2005 GEOLOGICAL REPORT

FOR THE

IRON RANGE PROPERTY

Nelson / Fort Steele Mining Division, Southeastern B.C.
Mapsheets 82F018, 82F019
Latitude 49°12'N, Longitude 116°24'W
NTS 6832001 N / 633500E

VOLUME IV

APPENDICES

APPENDIX VI CONDOR CONSULTING GEOPHYSICAL REPORT

Prepared for

EAGLE PLAINS RESOURCES LTD.
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Cranbrook, B.C., V1C 2P1
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December 2

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December 23, 2005

APPENDIX VI

CONDOR CONSULTING GEOPHYSICAL REPORT

REPORT ON REPROCESSING AND INTERPRETATION

of

IRON RANGE VTEM DATA

for

EAGLE PLAINS RESOURCES INC.

June 2005

Condor Consulting
Lakewood Colorado
USA

CONTENTS

1. INTRODUCTION

At the request of Mr. Chris Gallagher of Eagle Plains Resources Ltd. (Eagle Plains), VTEM EM and magnetic data over the Iron Range area have been reprocessed and interpreted by Condor Consulting, Inc. (Condor). The Iron Range claims are located approximately 55 km southwest of Cranbrook, BC Canada.

The Iron Range property covers a prominent mineralized structure. The area is prospective for both Iron-oxide-Cu-Au (IOCG) and sedimentary exhalative (SEDEX) Ag-Pb-Zn mineralization.

To assist the interpretation of the VTEM data, Condor has produced conductivity depth images (CDI), together with a number of image enhancements of the EM and magnetic data. The data and interpretation have been combined in MultiPlots™ showing a selection of profiles and mini-plates of several geophysical parameters as well as DTM images, topographic map and a geologic map supplied by Eagle Plains.

The inversions to produce CDIs were carried out using EM Flow software. Details are provided in Section 3 below.

The aim of the processing and interpretation was to provide Eagle Plains with a better understanding of the relationship of magnetics and EM to the geology and mineralization in the area and to generate specific geophysical targets for future exploration.

Geological information within this report is taken from the Eagle Plains website www.eagleplains.ca Reference was also made to a geological report provided by Eagle Plains (Marshall and Downie, 2002).

2. SURVEY DETAILS

The VTEM survey was carried out by Geotech Ltd. in March 2004 (Geotech 2004). Eagle Plains provided the VTEM database for the project.
A map showing the distribution of the flight lines superimposed on the topographic map is shown in Figure 1a and superimposed on the geology in Figure 1b. The survey area covered 58.2 km^2 and the total number of line kilometers flown was 695 line km.

Survey lines were flown in perpendicular directions. Lines designated as flight lines were flown in a NNW direction with a nominal spacing of 200m, with infill to 100 m spacing over much of the area. In addition, lines designated as tie lines were flown in an ENE direction with a nominal spacing of 250 m. The nominal EM bird terrain clearance was 35 m, but as the terrain is rugged with a total elevation difference of approximately 1250 m (from 671-1925 m) the pilot could not maintain a close drape and the average bird altitude was 68 m (with a standard deviation of 17 m).

The EM data is generally of good quality. However, the magnetic data has numerous "tares", which may be due to severe bird swing during steep climbs in relation to the earth's magnetic field. These tares produce spikes in 1st vertical derivative profiles and are particularly prevalent in lines in the southwest of the surveys area. This data needs to be used with caution.

Figure 1a. Iron Range VTEM. Flight path superimposed on topographic map.

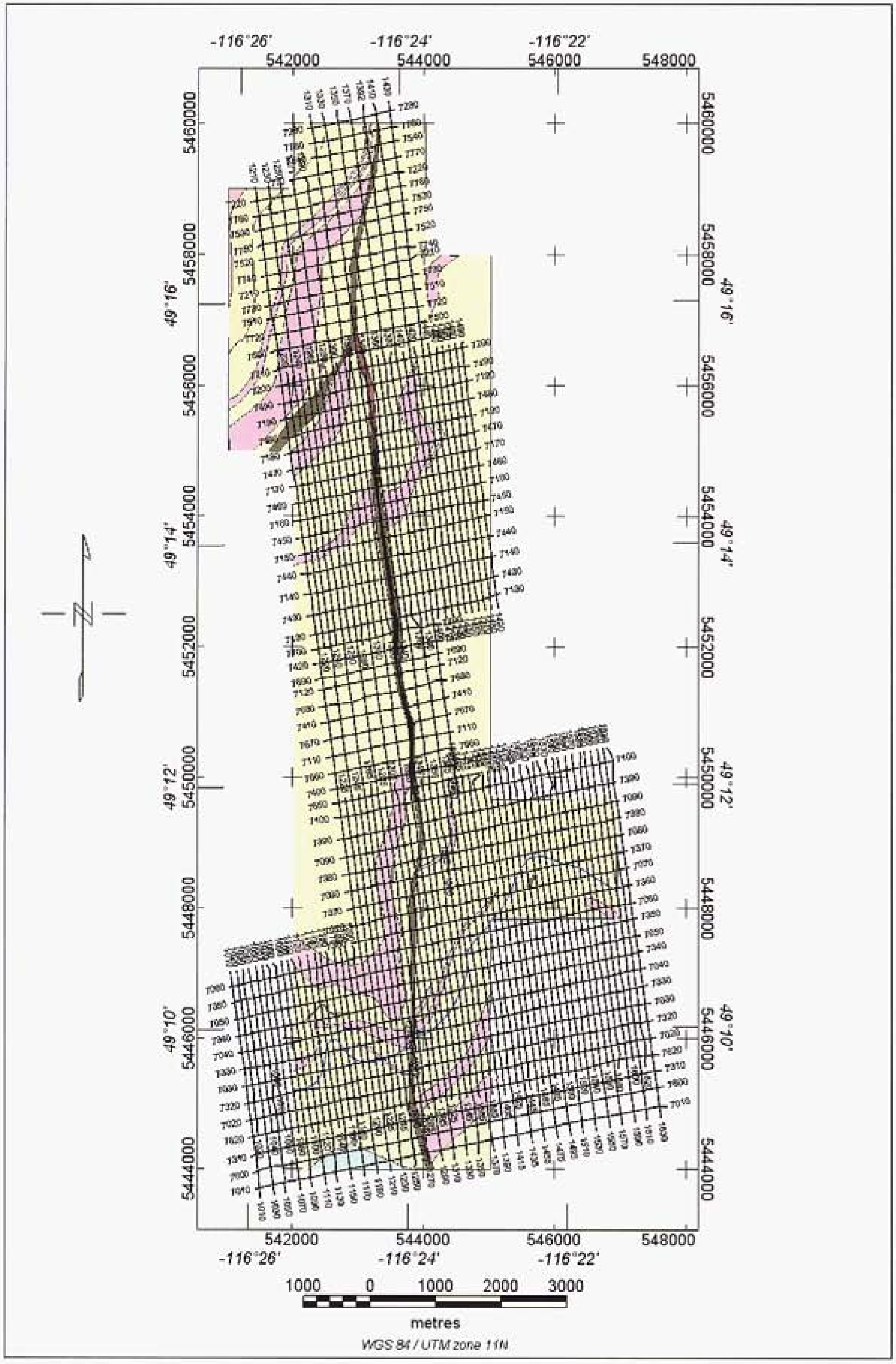

Figure 1b. Iron Range VTEM. Flight path superimposed on geological map.

3. EM PROCESSING

3.1 EM Flow

EM Flow is a software application that fits an approximate layered earth model to EM decay information on a fiducial by fiducial basis (Macnae et al 1998). These results are then displayed as depth-conductivity images (Conductivity Depth Images or CDIs). Due to the nature of the algorithm, flat lying conductors are more likely to be imaged at their proper depth whereas steeply dipping conductors tend to be imaged deeper than their actual depth. Whenever possible, conductor depths on CDIs should be calibrated with local geological control.

Processing parameters:-

Basis function: Tau range 0.05-2.0 ms

Smoothing: 0.5

Plotting parameters: Resistivities are in units of ohm-m, with a plotting range of 5-10,000 ohm-m.

3.2 AdTau Time Constant

The AdTau program that calculates the time constant (tau) from time domain decay data. The program is termed ***Ad***Tau since rather than using a fixed suite of channels is commonly done, the user sets a noise level and depending on the local characteristics of the data, the program will then select the suite of channels that fits these noise criteria. In resistive areas, earlier channels tend to be used where as in conductive terrains; the latest channels available can generally be used.

Figure 2 shows a typical decay fit; in this case, the last five channels are used.

The AdTau value is a measure of the conductivity and size (volume) of the conductive body.

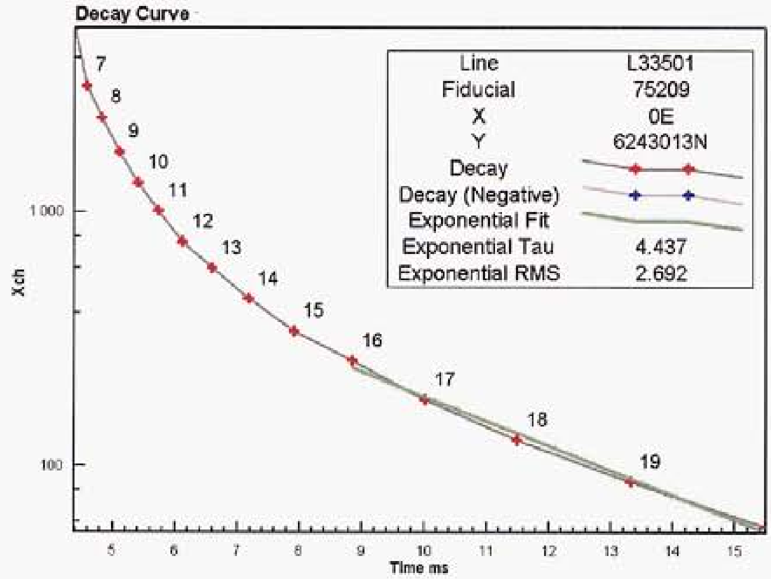

Figure 2. Calculation of AdTau time constant

4. PRODUCTS

4.1 MultiPlots™

MultiPlots™ (produced using Encom's Profile Analyst (PA) application) were produced for each survey line at a scale of 1:25,000. They display a variety of primary and derived data from the survey and are included on the DVD in .pdf and .jpg formats.

Each MultiPlot™ displays the following information:

- Mini-Plates™ of TMI, 1st Vertical derivative, EM Z Channel 6 (190 us), AdTau (cutoff 0.02 pV/Am^4) and Digital Terrain Model
- VTEM profiles for channels 7-28 (220-6340 us after the end of the pulse)
- TMI magnetics, 1st Vertical derivative and Analytic Signal
- AdTau profiles (cutoff 0.02 pV/Am^4) and power line monitor
- CDI showing flight path track
- TrackMap showing flight line on topographic map
- TrackMap showing flight path on geological map

4.2 Plan Products

Maps were produced at a scale of 1:25,000 showing images of the following survey parameters, each showing the picked EM anomalies.

- DEM (from VTEM))
- ZCh 7 (220 us) amplitude
- AdTau, using threshold of 0.02 pV/Am^4
- TMI
- TMI – reduced to the pole with 1st Vertical derivative
- TMI – Analytic Signal
- Geology

4.3 DVD

The DVD (Appendix D) contains the following:

- This report in .pdf format
- Geotech VTEM logistics report
- Geology supplied by Eagle Plains
- Profile Analyst session files and databases
- Profile Analyst MultiPlots™ in .pdf format
- Magnetic modeling – screen captures, AVI movies and dxf files of model plates

5. VTEM ANOMALY RESPONSES

The basic anomaly shapes for the VTEM concentric loop geometry (for both the Z and X components) are shown in the Figure 3 below. (Note, however, that only the Z component is acquired by the present VTEM system.) For the Z-component, two major response styles are observed from bedrock conductors - these are termed the inductively thin and thick responses.

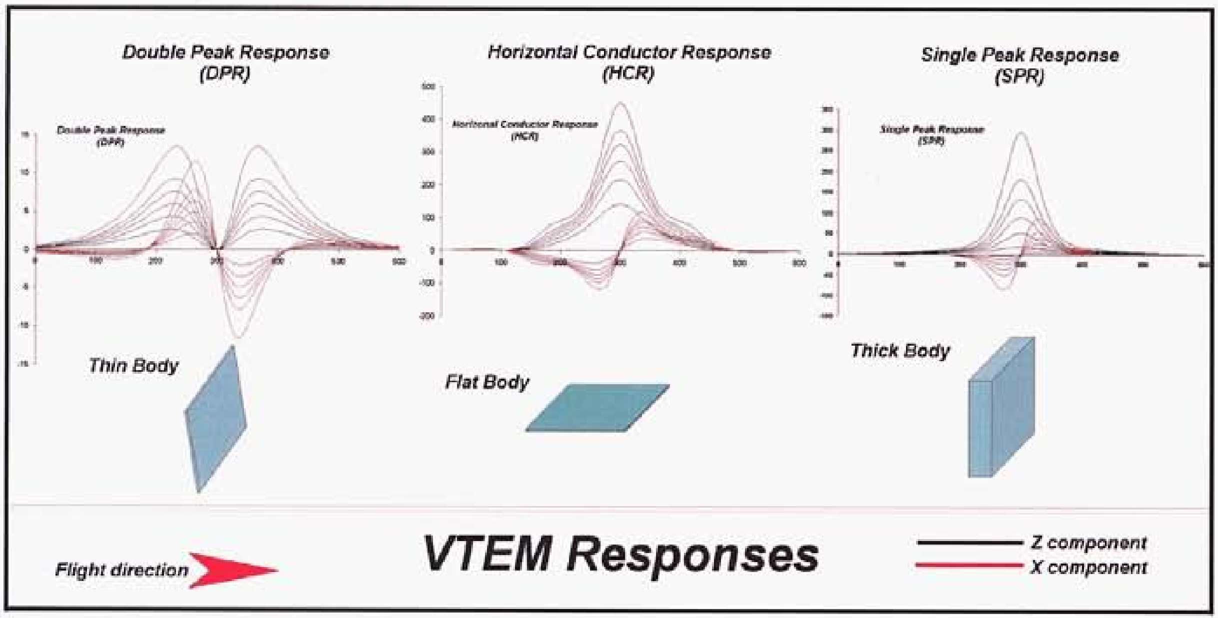

Figure 3. VTEM response characteristics.

In geophysical terms, the major difference between these two categories of responses is that in the thin case, the dominant induced current flow is along the sides of the body whereas for the thick response (& the horizontal conductor case) the currents are primarily constrained to the top of the body.

The thin response produces a double–peaked or "M"-shaped response with the low centered over the top of the body - Condor refers to this as a Double Peak Response or **DPR.** The thick conductor shows a single peak directly over the top of the conductor - Condor refers to this as a Single Peak Response or **SPR**. The third category of primary response, that derived from sources that are primarily horizontal to the surface are termed a Horizontal Conductive response or **HCR**. Note that the anomaly shape of the HCR response and SPR are similar, although the HCR shows broader flanks.

Further description and model results for plates at different depths and dips are contained in Appendix A.

6. INTERPRETATION

6.1 General Comments

As mentioned previously, the AdTau value is a function of the conductivity and size (volume) of a conductive body and so is often the most appropriate data for selecting targets for further follow up. Figure 8 shows the AdTau image for the survey.

Over most of the surveys the AdTau values are very low (less than 0.1 ms), indicating that the area is quite resistive and that there is a general lack of good conductors.

6.2 Specific Conductor Interpretation

Only two significant conductive zones are apparent, which are outlined in Figure 9 and labeled Zone A and Zone B. In Figure 10 these zones are overlain on the geology - unfortunately the geology map does not extend far enough to cover the full extent of the conductors). In Figure 11 these zones are overlain on the reduced to pole magnetics.

Zone A is a broad, flat-lying conductor with relatively small depth extent. It is oval in shape, approximately 1600 m in a north-south direction and 1200 m east-west and extends westwards beyond the survey area. The conductor largely conforms to the dip slope of the topography, as can be seen in Figure 12, which shows the CDI section for Line 7340 which crosses the central portion of the conductor. The peak AdTau value is over 2 ms. There is no direct magnetic correlation, although a broad magnetic anomaly is located along the southern and eastern sides of the conductor. This conductor appears to be located within mapped Middle Aldridge Formation, close to the contact with Rampart Facies, in the vicinity of the interpreted Sullivan time horizon (Eagle Plains website), which is prospective for SEDEX type mineralization. This extensive conductor should be easy to test, lying at shallow depth on a dip-slope.

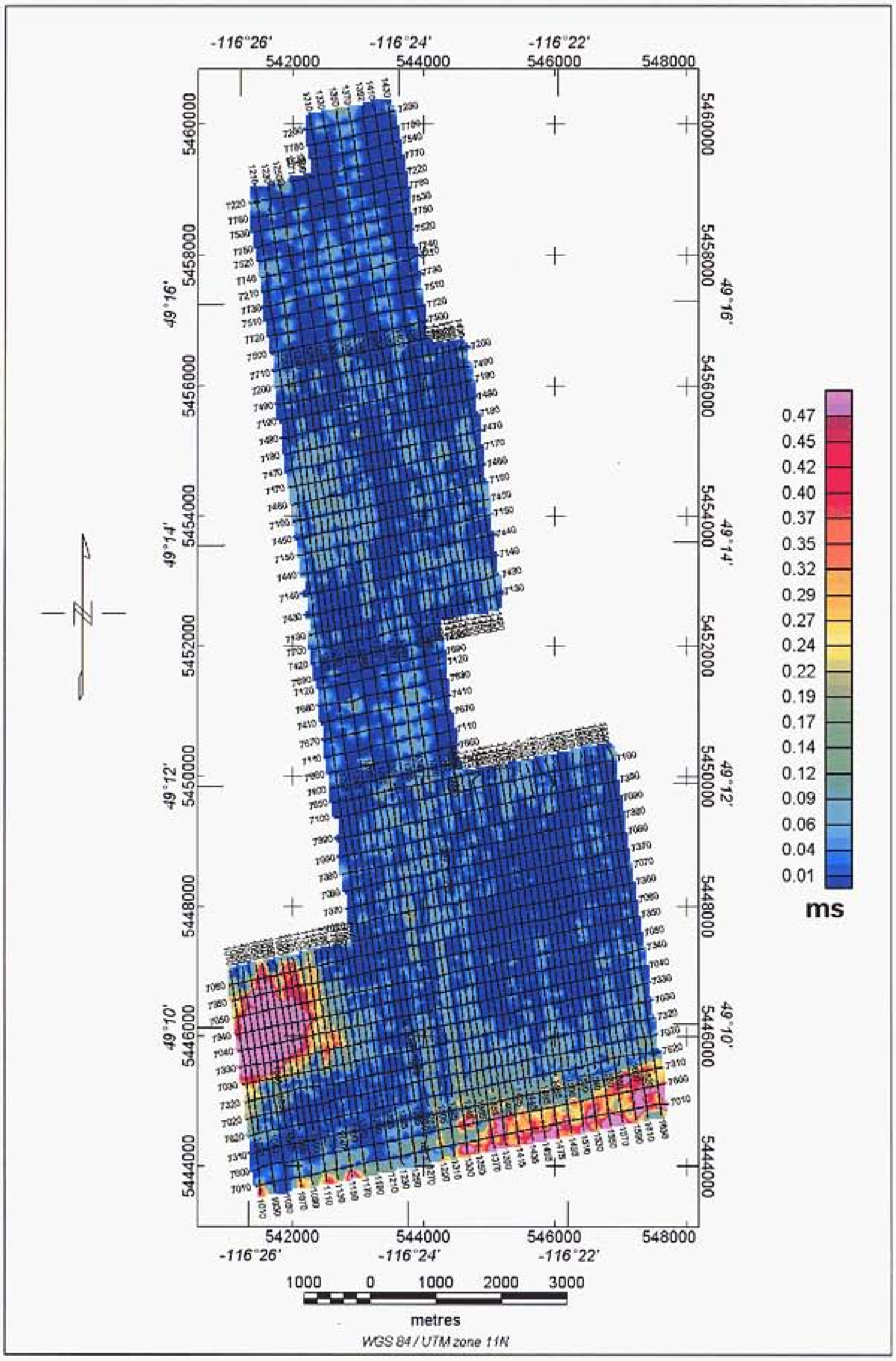

Figure 8. AdTau time constant image (cutoff 0.02 pV/Am^4).

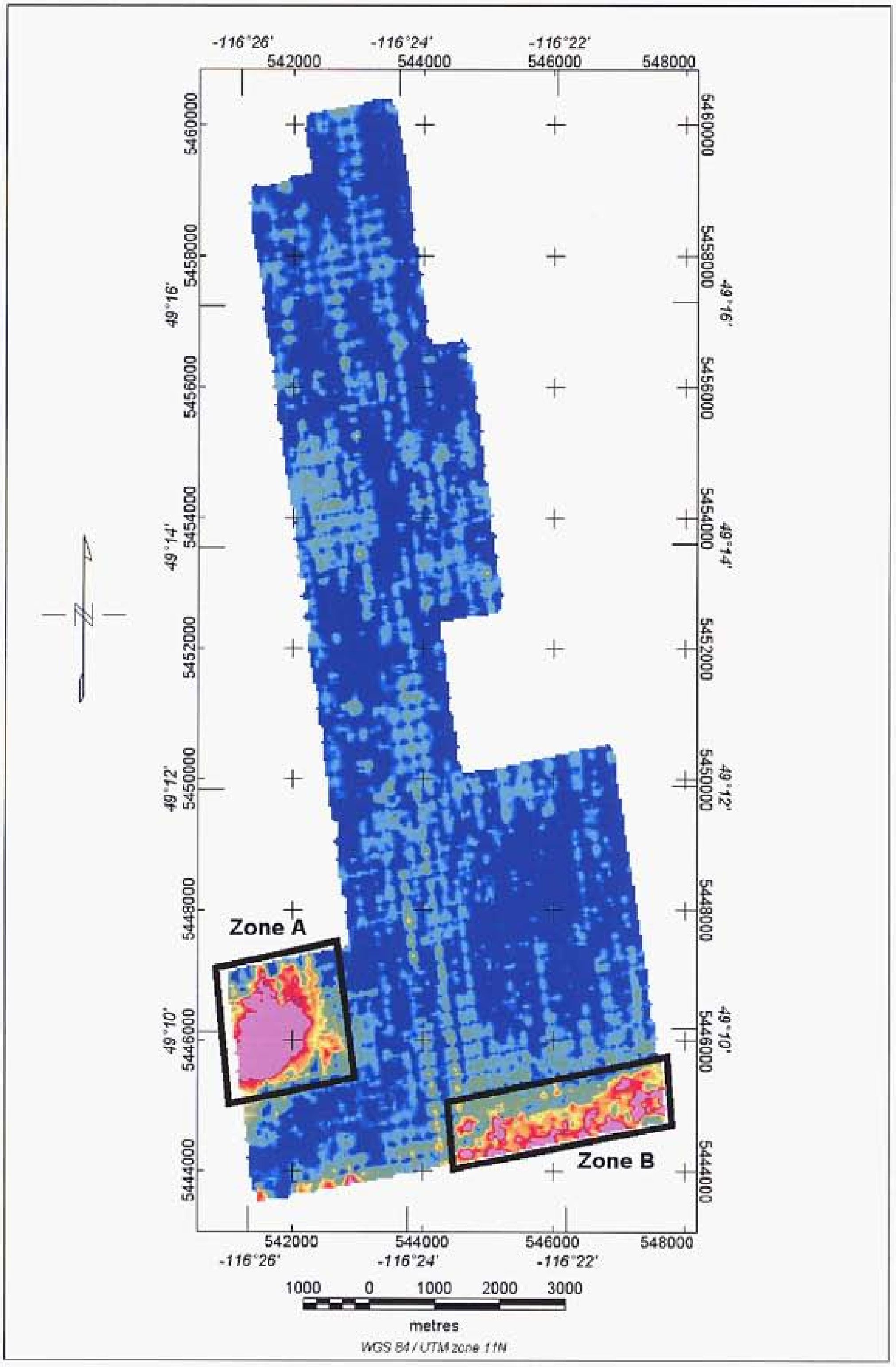

Figure 9. AdTau image showing Anomaly Zones.

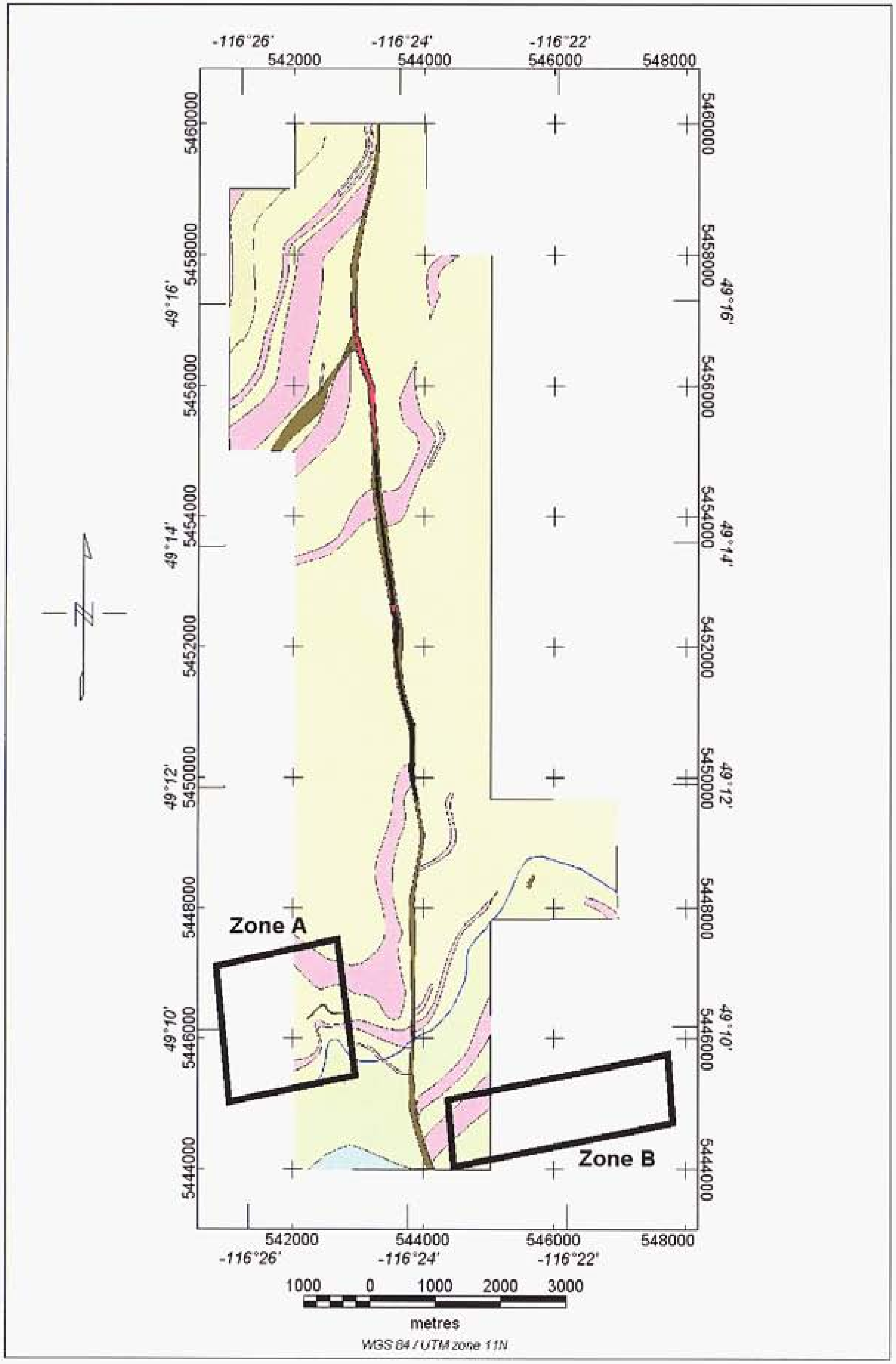

Figure 10. Geology showing Anomaly Zones.

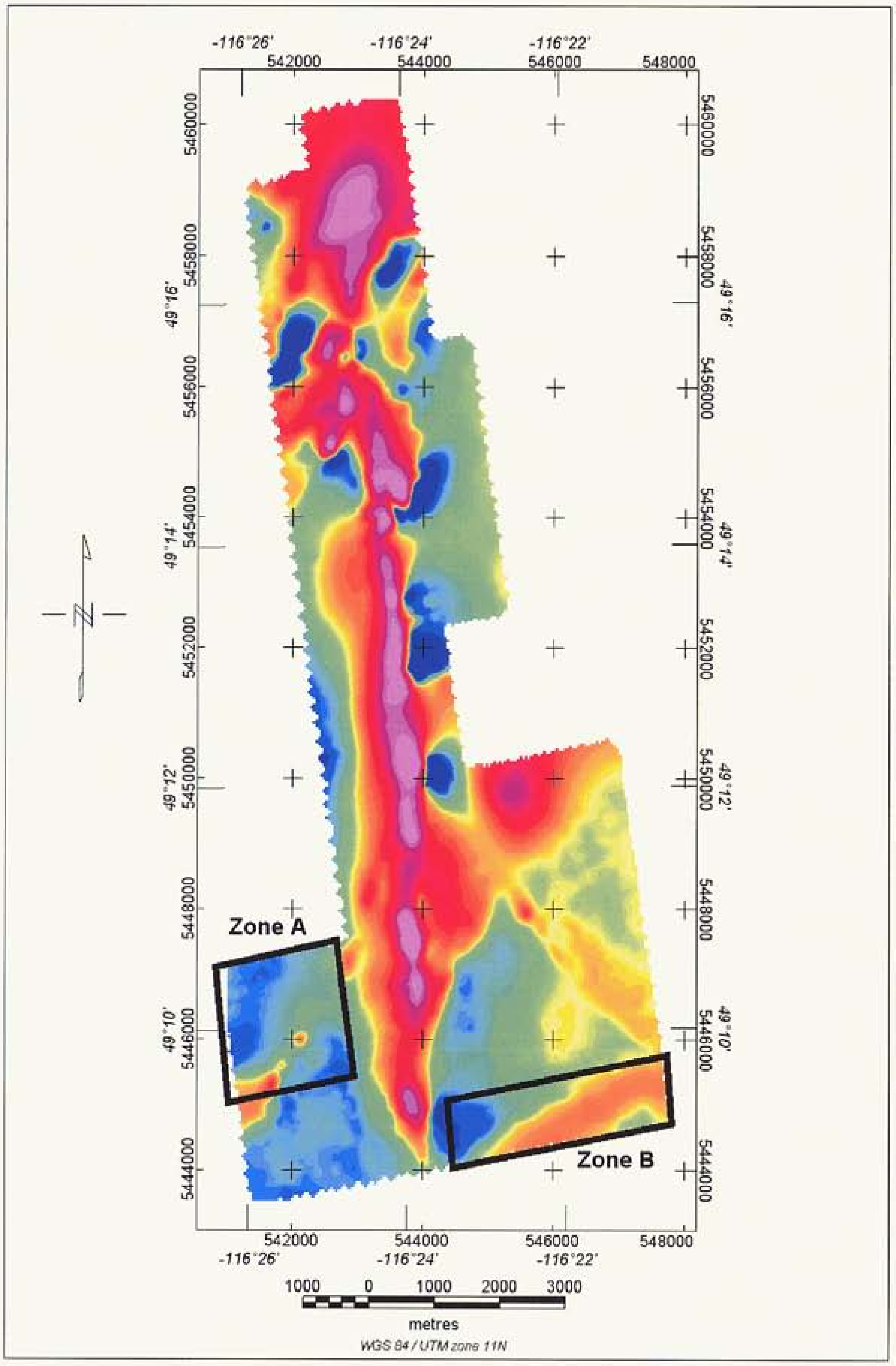

Figure 11. TMI Reduced to Pole showing Anomaly Zones.

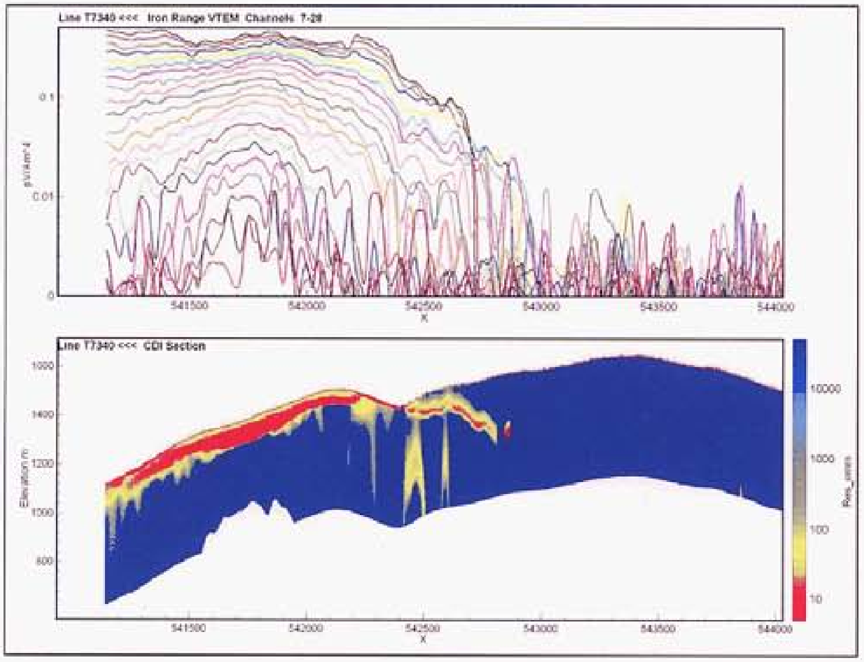

Figure 12. Example of Anomaly Zone A (T7340) - CDI section.

Zone B comprises a complex zone of near-surface conductors, mainly flat-dipping, but also some localized steep-dipping features. A typical example (Line 7600) is shown in Figure 13. Many of these appear to be caused by noise in the late channel data, but it not possible to write off these anomalies with certainty and some could be real. These conductors are located within the bottom of a broad valley (Figure 14) and this suggests that they may be due to moderately conductive, loosely consolidated sediments above the bedrock, which is likely to be Rampart Facies in this area. A broad magnetic anomaly trends in a NNE-SSW direction across the Zone, but this does not correlate with the distribution of the conductors. These conductors are unlikely to be economic.

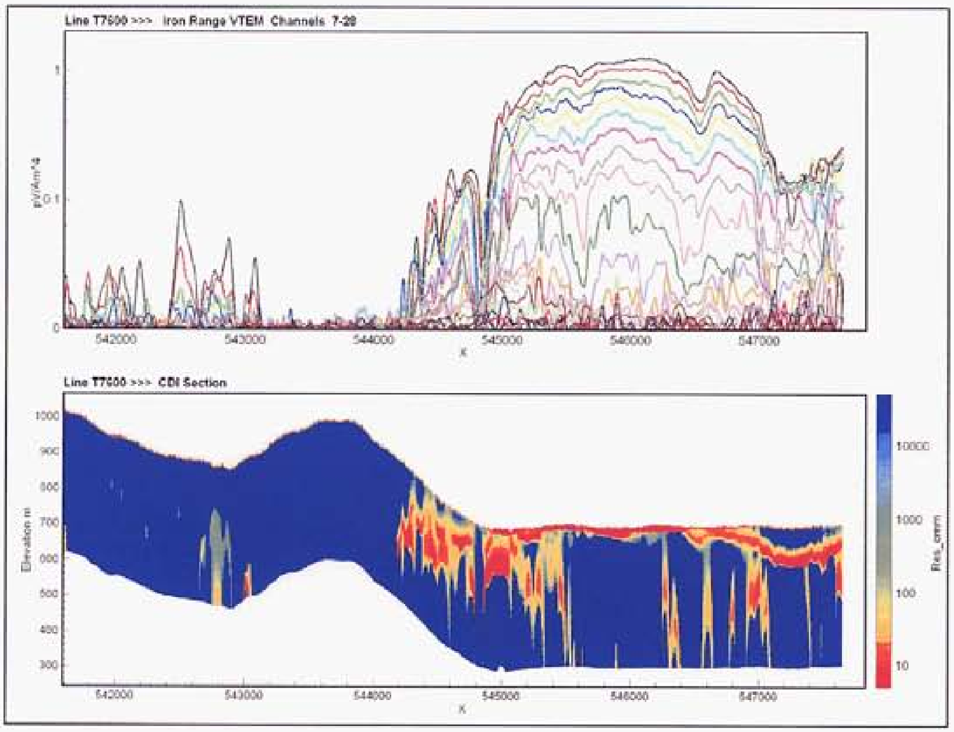

Figure 13. Example of Anomaly Zone B (T7600) - CDI section.

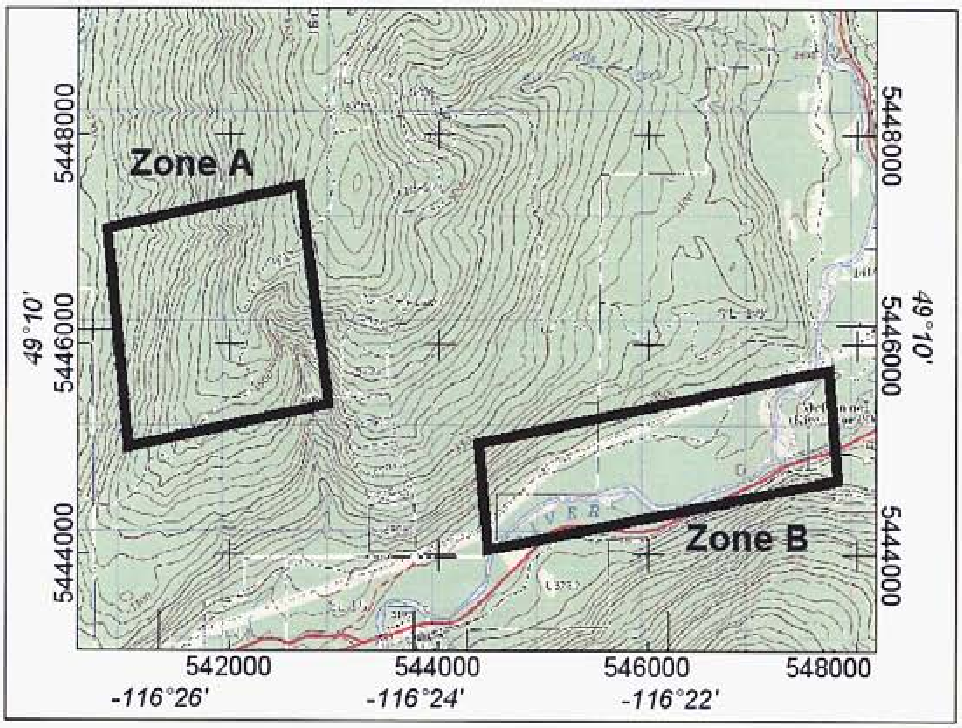

Figure 14. Anomaly Zones superimposed on topographic map.

6.3 Magnetic Modeling and Inversion

To expand the usefulness of the magnetic data a number of enhancements have been calculated. The basis of these enhancements is described by Shi and Butt (2004). They are shown in Figure 15 and a digital version is included on the DVD. Most of the images utilize various forms of high-pass filters and thus highlight the near-surface distribution of magnetic minerals.

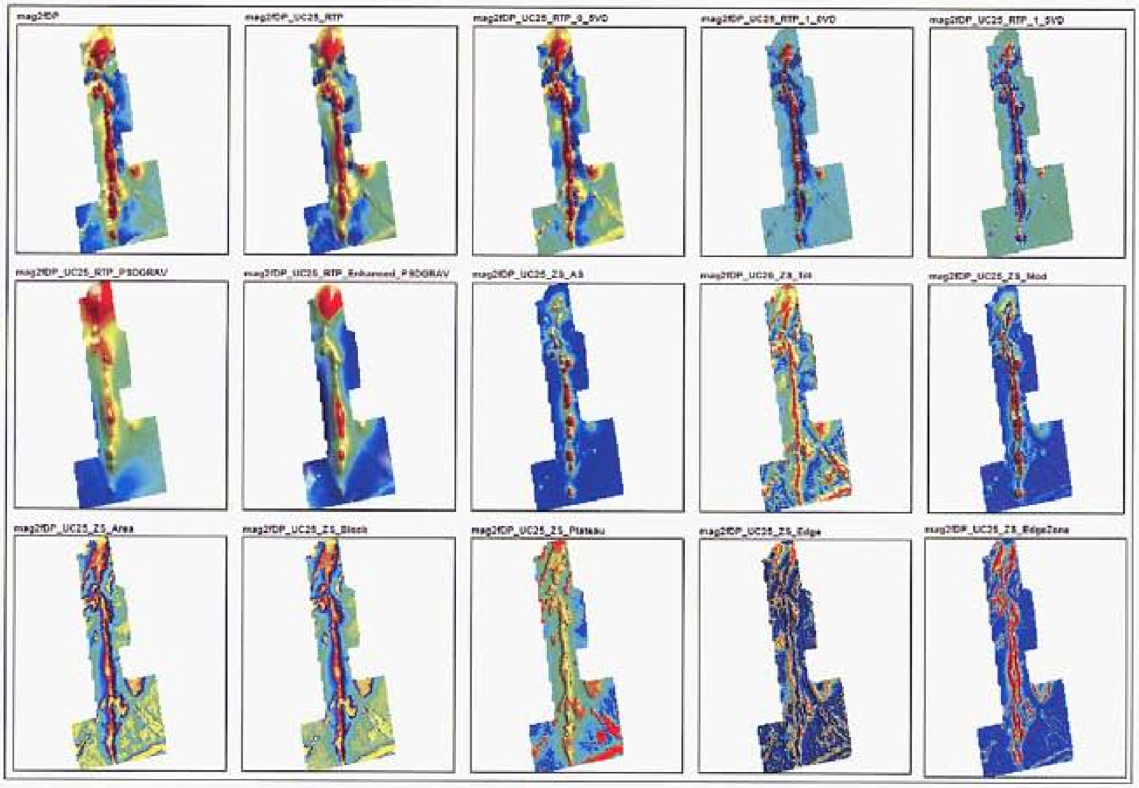

Figure 15. Enhancements of the magnetic data.

To better define the distribution of magnetic minerals with depth, extensive 3D modeling and inversion was carried out by Encom Technology Pty. Ltd. (Encom), under a subcontract from Condor. Encom utilized two different methods:-

- Inversion of plate models and slabs, using Encom's ModelVision Pro and Quickmag software. (Information on these software is available on Encom's website www.encom.com.au and product brochure are also included in Appendix C). This was a manually intensive process, where the magnetic anomalies were broken down into discrete segments, each having an approximately constant strike direction, width and intensity, and individual inversions were performed on each segment to derive the best-fit dipping plate/slab. These plates/slabs can then be viewed in 3D, or in plan or section, where the relationship between the magnetic sources and other data (e.g. geology, geochemistry) can be better appreciated, particularly at depth. A view of the fitted plates/slabs is shown in Figure 16, looking northwest (using Encom's Profile Analyst software). Note that the dips have been computed assuming induced magnetization only and could be significantly in error if significant remanent magnetization is present. A dxf file with the plate/slab coordinates is included on the DVD.

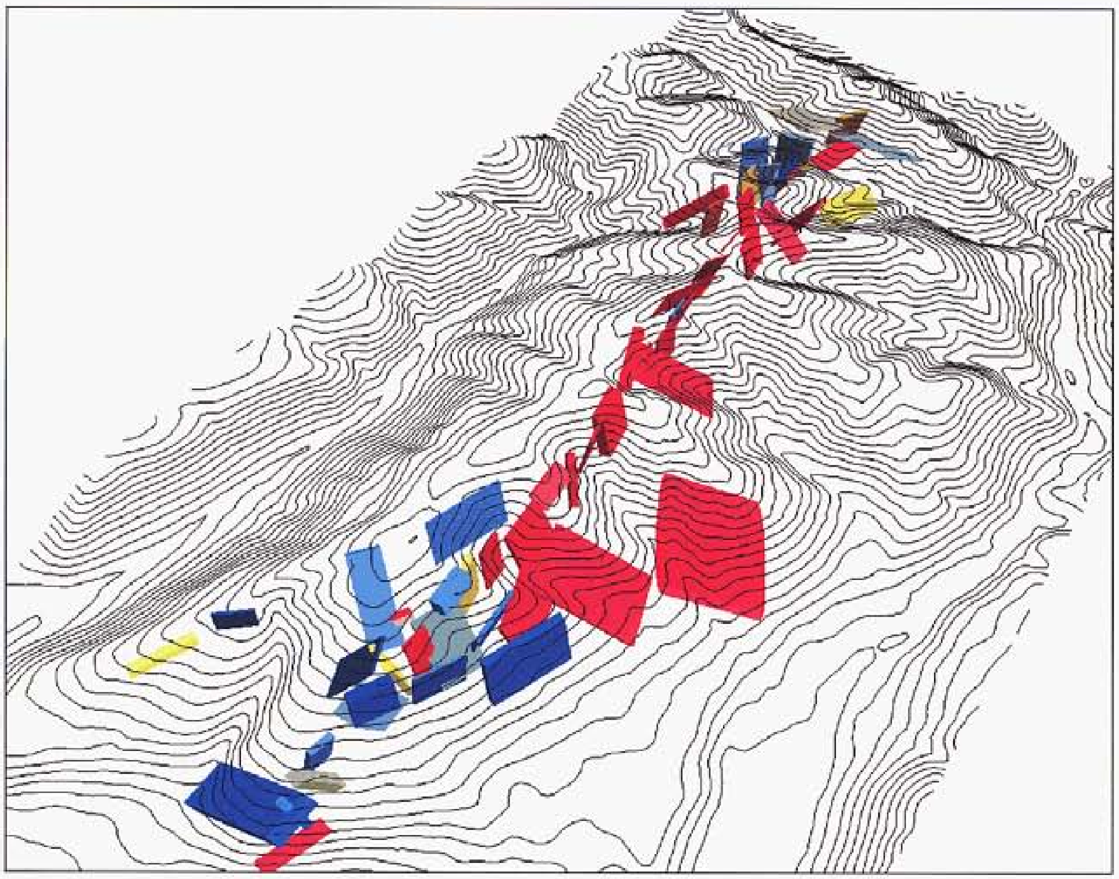

Figure 16. Plates/slabs generated using ModelVision inversion. Looking northwest.

- MAG3D inversion using software developed by University of British Columbia (UBC) (Li and Oldenburg, 1996). In this approach, the entire 3-D region is divided into a set of rectangular cells (voxels), each having a constant susceptibility, and the inversion attempts to derive the optimal value for this susceptibility in each cell, subject to various constraints which attempt to provide more "geological" distributions. Figure 17 shows the results from one inversion run, where the starting model has included the plates/slabs generated by the earlier ModelVision inversion. The majority of the voxels have been stripped away, so that only those above a susceptibility threshold are displayed. The inversion has retained the plates/slabs but has broadened and smoothed these – it has also generated a "rind" of near-surface susceptibility highs along the linear magnetic trend. A fundamental limitation

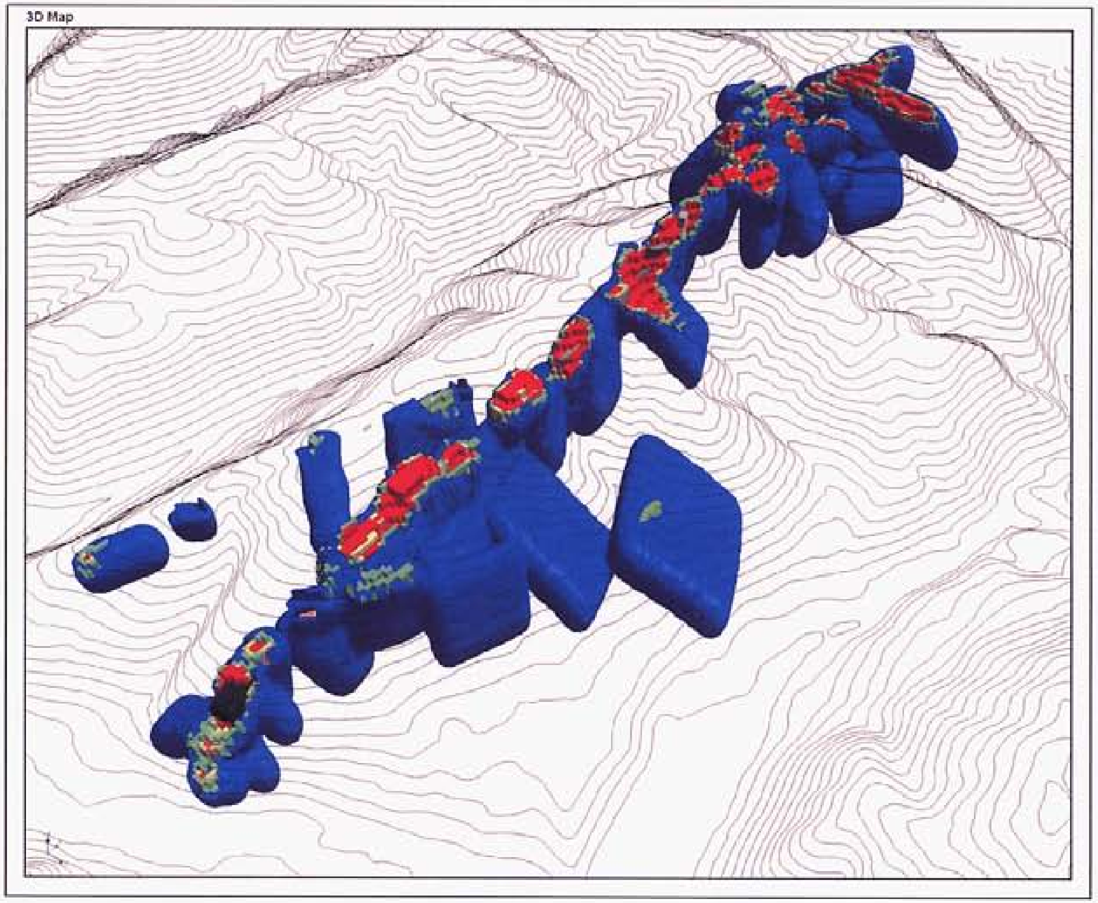

Figure 17. Plates/slabs generated using Mag3D inversion. Looking northwest.

of this style of inversion is the lack of a unique solution – the distribution of susceptibility in the final model is dependent on the starting model and the parameters used to constrain the inversion.

Fly-through renditions in 3D of the magnetic modeling as .avi files that can played in Windows Media Player and similar software are included on the DVD. A number of Profile Analyst session files are also included on the DVD that show other renditions of the geology, geophysics and topography.

7. CONCLUSIONS

The VTEM survey over Iron Range indicates that the majority of the area is quite resistive. However, it has delineated two sizeable conductive zones, one of which has high potential for economic sulfides. This target (Zone A) occurs close to the interpreted Sullivan time horizon, which is prospective for SEDEX type mineralization.

Processing and inversion of the magnetic data has delineated the depth and dip of the magnetic units in the area, which should materially assist in drill targeting.

Respectfully submitted

Condor Consulting, Inc.
June 8, 2005

8. REFERENCES

Geotech Ltd. (2004) Report on a helicopter-borne time domain electromagnetic geophysical survey: Kalum Claims Surveys, Terrace Area, BC, Canada, for Eagle Plains Resources. May 2004.

Li, Y. and Oldenburg, D.W. (1996). 3-D inversion of magnetic data. Geophysics Vol 61, pp394-408.

Macnae, J., King, A., Stolz, N., Osmakoff. and Blaha, A. (1998) Fast AEM data processing and inversion. Exploration Geophysics, Vol 29, pp163-169.

Marshall, L.J. and Downie, C.C. (2002) Geological report for the Iron Range Project. DELI 1-8, FeO 1-30, HC 1-10, IOX 1-12, IR 1-36, LUKE 1-8, TCK 1-8, Nelson Mining Division. Report prepared for Eagle Plains Resources Ltd., November 12, 2002.

Shi, Z. and Butt, G (2004) New enhancement filters for geological mapping. Abstracts, ASEG 17th Geophysical Conference and Exhibition, Sydney 2004.

APPENDIX A - VTEM Anomaly Responses and Modeling

VTEM ANOMALY RESPONSES

The basic anomaly shapes for the VTEM concentric loop geometry (for both the Z and X components) are shown in the Figure 1 below. (Note, however, that only the Z component is acquired by the present VTEM system.) For the Z-component, two major response styles are observed from bedrock conductors - these are termed the inductively thin and thick responses.

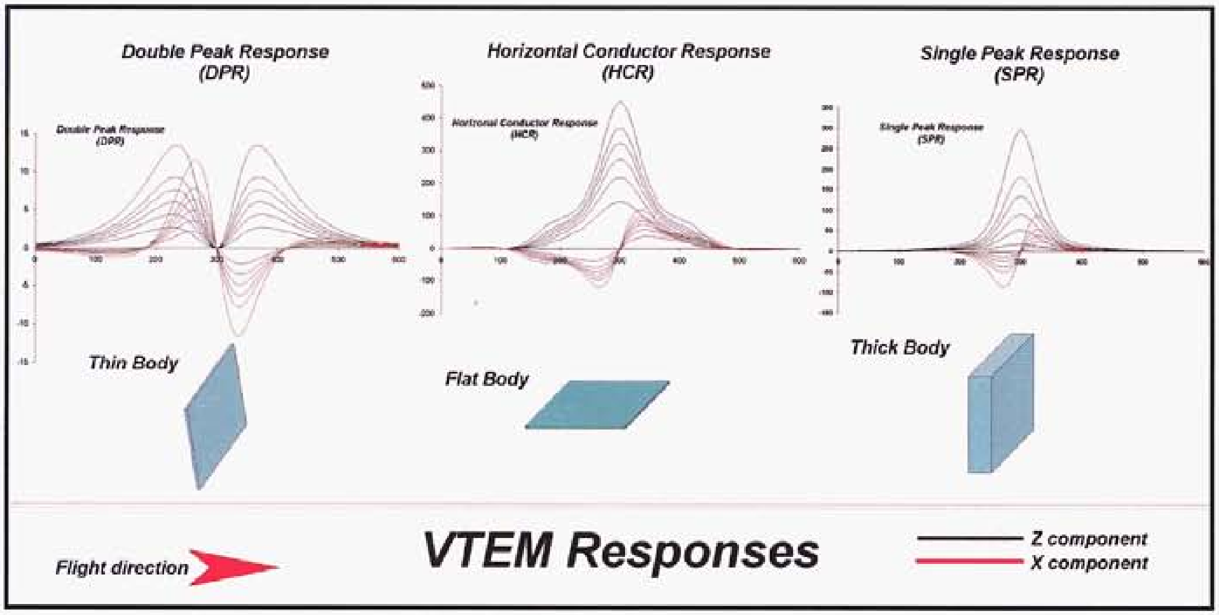

Figure 1. VTEM response characteristics.

In geophysical terms, the major difference between these two categories of responses is that in the thin case, the dominant induced current flow is along the sides of the body whereas for the thick response (& the horizontal conductor case) the currents are primarily constrained to the top of the body.

The thin response produces a double–peaked or "M"-shaped response with the low centered over the top of the body - Condor refers to this as a Double Peak Response or **DPR.** The thick conductor shows a single peak directly over the top of the conductor - Condor refers to this as a Single Peak Response or **SPR**. The third category of primary response, that derived from sources that are primarily horizontal to the surface are termed a Horizontal Conductive response or **HCR**. Note that the anomaly shape of the HCR response and SPR are similar, although the HCR shows broader flanks.

The two lobes of DPR will show a symmetric response for a vertically dipping conductor. This will become asymmetric as the conductor starts to dip. This effect is shown in Figure 2, for a conductor at 30 and 60 degrees.

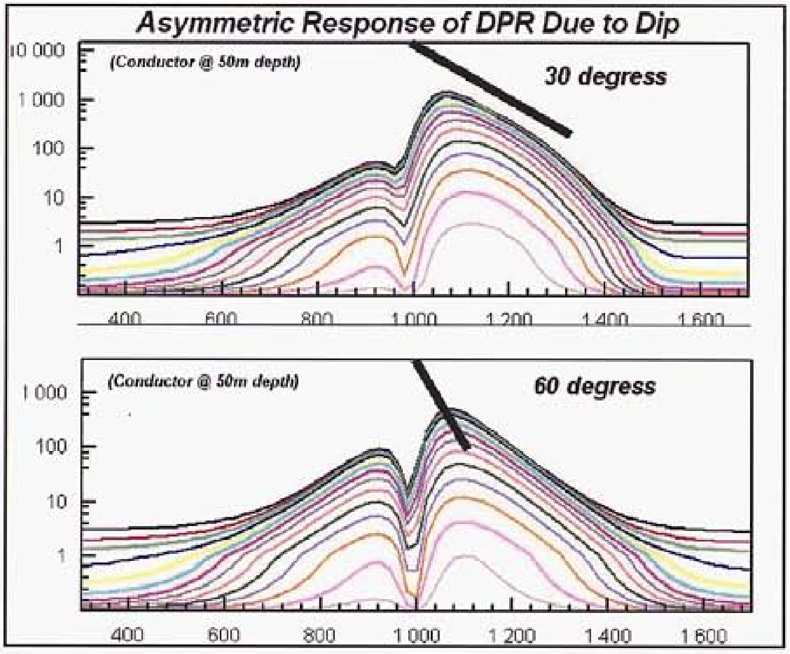

Figure 2. Effect of conductor dip on VTEM response

A more comprehensive set of model VTEM anomaly responses for thin-plate conductors, showing the effects of both dip and depth, is included below.

If the X-component is available, the anomaly shape for all three cases discussed above is a cross-over. Diagnostic information is obtained in this case from the polarity and slope of the cross-over.

Field data can typically be a mixture of all the major response types. Experience, CDI processing and sometimes an assessment of magnetic survey results are usually required to arrive at a satisfactory interpretation, especially in complex situations.

Examples of field VTEM profiles and corresponding CDIs for three different conductor types are shown in Figures 3, 4 and 5. Figure 3 shows a DPR response due to an inductively thin, vertically-dipping conductor. Figure 4 shows the responses of two, similar, DPR responses due to thin conductors dipping to the right of the section. Figure 5 shows an SPR response on the left, due to an inductively thick steep-dipping conductor, while on the right a wide conductor response is displayed. In the latter, note that the conductivity extends to depth on the CDI, indicating that the conductor has considerable depth extent.

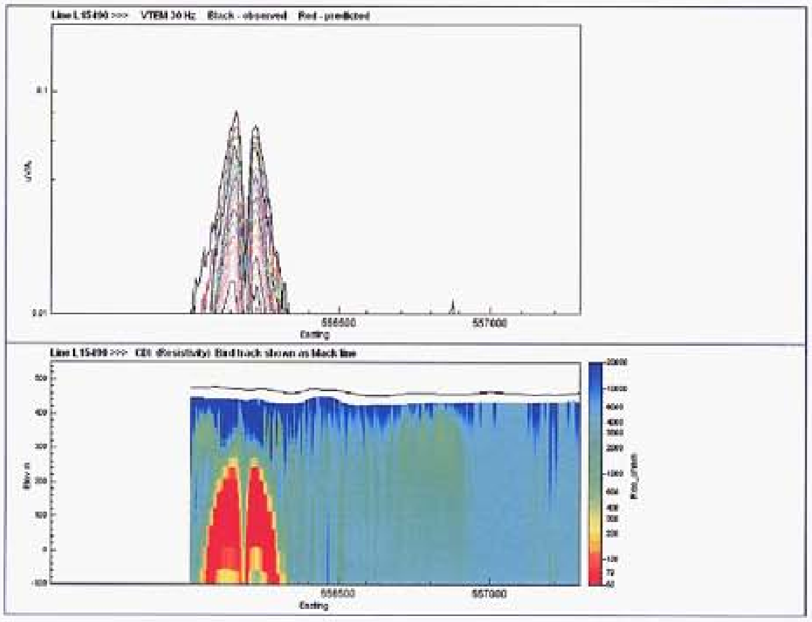

Figure 3. Example of VTEM vertical DPR response

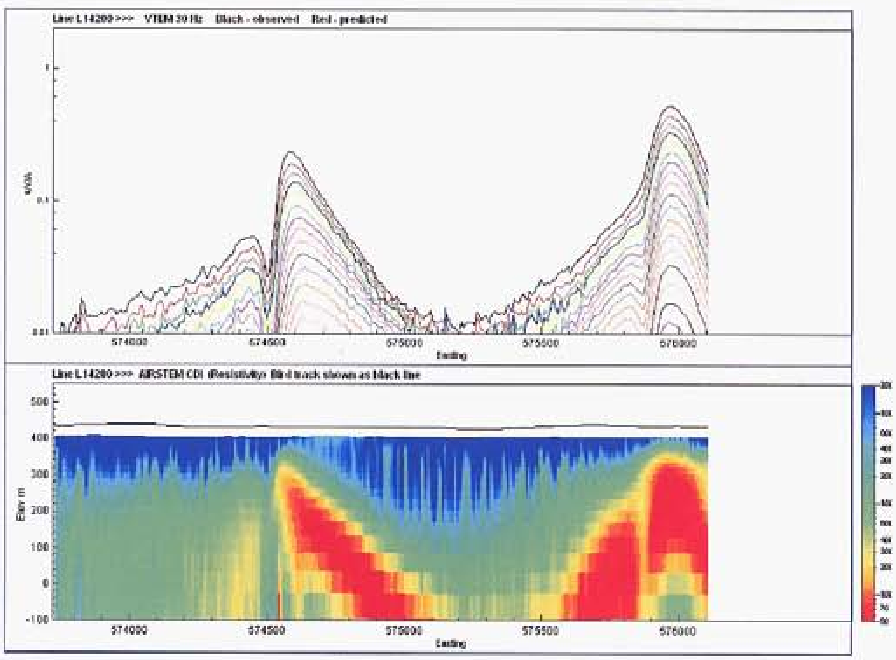

Figure 4. Examples of VTEM dipping DPR responses (dip is to the right).

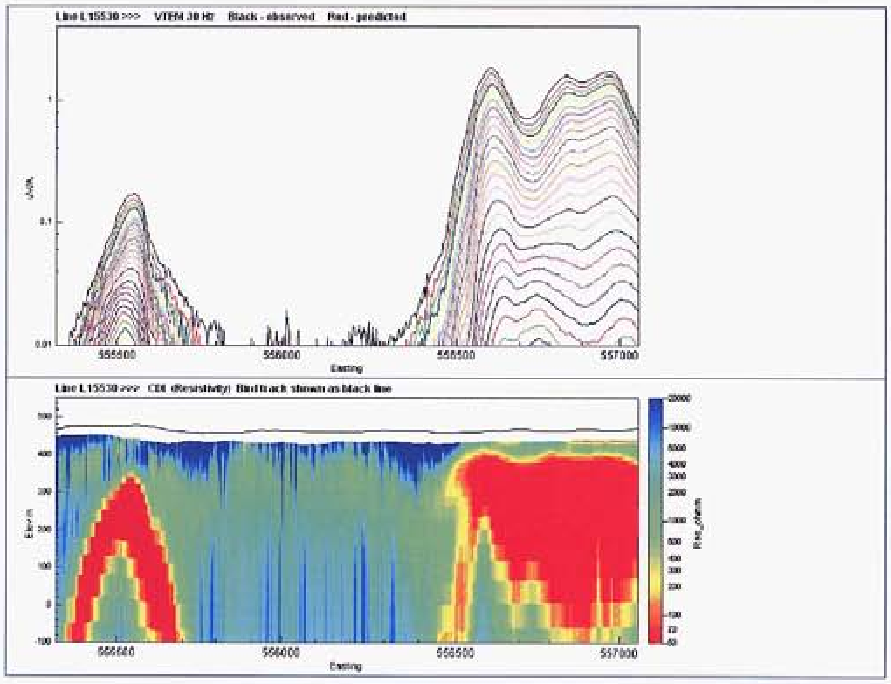

Figure 5. Examples of VTEM SPR and wide conductor responses

Geotech Ltd.

VersaTEM
Geometric Modeling

Condor Consulting, Inc.

In order to better understand how the co-incident loop geometry used by the VersaTEM system responses to typical targets, a series of models have been generated using the Raiche AMIRA 223 codes. These are preliminary results and further work should be done to model both more varied geometric shapes as well as incorporate the details of the new waveform once established along with the corresponding noise levels[1].

Modeling Suite

For the study, only plates in a very resistive host (10,000 Ω-m) were modeled using Leroi_Air. The study is broken up into four parts. The key attributes of each suite are summarized below.

Part 1: Target Size- 300 m depth extent; 600 m strike length; Conductance 20 S

- Plate 1: Dip 30°; depths 5, 50, 100 & 200 m
- Plate 2: Dip 60°; depths 5, 50, 100 & 200 m
- Plate 3: Dip 90°; depths 5, 50, 100 & 200 m

Part 2: Target Size- 300 m depth extent; 600 m strike length; Conductance 20 S

- Plate 4: Depth = 5 m, dip = 30°, 60° & 90°
- Plate 5: Depth = 200 m, dip = 30°, 60° & 90°

Part 3: Target Size- 300 m by 300 m; dip 0° (horizontal); Conductance 50 S

- Plate 6: Depth = 50, 100, 150, 200, 250 m

Part 4: Depth = 50 m, Conductance 20 S

- Plate 7a: Dip = 90°; Target: 600 m by 300 m, 400 m by 200 m, 200 m by 100 m and 100 m by 50 m
- Plate 7b: Dip = 45°; Target: 600 m by 300 m, 400 m by 200 m, 200 m by 100 m and 100 m by 50 m

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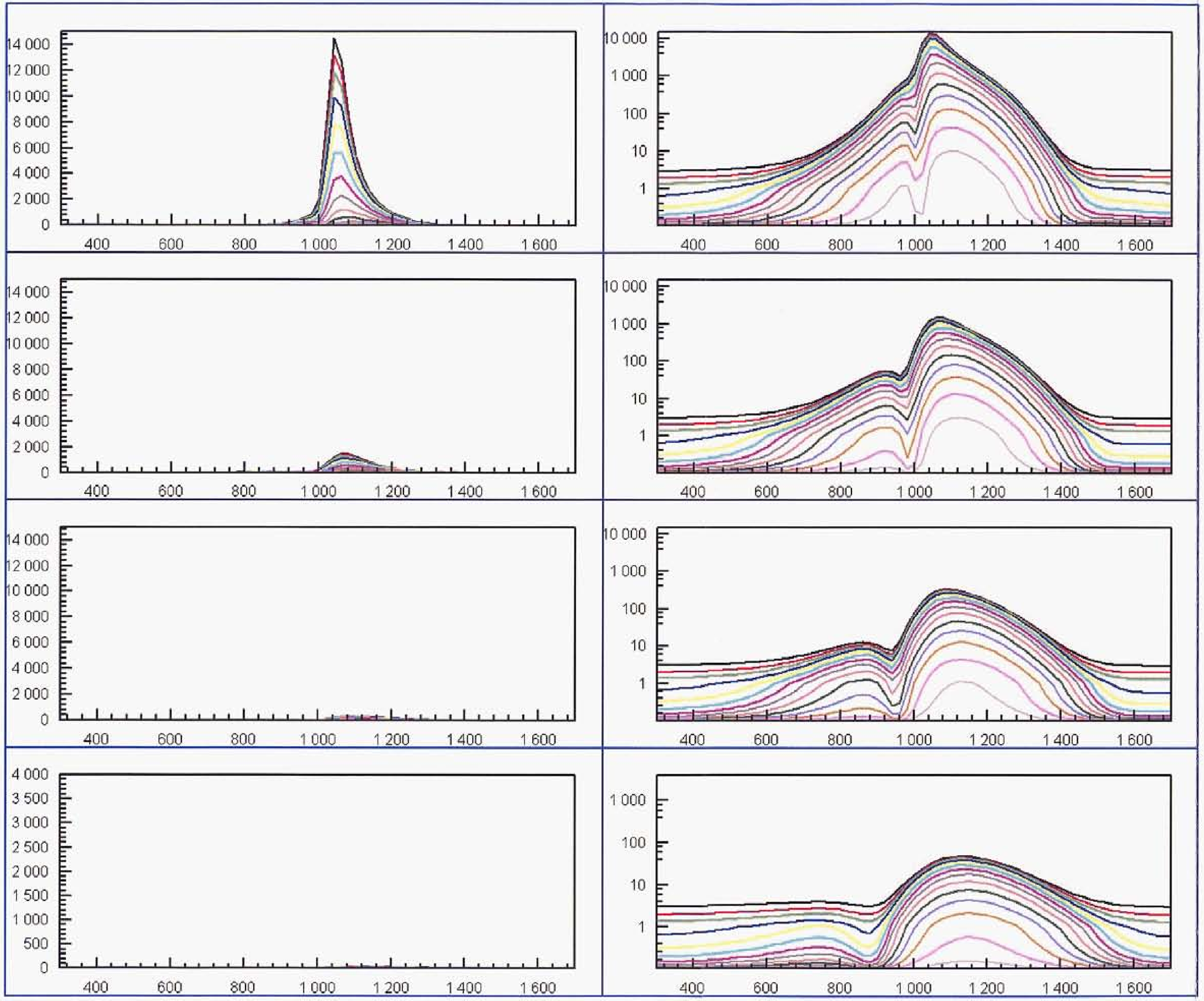
[1] The initial Tx design experienced higher than optimal noise at early times due to small current flows in the Tx circuit FETs.

VERSATEM PLATE MODEL (Top of plate at 1000E)
EFFECT OF DEPTH

COND=20S

DIP=30 deg

LINEAR SCALE — LOG SCALE



DEPTH=5m

DEPTH=50m

DEPTH=100m

DEPTH=200m

Plate 1

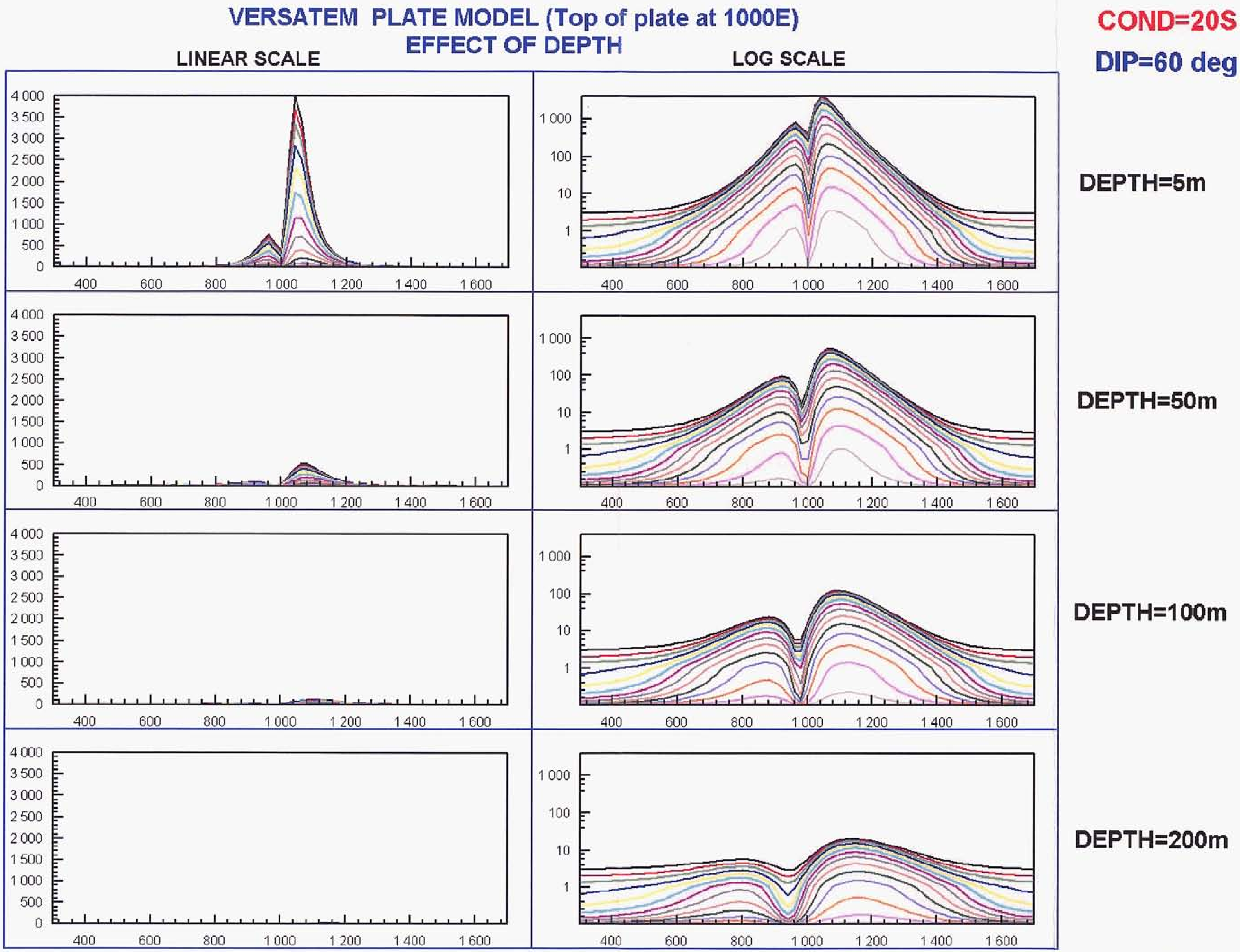

VERSATEM PLATE MODEL (Top of plate at 1000E)
EFFECT OF DEPTH
LINEAR SCALE
LOG SCALE
COND=20S
DIP=60 deg
DEPTH=5m
DEPTH=50m
DEPTH=100m
DEPTH=200m
4 000
3 500
3 000
2 500
2 000
1 500
1 000
500
0
1 000
100
10
1
400
600
800
1 000
1 200
1 400
1 600

Plate 2

VERSATEM PLATE MODEL (Top of plate at 1000E)
EFFECT OF DEPTH

COND=20S
DIP=90 deg

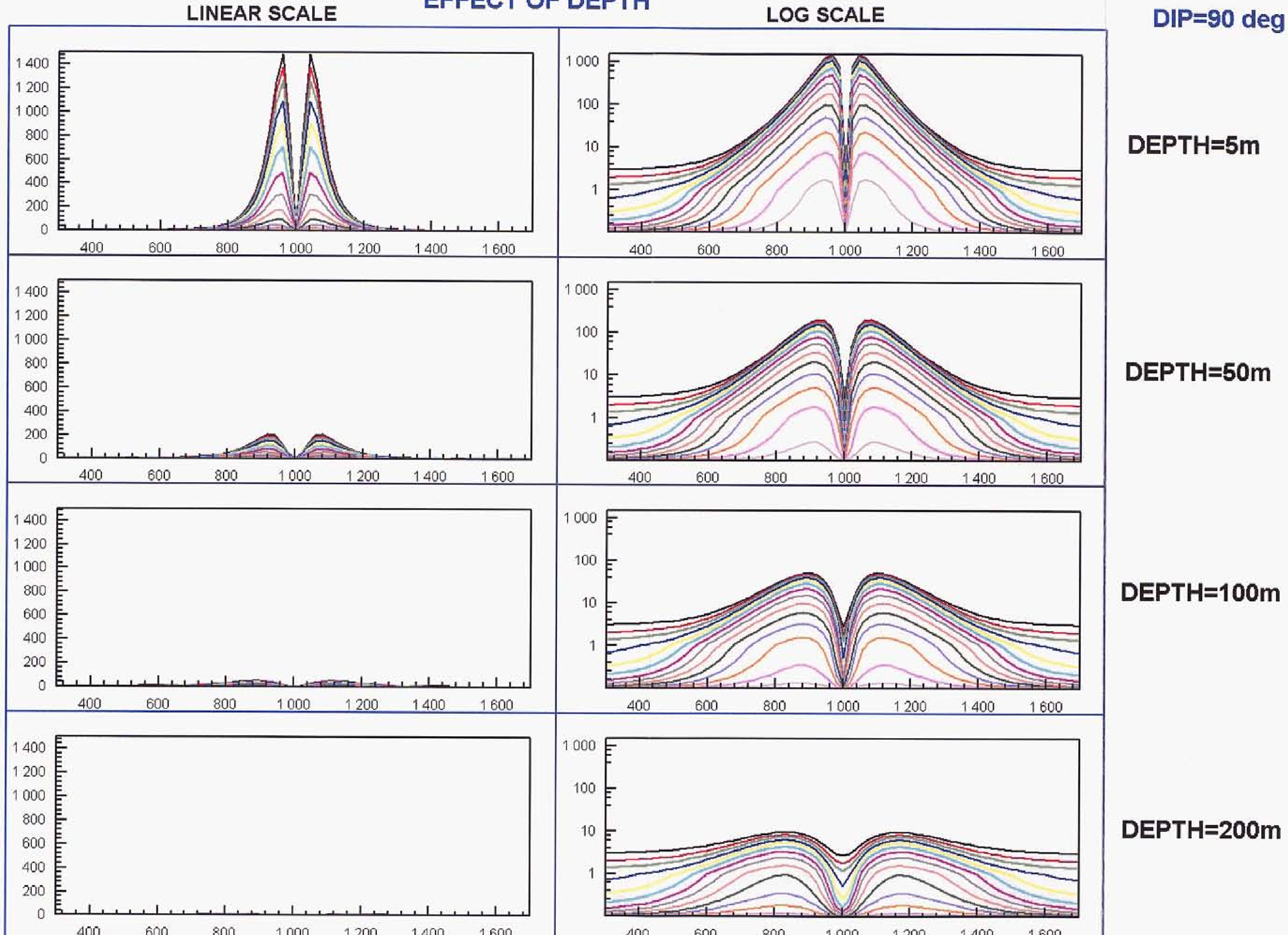
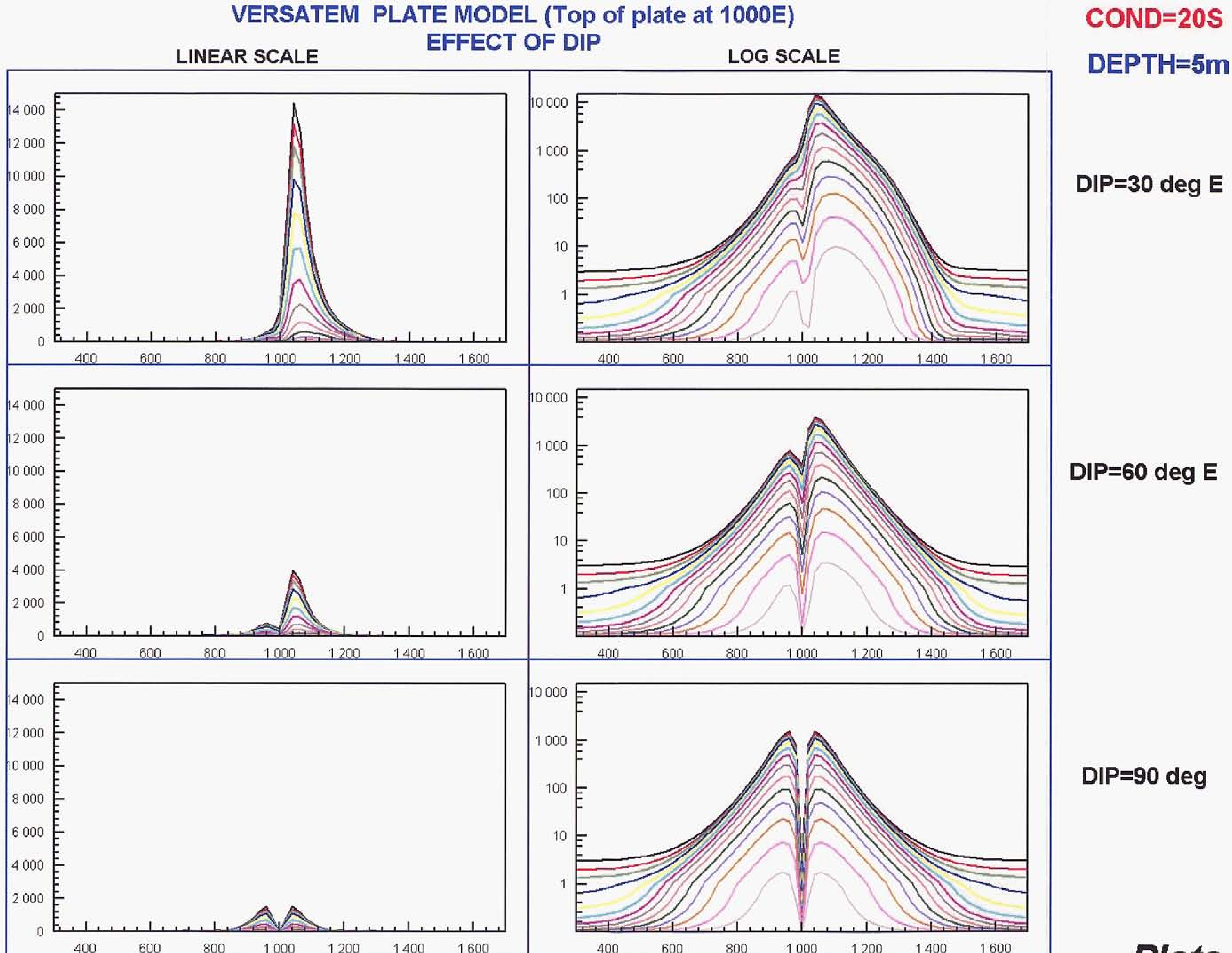


Plate 3



VERSATEM PLATE MODEL (Top of plate at 1000E)
EFFECT OF DIP
LINEAR SCALE
LOG SCALE
COND=20S
DEPTH=5m
DIP=30 deg E
DIP=60 deg E
DIP=90 deg

Plate 4

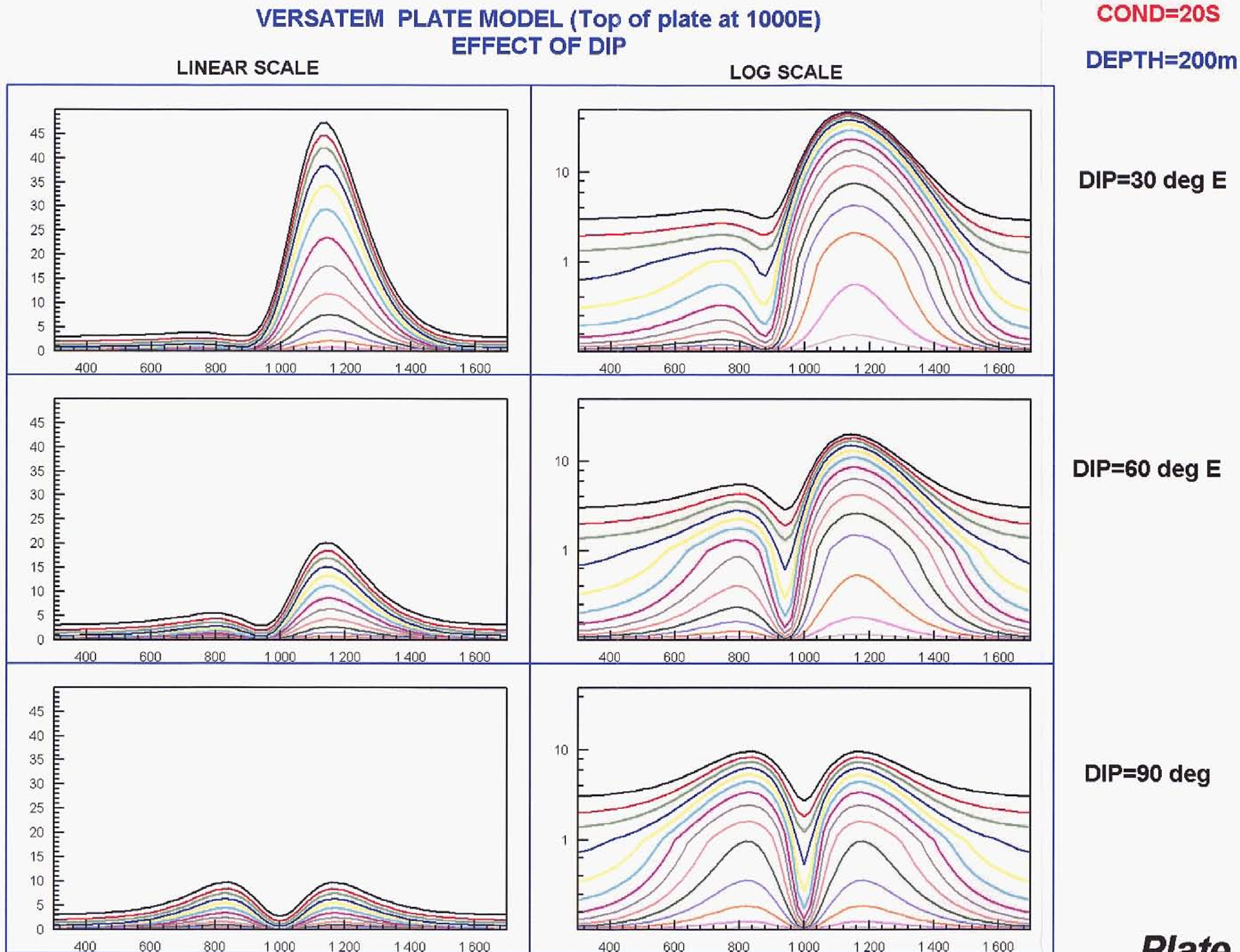
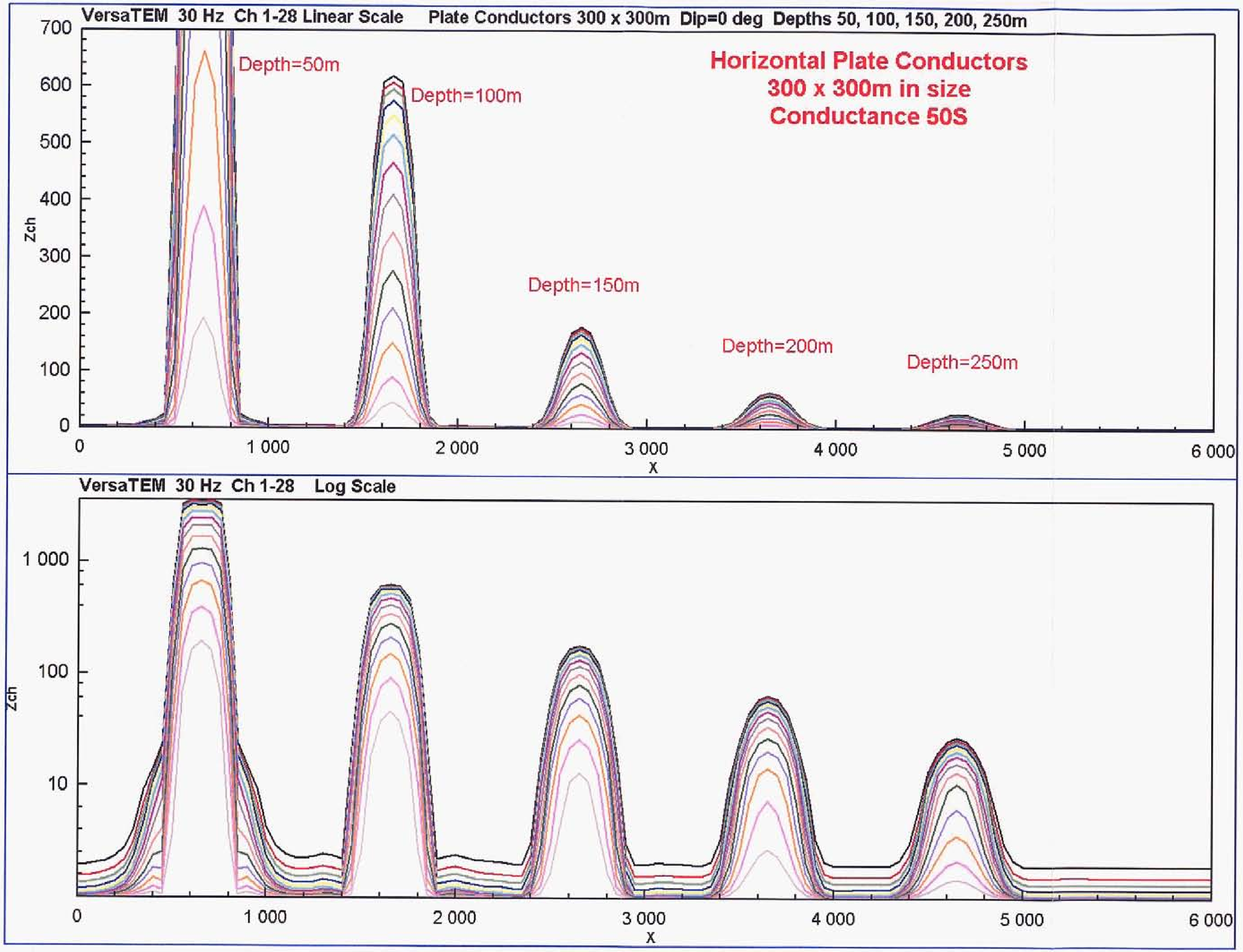

VERSATEM PLATE MODEL (Top of plate at 1000E)
EFFECT OF DIP
LINEAR SCALE
LOG SCALE
COND=20S
DEPTH=200m
DIP=30 deg E
DIP=60 deg E
DIP=90 deg

Plate 5


VersaTEM 30 Hz Ch 1-28 Linear Scale Plate Conductors 300 x 300m Dip=0 deg Depths 50, 100, 150, 200, 250m
Horizontal Plate Conductors
300 x 300m in size
Conductance 50S
Depth=50m
Depth=100m
Depth=150m
Depth=200m
Depth=250m
Zch
700
600
500
400
300
200
100
0
1 000
2 000
3 000
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X
VersaTEM 30 Hz Ch 1-28 Log Scale
Zch
1 000
100
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X

Plate 6

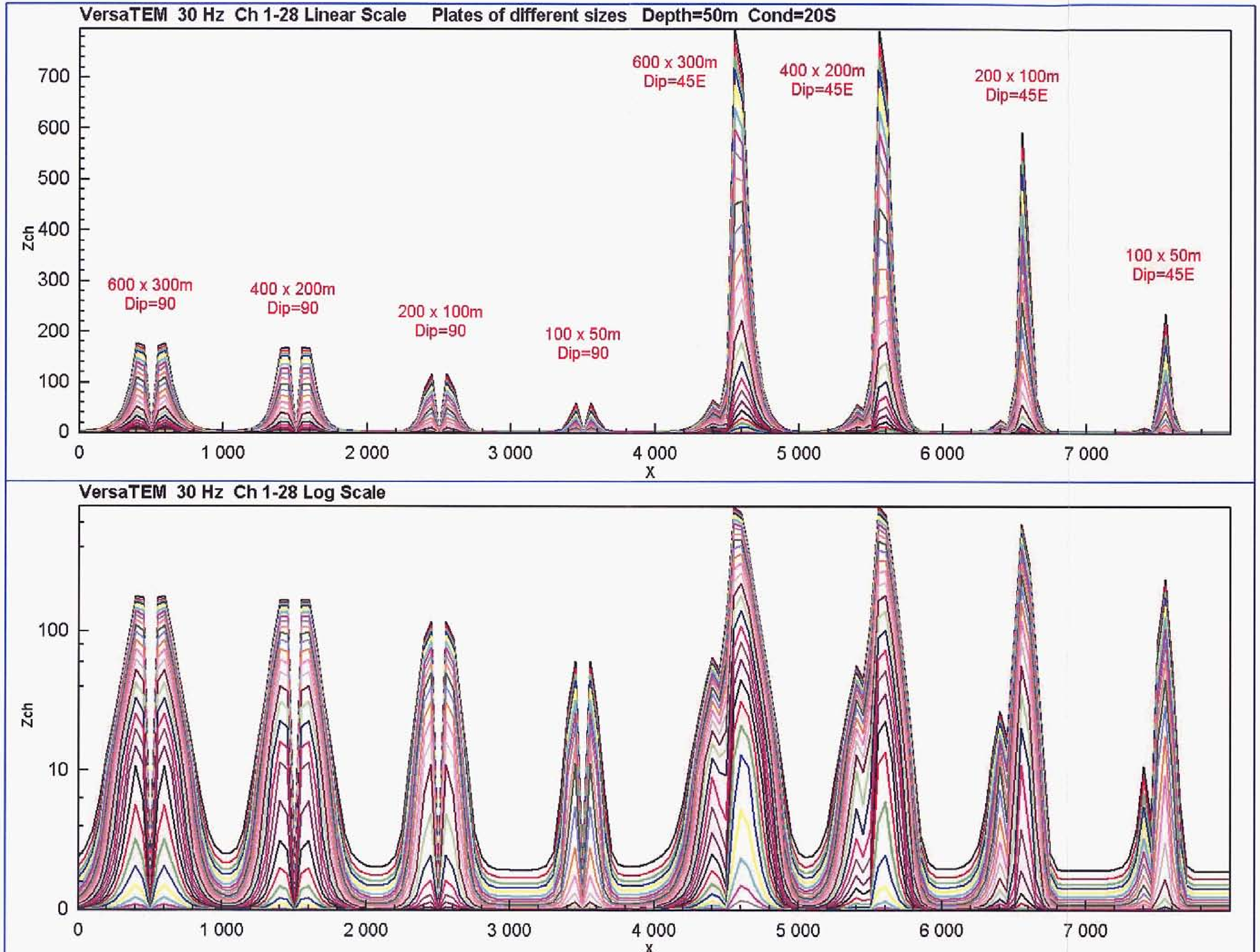

Plate 7a

Plate 7b

APPENDIX B - New enhancement filters for geological mapping.

New enhancement filters for geological mapping

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SUMMARY

Two types of filters have been developed for the purpose of enhancing weak magnetic anomalies from near-surface sources while simultaneously enhancing low-amplitude, long-wavelength magnetic anomalies from deep-seated or regional sources. The Edge filter group highlights edges surrounding both shallow and deeper magnetic sources. The results are used to infer the location of the boundaries of magnetised lithologies. The Block filter group has the effect of transforming the data into "zones" which, similar to image classification systems, segregate anomalous zones into apparent lithological categories. Both filter groups change the textural character of a dataset and thereby facilitate interpretation of geological structures.

The effect of each filter is demonstrated using theoretical model studies. The models include both shallow and deep sources with a range of magnetisations. Comparative studies are made with traditional filters using the same theoretical models. In order to simulate real conditions, Gaussian noise has been added to the model response. Techniques for noise reduction and geological signature enhancement are discussed in the paper.

The new approaches are applied to actual magnetic survey data covering part of the Goulburn 1:100 000 scale map sheet area, New South Wales. Some new geological inferences revealed by this process are discussed

Key words: Enhancement filters, magnetic sources, geological mapping.

INTRODUCTION

High-resolution aeromagnetic survey data represent a rich source of detailed information for mapping surface geology as well as for mapping deep tectonic structure. Traditional enhancement techniques, such as first vertical and horizontal derivatives (1VD, 1HD), analytic signal (AS), and high-pass in-line or grid filters are used in enhancing magnetic anomalies from near-surface geology.

In recent years the potential field tilt filter has been introduced (Miller and Singh, 1994) and it has achieved recognition for its value in the analysis of potential field data for structural mapping and enhancement of both weak and strong magnetic anomalies (Verduzco *et al*, 2004). The total horizontal derivative of the TMI reduced to the pole is also widely used for detecting edges or boundaries of magnetic sources (Cordell and Grauch, 1985; Blakely and Simpson, 1986; Phillips, 1998).

Several disadvantages pertain to the use of these traditional filters. They often only diffusely identify source location and boundaries, particularly in colour image presentations. They usually emphasise short wavelength anomalies at the expense of signal from deeper magnetic sources and the range of amplitudes remaining in the filtered output may dominate the source boundary information being sought. In addition, some traditional filters emphasise noise with resultant impact on the interpretation of source boundaries.

This paper identifies new processes which have been developed to address these disadvantages and provide output which can improve map-based interpretations.

Unless otherwise stated, all filters have been operated on TMI data reduced to the pole (RTP).

METHOD AND RESULTS

Theoretical Model Testing

A theoretical 2D grid of total magnetic intensity (TMI) computed at the surface was created by forward 3D modelling of the TMI response from a set of theoretical magnetic sources having variable width, strike extent, depth, depth extent (DE), dip, magnetic susceptibility and strike azimuth. A list of these parameters is presented in Table 1. In two of the sources, remanence was simulated using negative magnetic susceptibility. The TMI of the theoretical models was computed at a geomagnetic inclination of -60 degrees using a notional east–west line spacing of 200 m and a grid cell size of 40 m. The TMI grid was then reduced to the pole (RTP) (Figure 1).

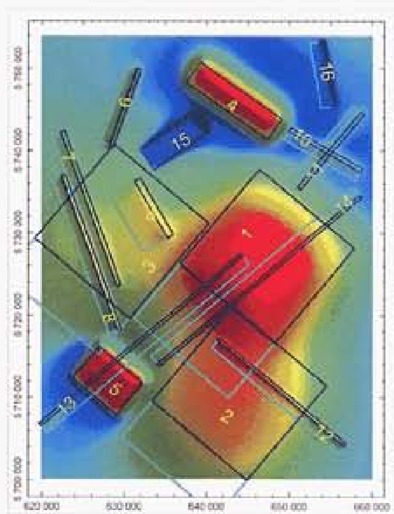

Figure 1. RTP image derived from multiple theoretical 3D magnetic sources, shown as wire frame outlines

A set of traditional filters was operated on the theoretical RTP grid. They include AS, 1VD, modulus of horizontal derivatives (MS) and Tilt and the results are presented in

Figure 2. The output grids variously show discontinuous trending (crossed sources in upper right of AS image), diffuse, weak edges (deep source in centre right of the MS image) and lack of precise source edge definition (1VD and Tilt).

Model Label	Depth (m)	Width (m)	DE (m)	Dip (deg)	Magnetic Susceptibility (SI)	Strike Length (m)	Azimuth (deg)
1	4000	15000	15000	120	0.010	15000	-050
2	6000	15000	10000	120	0.010	15000	-050
3	10000	15000	10000	120	0.010	15000	-050
4	1000	3000	4000	70	0.010	12000	-055
5	500	5000	2000	60	0.010	7000	-050
6	1000	800	2000	150	0.005	6000	-030
7	600	500	2000	120	0.001	20000	-020
8	200	500	2000	120	0.001	20000	-020
9	500	500	2000	120	0.003	10000	020
10	1000	500	2000	120	0.003	10000	-060
11	1000	600	2000	120	0.003	12000	040
12	200	400	2000	120	0.001	20000	-050
13	500	400	1000	40	0.002	32000	050
14	500	400	1000	140	0.001	32000	050
15	600	3000	4000	90	-0.002	8000	055
16	400	600	2000	120	-0.010	8000	-010

Table 1. List of parameters of theoretical magnetic sources

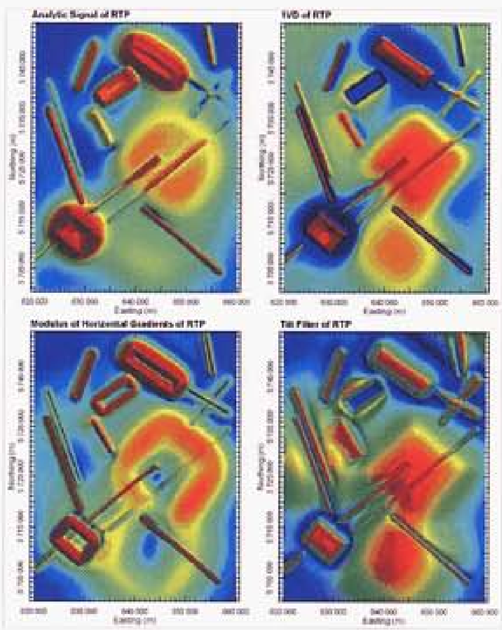

Figure 2. Comparison of enhancement filters of RTP: AS, 1VD, MS and Tilt filter. The models used are those depicted in Figure 1.

Edge Filters

The first avenue of development was to increase the sharpness of the anomalies used to map the edge of the magnetic sources. The MS grid yields anomaly peaks over the source edge locations, whereas these edges coincide with gradients in the 1VD, Tilt and AS filtered outputs. None of these filters produces easily interpreted edges in image form when the sources are weakly magnetised or are deep.

A new linear, derivative-based filter termed the ZS-Edgezone filter has been developed to improve edge detection in these situations. Its effect is shown in Figure 3 using the same theoretical models discussed earlier. The advantages of the filter are greatly increased anomaly sharpness over source edges and compression of the amplitude range so that differences in the original TMI amplitudes do not persist to dominate the edge interpretation. This has the ancillary effect that the method can be modified to provide automated edge conversion to vectors for use in GIS systems.

Although this filter significantly improves the precision of edge determination, it is subject to normal potential field limitations which determine that source edges cannot be resolved where the source is narrow relative to its depth. The filter also can produce a "halo" type artefact due to superposition of the response of a limited depth extent shallow source (Figure 1, Model 6) on that of deeper sources. A similar "halo" effect can be seen around the edges of remanently magnetised Model 15, also in Figure 1.

The ZS-Edge filter (Figure 4) has also been developed to map source edges. This filter differs from the ZS-Edgezone filter in that a greater contribution of the TMI anomaly amplitude over the source is retained, thereby improving anomaly characterisation at the expense of edge sharpness.

Both these filters produce edges which migrate down-dip towards the deepest edge of the source. This effect produces anomaly asymmetry that can assist interpretation of dip, although this effect is more pronounced for the ZS-Edge filter than for the ZS-Edgezone filter. Down-dip source extensions are depicted in cyan in Figure 1.

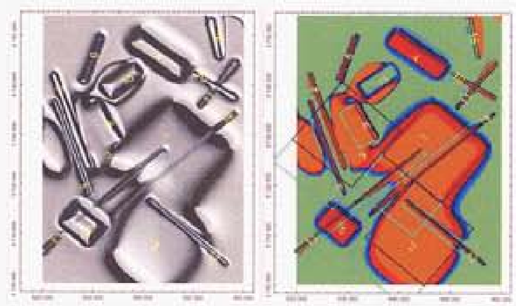

Figure 3. Anomaly edge and block enhancements using the ZS-Edgezone (left) and ZS-Block filters (right). Model positions are shown using wire frames.

Block Filters

In attempting to improve edge detection filters, an obvious progression is to highlight the magnetic regions whose edges have been mapped. To do this, a set of filters called "block" filters has been developed.

The Block filter group has the effect of transforming the potential field data into "zones" which, similar to image classification systems, segregate anomalous zones into apparent lithological categories. These filters can be imported for use in image classification systems or displayed in RGB space with other grids for empirical classification purposes.

The block filters, like the edge filters, are linear, derivative-based filters which use a combination of derivative and amplitude compression techniques to render the magnetic data into regions whose edges are sharply defined and whose amplitudes have a reduced range in comparison to the original TMI.

The ZS-Block filter (Figure 3) and the ZS-Plateau filter (Figure 4) depict the magnetic data as a 2D plan of apparent magnetic source distribution. Artefacts may occur as discussed for the edge filters.

The choice of ZS-Block, ZS-Plateau or ZS-Area filters will depend on the data characteristics of each magnetic survey and on the end-use requirement. The ZS-Plateau filter, for example, yields less variation in amplitude "texture" over a magnetic unit that either the ZS-Block or ZS-Area filters.

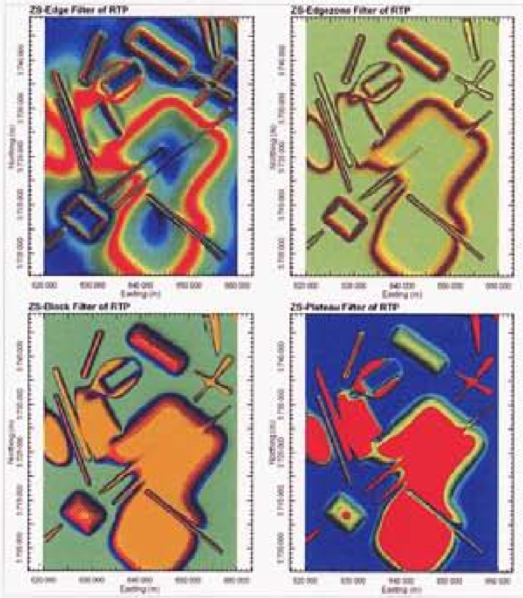

Figure 4. Comparison of ZS-Edge, ZS-Edgezone, ZS-Block and ZS-Plateau filtered outputs of RTP data

Effects of Noise

The influence of noise on the operation of these enhanced grids was tested by adding a large component of noise to the theoretical TMI profile data. This noise had a Gaussian distribution with a standard deviation equal to ten percent of the TMI standard deviation. The noise-modified TMI profile data were then de-spiked using a non-linear technique. Both the noise-affected and the de-spiked TMI data were then gridded and converted to RTP. The RTP data were then processed both with the traditional and newly developed filters.

Figure 5 shows the effect of the noise on the computations. The image of the noise-affected 1VD RTP data (top right) shows that weak and deep sources have been severely masked by the noise. Significant improvement can be achieved by using de-spiked data (lower left) or by low-pass grid filtering — for example, using an upward continuation filter (lower right).

Figure 6 shows that if real data with significant noise is encountered, a standard de-spiking or low-pass smoothing procedure may be used to achieve successful application of both the traditional and newly developed filters.

Figure 6 also depicts the use of enhanced outputs in RGB space to provide examples of how the combination of amplitude information (red colour) with edge information (green and blue colours) can be used to highlight source boundaries and remanence in a single image.

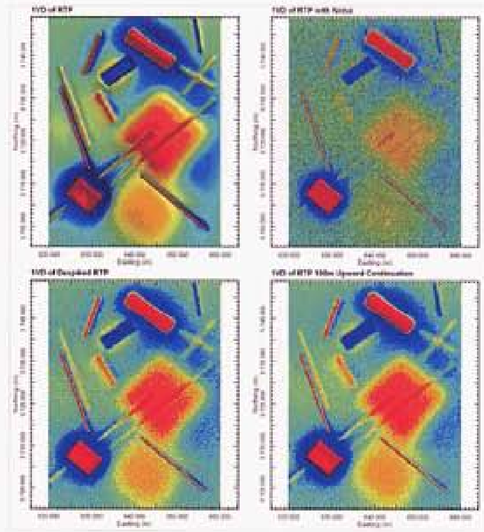

Figure 5. Comparison of 1VD of original model RTP data (top left) with noise-affected RTP data (top right) and noise-reduced RTP data (lower images)

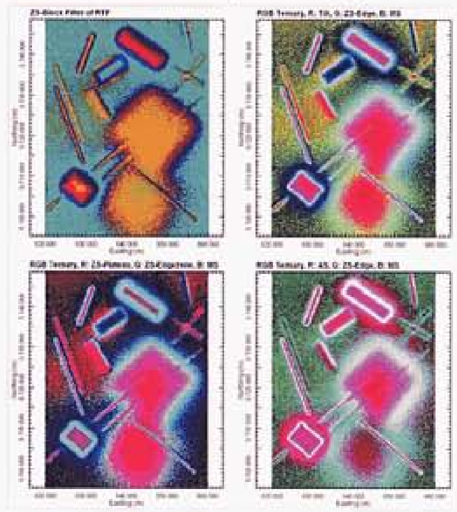

Figure 6. ZS-Block filter using noise-reduced RTP data (top left) and examples of filter combinations in RGB space using noise-reduced RTP data

Application to Field Data, Goulburn 1:100 000 Scale Map Sheet Area, New South Wales

Both the traditional and new enhancement filters were applied to test their suitability for geological definition to airborne magnetic survey data over the Goulburn 1:100 000 scale map sheet area (Johnson *et al,* 2003). These data were acquired as part of a joint program between the NSW Department of Mineral Resources and Geoscience Australia, with 250 m–spaced east–west flightlines. The magnetometer sensor occupied a nominal terrain clearance of 80 m. This dataset was selected since new detailed geological mapping had been recently completed. All the enhancements have been computed using TMI data reduced to the pole.

Figure 7 shows a comparison of part of the Goulburn 1:100 000 map sheet area surface geology with the ZS-Area filter output. In the area surrounding location C, the ZS-Area filter transforms the magnetic data into separate magnetic units, which comprise the Devonian Bindook Volcanic Complex. The magnetic regions correlate closely with mapped andesites (Dkqa–cream coloured unit in Figure 7) whilst the intervening less-magnetic units correlate with rhyolitic ignimbrites (Dkqy–red unit in Figure 7)

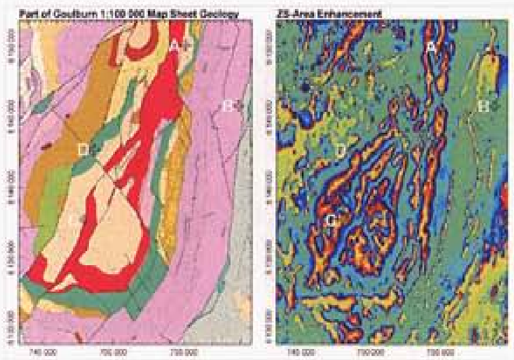

Figure 7. Comparison of geology and ZS-Area enhancement over the Bindook Volcanic Complex

Figure 8 displays some of the advantages of the edge detection filters. At location A, ambiguity concerning the continuity of Quialigo Formation units (cream and red units in Figure 7) is resolved by the ZS-Edgezone filter. At location B, a subtle lineament is confirmed, whilst at location D, the extent of the Bullamalita Conglomerate (green unit in Figure 7) is clearly mapped by the ZS-Edge filter. Structural breaks are often more easily interpreted using these transforms, for example, immediately southwest of location D.

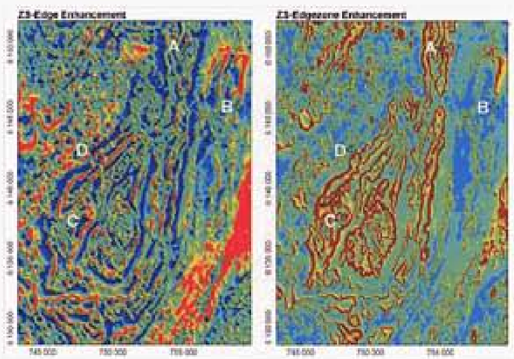

Figure 8. Comparison of ZS-Edge and ZS-Edgezone enhancements over the Bindook Volcanic Complex

Figure 9 shows standard RTP and Tilt transforms over the same area for reference.

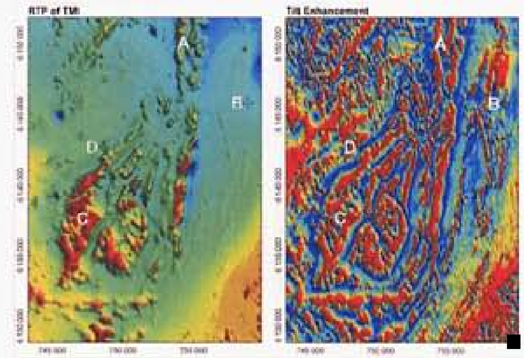

Figure 9. Comparison of RTP and Tilt filters over the Bindook Volcanic Complex

CONCLUSIONS

Traditional filters used to enhance magnetic data, including the more recently developed potential field tilt filter, are currently used to assist in determination of the location and extent of magnetic units.

Newly developed derivative-based filters may be used to improve the precision of source edge detection and, by extension, the determination of the spatial extent of magnetic units. These filters are demonstrated to perform successfully on both strongly magnetised features as well as on weakly magnetised or deep magnetic features. Artefacts may result particularly where anomaly superposition occurs.

The impact of noise in real data may be accommodated by these new methods provided noise-reduction techniques are employed.

The new filter outputs may be used as part of regional or detailed geological mapping projects, including in classification systems or in RGB space, to improve lithological discrimination and mapping.

The speed of magnetic unit mapping can be considerably increased through reliance on edge detection filters. Further improvements in mapping speed can be envisaged through automated conversion of edge anomalies to vector files.

ACKNOWLEDGMENTS

The authors would like to acknowledge the New South Wales Department of Mineral Resources for permission to use aeromagnetic and geological data from the Goulburn 1:100 000 map sheet area and helpful comments by David Robson during the project.

The authors wish to acknowledge Encom Technology for permission to publish the results of research into the proprietary filters used in this paper. The 3D modelling was carried out using Encom ModelVision Pro software, whilst processing and data visualisation were accomplished using Geosoft OASIS montaj and Encom Geoscape.

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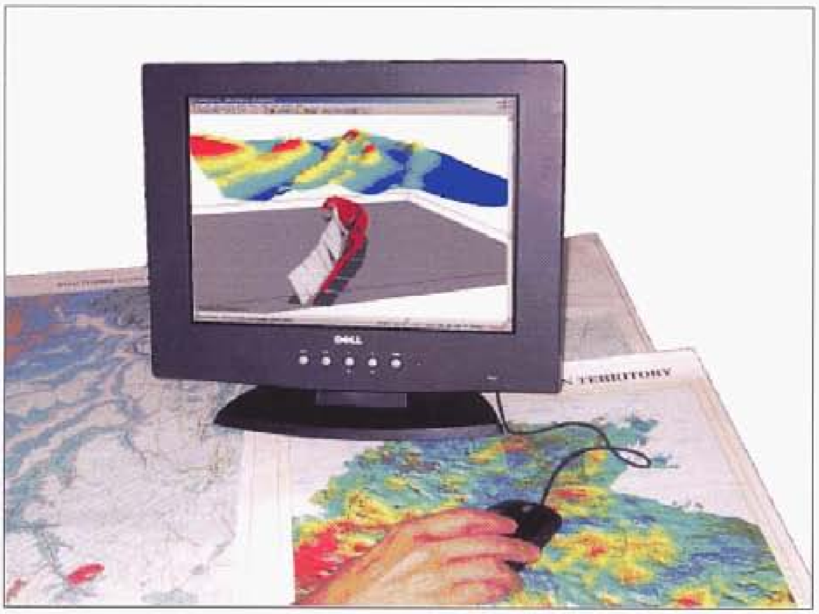
APPENDIX C – Product Brochures: ModelVision and Quickmag

encom

Encom Technology Pty Ltd
ABN 28 002 841 349

Encom ModelVision Pro 6.0

Advanced 3D Magnetic and Gravity Interpretation



The industry standard for integrated 3D magnetic and gravity interpretation

Encom ModelVision Pro provides a solution for every 3D potential field problem. Whether you work in mineral exploration, diamond exploration, petroleum exploration, environmental geophysics, engineering, unexploded ordinance or underground hazard assessment, ModelVision Pro can provide you with a complete interpretation environment. Designed by geophysical interpreters for geophysical interpreters, ModelVision Pro is the most advanced general purpose model-based interpretation system available.

A Total Modelling Application

Magnetic and gravity geophysical methods are applicable to solving problems in a wide range of disciplines including mineral exploration for base metals, gold and iron ore, diamond exploration, petroleum exploration, coal hazard assessment, environmental, engineering and unexploded ordinance.

Every problem is different in some way and Encom ModelVision Pro has the versatile tools that you need to solve these problems. Whether you need to look at micro-magnetic signature of joint zones or basement signatures in petroleum basins, ModelVision Pro can be applied to find a solution.

The tools have been progressively refined over 20 years by professional interpreters working on routine to advanced geophysical applications. You receive the benefit of this experience in one package.

Leading Edge Technology

Encom's research team is continually responding to industry challenges to provide new features and integration with other industry software products.

Full 3D tensor modelling of gravity and magnetic gradiometer systems has been available for several years, allowing our clients to test the benefits of this new technology to their own exploration problems. With ModelVision Pro, you can model a survey or simulate one over a target geology of your design.

Model single profiles or complete anomalies depending on the problem you need to solve. Link this to constrained 3D inversion methods so that you can quickly test and refine your geological models.

Model gravity and magnetic data simultaneously to reduce the geological ambiguity of your interpretation.

More than Modelling

Your data rarely comes ready for modelling and you will need a comprehensive set of tools to analyse and isolate the data that you need to study.

ModelVision Pro provides you with a wide range of import and export formats, utilities for gridding, filtering and numerical manipulation.

There are tools for survey simulation so that you can plan and predict the field specifications for gravity and magnetic surveys. You can create an airborne survey from a digital terrain grid or create a set of synthetic drillholes in a simulated geological model.

Create outputs for other programs or document your report directly from ModelVision Pro using the layout tool to compose your presentation.

Solutions

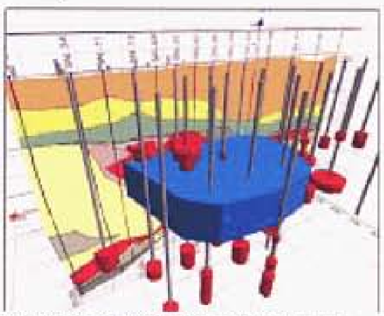
Gravity and magnetic surveying is commonly used in most geoscience applications including mineral, petroleum and diamond exploration, coal mine hazard assessment, groundwater studies, unexploded ordinance, environmental and engineering applications.

Mineral Exploration

The magnetic and gravity methods are used widely in exploration for base metals, gold and other precious metals, diamonds and mineral sands.

Base metal exploration

Encom ModelVision Pro is used by mineral exploration companies in most parts of the world because it has the ability to model complex geological shapes in three dimensions with a minimum of effort. The combined use of gravity and magnetic methods makes it possible to deduce many geological factors about a potential deposit prior to drilling.

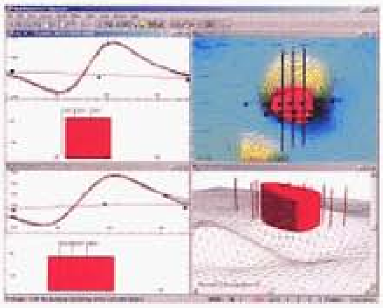


Example of a ModelVision Pro model of the gravity response of the San Nicolas polymetallic (Zn, Cu, Au, Ag) deposit in Mexico visualised in Profile Analyst with drillhole geochemistry and a geological section

Diamond exploration

Modelvision Pro is used by diamond explorers to model magnetic targets believed to be associated with kimberlite pipes.

Gravity data is often used with the magnetic method and simultaneous modelling of gravity and magnetic data helps geologists to design an optimized drilling program. ModelVision Pro's drillhole simulator allows you to create drilling programs and see where the holes are expected to intersect the target.



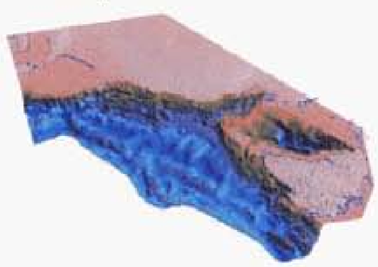
Example model for the Seppelt kimberlite diamond pipe showing two cross-sections, an image map and a 3D view of the model with a drilling program simulation.

Petroleum Exploration

Encom ModelVision Pro is used for depth to crystalline basement studies, the study of salt diapirs, seismic controlled layered sequences and the analysis of micromagnetic features which may be magnetic hydrocarbon indicators.

Depth to crystalline basement

Gravity and magnetic surveys are used in many parts of the world to help understand under-explored petroleum basins. Even in mature basins, magnetic data is being used to re-evaluate basement structural controls that may have influenced the evolution of the sedimentary section.

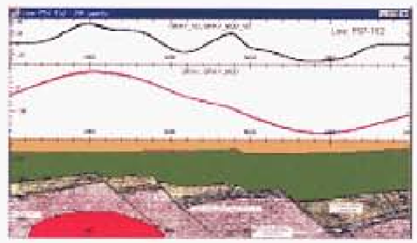


SEEBASE™ example of a depth to crystalline basement model

SEEBASE is a trademark of SRK Consulting and provides a good example of using magnetic and gravity data to enhance sparse seismic control using structural geological principles. SRK uses the results from ModelVision Pro to build geological models of petroleum basins.

Seismic horizon integration

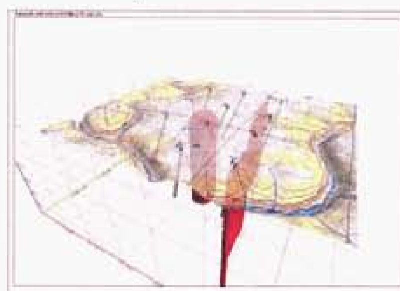
You can use depth-converted images of seismic data as backdrops in your section to constrain your interpretation or import seismic horizon data as horizon grids or horizon sections.



Example of a depth converted bitmap of a seismic section with a ModelVision Pro gravity and magnetic model superimposed

Hazard Assessment

Intrusions within coal mines can cause major disruption to coal production and degrade coal quality. Early detection through the use of magnetic data can save millions of dollars in lost production.



Example of intrusive pipes modelled in ModelVision Pro and a test drilling program designed to assess the impact on sub-surface coal measures. Visualisation in Profile Analyst

ModelVision Pro is used to assess intrusive dykes, sills, plugs and diatremes.

encom

Encom ModelVision Pro

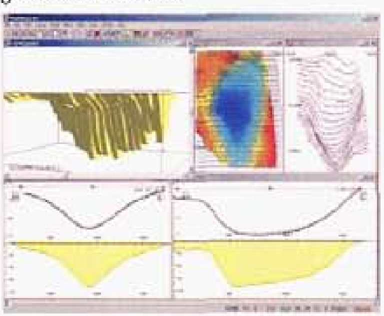
Features

Groundwater

There are many aspects of groundwater research and management that can utilise magnetic and gravity modelling. Gravity may be used to map the location of buried channels and the magnetic method can detect the depth of cover where the channels are sitting on a magnetic basement.

AutoMag example used to determine the depth of steeply dipping magnetic units in magnetic basement

Use both gravity and magnetic modelling with inversion to build a 3D model of buried river channels, deep leads and groundwater basins.

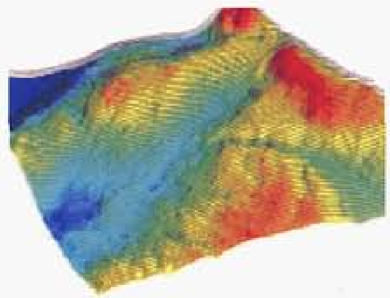


3D interpretation of the Banting Tertiary Basin in Malaysia

Survey planning & research

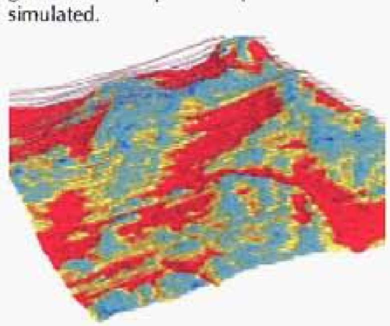
ModelVision Pro can model gravity and magnetic data for any 3D model at any x,y,z spatial location including the ground surface, airborne surveys and drillholes. ModelVision Pro is renowned for its ability to interpret 3D potential field data and you can use it to simulate a survey for a wide range of geological models and a wide range of survey types.

ModelVision Pro has a synthetic line and dillhole calculator that creates predetermined sample locations for modelling. In the case of an airborne survey, you can use an existing digital terrain model to derive the local elevation along the line and offset it vertically to create the necessary terrain clearance. You can apply a damping filter to the clearance to simulate the characteristics of the aircraft.



Simulation of an airborne survey flight line set over rugged terrain in PNG

Around the world, geoscience organizations use ModelVision Pro to research issues from processing through to the detectability of subtle buried targets. It is used in research and teaching for introductory training in geophysics through to the solution of advanced research problems. When combined with the synthetic survey capability almost any geoscience interpretation problem can be simulated.

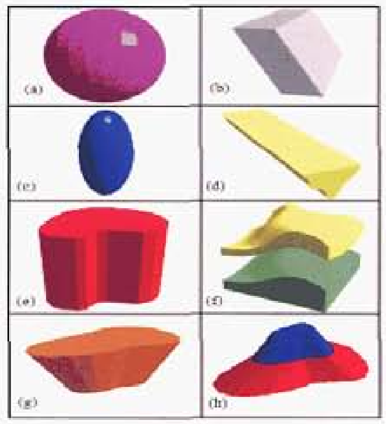


Actual survey flight path over rugged terrain in PNG with colour coding of terrain clearance

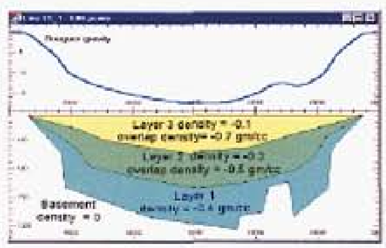
Airborne contractors and QC personnel use ModelVision Pro to analyse daily results and simulate the expected responses from detailed surveys with 50m line spacing to regional surveys with 1km line spacing. ModelVision Pro is packed with features designed to solve the great diversity of geological investigations that are suited to magnetic and gravity investigations.

2D/3D modelling

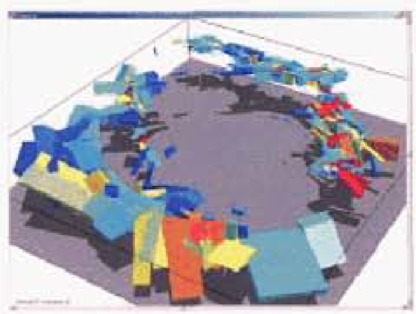
ModelVision Pro performs all modelling in 3D but provides the operational efficiency of 2D modelling by providing optimised cross-sections.



View of different 3D model shapes, sphere (a), tabular (b), ellipse (c), polygon (d), plunging prism (e), polyhedron (f) and frustum (g), (h).



Cross-section through a 3D model allows editing in the section view

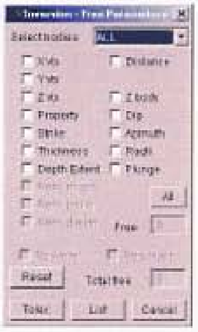


Tanami district 3D model of magnetic features surrounding a large granitic pluton

Features cont'd

Guided 3D inversion

ModelVision Pro guided inversion supports your geological modelling by allowing you to select individual parameters for refinement.



ModelVision Pro inversion control panel provides acess to any body parameters in any and all bodies in the model

ModelVision Pro supports single profile inversion for isolated cross-sections and full 3D inversion of multiple lines of data. With modern GPS surveying you can invert on data collected along multiple lines with computations made at the elevations of the sample locations. This feature allows you to do precision modelling in rugged terrain or for data collected in drillholes.

Active Point mode allows you to select a subset region in a map or cross-section. This means that you can model part of a large survey without having to model every data point. You can perform multi-body inversion with control over individual parameters such as body position, physical property, vertex position, dip, strike, remanence vector etc.

Gravity and magnetic gradiometer simulation

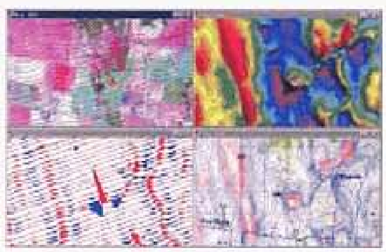
ModelVision Pro models the full gravity tensor so you can model data collected by the BHP Billiton Falcon™ or Bell Geospace airborne gravity gradiometer systems.

You can simulate total field magnetic gradiometer surveys ont the next generation of SQUID magnetometers that measure the full magnetic field tensor.

You can analyse the model components, the vertical gradient or full tensor. The 3D visualisation assists with understanding the relationship between the model and the tensor direction. The 3D colour modulated ribbon allows you to colour code the ribbon by another channel such as terrain clearance.

Mapping & imaging

An example of stacked profiles over a Landsat image, colour image with contours, variable area stacked profiles and colour contours over a scanned map image is shown.



ModelVision Pro supports a variety of mapping methods and allows you to superimpose the plan view of your model in the map view

Processing & utilities

ModelVision Pro is packed with useful utilities such as minimum curvature gridding, grid filtering, line filtering and a calculator that operates on lines, points, drill holes and grids.

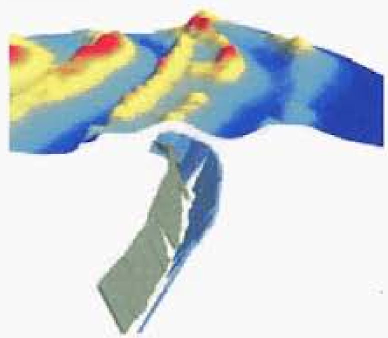
The utilities include a survey simulator and a drillhole simulator that can be tagged to a topographic surface and viewed in 3D.

ModelVision Pro is integrated with other products and extensions designed to optimise the benefits derived from advanced interpretation of magnetic and gravity data.

Related Products

Encom AutoMag

Encom AutoMag is an advanced implementation of Dr Zhiqun Shi's Naudy method for automatic location and inversion of magnetic anomalies. It is integrated with ModelVision Pro to provide confirmation of automated solutions in a way that cannot be achieved by conventional automated methods.



AutoMag solutions along a syncline converted to ModelVision Pro tabular bodies

Any solution from AutoMag can be converted to a ModelVision Pro model body and the forward model response compared with the original data.

A suite of QC tools allow you to prioritise the responses, apply strike corrections and use inversion to refine the initial models. The tools are used to obtain rapid estimation of depth of cover for petroleum, mineral and groundwater applications.

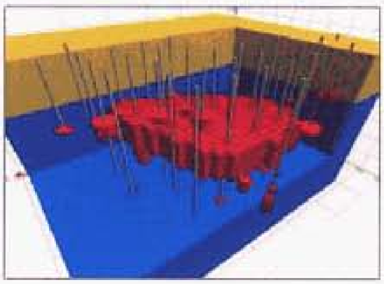
UBC – GIF voxel models

Encom has developed an optional extension for ModelVision Pro that makes it easy to prepare and run UBC-GIF, GRAV3D and MAG3D smooth inversions.

Use ModelVision Pro to generate the initial model for the inversion along with the associated data and constraint files. The solid models in ModelVision Pro are converted to mesh models by assigning properties to each mesh cell that falls inside a body. The density and susceptibility of that body are assigned to each cell.

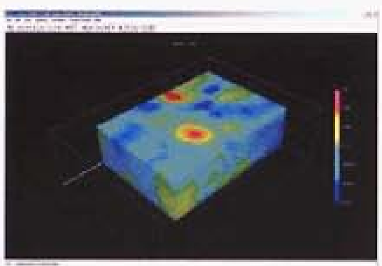
encom

Encom ModelVision Pro



A UBC-GIF constraint voxel model created by ModelVison Pro and visualised in Profile Analyst

You can use the standad UBC tools to visualise the results of the smooth inversion or Profile Analyst's rich range of visualisation options to integrate the inversion results with other models and data sets.



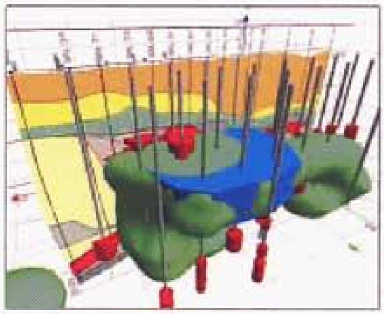
UBC Meshtools3D used to display the results of a smooth inversion seeded by ModelVision Pro

The benefits of using ModelVision Pro with the UBC GIF programs include:

- Easy connection to industry data formats
- Prepares topographic model
- Prepares data files
- Removal of the regional field
- Prepare a starting model
- Prepares a bounds file (GRAV3D)
- Runs the UBC-GIF programs
- Visualise the results with UBC viewer
- Visualise the model in Profile Analyst.

ModelVision Pro allows you to integrate geological controls into the UBC-GIF smooth inversion. ModelVision Pro can create and populate the entire model with physical properties based on geological modelling with limited controls.

You can add an unconformity layer to minimise the leakage of high density or susceptibility values into a low contrast domain. This forces the properties to be distributed below the unconformity and subsequently produces more realistic geological solutions.



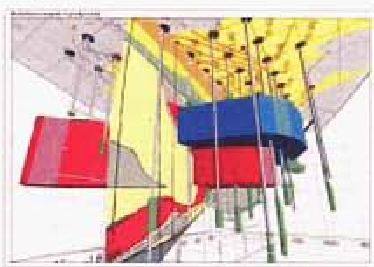
A Profile Analyst iso-surface view of the UBC inversion results superimposed on the ModelVision Pro seed model

A comparison of the ModelVision Pro model and UBC Inversion results in Profile Analyst allows you to assign confidence zones to the UBC inversion.

Encom Profile Analyst

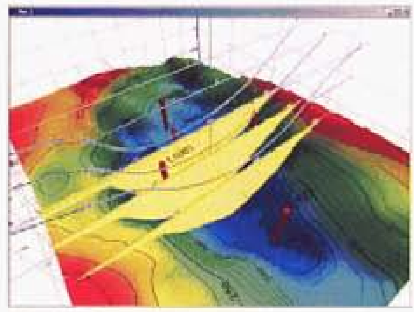
Encom Profile Analyst is Encom's premier model and data integration tool for 1D, 2D and 3D geoscience information. It connects to other Encom products and many other industry geoscience products such as Oasis montaj™, Intrepid and ER Mapper. ModelVision Pro provides direct support for the following information types:

- 3D models
- 3D cross-sections
- Model computations for lines, points, drill holes & grids.
- Synthetic drillholes



ModelVision Pro gravity and magnetic models for the San Nicolás deposit integrated with drillhole assay data and geological section

Use Profile Analyst to compare your results with other information sources such as drillhole data, outcrop mapping, models from other geophysical packages.



ModelVision Pro gravity interpretation cross-sections visualised in the context of the basin container

Encom QuickMag Pro

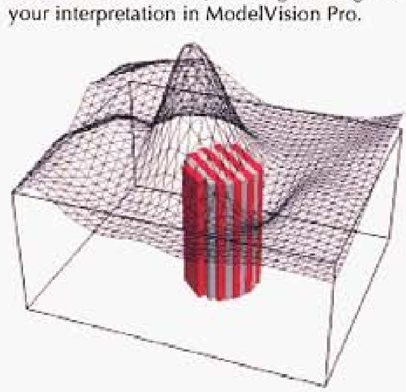
Encom QuickMag Pro provides a rapid method of 3D modelling of magnetic targets and can export its models in ModelVision Pro tabular block or polyhedral format.

QuickMag Pro is used to map the distribution of magnetic sources on an unconformity surface. This includes dykes, steeply dipping and folded volcanic units and intrusive plugs.

QuickMag Pro includes an expert system for auto-identification of 2D magnetic anomalies and an advanced inversion technology that allows you to match the inversions for different geological styles.

QuickMag Pro segments a complex geological target into a set of linked tabular blocks whose properties can vary in a controlled manner along the axis of the model.

Use the results from QuickMag Pro to guide your interpretation in ModelVision Pro.



Example of a QuickMag Pro pipe showing each of the tabular blocks used to build a model for an intrusive pipe

Use QuickMag Pro to complement your ModelVision tools by rapid 3D analysis of large data sets.

Specifications

Import

ModelVision Pro supports a wide range of industry standard line, point, grid and image data formats.

Lines

- General ASCII import wizard
- ASEG-GDF2
- Geosoft Oasis montaj (.GDB)
- Geosoft multi-line (.XYZ)
- Geosoft single line (.DAT)
- Oasis multi-line (.XYZ)
- Simple XYZ format (.LIN)
- Mutli-file single line (.DAT)
- Separate header and data (.HDR + .LIN)
- ER Mapper 4,5 (.ASC) (.TXT)
- AMIRA (.TEM)
- TOOLKIT (.TK)
- External Data Link (User defined)

Grids

- ER Mapper (.ERS)
- Geosoft uncompressed (.GRD(
- ASEG-GXF
- USGS (.USG)
- Geopak (.GRD)
- Encom (.GRD)

Drillholes

- Geosoft Oasis montaj (.GDB)
- Simple XYZ (.LIN)

Points

- Geosoft Oasis montaj (.GDB)
- Simple XYZ (.PTS)
- Geosoft single Line (.DAT)
- ER Mapper 4 ASCII Profile (>ASC)
- Toolkit format (.TK)
- AutoMag solutions

Images

Images can be imported as Microsoft BMP files and geo-referenced for inclusion in cross-sections or map views. Depth-converted seismic sections or scanned geological sections can be used as backdrops on model sections

Vectors

- ESRI Shape files (.SHP)
- MapInfo interchange (.MIF)
- AutoCad 2D (.DXF)
- ER Mapper vector (.ERV)

Models

- ModelVision & Toolkit (.TKM)
- External links

Export

You have access to a wide range of export facilities for both models and data created within Modelvision Pro.

Lines

- ASEG-GDF2
- Geosoft Oasis montaj (.GDB)
- Geosoft multi-line (.XYZ)
- Geosoft single line (.DAT)
- Simple XYZ format (.LIN)
- TOOLKIT format (.TK)
- AMIRA format (.TEM)
- External Links (User defined)

Grids

- ER Mapper (.ERS)
- ASEG-GXF
- Geosoft (.GRD)
- USGS (.USG)
- Geopak (.GRD)
- Encom (.GRD)

Drillholes

- Geosoft Oasis montaj (.GDB)
- Simple XYZ (.LIN)

Points

- Geosoft (Oasis montaj (.GDB)
- Simple XYZ (.PTS)
- AutoMag solutions

Models

- ModelVision Pro (.TKM)
- ModelVision SE (.TKM)
- TOOLKIT (.TK)
- AutoCAD 3D (.DXF)
- UBC mesh model
- External link (user defined)
- Profile Analyst geocoded sections (.EGB)
- GoCAD (tsurf)

Encom Profile Analyst

ModelVision Pro provides support for Profile Analyst in a variety of methods including:

- Grid (.ERS)
- Lines (.GDB)
- Holes (.GDB)
- Points (.GDB)
- Models (.3D .DXF)
- Sections (.EGB)

You can save nearly all data, grids and models in a format that is immediately available for visualisation in Profile Analyst.

Images

Most graphic windows support the creation of high-resolution bitmaps (BMP) as an export option. These images are suitable for inclusion in reports.

Model types

ModelVision Pro models are designed to provide convenient methods for creating and editing a range of simple to complex geological shapes.

- Polygonal vertical cross-section with dip
- Polygonal horizontal cross-section
  - > dip
  - > azimuth
- Inclined upper surface
- Frustum
- Dipping tabular block
- Ellipsoid
- Sphere
- Horizontal elliptic cylinder

Combinations of these basic building blocks can reproduce almost any geological environment.

Modelling methods

Section (3D)

Create, select and edit models in a single section or multiple geological sections with all the advantages of 2D modelling in a 3D volume. Graphical access to body-specific spatial attributes such as polygon vertices or body location.

Map (3D)

Create, select and edit models in a map view. Graphical access to body specific spatial attributes such as polygon vertices or body location. Use the body property to access spatial, physical property and visual attributes.

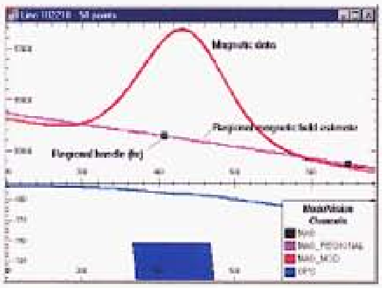
Field Components

Gravity modelling supports the total gravitation attraction Gx, Gy, Gz and the full gravity tensor Gzz, Gxx, Gyy, Gxy, Gxz, Gyz and some derived components such as the analytic signal.

Magnetic modelling supports the total magnetic intensity Bx, By, Bz and along-line components. The along-line component can be used for the axial drillhole component.

Regional 1D/ 2D

Manipulate 1D and 2D regional gravity and magnetic fields depending upon the modelling mode. Auto-compute a starting regional and then use manual editing methods to adjust the shape.



1D regional manipulation in a cross-section view

Active data zones

ModelVision Pro can work with a complete survey by activating segments of the survey for modelling. This may be a single line, multiple lines or segments of one or more lines. In this way, it is possible to reduce the large computational overhead of modelling large data sets by focusing on anomalous data regions.

Manual/immediate/compression

You can model using compute-on-demand or immediate (real-time) computing modes. If you are working with large data sets and complex models, you can speed up the computation process using a data compression option.

In-line filters

You can turn on an active filter that allows you to view your model and field data through the same filter. Use a first vertical derivative filter to improve depth precision or an upward continuation filter for noise affected data.

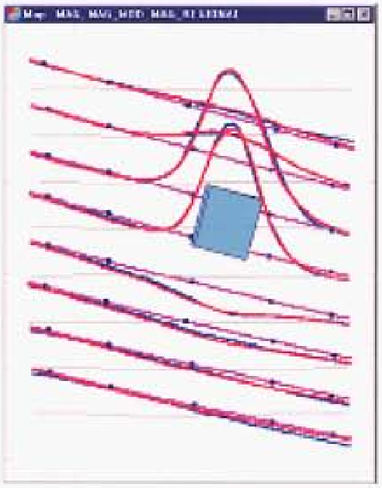
3D data types

3D gravity and magnetic modelling is supported for 4 different data types:

- Lines
- Points
- Drillholes
- Grids

Inversion methods

The guided inversion method allows you to free parameters from one or more bodies at a time. Parameter ranges can also be fixed to ensure that they do not move outside reasonable bounds.



Comparison of field data and model data in a milt-line 3D inversion

3D visualisation

- Models
- Flight path/profiles
- Drillholes
- Points
- 3D Grids with colour drape
- AutoMag points
- Vectors

Map visualisation

- Model
- Stacked profiles
- Contours
- Grid profiles
- Vector files
- Drill holes
- Images
- Bitmaps
- Points/symbols
- AutoMag solutions
- Profile vectors
- Base lines
- Flight path
- Legend
- North arrow
- Coordinate grid

Section visualisation

- Model (colour modulation)
- Gravity & magnetic data
- Computed magnetic & gravity data
- Regional gravity & magnetic field
- In-line filters
- Auxiliary curves
- Vectors
- Terrain
- Data collection path
- Drillholes
- AutoMag solutions
- Similarity coefficients
- Bitmap sections (geocoded)
- Titles & legends
- Next line function

Multi-track visualisation

Fast multi-channel, multi-track trace analysis with multiple display styles and drag and drop functionality.

Filters

Line Convolution

- Low pass
- High pass
- Band pass
- 1st/2nd horizontal derivative
- 1st vertical derivative
- Analytic signal
- Moving average
- Median
- Fourth difference
- Upward continuation
- AGC
- Noise generator

Line FFT

- Low/high/band pass
- 1st horizontal derivative
- 1st vertical derivative
- Upward continuation
- Downward continuation
- Reduction to the pole
- Pseudo-gravity

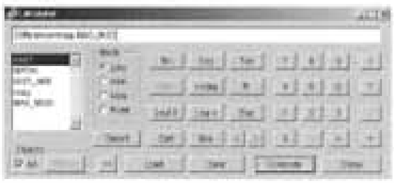
Grid Convolution Filters

- Average
- Gaussian
- Low/high/band pass
- Laplace
- Sharpen
- Sobel
- Illumination
- Noise generator

Utility capabilities

Calculator

The calculator supports algebraic and trigonometric operations on lines, drillholes, points and grids.



Interpolator

Interpolate lines to a new sample spacing. This can be used to reduce the amount of data or create evenly spaced data samples for filtering.

Synthetic lines & drillholes

Generate a synthetic airborne survey over a digital terrain grid, use the interpolator to extract elevation data and then apply an offset to simulate terrain clearance. You can apply a convolution filter to the flight path elevation to simulate aircraft climb rates.

Generate synthetic drillholes using a DTM to check the intersection of a drilling program with the proposed target.

Gridding

A minimum curvature algorithm that generates grids from any loaded point or line data channel.

Sample grid to lines

Resample multiple grids on to a line dataset to create additional channels that are co-sampled. This is useful for simultaneous modelling of airborne magnetic data with ground gravity data.

Statistics

Statistic reporting for lines, drillholes, points and grids.

Data maintenance

Delete lines, drillholes, grids and point sets from memory. Rename and delete channels, plus many other utility functions.

Subsetting a project to a limited rectangular area can be performed graphically. This will cut a slice from all lines, grids and points. Models remain intact.

Reference Material

ModelVision Pro comes with an extensive reference library including an introductory Getting Started Guide, User Guide, full reference manual, tutorials and an integrated searchable help system.

Integrated help system menu provides fast access to context sensitive information.

Operating system & hardware requirements

ModelVision Pro runs on Microsoft Windows 98, NT, 2000 and XP. The amount of memory required is operating system dependent. 256MB of RAM is recommended, but ModelVision Pro will run in 128 Mb on most versions of the operating system.

For more information

For more information about Encom ModelVision Pro, visit our website at www.encom.com.au, or talk to Encom to arrange a demonstration or request an evaluation copy of the software. To contact an authorised reseller in your region, visit www.encom.com.au/resellers

Encom ModelVision Pro is one of a suite of specialist geophysical and GIS software tools from Encom Technology. For information about Encom Profile Analyst, Encom QuickMag Pro, EM Flow, EM Vision, Encom Discover for MapInfo Professional, Encom Discover Mobile, Encom GPINFO and other products, contact Encom.

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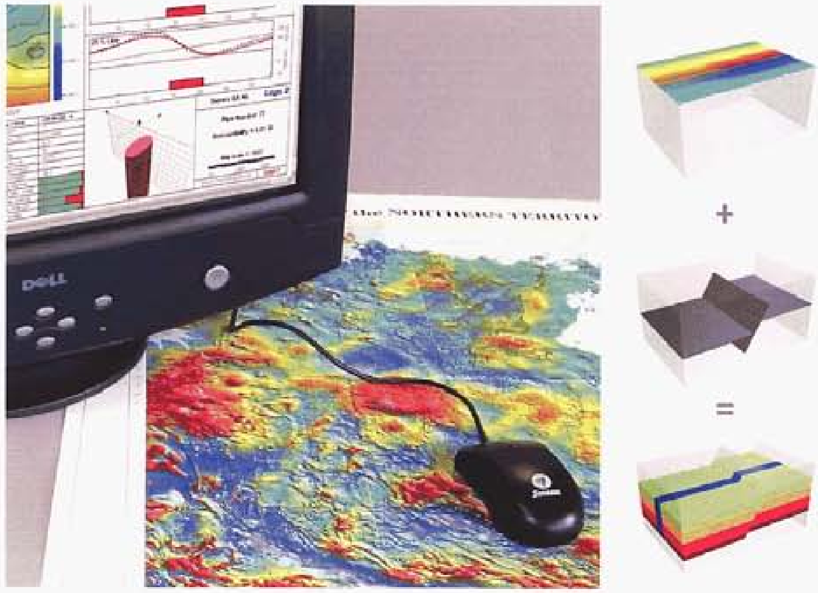
ABN 28 002 841 349

Encom QuickMag Pro 2.0

Expert Magnetic Modelling System



3D Magnetic Interpretation in 3 easy steps

Encom QuickMag Pro is the revolutionary new magnetic modelling package from Encom Technology. Based on three years of expert systems research, Encom QuickMag creates realistic 3D magnetic models, in less time and with less effort than ever before.

Fast, realistic geological modelling

Encom QuickMag allows you to construct realistic geological models of magnetic anomalies in a fraction of the time of manual methods.

Just point at an anomaly, choose a geological style and in seconds Encom QuickMag will automatically construct a 3D model of the magnetic source.

On a standard desktop computer, Encom QuickMag will build a realistic 3D geological model in less than 5 seconds, and a full inversion in less than 60 seconds.

Because Encom QuickMag removes much of the laborious work required to manually build complex 3D models, you can tackle interpretations that you once regarded as impractical, in a systematic and time-effective manner.

Unique processing technology

Encom QuickMag is based on three years of government-backed research by Encom into methods for automatically constructing realistic 3D geological models from magnetic surveys.

Encom QuickMag is the first commercial product to be developed from this research. At its core is the unique Quick Match process, which isolates an anomaly from its surroundings to instantly produce realistic starting models with quality depth estimates.

You can improve on the Quick Match results by experimenting with different geological shapes to obtain the best match between magnetic data and the interpreted geological style. Because it is easy to change the geological style, you can test a wide range of models and develop a good understanding of the model uncertainties.

Control and compatibility

With Encom QuickMag, you can fully control the characteristics of your geological model. The style selector lets you control the mapped shape, depth profile, magnetic susceptibility, faulting and dip of your chosen geological style.

Encom QuickMag reports provide detailed cross-checks of the interpretation quality and the profile cross-sections let you evaluate any residual mismatch between the original data and computed model response.

You can select from a range of report template styles and customise them to suit your individual needs.

Encom QuickMag comes with plug-ins for Geosoft Oasis montaj™ and Encom ModelVision. Encom QuickMag pages can also be copied into Microsoft Word and other Windows applications.

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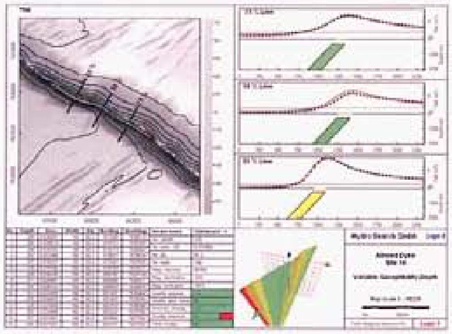
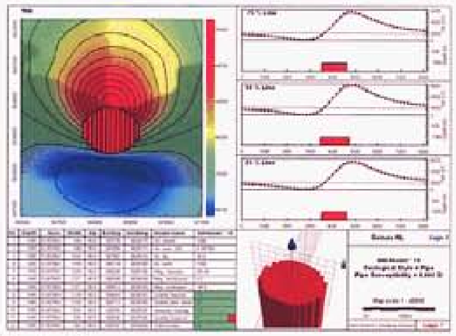
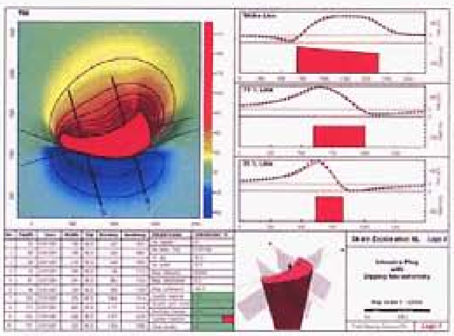
Fast, realistic geological modelling



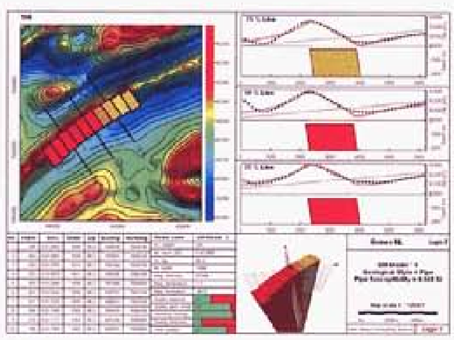
Dyke interpretation



Intrusive plug



Dipping unconformity

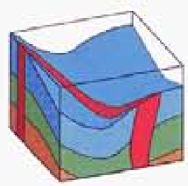


Folded volcanics

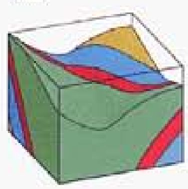
How it works

Encom QuickMag is based on ground-breaking new research into automatic geological modelling techniques. Encom QuickMag is suitable for mapping of magnetic dykes, steeply dipping folded volcanics, intrusive pipes and intrusive plugs. It maps the distribution of magnetic material across an unconformity surface.

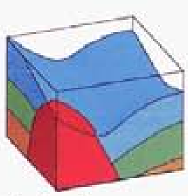
This model style suits a wide range of geological mapping problems and the unconformity can be flat, dipping, undulating or faulted. The adoption of this geological model makes it possible to automate the 3D construction of the magnetic unit below the unconformity.



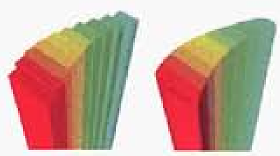
Dyke



Folded volcanics



Intrusive plug



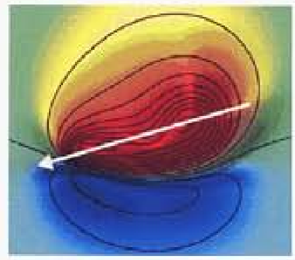
Blocked and smooth visualization styles for QuickMag models

The magnetic unit is approximated by a series of linked blocks where the depth, width, dip and magnetic property can vary from one block to the next. The linked attributes must conform to the selected geological style and this allows Encom QuickMag to define a wide range of geological shapes.

This process and the Quick Match technology provide faster and more precise results in a wide range of geological circumstances than other automated modelling systems.

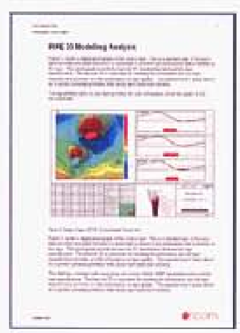
Speed and control

Encom QuickMag optimises your time because it allows you to perform the model interpretation directly from the image view of your data. This is the natural way to work with magnetic data.



Example of magnetic anomaly selection

First you select the geological style and then you select the anomaly by dragging the mouse along the approximate axis of the magnetic anomaly. QuickMag does the rest in a few seconds by building a model that best matches your style selection and the magnetic data. If the match is poor, you can change the style to see if you can improve the result. Now you can build complex geological models without having to worry about the details of manual model construction.



QuickMag makes reporting easy. Simply use the Edit menu to copy the report page to the clipboard and then paste it directly into your report.

Reports

Each element of the QuickMag report is an active object that delivers dynamic information on the results of your interpretation. With these advanced reporting features you can create high quality presentations from a selection of templates. The report templates can also be customised for individual needs.

Image maps

The image map style, contours, illumination direction, model attributes, titles and anomaly selection are fully controlled from a pop-up menu. Pan and zoom to any part of the map using dynamic colour stretching.

Pan and Zoom tools

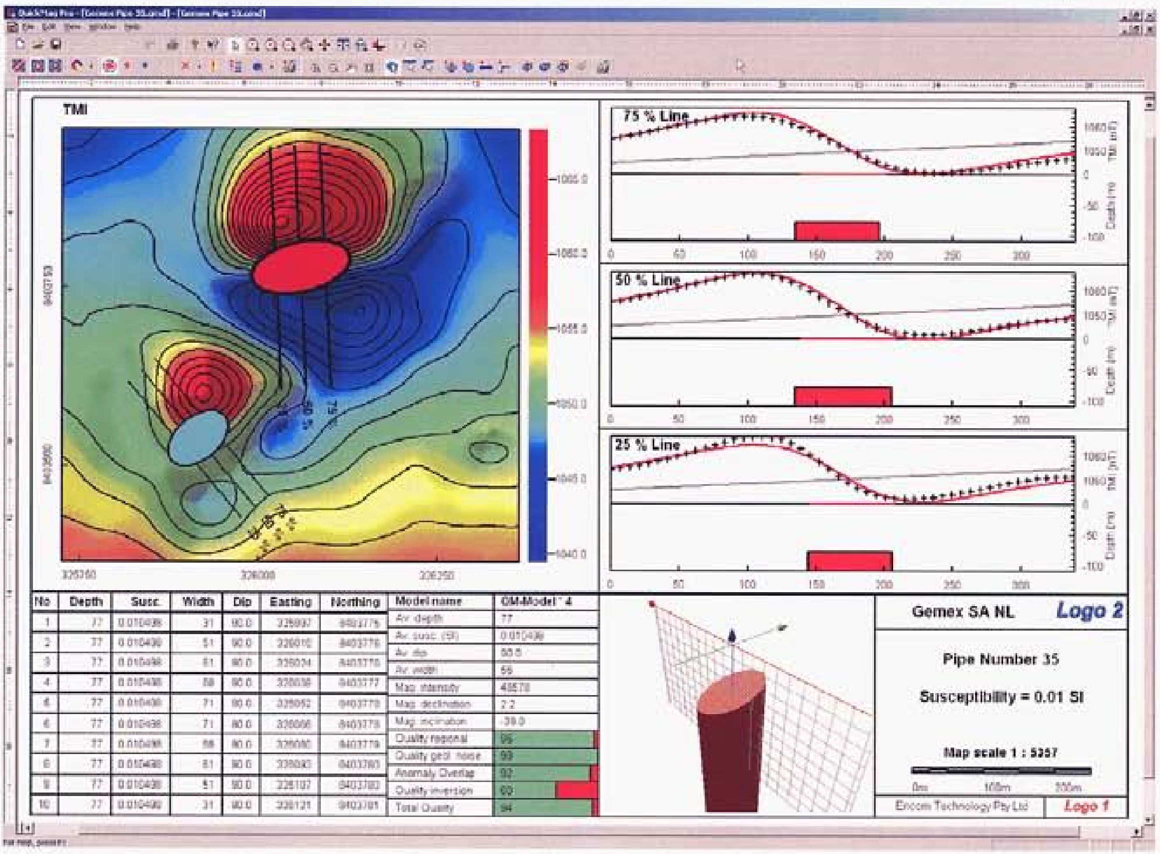
QuickMag uses data and page navigation tools. The data zoom and pan allows you to position your map view over a magnetic anomaly while the page zoom allows you to view your printed page at high resolution.

Control panel

QuickMag provides a comprehensive control panel to define the geological style in terms of depth, susceptibility width, position and dip shapes. You can insert known values such as susceptibility and clamp parameters during inversion.

Cross-section

Cross-sections help you to evaluate the results of the interpretation, by providing visual feedback on data mismatches. Turn on the first vertical derivative option to improve depth sensitivity. The regional is updated automatically.



Block model spreadsheet

The primary attributes of each block in the model are summarized in the block model spreadsheet. Spreadsheet columns can include depth, width, dip, position and other attributes.

Quality report

The quality report provides quantitative estimates of the quality of factors that influence the geological model interpretation such as regional, shallow geological noise, anomaly overlap and inversion RMS match.

3D model display

Interactive 3D displays provide a useful presentation of complex models that may not be easily visualized in a map or limited number of cross-sections. Optional display of 3D axes and cross-section locations.

Title Blocks

You can modify the standard templates to include your own details and logos and re-use the templates at a later time. Use the active scalebar object to enter a precise scale. You have full control over font selection and style.

encom

Encom QuickMag Pro

Features and specifications

Major features

- Simplicity for 3D modelling
- Builds 3D models in seconds
- Wide range of geological model styles
- Operates from image maps
- Quality classification of models
- Easy, high-quality reports
- Works with other products
- Low inclination magnetic field capability
- High quality multi-layer image maps
- Interactive control of active data zone
- Edit your own templates

Applications

- Base metal exploration
- Gold exploration
- Diamond exploration
- Petroleum exploration basement mapping
- Petroleum exploration intrusion assessment
- Regional mapping
- Coal mining hazard assessment
- Engineering geophysics
- Environmental geophysics
- Unexploded ordinance

Model Styles

- Intrusions
  - > elliptic pipes and plugs
- Dykes
- Folded volcanics
- Variable width dykes and volcanics
- Unconformity
  - > flat, sloping, undulating
- Vertical faults
- Lateral faults
- Uniform, folded and faulted dip

Reports

- Selection of report styles
- A4 and US Letter paper sizes
- Components
  - > Image with colour selection
  - > Contour overlay
  - > Cross-sections
  - > Block summary spreadsheet
  - > Model summary spreadsheet
  - > Quality summary spreadsheet
  - > 3D perspective view
  - > Title block
  - > Scale bar
  - > User logs
- Copy to clipboard
  - > BMP
  - > MS Windows metafile
  - > MS Windows enhanced metafile
- Print preview
- Additional report styles on request

Inputs

- Grid of magnetic data
  - > Geosoft uncompressed (grd)
  - > ER Mapper (ers)
  - > ASEG-GXF (gxf)
  - > USGS (usg)
  - > Surfer binary (grd)
  - > Encom (grd)
  - > Geopak (grd)
- TMI or RTP grids
- Magnetic field specification
- DTM reference surface
- Geotiff reference image
- ER Mapper algorithms

Outputs

- Printed colour reports
- Multi-model project database
- Work session files
- Encom ModelVision models (TKM, DXF)
- ASCII model summary
- MS Windows bitmaps and metafiles

Plug-ins

- Geosoft Oasis montaj™
- Encom ModelVision Pro

Product compatibility

- Encom ModelVision Pro (advanced modelling)
- Geosoft Oasis montaj™ (plug-in and models)
- Encom Profile Analyst (3D models)
- Encom Discover for MapInfo (3D models)

Media

- Comprehensive User Guide
- CD media
- Training tutorials
- On-line help with search
- Electronic version of User Guide

Minimum system requirements

- Pentium III processor
- Microsoft Windows 98©, 2000©, XP©
- 128 Mb RAM
- 20 Mb available disk space
- CD-ROM drive

For more information

For more information about Encom QuickMag Pro 2.0, visit our website at www.encom.com.au, or talk to Encom to arrange a demonstration or request an evaluation copy of the software. To contact an authorised reseller in your region, visit www.encom.com.au/resellers

Encom QuickMag Pro is one of a suite of specialist geophysical and GIS software tools from Encom Technology. For information about Encom Profile Analyst, Encom ModelVision, EM Flow, EM Vision, Encom Discover for MapInfo, GPinfo and other products, contact Encom.

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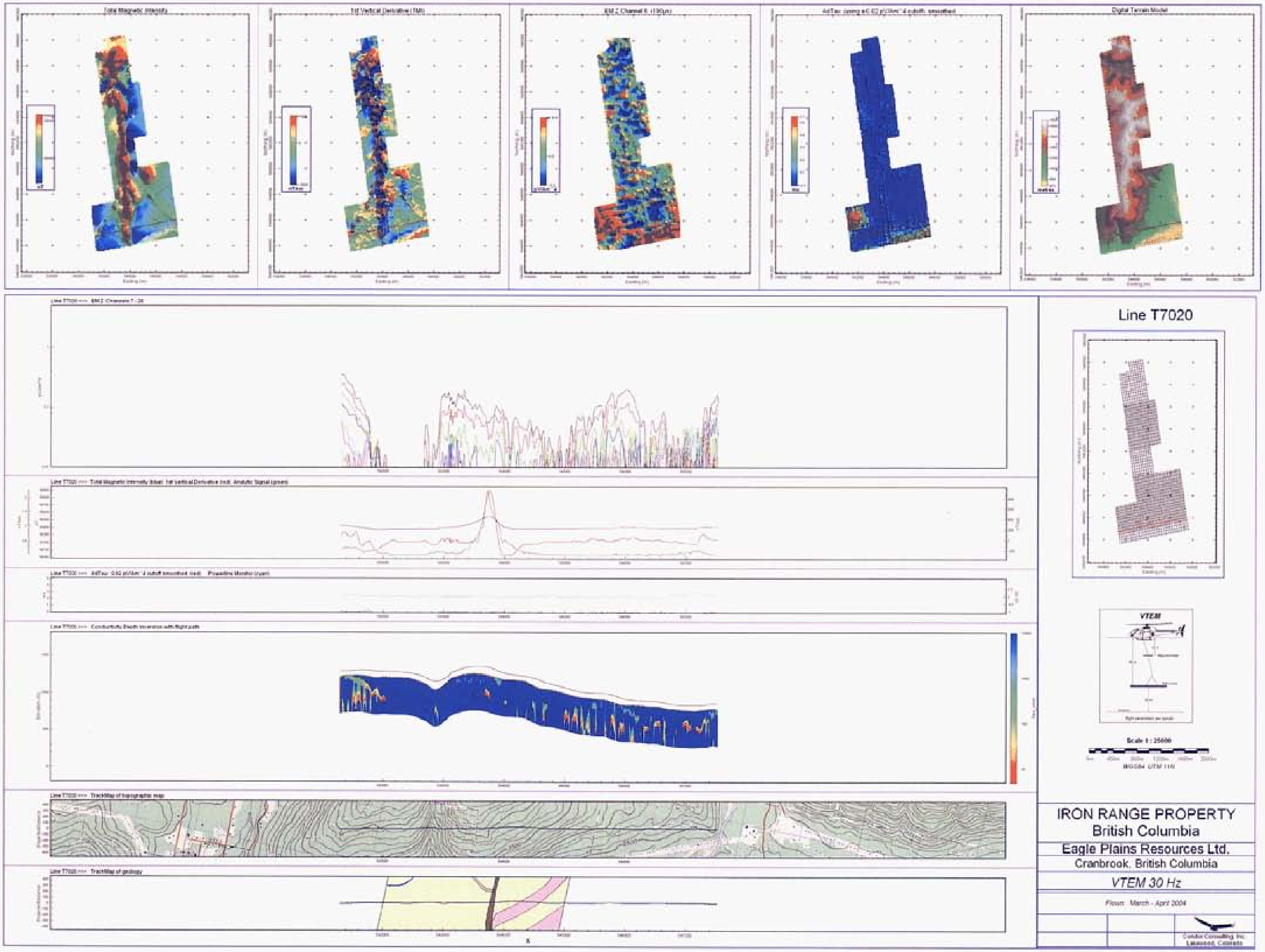

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WGS84 UTM 11N
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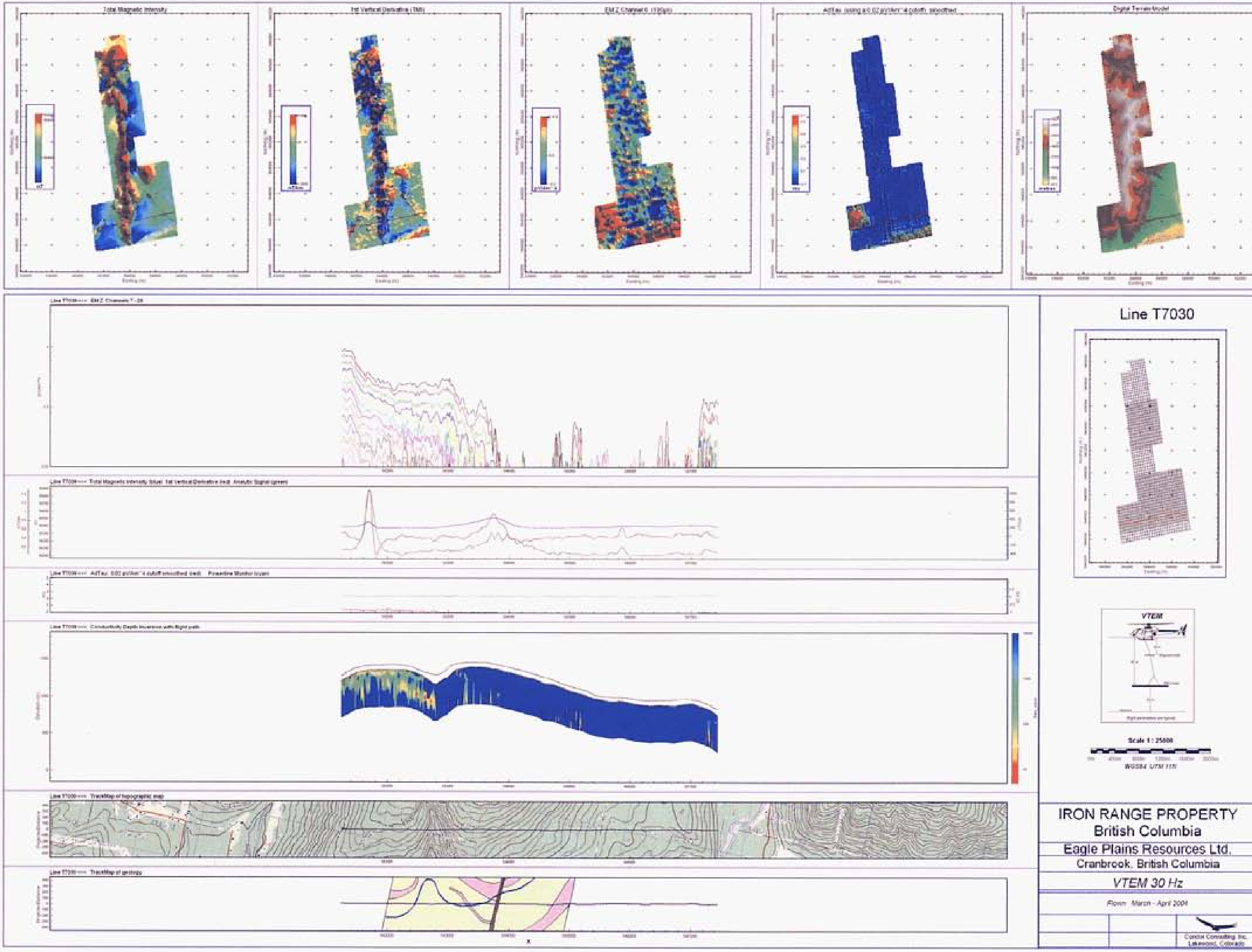
British Columbia
Eagle Plains Resources Ltd.
Cranbrook, British Columbia
VTEM 30 Hz
Flown: March - April 2004
Condor Consulting, Inc.
Lakewood, Colorado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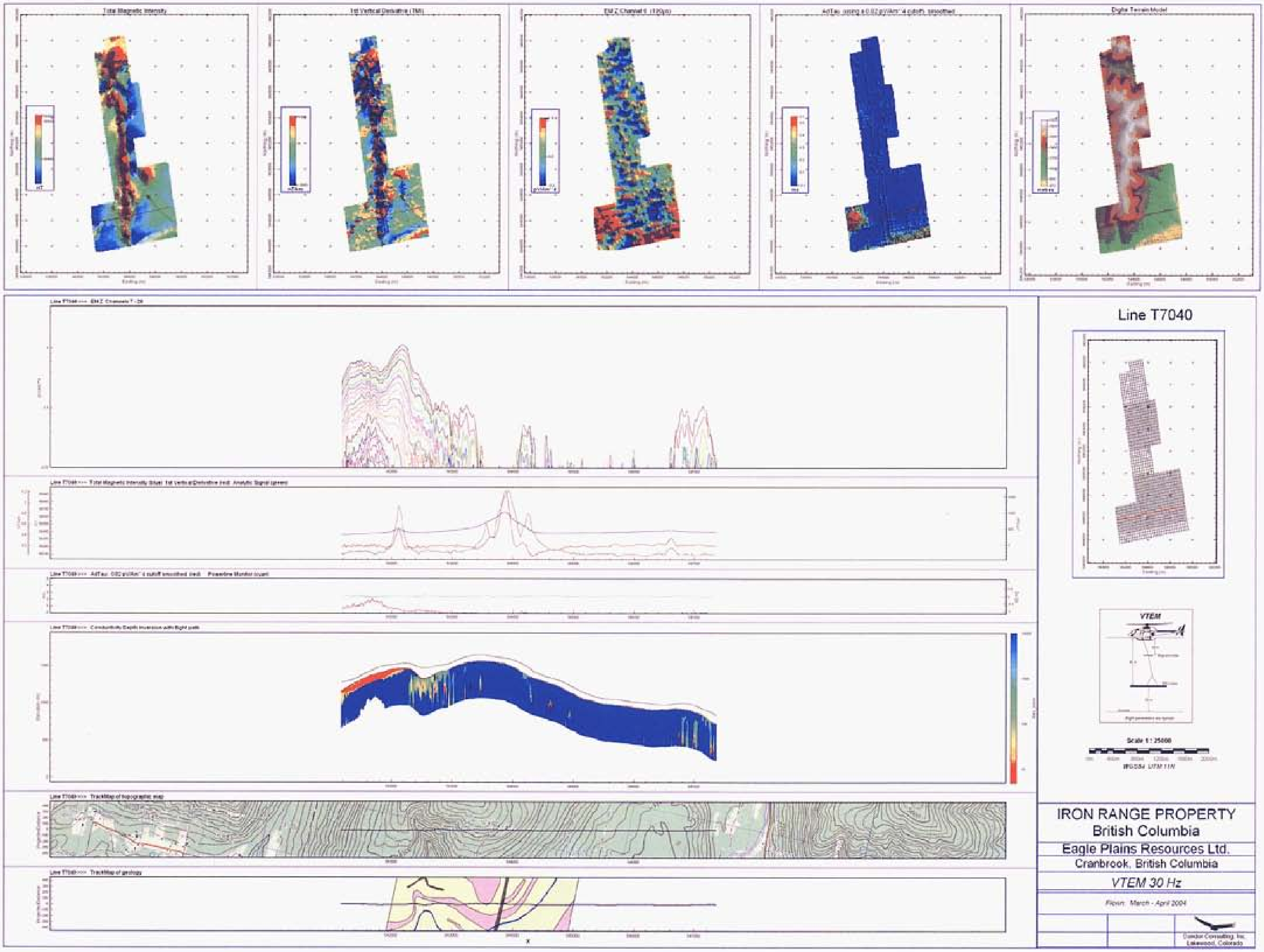
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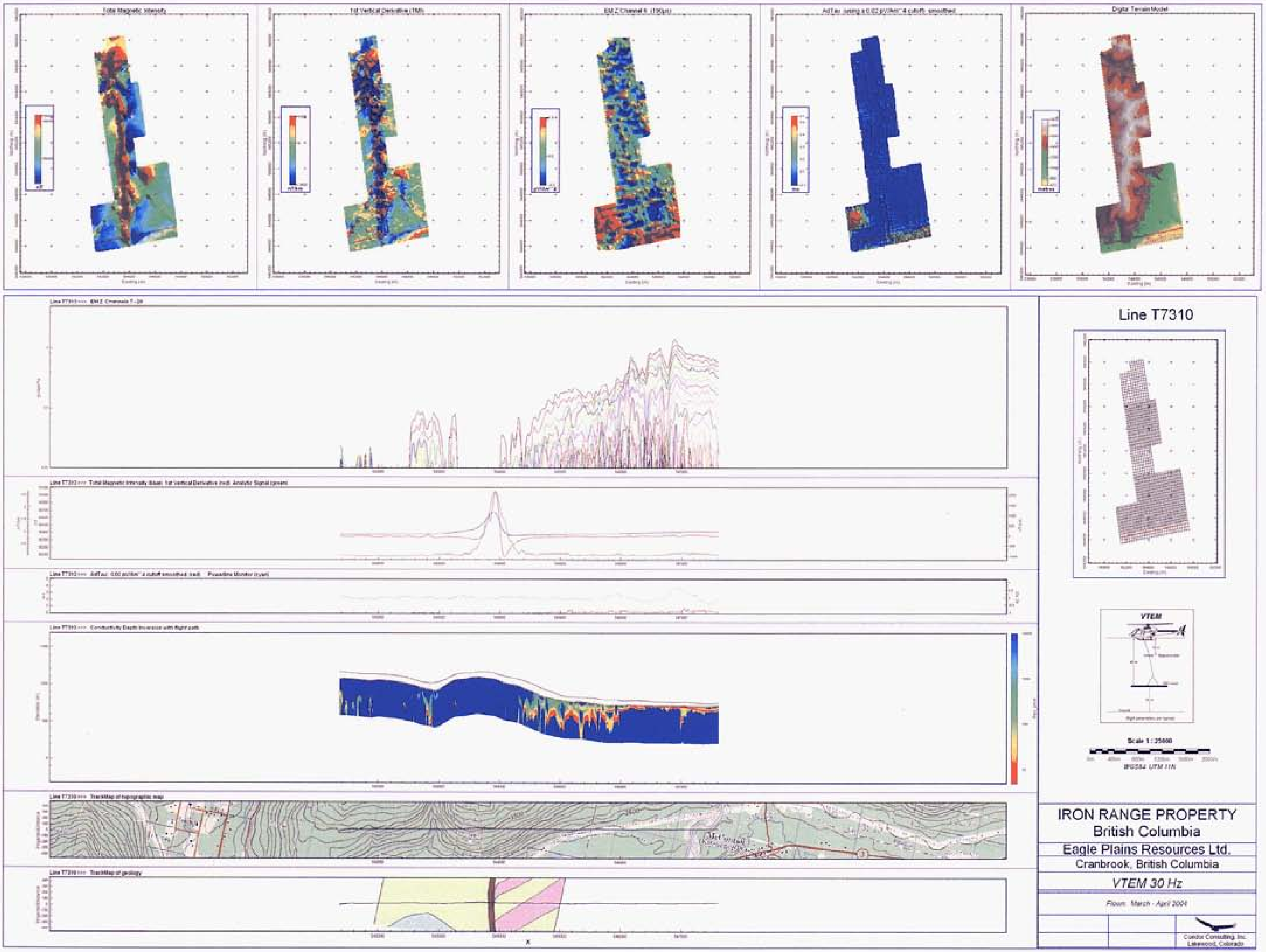
Lakewood, Colorado



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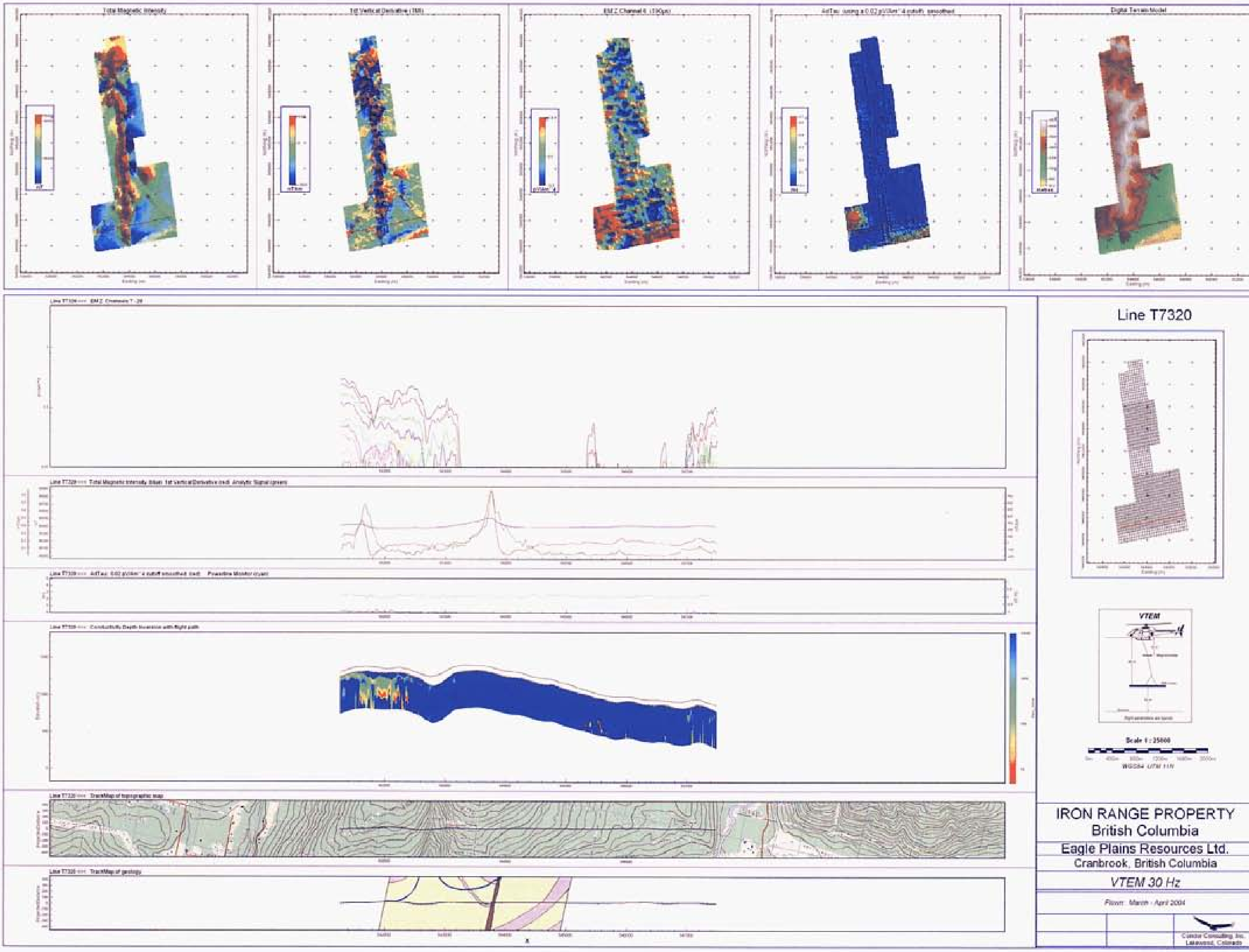
Lakewood, Colorado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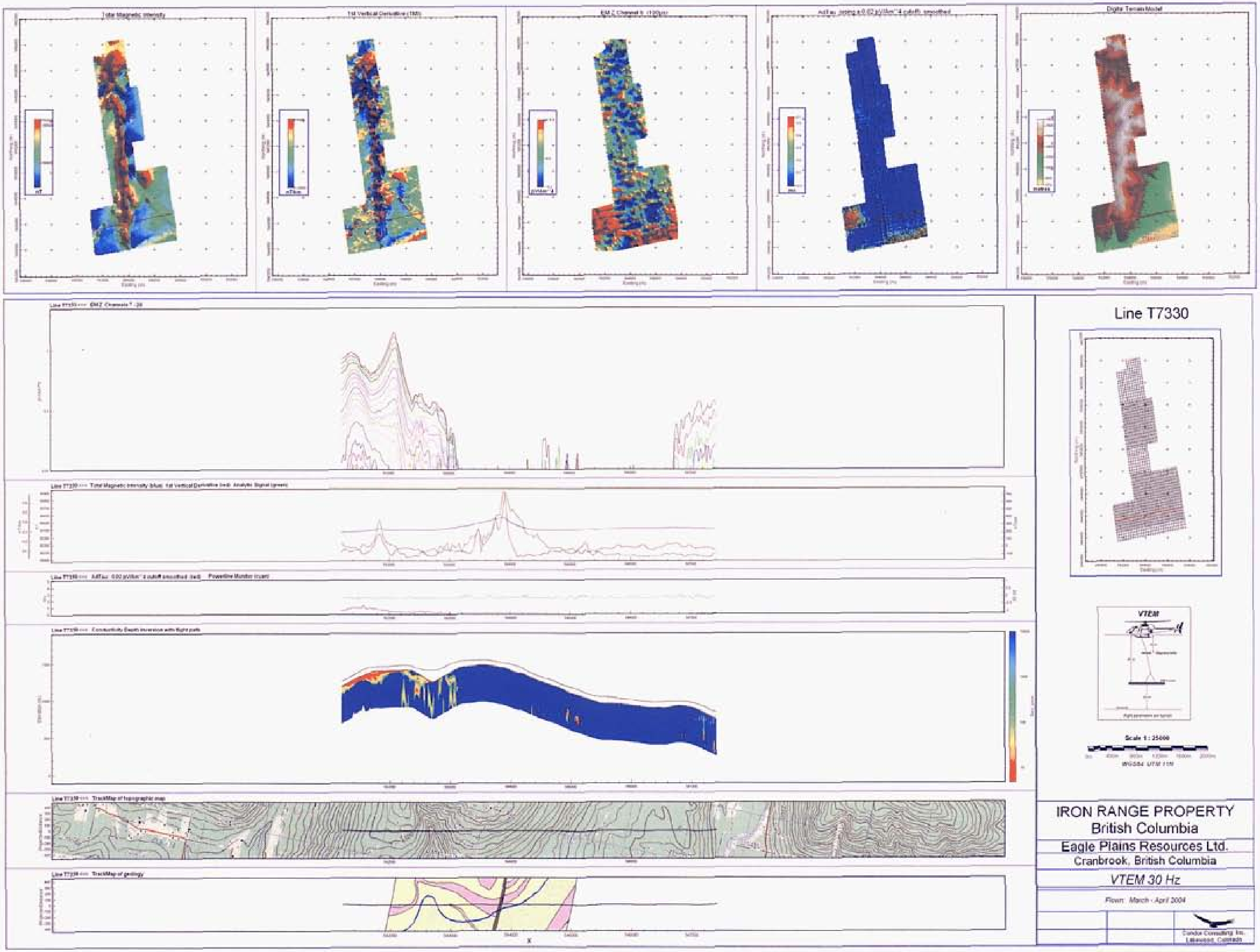
Lakewood, Colorado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Cranbrook, British Columbia
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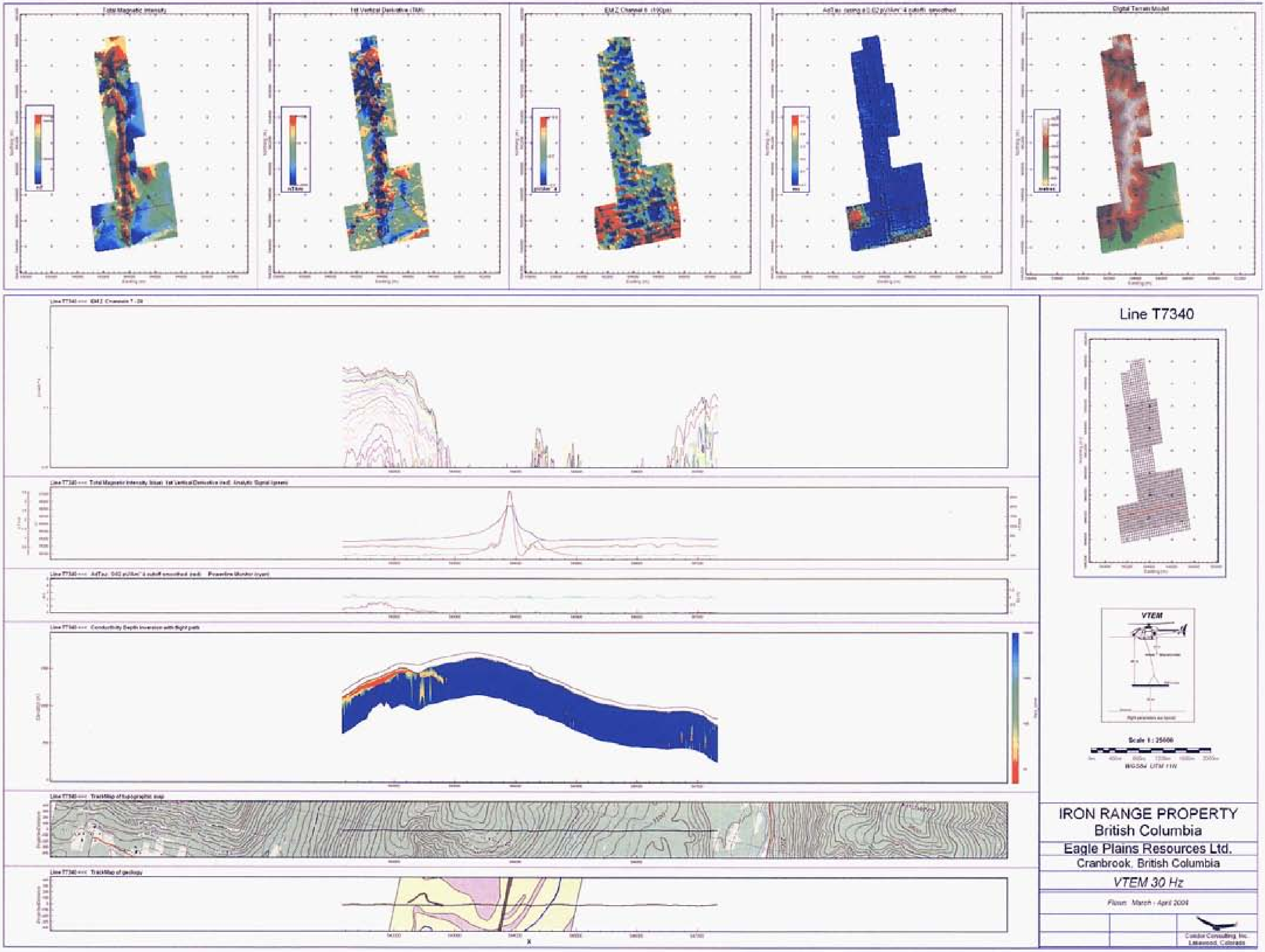
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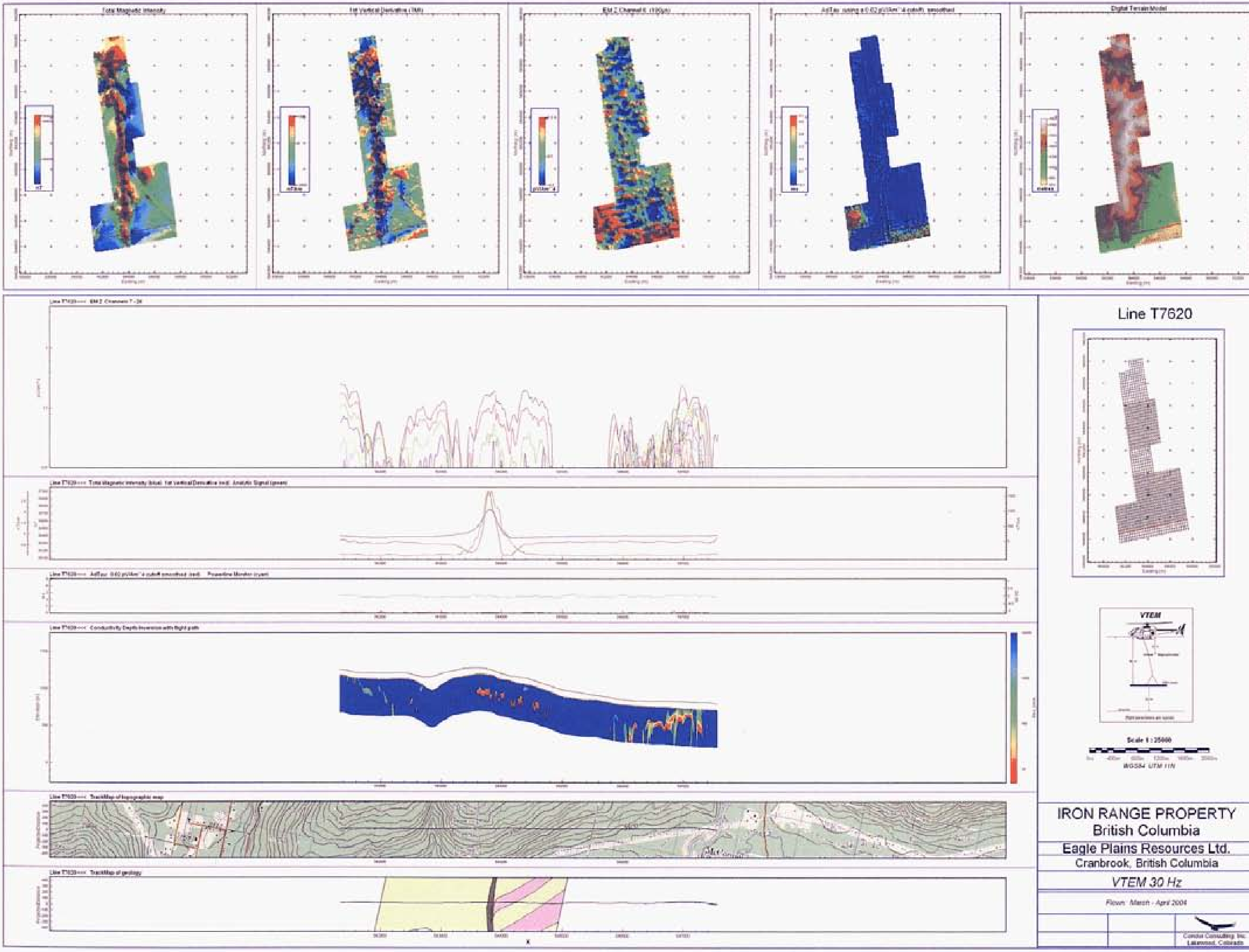
Eagle Plains Resources Ltd.
Cranbrook, British Columbia
VTEM 30 Hz
Condor Consulting, Inc.
Lakewood, Colorado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WGS84 UTM 11N
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British Columbia
Eagle Plains Resources Ltd.
Cranbrook, British Columbia
VTEM 30 Hz
Flown: March - April 2004
Condor Consulting, Inc.
Lakewood, Colorado