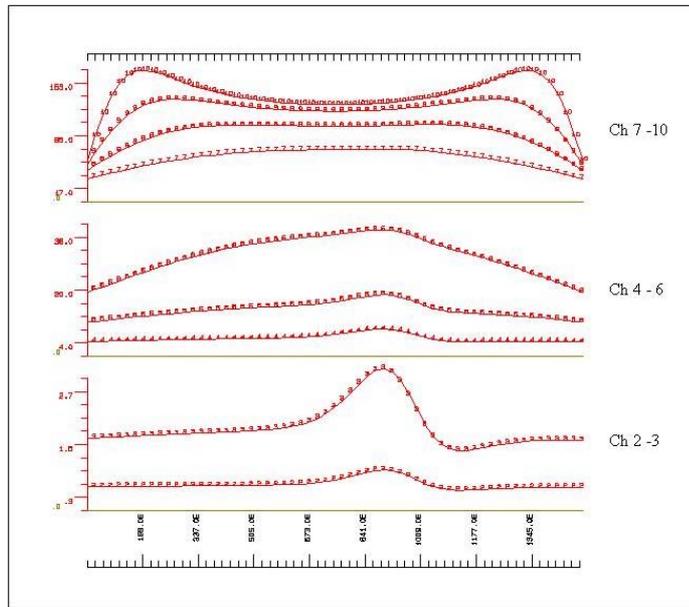


Figure 2. Boco Siding Anomaly 1 UTEM response: Target dip 50 deg, sigt=100 siemens

Boco Siding Anomaly 1 UTEM response : Target dip 50 deg ,sigt =50 siemens

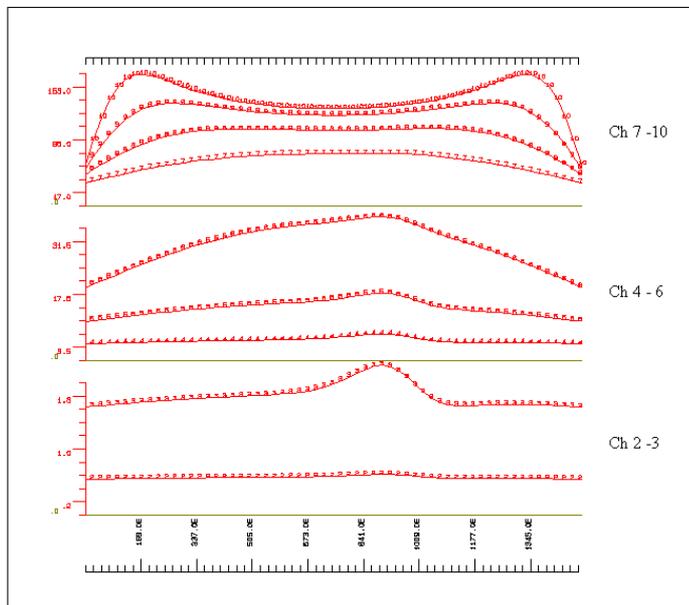


Figure 2a. Boco Siding Anomaly 1 UTEM response: Target dip 50 deg, sigt=100 siemens

Boco Siding Anomaly 2 UTEM response : Target dip 30 deg ,sigt=100 siemens

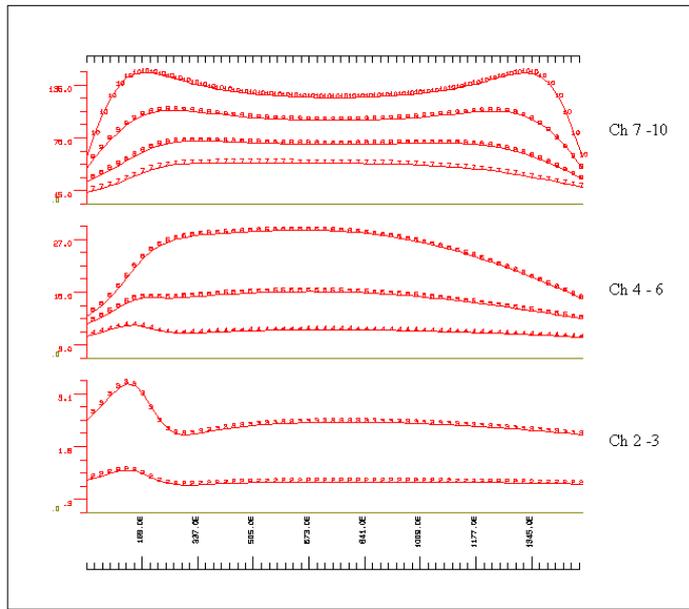


Figure 3. Boco Siding Anomaly 2 UTEM response: Target dip 30 deg, sigt=100 siemens

Boco Siding Anomaly 2 UTEM response : Target dip 40 deg ,sigt=100 siemens

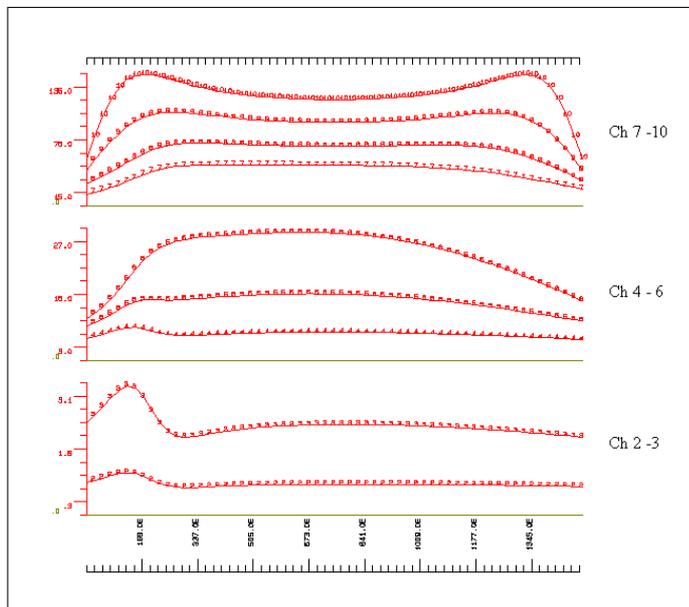


Figure 3a. Boco Siding Anomaly 2 UTEM response: Target dip 40 deg, sigt=100 siemens

Boco Siding Anomaly 2 UTEM response : Target dip 50 deg ,sigt=100 siemens

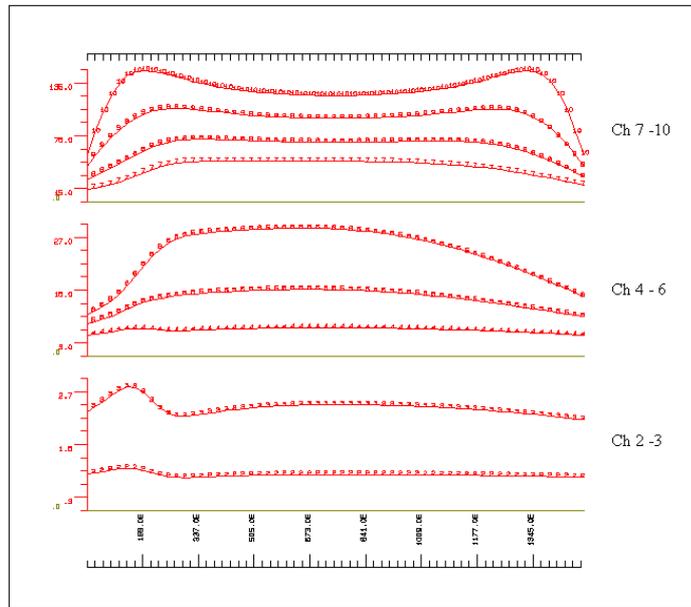


Figure 3b. Boco Siding Anomaly 2 UTEM response: Target dip 50 deg, sigt=100 siemens

Boco Siding Anomaly 2 UTEM response : Target dip 50 deg ,sigt =50 siemens

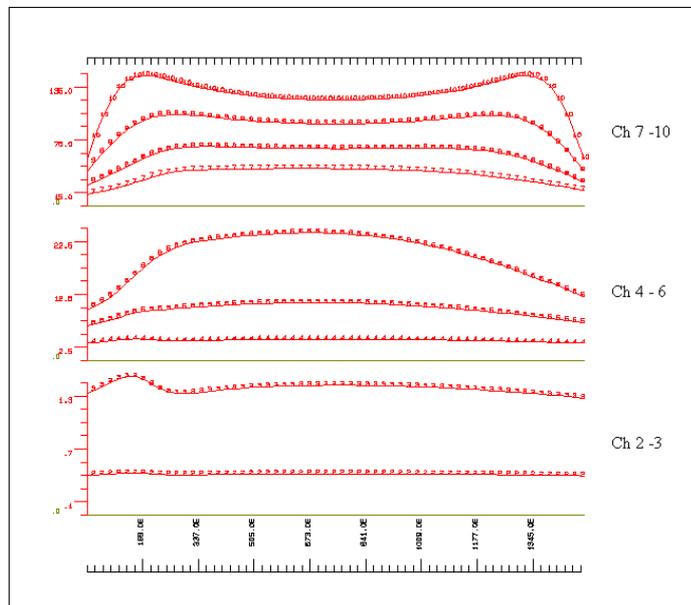


Figure 3c. Boco Siding Anomaly 2 UTEM response: Target dip 50 deg, sigt=50 siemens

Boco Siding Anomaly 2 UTEM response : Target dip 60 deg, sigt=100 siemens

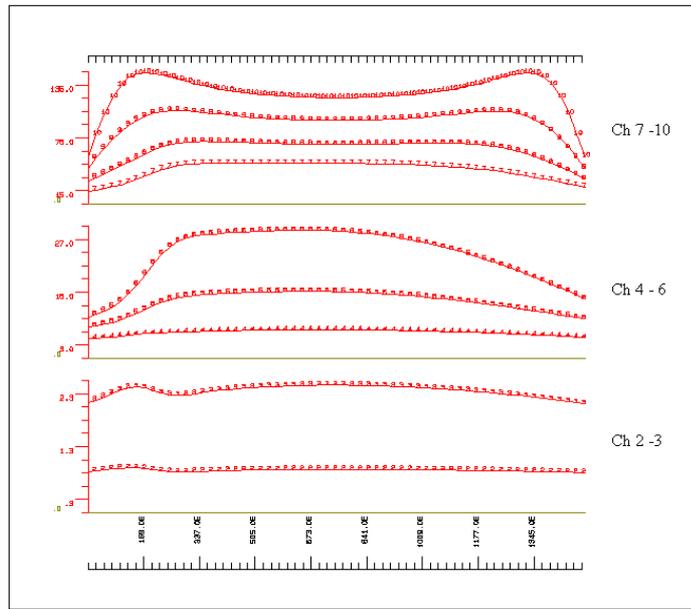


Figure 3d. Boco Siding Anomaly 2 UTEM response: Target dip 60 deg, sigt=100 siemens

Boco Siding Anomaly 2 UTEM response : Target dip 70 deg, sigt=100 siemens

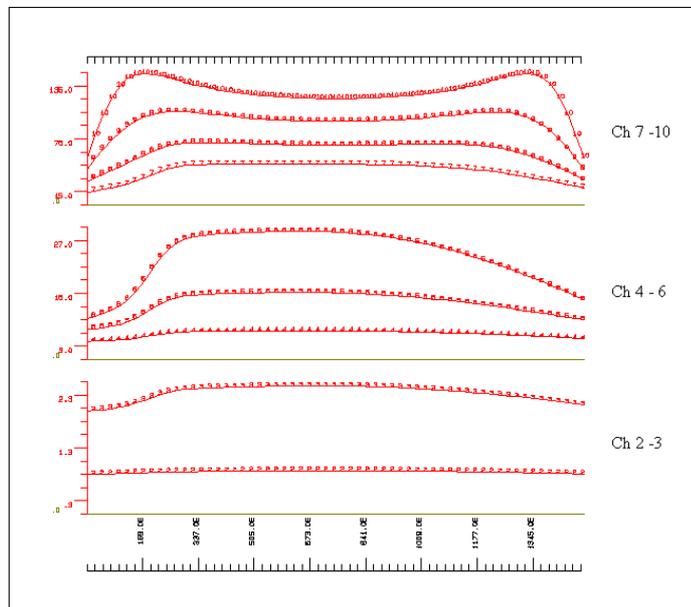


Figure 3e. Boco Siding Anomaly 2 UTEM response: Target dip 70 deg, sigt=100 siemens

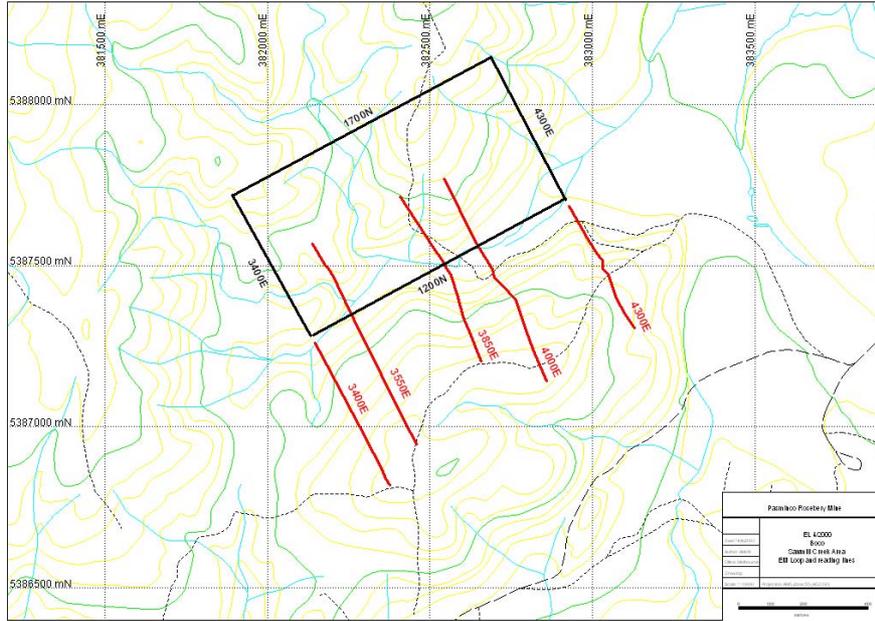


Figure 4. Boco Siding EL4100 : 2002 Crone Pulse EM Survey lines and loop

This new TDEM data from (Figures5 –5d), however did not identify any responses which could be attributed to a conductive target at depth. Some “system” “self response” however is evident in the data with early time crossover stationary at the loop edge. This system self-response however would not have prevented the detection of conductive target, which could be attributed to significant accumulation of sulphide mineralisation.

Surface EM Boco Siding : Line 3400 E Vertical component

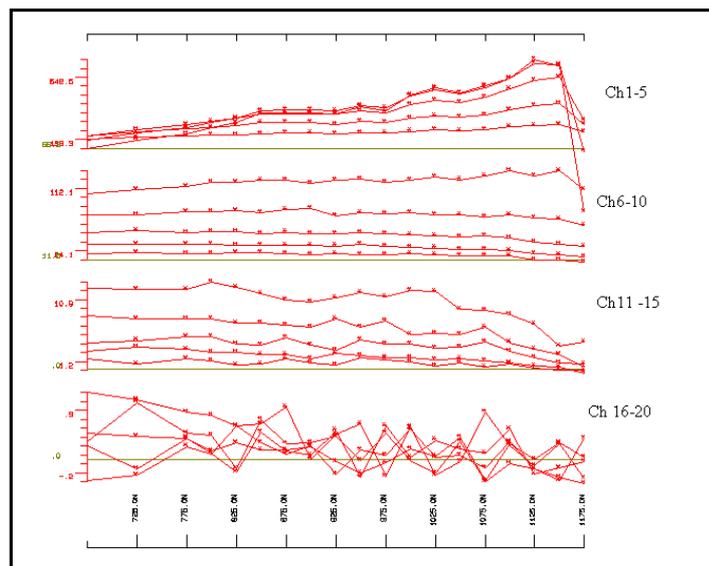


Figure 5. Surface EM Boco Siding: Line 3400 E Vertical Component.

Surface EM Boco Siding : Line 3550 E Vertical component

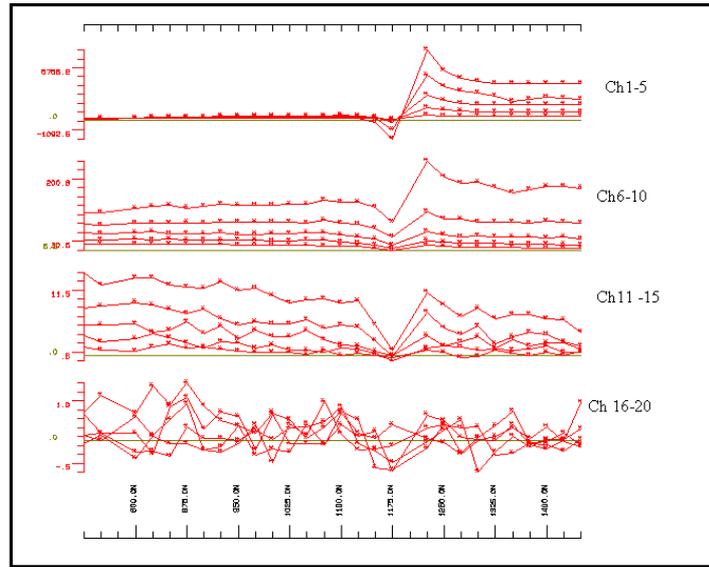


Figure 5a. Surface EM Boco Siding: Line 3550 E Vertical Component.

Surface EM Boco Siding : Line 3850 E Vertical component

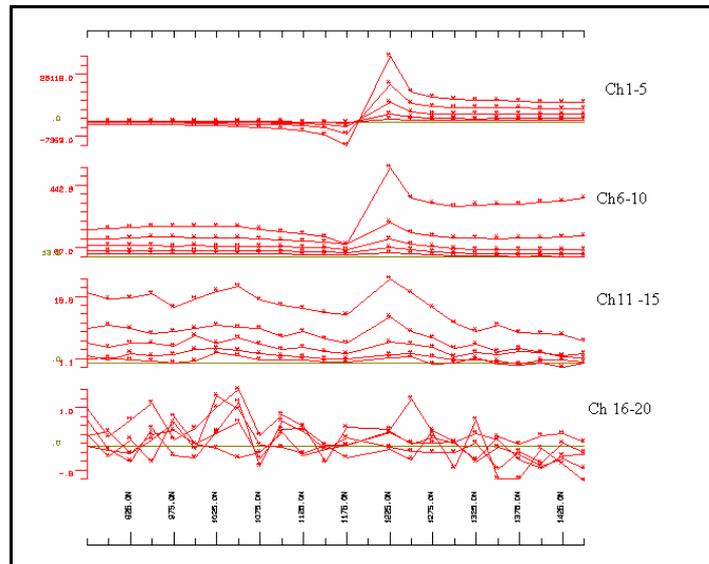


Figure 5b. Surface EM Boco Siding: Line 3850 E Vertical Component.

Surface EM Boco Siding : Line 4000 E Vertical component

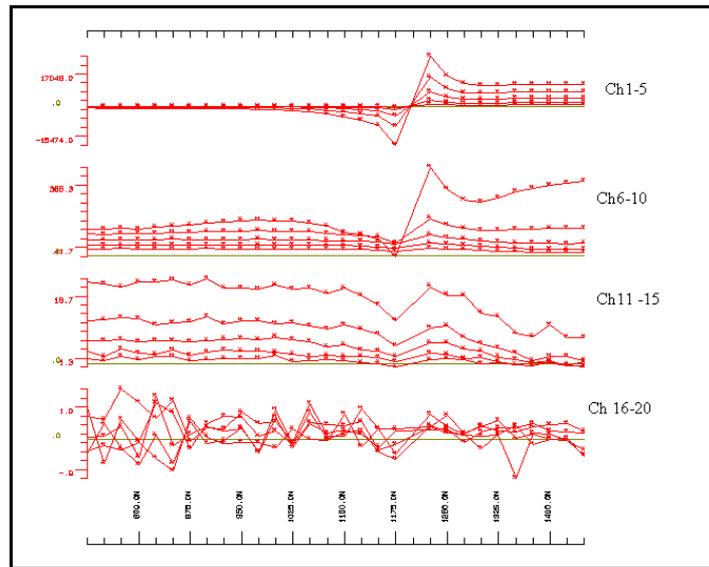


Figure 5c. Surface EM Boco Siding: Line 4000 E Vertical Component.

Surface EM Boco Siding : Line 4300 E Vertical component

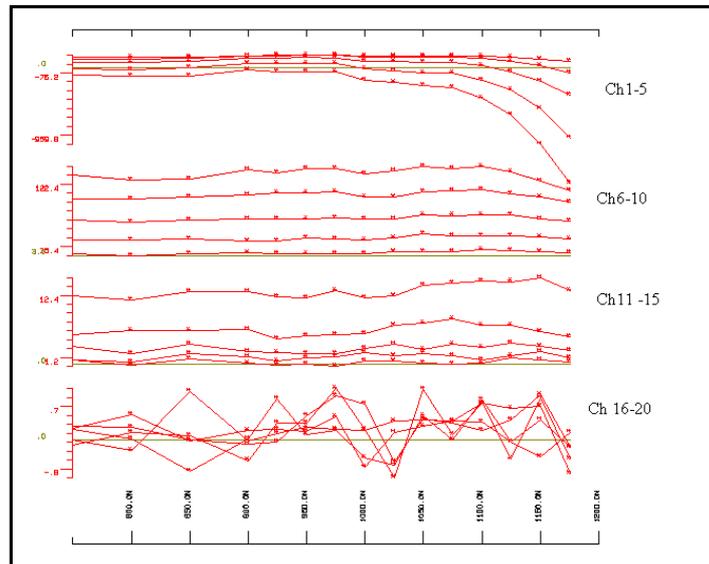


Figure 5d. Surface EM Boco Siding: Line 4300 E Vertical Component.

a. WSP10

The only “anomalous response within this drillhole last till about channel 14 or about 2.3 milliseconds, and identify a target or targets with a very short or about .75 milliseconds time constant. This anomalous response cannot be modeled with a single sheet or a series of conductive sheets responses (Figure 7 – 7b).

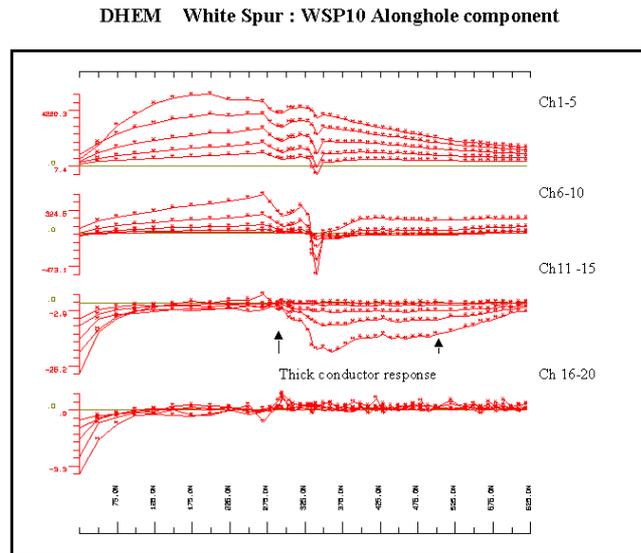


Figure 7. DHEM White Spur: WSP10 Alonghole component.

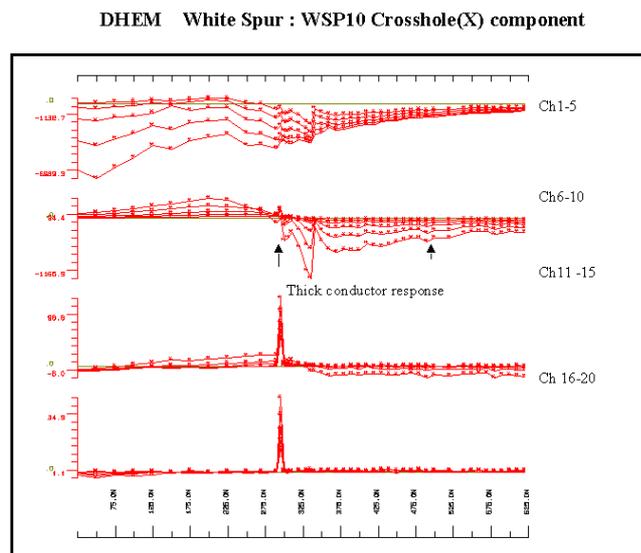


Figure 7a. DHEM White Spur: WSP10 Crosshole (X) component.

DHEM White Spur : WSP10 Crosshole(Y) component

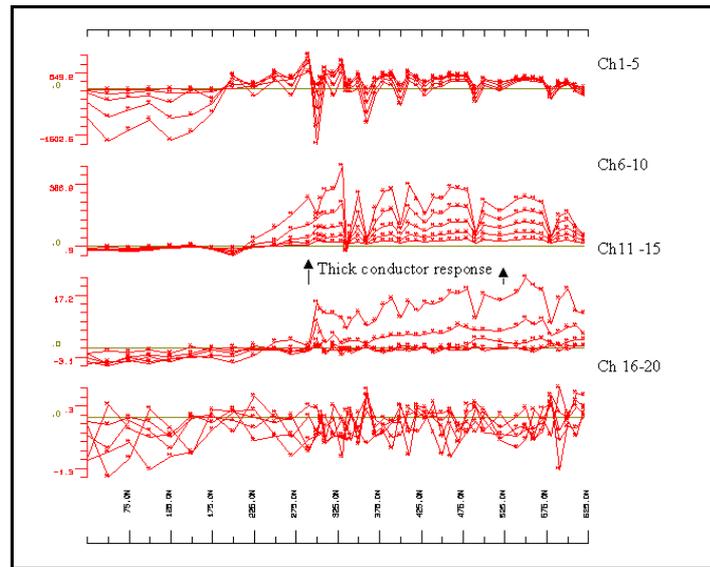


Figure 7b. DHEM White Spur: WSP10 Crosshole (Y) component.

Instead data from Ch 11 - 14 (or from 1 to 2.3 milliseconds) is best explained by a continuous or a set of closely spaced conductors from about 275 to 450 -475 meters down hole distance. The early time data from Ch 1 - Ch 6 , defines a conductor which is intersected by a drillhole from 275 (300) - 375 meters, with later time currents migrating downwards and past the drillhole intersection. Inspection of the geological data suggests that this “thick” interpreted conductor corresponds to the intersected shale horizon above the Central Volcanic sequence contact. As such, considering the short time constant of this response, no targets that can be attributed to the significant accumulations of sulphides are interpreted. The EM response is interpreted to be exclusively related to the poorly conductive shale unit overlaying the central volcanic sequence.

b. YWS1

The early to medium time response in drillhole YWS1 (Figure 8 - 8b) is centered at an along hole distance of 340 meters and is coincident with the White Spur formation massive carbonate rich sandstones and black shales. The drill hole is interpreted to be inside the conductor with currents flowing above and below the drillhole.

At late times however, with the sign of the alonghole component exclusively negative (Figure 8) implies that conductors which are not intersected by the drillhole are affecting the EM response. All attempts however to explain this late time response in terms of a single conductor response have failed. This problem is essentially related to the fact that for almost the entire length of the drillhole late time alonghole component data values are negative. As such, this response cannot be reconciled with the response of a single conductor centers some 340 - 350 meters downhole distance, below and approximately inline with the negative peak in the along hole response (Figure 8).

DHEM White Spur : YWS1 Alonghole (Z) component

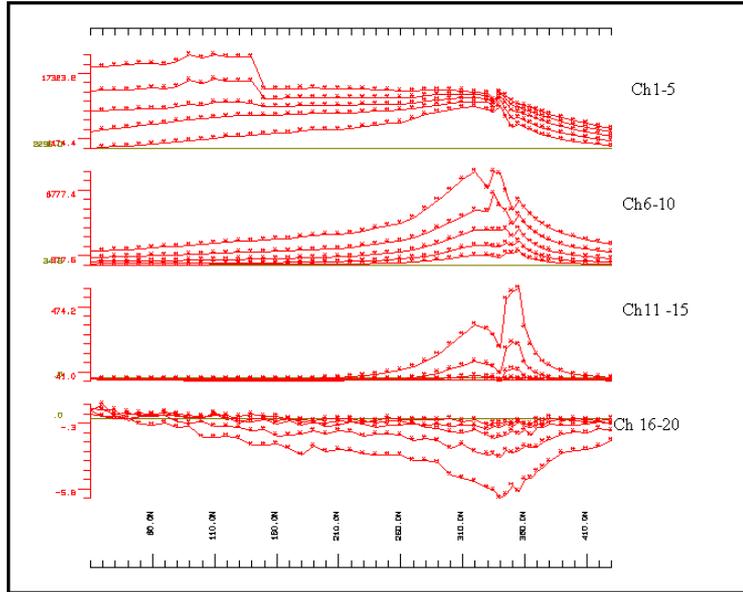


Figure 8. DHEM White Spur: YWS1 Alonghole (Z) component.

DHEM White Spur : YWS1 Crosshole (X) component

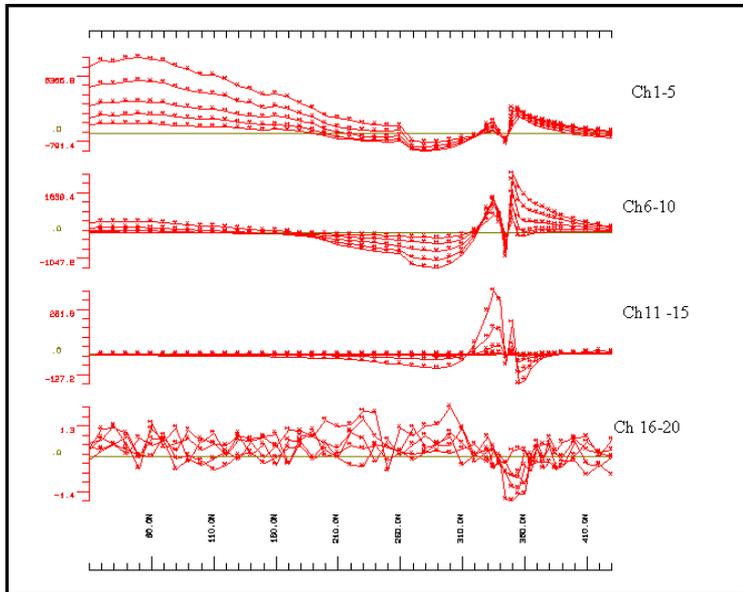


Figure 8a. DHEM White Spur: YWS1 Crosshole (X) component.

DHEM White Spur : YWS1 Crosshole (Y) component

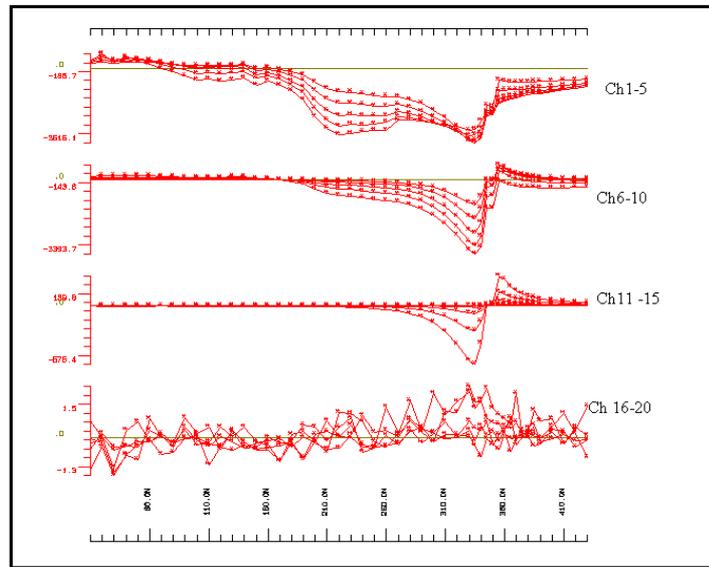


Figure 8b. DHEM White Spur: YWS1 Crosshole (Y) component.

A number of possibilities were then investigated to explain this broad late time negative response. The most satisfactory solution includes the additive response of two conductors (Figure 9).

White Spur YWS1 : Modeled and Observed data
Alonghole Component

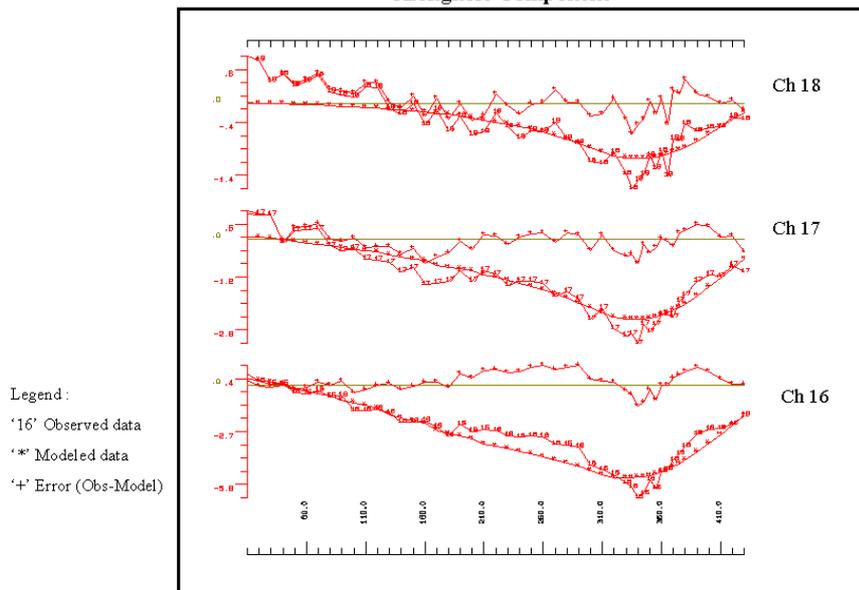


Figure 9. White Spur YWS1: Modelled and Observed data Alonghole component.

The first conductor is located beneath the drillhole at RL 225 and inline with downhole distance of about 320 – 340 meters. As such this target appears to be within the White Spur formation block shale unit. The parameters of this conductor are as follows;

Location targets Top mid point : 377400E, 5360050N, 225RL
 Dip : From vertical to 60° from East
 Conductivity Thickness : 50 – 80 siemens
 Dip extent : 200 –250 meters.

The other conductor which is required to explain the negative late time data values throughout the drillhole is interpreted to be to the west and to the south of the drillhole collar. Although the location of this target and its characteristics cannot be determined with precision (drillhole would need to go past the targets location for this to be the case), the best guess as given by the inversion process for the target parameters is as follows:

Location of targets top mid point : 377250E, 5359700N, 200RL
 Dip : 0 - 20° (flat)
 Conductivity thickness : 30 – 50 siemens
 Strike extent : 400 meters
 Plunge : 10 – 20° to the north

However, as pointed out previously the target parameters cannot be considered as well defined. The interpretation process however is indicating the possibility that there might be a conductor to the west and south of YWSP1 drillhole collar.

c. WSP6

The early time data in WSP6 drillhole identifies as poorly conductive unit from about 270 – 350 meters along hole distance. This poor conductor response co-incides with the intersected black shale sequence (Figure 10 – 10b).

Late time response however, for example is characterised by increasing and positive value towards the top of the drillhole (Figure 10).

One of the explanation for this response is from a conductive source to the west of the drillhole collar with the following parameters (Figure 11).

Location of targets top mid point : 377075E, 5359600N, 305RL
 Dip : 0 – 20° (flat)
 Conductivity thickness : 80 - 120° siemens
 Strike extent : 500 meters
 Plunge : 0 – 20° to the north

DHEM White Spur : WSP6 Alonghole(Z) component

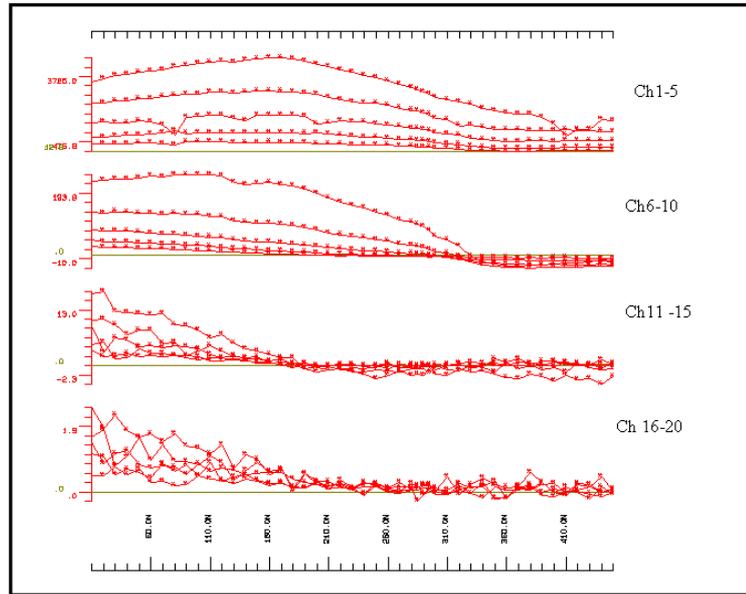


Figure 10. DHEM White Spur: WSP6 Alonghole (Z) component.

DHEM White Spur : WSP6 Crosshole(X) component

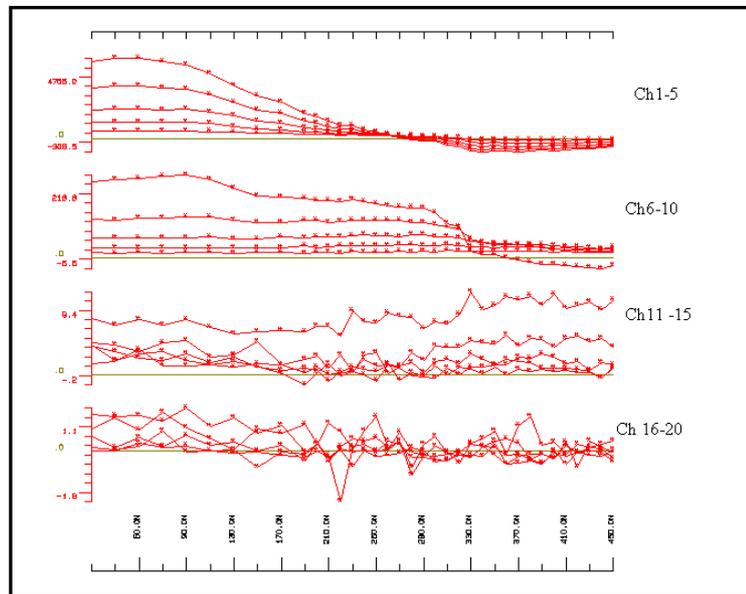


Figure 10a. DHEM White Spur: WSP6 Crosshole (X) component.

DHEM White Spur : WSP6 Crosshole (Y) component

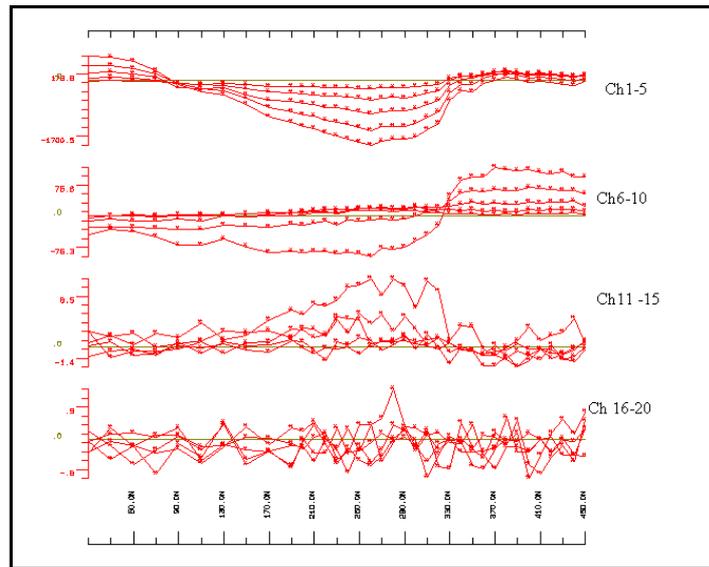


Figure 10b. DHEM White Spur: WSP6 Crosshole (Y) component.

White Spur WS6 : Modeled and Observed data
Alonghole Component

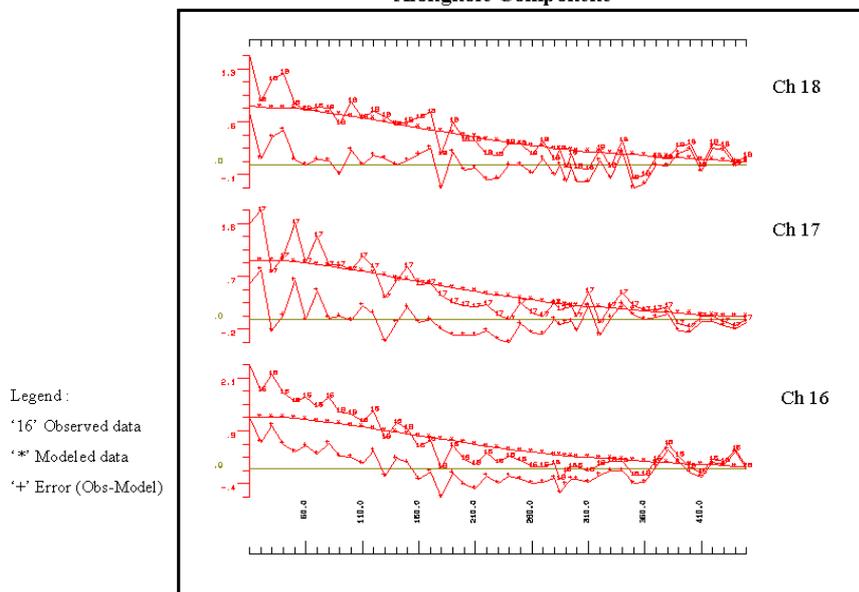


Figure 11. White Spur WSP6: Modelled and Observed data Alonghole component.

Nevertheless because the drillhole trace does not cross the targets interpreted location and at the nearest distance to the conductor is still some 150 – 200 meters away, the interpreted target parameters are only very approximate, in particular the target location. It however seems, that the target to the west of the WSP6 drillhole

collar is more or less in the same location as the western target interpreted from the YWS1 data.

d. YWS1 and WSP6 data

Considering YWS1 and WSP6 interpretation of the data suggests that a conductor target area as shown in Figure 12 should be considered, and on the basis of geological data appraised as a possible source for sulphide mineralized conductor. As suggested in previous sections however, no reliable accurate estimates for the conductor's location and parameters can be obtained from the YWS1 and WSP6 data set. As well, although the effects that are noted in the late time YWS1 and WSP6 data do not appear to be caused by "instrumental" problems, on the basis of this limited data set this cannot be ruled out.

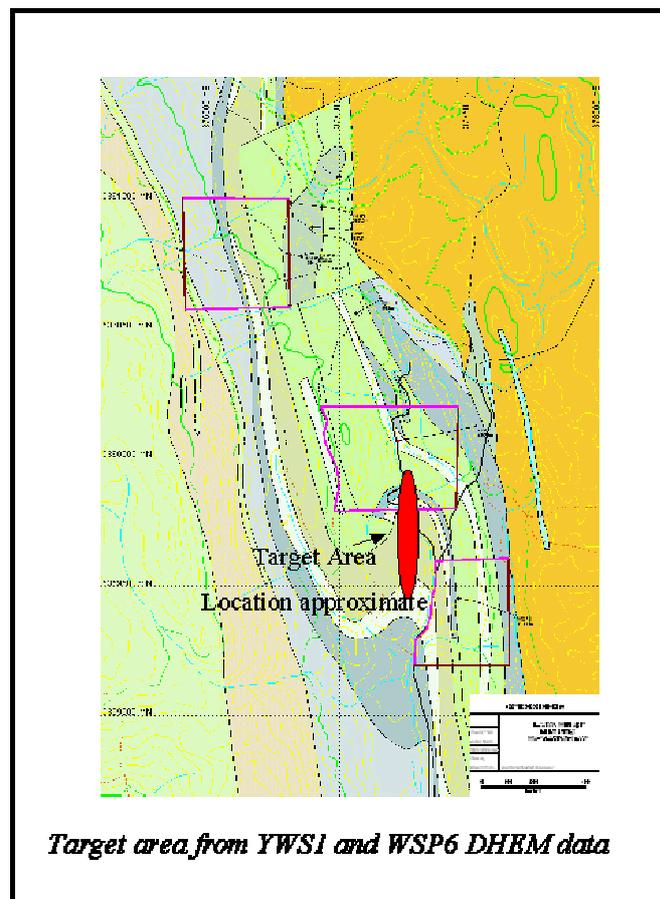


Figure 12. Target area from YWS1 and WSP6 DHEM data.

3. Silver Falls

One drillhole HRD1 was surveyed at the Silver Falls prospect (Figure 13). The survey however did not identify the presence of any conductors which could be associated with mineralized sulphide rich body (Figure 14).

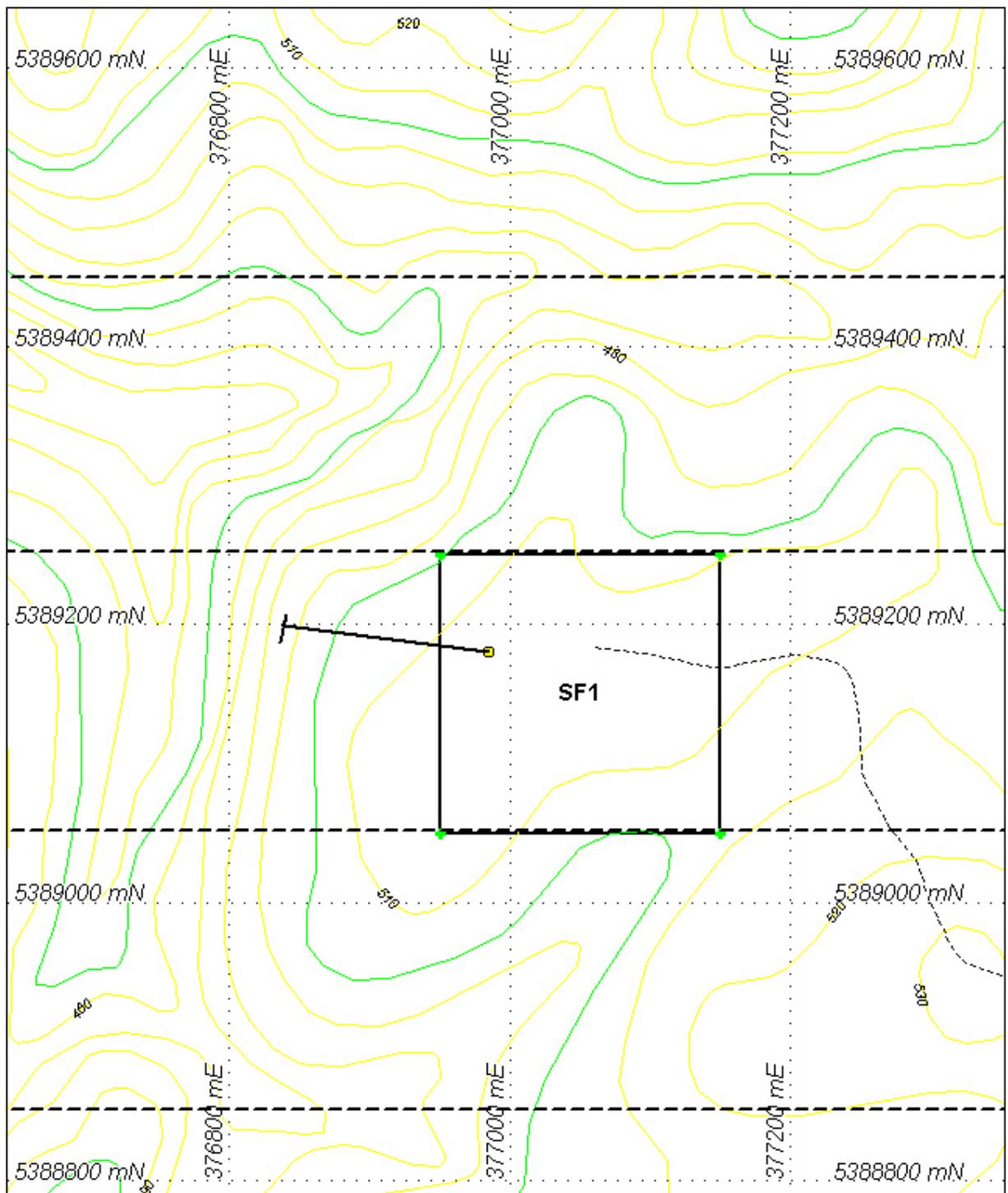


Figure 13. Silver Falls DHEM Survey Loop and drillhole location.

DHEM Silver Falls : HRD1 Alonghole component

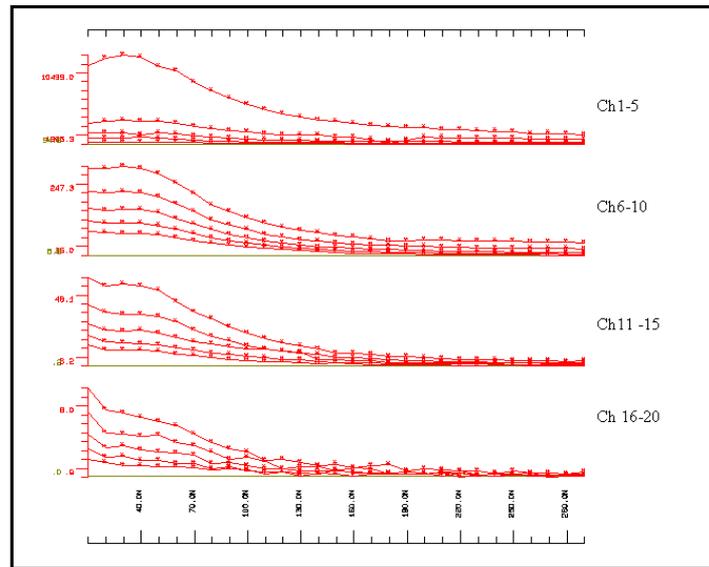


Figure 14. DHEM Silver Falls: HRD1 Alonghole component.

5. CONCLUSIONS

Surface and Downhole EM surveys at the Boco Siding, White Spur and Silver Falls prospects have not defined any targets that would be clearly associated with significant conductive sulphide accumulations at the prospective time horizons. At Boco Siding and Silver Falls, no conductors of any significance were detected.

The three holes DHEM White Spur data set defined a number of conductors, with the intersected shale unit characterized by short time constant responses. From drillhole YWS1 data an offhole conductor with a late time response can be interpreted as associated with the projected location of the intersected shale sequence, and above the central volcanic sequence contact. As well a conductor to the west of the YWS1 and WSP6 drillhole collars appears to be affecting the data set. The precise location for this conductive target cannot be determined, because neither the YWS1 nor WSP6 drillholes traverse across the target.