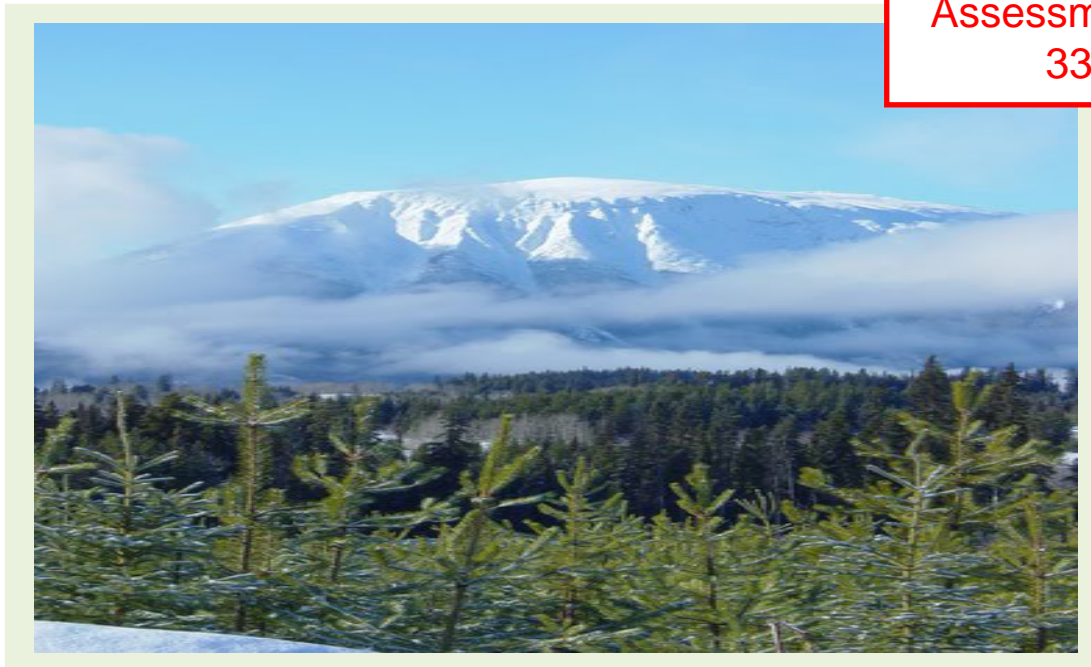**Leaders in Deep Exploration**

Quantec Geoscience

Titan-24 DC / IP / MT Survey
Geophysical Report

Silver Queen Project
(British Columbia, Canada)
on behalf of
New Nadina Explorations Ltd.
(British Columbia, Canada)

QUANTEC GEOSCIENCE LTD
146 SPARKS AVE, TORONTO, ONTARIO, M2H 2S4, CANADA
PHONE: (416) 306-1941 / FAX: (416) 306-1949
WWW.QUANTECGEOSCIENCE.COM

NASREDDINE BOURNAS
JOANNE COWBURN

03/10/2011

EXECUTIVE SUMMARY

INTRODUCTION

A Titan-24 DCIP &MT survey was carried out by Quantec Geoscience Ltd. over the Silver Queen project area, near Houston, British Colombia on behalf of New Nadina Explorations Ltd. from 2011/07/07 to 2011/07/20. The survey consisted of 8 lines of 2400 m each and oriented in the EW direction. 4 lines were acquired in the Central area of the Prospect, whereas 2 in the northern and the other 2 lines in the southern portion of the Prospect. The average line spacing was 300m and the total length of the survey including current extensions for the DCIP survey was approximately 24.6 line kilometres. The DCIP dipoles were 100m in length and the MT sites were spaced at an equal distance of 100m as well. The tensor magnetotelluric data were acquired over the frequency range of 10 kHz to 0.01 Hz.

SURVEY OBJECTIVES

The objectives of the Titan 24 DCIP & MT survey over the Silver Queen project area are summarized in the following points:

- Detect and delineate favourable zones related to emplacement of Porphyry style mineralization to depths of up to 750 metres with IP and DC-resistivity, and to depths of up to 1500 meters with MT resistivity.

- Identify new targets associated with vein type mineralization within the Silver Queen project area.

- Map and delineate Potential Porphyry target for drill testing.

RESULTS

The Titan-24 DCIP and MT survey that was carried out within the Silver Queen project area was successful at identifying and delineating two new targets based on their chargeability and conductivity properties. The shallow-seated Target A exhibits a moderately strong IP response associated with a resistivity high. This target is suggested to be related to known vein type mineralization. The second Target (B) exhibits however, a large and strong IP response occurring in coincidence with a large conductive zone consistent with the possible existence of Porphyry style mineralization and related alteration. The MT results suggested however, that the presumed Porphyry Target has substantial depth extension.

At the time of writing this report New Nadina Explorations ltd. announced that significant stockwork and Porphyry style mineralization was encountered when drill testing the new identified Targets based on the preliminary inversion results. Further to the very successful drilling results a drilling campaign is underway to map the outlines of the identified Porphyry stockwork.

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

No table of figures entries found.

1   INTRODUCTION

This report presents the logistics and the results of the analysis of the Titan-24 DC IP & MT data acquired from 2011/07/07 to 2011/07/20 over the <u>Silver Queen Project</u>, on behalf of <u>New Nadina Explorations Ltd.</u>

The first part of this report presents the inversion results, their geophysical interpretation, and some recommendations for future follow-up on the property.

The second part of the report presents the logistics of the survey, including the survey parameters and methodology, and the survey results (data) in digital documents.

1.1   SURVEY OBJECTIVES

The exploration objective of the Titan 24 DCIP & MT survey at <u>Silver Queen Project</u> was to map and detect Copper-Silver related mineralization to depth for drill targeting, and delineation of mineralization and alteration. More specifically the objectives are summarized in the following points:

- Detect and delineate favourable zones related to emplacement of Porphyry style mineralization to depths of up to 750 metres with IP and DC-resistivity, and to depths of up to 1500 meters with MT resistivity.

- Identify new targets associated with vein type mineralization within the Silver Queen project area.

- Map and delineate Potential Porphyry targets for drill testing.

The Titan 24 **D**istributed **A**cquisition **S**ystem (**DAS**; Sheard, 1998) employs a combination of multiplicity of sensors, 24-bit digital sampling, and advanced signal processing. It provides three in-dependent datasets capable of measuring subsurface resistivity's (structure, alteration & lithology) and chargeability (mineralization) to depth.

The DC/IP component of the survey should provide an excellent means of delineating target mineralization within the top 500m to 750m pending geologic and cultural environment. The MT resistivity provides additional resistivity information from surface to depths beyond 1km. The MT resistivity is useful for mapping geological contacts with resistivity contrasts and deep conductors that may potentially represent alteration or mineralization.

1.2 GENERAL SURVEY INFORMATION

|	
Quantec Project No.:	CA00857T
Client:	New Nadina Explorations Ltd.
Client Address	Box 130, 298 Greenwood Street, Greenwood, British Columbia, V0H 1J0 Canada,
Client representative:	Ellen Clements Phone: (250) 445-2260 Email: Karine.brousseau@innovexplo.com
Project Name:	Silver Queen Project
Survey Type:	Titan-24 DC IP & MT
Project Survey Period:	2011/07/07 to 2011/07/20
General Location:	Approximately 45 km South of Houston
Province	British Columbia
District	Houston area
Nearest Settlement:	Houston
Datum & Projection:	WGS 84/Zone 9U
Latitude & Longitude:	Approx. 126°42'30"W, 54°04'39"N
UTM position:	Approx. 650402m E, 5994595m N

Figure 1-1: General Project Location[1].
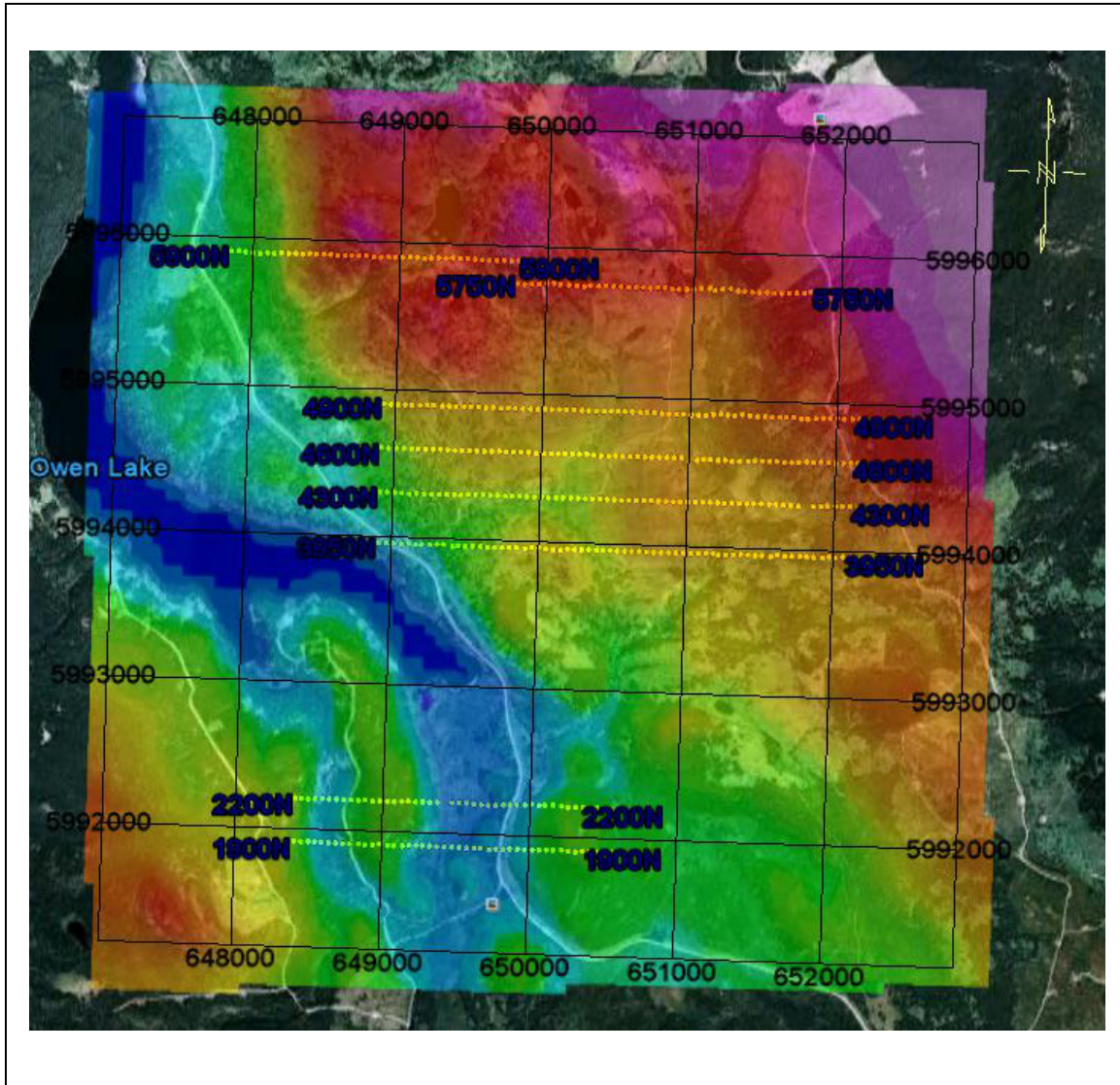
Figure 1-2: Titan Survey Layout (Background, SRTM and Satellite images).

2 PREVIOUS WORK & GEOLOGY

2.1 PROPERTY DESCRIPTION

The Silver Queen Property is located in Central BC, approximately 36 km south of Houston, and 30 km southwest of the Equity Silver Mine. The property is bordered to the west by the Owen Lake. The terrain shows a moderate slope in the southwest direction. Access to the property is south from Houston via the Morice-Owen Forest service Road.

2.2 GEOLOGY OF THE AREA

The project area lies within a series of volcanic and intrusive rocks. The volcanic formations consist mainly of dacites and Dacitic andesites which likely form a part of the Upper Cretaceous-Eocene Endako Group. A sill-like body of micro-diorite intrudes these volcanic rocks and is referred to as the Mine Hill micro-diorite which is part of the Middle-Late Bukley intrusions. The volcanic rocks and the micro-diorite have been intruded by dikes and sills of porphyritic felsites and by basalt dykes, (Figure 2-1).

Approximately 20 mineralized veins have been discovered to date. The average width of the veins is around 1 m with local increase of up to 5 metres approximately. In general, the veins are controlled by NW striking fractures that cut all geological formations. Widespread alteration on the property is present. Pyrite-sphalerite-chalcopyrite and sphalerite-galena are the two general types of sulphide mineralization occurring in the veins. Moderate to high grades of Ag and Au are generally associated with the chalcopyrite-sphalerite veins. Other sulphide minerals include pyrite, tetrahedrite and tennantite. The gangue is mainly cherty quartz, carbonate minerals, and some barite. Local intense alteration of wallrock along veins and fissures has resulted in a mixture of clay and carbonate minerals, some chlorite, minor epidote and disseminated pyrite[2].

2.3 HISTORIC WORK

Several exploration programs have been conducted on the property since its initial discovery in 1912. 200,000 tonnes were produced by Bradina JV during 1972-1973. Later, in the late 80s an extensive development and exploration project was conducted including 35,000 ft of diamond drilling and 8,100 ft of cross-cutting tunnelling.

In 2009 and 2010 New Nadina completed a check sampling program which included ¼ core on all remaining usable core samples.

A ground EM (Max-Min) was conducted in 1996 and a 3D-IP geophysical study was carried out on Silver Queen property in early 2005 by SJ Geophysics Ltd. Recently the property was flown with a ZTEM helicopter-borne survey.

---

[2] JDS Energy and Mining Inc. (2011)
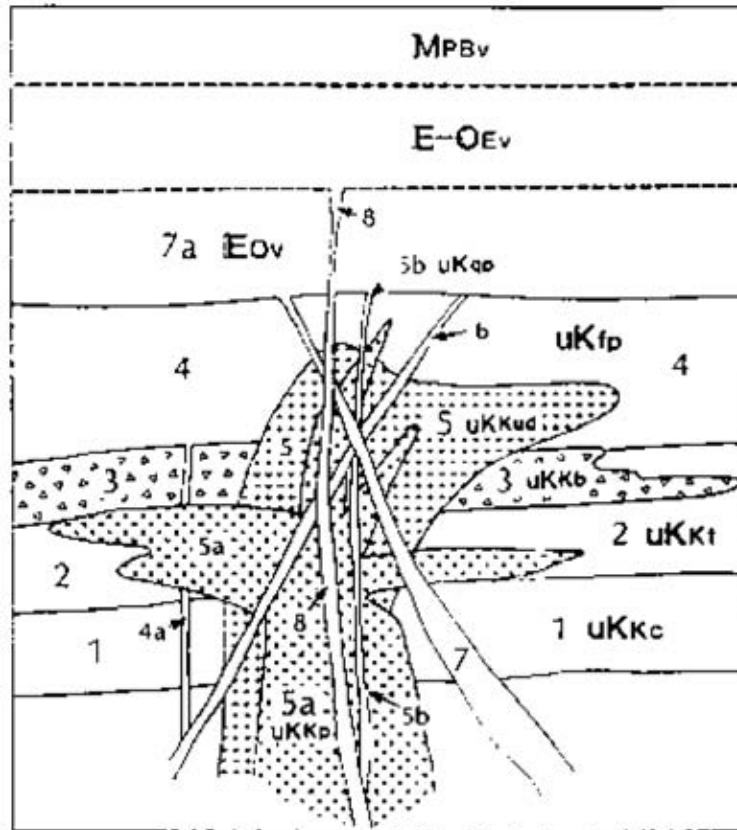
Legend:

MPBv- Olivine basalt

EOEv-8-Basalt, diabase dykes

EOv- 7a- Trachy-andesite, basalt, **7-**Feldspar porphyry dykes, **6**- Amygdular dykes

uKgp- 5b- Qz-Rhyolite dikes, stock,

uKKp- 5a- Intrusive porphyry sills, stock

uKKud-5- Mine Hill micro-diorite

uKKfp-4a-Feldspar biotite porphyry sills, stock, **4-** Feldspar porphyry

uKKb-3- Medium to coarse tuff-breccia

uKKt-2- Crystal tuff, local lapilli tuff, **2a-** Fine ash tuff

uKKc-1- Basal conglomerate, sandstone and shale interbeds.

***Figure 2-1: Schematic diagram of stratigraphic and intrusive units**[3]*

---

[3] JDS Energy and Mining Inc. (2011)

3   RESULTS AND INTERPRETATION

This section presents the results of the 2D inversion of the Titan-24 data and interpretation in context with the survey objectives and significance to future exploration at the Silver Queen Project.

The Titan-24 system acquires three types of geophysical data – magnetotelluric (MT), direct current resistivity (DC), and induced polarization (IP).

The MT and DC methods are used to resolve the resistivity distribution of the subsurface by measuring the electric potential (DC) and the variation of natural source electric and magnetic fields (MT). Resistivity can be an indicator of metallic mineralization, but is more often than not controlled by rock porosity and is therefore an indirect indicator of alteration and mineral grain fabric.

In the induced polarization method, electrical capacitance or chargeability of the subsurface is measured. Chargeability is a near-direct indicator of the presence of sulphide mineralization, in both massive and disseminated forms. Chargeable mineralization is most commonly various sulphides and graphite, but also includes clay-type minerals potentially making it a useful tool for base-metals exploration.

For each line surveyed, the DC-IP utilized a pole-dipole configuration with 100m dipoles with the current injection points located at every 100m between the potential dipoles along the lines. There was no current extension at the end of each profile.

The MT utilized the same DC-IP dipoles, plus another set of 100m dipoles oriented perpendicular to the profile at every second site to acquire electric field data. One set of high-frequency and one set of low frequency magnetic sensors was used on the line. A remote site with the same magnetic sensor configuration was used to improve processing of the MT data.

Detailed information on the survey logistics, acquisition parameters and screen capture of the acquired data for the survey are provided in appendices at the end of this report.

The final inversion models are presented graphically in Geosoft plot format along with an interpretation overlay and comments on the most significant results and recommended targets. Scaled sections and plan maps of the resistivity (DC and MT) and of the chargeability models are also provided at the end of this report.

Detail results, i.e. observed DC-IP-MT data and equivalent calculated responses for each model, are presented on a line per line basis in PowerPoint (PDF) documents delivered in the digital archive (CD/DVD) attached to this report.

3.1   OVERVIEW OF INVERSION PROCEDURE

3.1.1   *DC RESISTIVITY & INDUCED POLARIZATION INVERSIONS*

DC-IP is an electrical method that uses the injection of current and the measurement of voltage difference along with its rate of decay to determine the subsurface resistivity and chargeability, respectively. Depth of investigation is mainly controlled by the array geometry, but may also be limited by the received signal, which is dependent on transmitted current, and ground resistivity. The chargeability parameter is particularly susceptible to cases with a low signal-to-noise ratio. In its standard configuration (a=100m / n=0.5-23.5) the Titan-24 surveys typically image DC resistivity to

depths of 500-750m, and the IP typically images to 500-750m, in sub-vertical tabular geologic settings and up to 50% more for sub-horizontal. The differences in penetration are a function of the relative property contrasts and relative signal-to-noise levels between the two measurements. decreases or increases proportionally to the dipole-size (i.e., 300-500m for 50m dipoles, and 1000-1500m for 200m dipoles). A detailed introduction to DC-IP is given in Telford, et al. (1976).

The primary tool for evaluating the Titan-24 data is through the inversion of the data in two-dimensions (2D). An inversion model depends not only on the data collected, but also on the associated data errors in the reading and the "model norm". Inversion models are not unique and may contain "artefacts" from the inversion process. The inversion model may not accurately reflect all of the information apparent in the actual data. Inversion models must be reviewed in context with the observed data, model fit, and with an understanding of the model norm used.

The Titan-24 DC and IP data were inverted to produce cross-sections of the resistivity and chargeability variations along the survey lines. The UBC DCIP2D inversion code (Oldenburg & Li, 1994) was used for the 2D inversion of the DC and IP data.

Potential difference (voltage) and phase values were used as input data in the DC and IP inversions, respectively. DC Resistivity and induced polarization (IP) data are first pre-conditioned; the error of each data point is adjusted for the inversion process using a general error equation similar to:

$$errors\begin{pmatrix} Vp \\ IP \end{pmatrix} = A\% \begin{vmatrix} Vp \\ IP \end{vmatrix} + B \times \text{Acq\_Error}\begin{pmatrix} Vp \\ IP \end{pmatrix} + C \text{ (floor)}$$

with the set of parameters $\{A, B, C\}$ adjusted (and large errors data points removed) for each dataset until we achieve convergence with relaxation of the DC or IP models (see example of Model Norm fit curve on Figure 3-1).

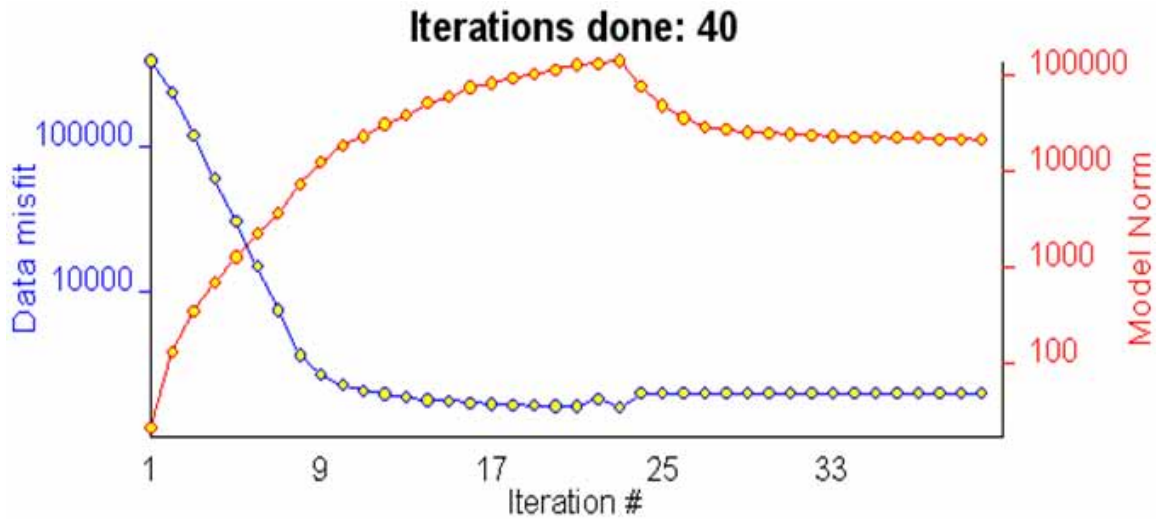*Figure 3-1: Example of DC-IP misfit curves showing relaxation of the model after iteration #40.*

Three 2D inversions were carried out along each line.

The DC data was inverted using an unconstrained 2D inversion with a homogenous half-space of average input data as starting model. The DC models are labelled as 'smDC' or 'DC'.

Two IP inversions are calculated from the same data set and parameters, but they use a different

reference model[4]. The first inversion of the IP data uses the previously calculated DC model as the reference model, and is labelled the 'IP_DC model'. The second IP inversion uses a homogeneous half-space resistivity model as the reference model and is labelled 'IP_HS model' or 'IP *nullcon'* model. This model is included to test the validity of chargeability anomalies, and to limit the possibility of inversion artefacts in the IP model due to the use of the DC model as a reference.

The DC and IP inversion use the same mesh. The horizontal mesh was set as 2 cells between electrodes on the double spread lines, and as 3 cells between electrodes on the single spread lines. The vertical mesh was designed with a cell thickness from 10 to 15m for the first 200-300m to accommodate the topographic variation along the profile, and then it increases from 20 to 100m with depth. The inversions were generally run for a maximum of 50 iterations.

3.1.2   AUDIO-MAGNETOTELLURIC INVERSIONS

The Audio-Magnetotelluric (AMT) method is a natural source method that measures the variation of both the electric (E) and magnetic (H) field on the surface of the earth in order to determine the distribution at depth of the resistivity of the underlying rocks. A complete review of the method is presented in Vozoff (1972) and Orange (1989).

The measured MT impedance Z, defined by the ratio between the E and H fields, is a tensor of complex numbers. This tensor is generally represented by its two off-diagonal elements. In a 1D earth model, i.e. the resistivity varies only with depth, there is no strike direction and the two off-diagonal impedances are equal. In the 2D case, i.e. when the resistivity varies with depth and perpendicularly to the strike, and when the profile is set perpendicular to the strike direction, the two off-diagonal elements are not equal but reflect the variation of the resistivity along two directions, one parallel and the other perpendicular to the strike, i.e., the TE (Transverse Electric; E parallel to the strike) and the TM (Transverse Magnetic; E perpendicular to the strike) modes.

Both TE and TM impedances are represented by an apparent resistivity (a parameter proportional to the modulus of Z) and a phase (argument of Z). The variation of those parameters with frequency relates the variations of the resistivity with depth, the high frequencies sampling the sub-surface and the low frequencies the deeper part of the earth. However the apparent resistivity and the phase have an opposite behaviour. An increase of the phase indicates a more conductive zone than the host rocks, and is associated with a decrease of the apparent resistivity. The objective of the inversion of MT data is to compute a distribution of the resistivity of the surface that explains the variations of the MT parameters, i.e. the response of the model that fits the observed data. The solution however is not unique and different inversions must be performed (different programs, different conditions) in order to test and compare solutions for artefacts versus a target anomaly.

The primary tool for evaluating the Spartan MT data is 1D, 2D, and 3D inversion.

The depth of investigation is determined primarily by the frequency content of the measurement. Depth estimates from any individual sounding may easily exceed 20 km. However, the data can only be confidently interpreted when the aperture of the array is comparable to the depth of investigation.

The inversion model is dependent on the data, but also on the associated data errors and the model norm. The inversion models are not unique, may contain artefacts of the inversion process and may not therefore accurately reflect all of the information apparent in the actual data. Inversion models need to be reviewed in context with the observed data, model fit. They must have an understanding of the

---

[4] The reference model is used to calculate the sensitivity matrix used at each iteration for the IP inversion.

model norm used and if the model is geologically plausible.

For this study, 1D and 2D inversions were performed on the data.

A 1D model at each MT site and for each mode (TE, TM, and DET-determinant) has been calculated as a QA/QC tool using an Occam layered inversion program. This inversion calculates a 1D resistivity earth model (i.e., the resistivity varies only with depth) that best fits the data. When comparing the 2D MT results obtained from a half space starting model and 1D starting model we found that the results with half space starting model are close to the DC-resistivity model. Therefore, the MT interpretation was based on the 2D MT models generated with a half-space starting model.

The 2D inversions were completed on each profile using the "un-rotated" data which assumes the strike direction is perpendicular to the profile for all sites: the TM mode is then defined by the inline E-field (and cross line H-field), and the TE mode is defined by the cross line E-field (and inline H-field) data.

Two different 2D inversion algorithms were used to invert the MT data. The first inversion procedure was carried out using the Quantec proprietary Phil Wannamaker inversion algorithm (PWm). The second inversion was carried out using the Randy Mackie inversion code (RLM). From previous work, we noticed that the PWm code has a tendency to accentuate anomalies with sharp vertical boundaries and to locate these anomalies at a greater depth than the RLM code. In contrast, the RLM code has a tendency to accentuate anomalies with a layered (horizontal) aspect resulting in a smooth lateral variation and lower depth to top of the anomalous bodies. Therefore, the choice of the inversion algorithm and the inversion results to be used in interpretation is generally dataset definitive and must confirm with the geological setting of the survey area.

All inversions used the TE and TM resistivity and phase from 10 kHz to 0.01Hz, interpolated at 6 frequencies per decade, assuming 5% error for the resistivity and 3 degrees error for the phase.

The different models calculated are:

> The PWm model <u>PUTH4</u> was computed from the TE and TM apparent resistivity and phase MT data starting from a half space model of 100 Ohm-m but with the topography included in the inversion.

> The PWm model <u>PUTD4</u> was computed using the TE and TM apparent resistivity and phase MT data but starting from the smooth stitched 1D DET inversion model.

The final 2D inversion MT model presented in this report and used in the interpretation is the PWm inversion starting from a half space model of 100 Ohm-m, and using TM and TE apparent resistivity and phase from 10kHz to 0.1Hz because of its fit to the data and its correlation with the DC and IP models.

3.2   DISCUSSION OF RESULTS

In this section we will present and discuss the results obtained from the DCIP and MT inversions. The DCIP inversions (Resistivity and Chargeability Smooth Models) were obtained from inverting the Titan DCIP data using the 2D UBC code[5]. A half space was used as a starting model for the DC inversion, whereas the IP inversion was performed with half space and DC referenced models. The MT inversion

---

[5] Oldenburg D.W. and Li Y., 1999

was carried out using the 2D PWm code[6] under Geotools MT platform and based on finite element algorithm. The 2D inversion was implemented with a 100 Ohm-m half space and 1D determinant starting models. The inversion results obtained from the 2D DCIP inversions are presented as resistivity-depth sections and chargeability depth sections (half space and DC referenced), whereas the MT inversion results are presented as resistivity-depth sections. In all sections, x and y axis were represented by stations and elevations, respectively. Depth plan maps (depth slices) obtained at different elevation levels were also generated and presented in this report with x and y UTM coordinates. Station locations were also plotted on all plan maps.

The section maps were generated for each line and include elements of interpretation, which are based on the detection and delineation of anomalous zones presenting resistivity and chargeability contrasts with the hosting medium.

▬ ‧ ▬ ‧	▬ ▬ ▬ ▬	··········	IP_A	DC_A	MT_A
IP Anomaly	DC/MT Anomaly	Fault	IP ID	DC ID	DC ID

Sections and maps Legend

Line 5900N

Results of the DCIP and MT inversions for this line are shown in Figures 3-2 and 3-3, respectively. This northernmost line consisted of 1 Titan spread of 2400 m length. Extra DCIP information on both sides of the line was gained by using 700 m of current extension to the east and 500 m current extension to the west. The IP models (DC-referenced and Half-space referenced) include a broad and deep seated moderately chargeable zone (≈40 mrads), which appears to be coincident with a resistivity high (≈1000 Ohm-m). This anomalous zone is overlain by weakly or non-chargeable formations attributed likely to felsic volcanic rocks. The DC model section highlights however, a slightly conductive zone in the westernmost portion of the section associated with a non-chargeable zone.

The upper portion of the MT resistivity model section illustrated in Figure 3-3 agrees well with the DC-model by highlighting the same anomalous features. However, the MT section indicates a possible deep faulting zone dipping westward.

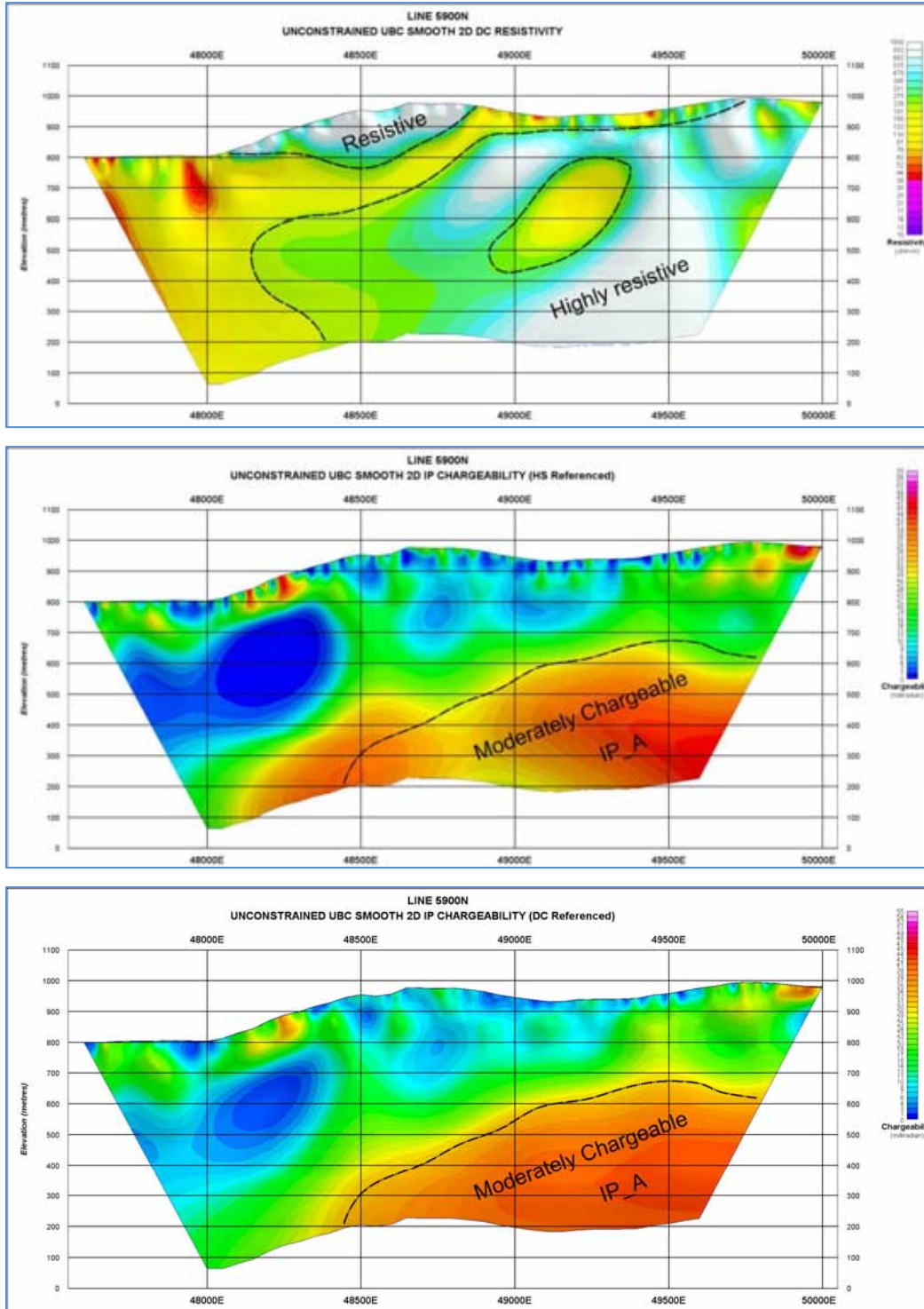---

[6] Delugao P.P. and Wannamaker P.E., 1996

Figure 3-2: *2D DCIP inversion results for line 5900N*

Figure 3-3: *2D MT inversion results for line 5900N*

Line 5700N

DCIP and MT inversion results for this line are illustrated in Figures 3-4 and 3-5 below. The DCIP survey was conducted with 700 m current extension on both sides of the line. The DC-resistivity model shown in Figure 3-4 highlights 2 strong anomalous zones; The first one is a flat lying and near the surface that corresponds to non-chargeable materials. This anomalous zone is likely associated with basaltic formations that exhibit resistivity low. The second zone (DC_B) is a deep seated anomaly (>500m) that occurs in coincidence with a chargeability moderately high (IP_B) as indicated in the half-space referenced and DC-referenced IP model sections. This deep seated anomalous feature may be associated with porphyry style alteration zone and therefore represents a target of interest.

The MT-resistivity model section correlated well with the DC-resistivity model and highlights the same anomalous features. However, anomaly MT_B, which corresponds to the anomaly DC_B appears to occur at lesser depth (<500m). On the other hand, the resistive zones shown in both DC and MT models seem to be associated with resistive felsic volcanic rocks.

Line 4900N

DCIP and MT inversion results for this line are illustrated in Figures 3-6 and 3-7 below. The DCIP survey was conducted with 700 m current extension on both sides of the line. The DC-resistivity model highlights a strong near the surface anomalous zone that dominates the eastern portion of the section. This anomalous zone corresponds to non-chargeable features and is likely attributed to basaltic formations. The second anomalous zone (DC_B) is a deep seated target (≈550 m) centred on station 50250E and occurs in coincidence with chargeability high (>50 mrads), IP_B. The identified Target B is suggested to represent a favourable target for the exploration of Porphyry related alteration and mineralization zones. On the other hand a moderately chargeable and flat lying zone located near the surface is depicted in the western portion of the section. It could correspond to chargeable sedimentary formations.

Target B appears to have a bigger size in the MT-resistivity model section. Furthermore, the MT model indicates that this anomalous zones extents to great depth (1000 m approximately), confirming the possible association with a large Porphyry target.
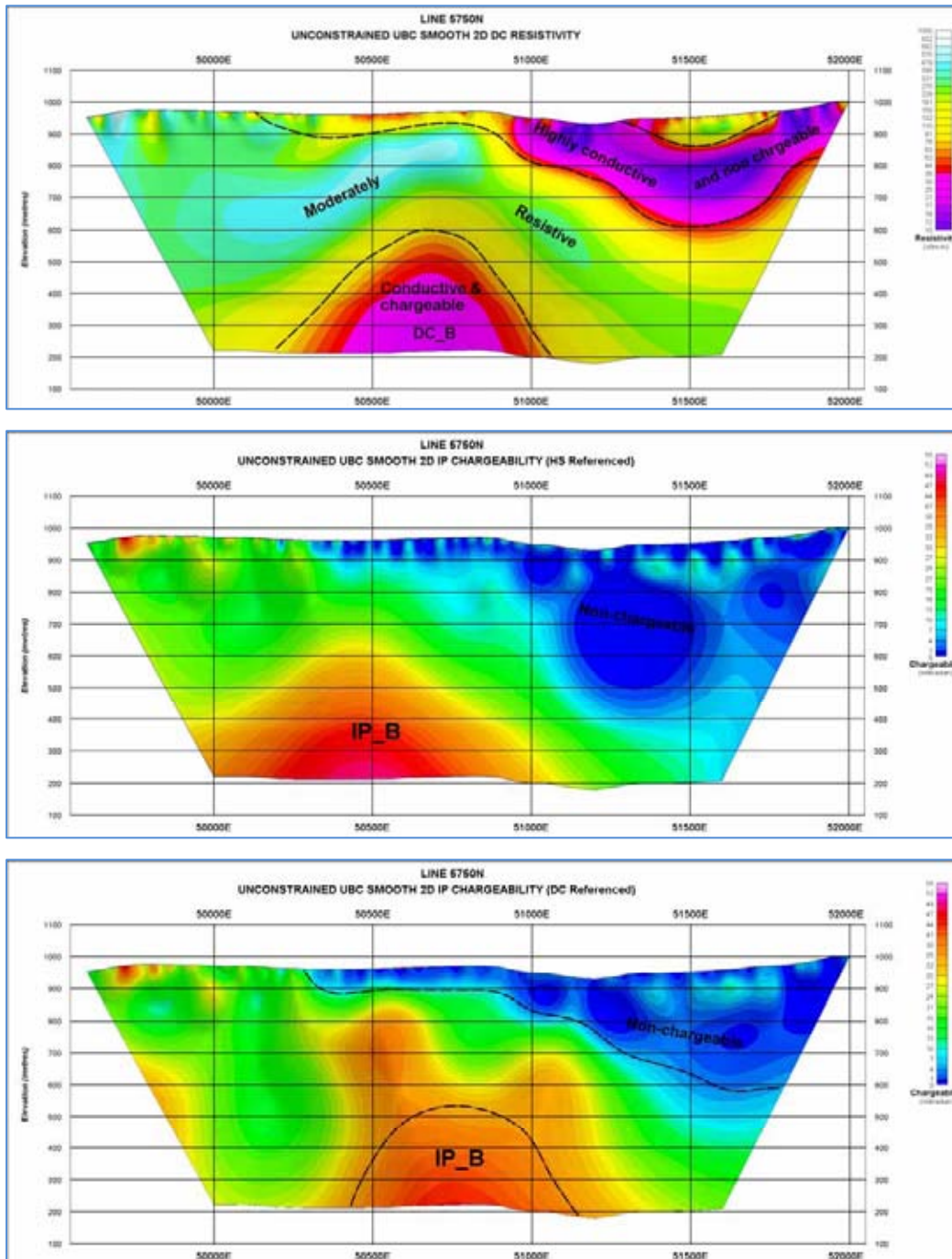
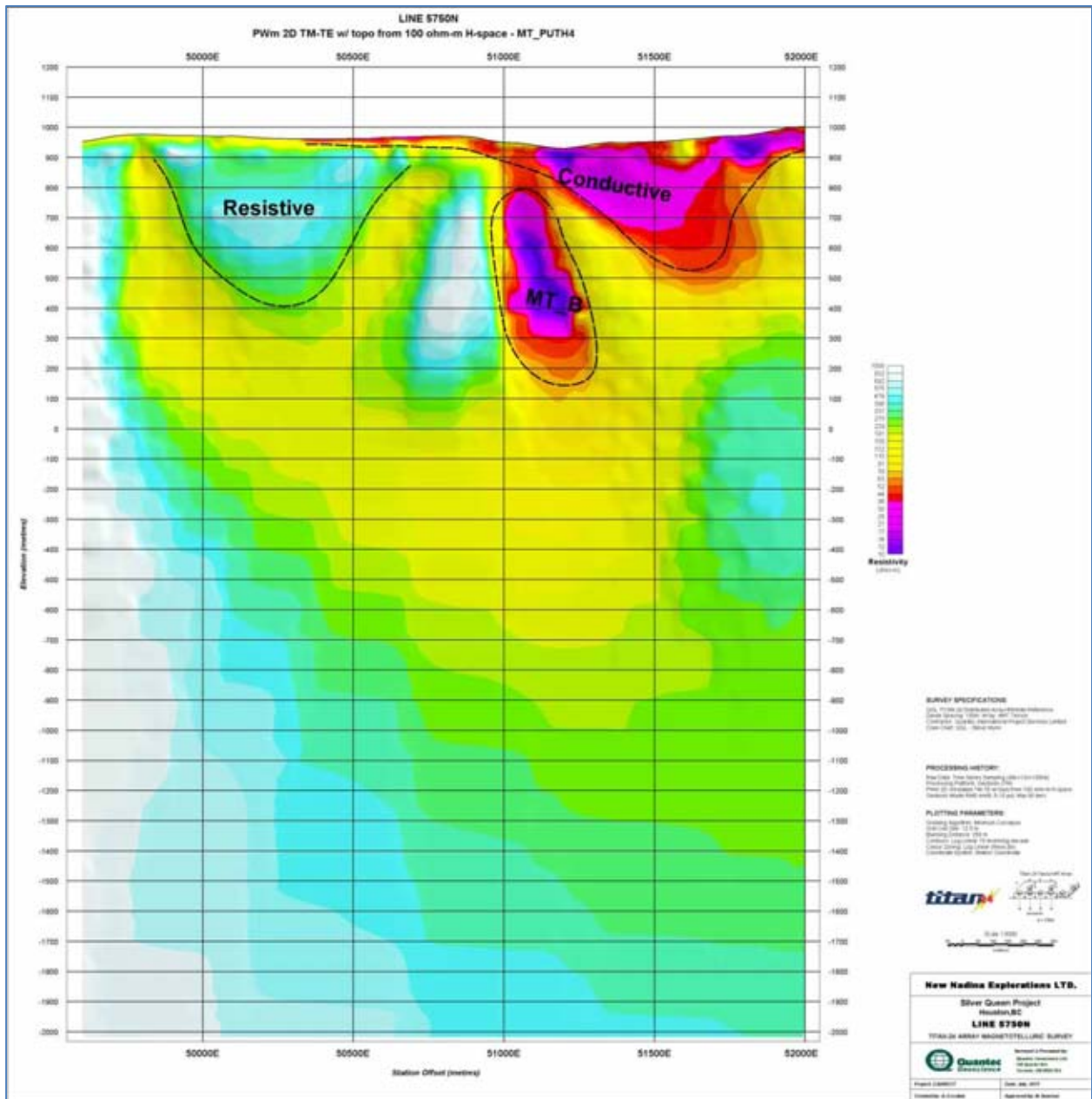**Figure 3-4:** *2D DCIP inversion results for line 5750N*

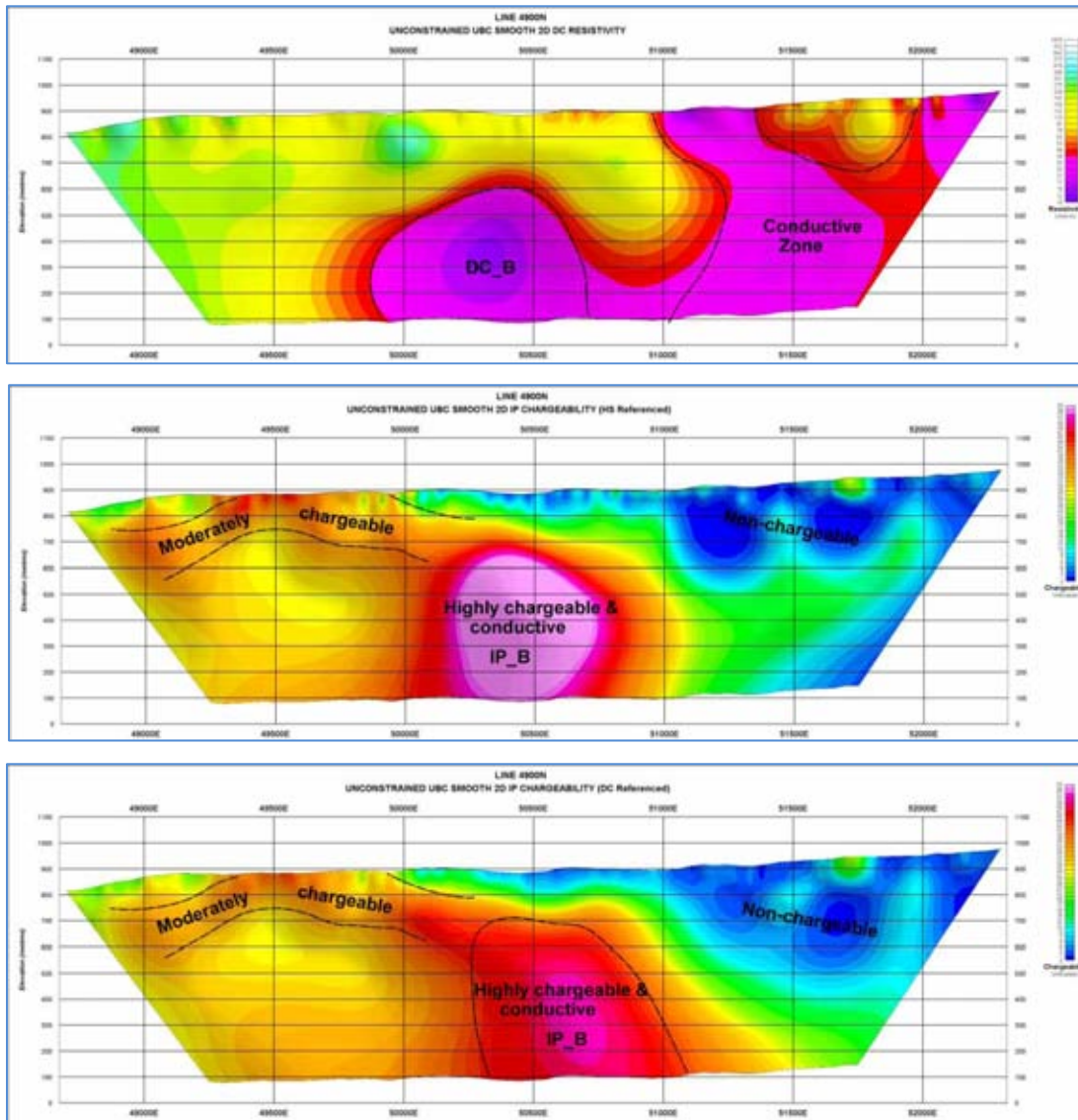**Figure 3-5:** *2D MT inversion results for line 5750N*

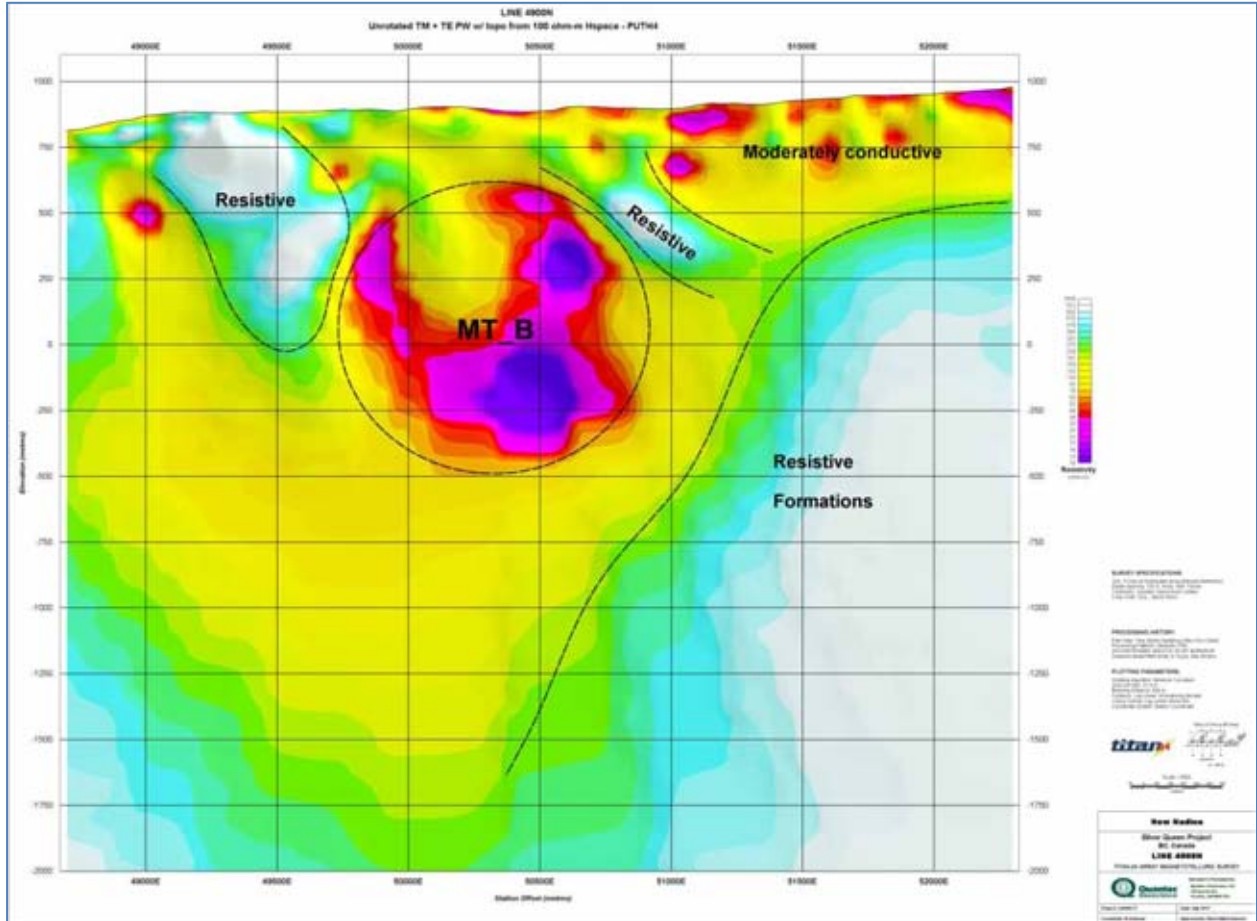**Figure 3-6:** *2D DCIP inversion results for line 4900N*

Figure 3-7: *2D MT inversion results for line 4900N*

Line 4600N

Figure 3-8 and 3-9 below depict the DCIP and MT inversion results for this line. The IP models (half-space referenced and DC-referenced) highlight 2 superb IP zones, IP_ A and IP_B. The deep seated anomalous Zone IP_B exhibits a chargeability high (>50 mrads) and occurs in coincidence with resistivity low (DC_B). As mentioned before, this Target may be associated with a large Porphyry zone that seems to be elongated in the NS direction. The second IP anomaly (IP_A) is a more confined anomaly located at shallower depth (<250m) and appears to be associated with a resistivity moderately high. This anomaly constitutes a favourable target for vein type mineralization. On the other hand, the models sections highlight a conductive zone dominating the upper eastern portion of the section and associated with non-chargeable formations. As mentioned in the previous sections, this anomalous feature is likely associated with conductive basaltic flows.

The MT resistivity model section in general agrees well with the DC-resistivity model but also indicates that the main conductive target (MT_B) appears to have bigger size and greater depth extension ($\approx$ 1000 m) confirming the possible existence of large porphyry target at depth. Moreover, the MT section highlights a banana shape moderately conductive layer in the eastern portion of the section. It could be associated with deep seated conductive sediments as shale interbeds.

Line 4300N

DCIP and MT model sections for line 4300N are shown in Figures 3-10 and 3-11 below. The DCIP model sections look very similar to those of the previous line by highlighting mainly the two targets A and B. This confirms thus the possible existence of a large porphyry system (Target B) and vein mineralization (Target A). On the other hand, the MT model confirms the evidence of the possible presence of Porphyry related target (B) and also highlights a banana shape moderately conductive layer attributed likely to deep seated sedimentary formations.

Line 3950N

Figures 3-12 and 3-13 below illustrate the DCIP and MT model sections for line 3950N. The upper most portion of the DC model section is dominated by resistivity low, particularly in the eastern part of the section and corresponding likely to conductive and non-chargeable basaltic flows. The deepest part of the DC model is dominated by broad conductive zone including mainly 2 deep-seated anomalies (DC_B and DC_C). Anomaly DC_B occurs in coincidence with chargeability moderately high (>40 mrads) and is considered as being related to Porphyry target, whereas anomaly DC_C seems to be not related to a particular chargeable feature, although a moderately chargeable zone can be noticed in the IP referenced model at the same location. The confined and shallow seated IP anomaly (IP_A) occurs in coincidence with a resistivity high suggesting the possible association with vein type mineralization.

The MT model section is however, dominated by large conductive zone occurring mainly in the eastern portion of the section. The near the surface conductive features are likely attributed to basaltic flows,

whereas the deep seated anomalous zones are partly related to possible presence of porphyry systems and partly to deep seated alteration zones (MT_D).
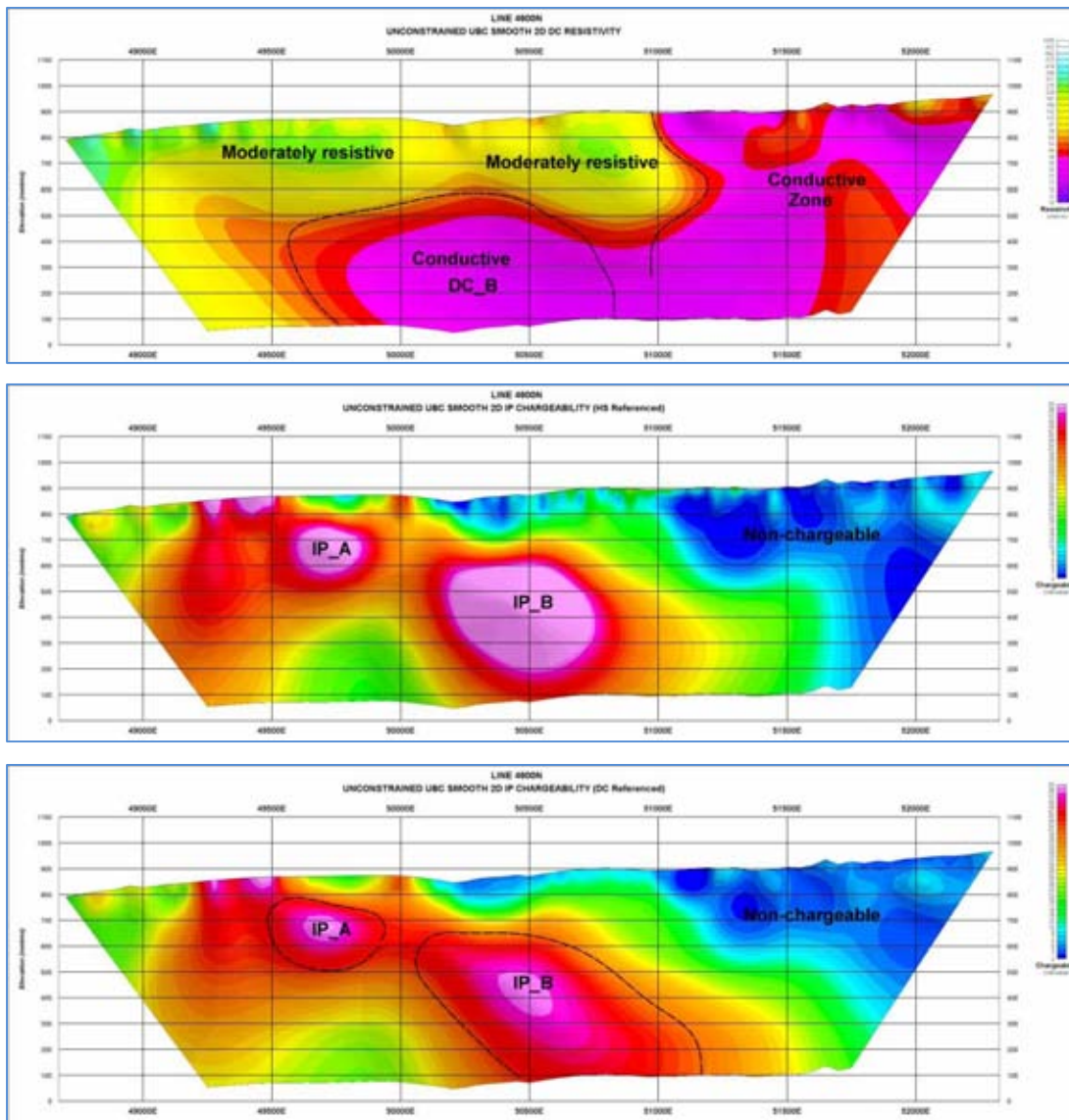

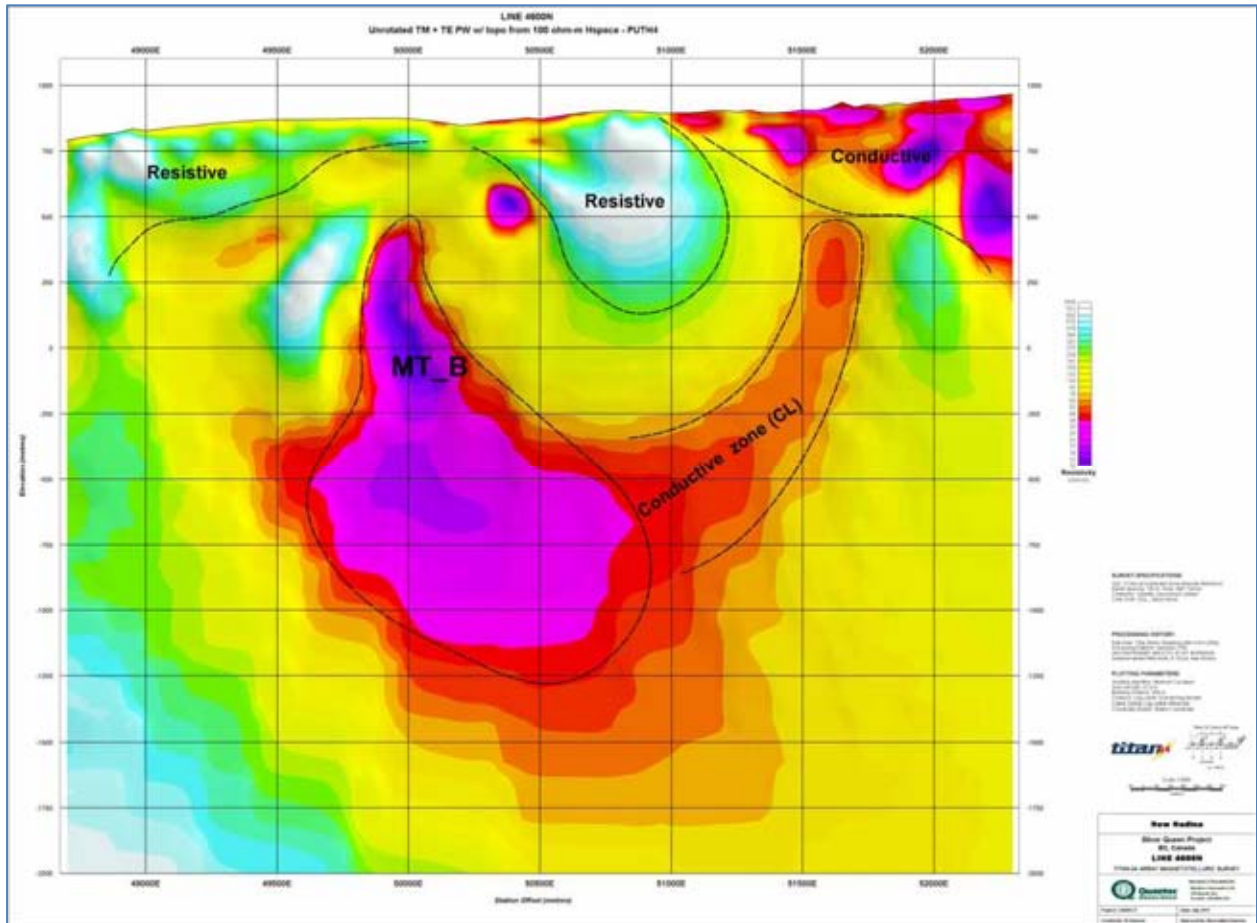**Figure 3-8:** *2D DCIP inversion results for line 4600N*
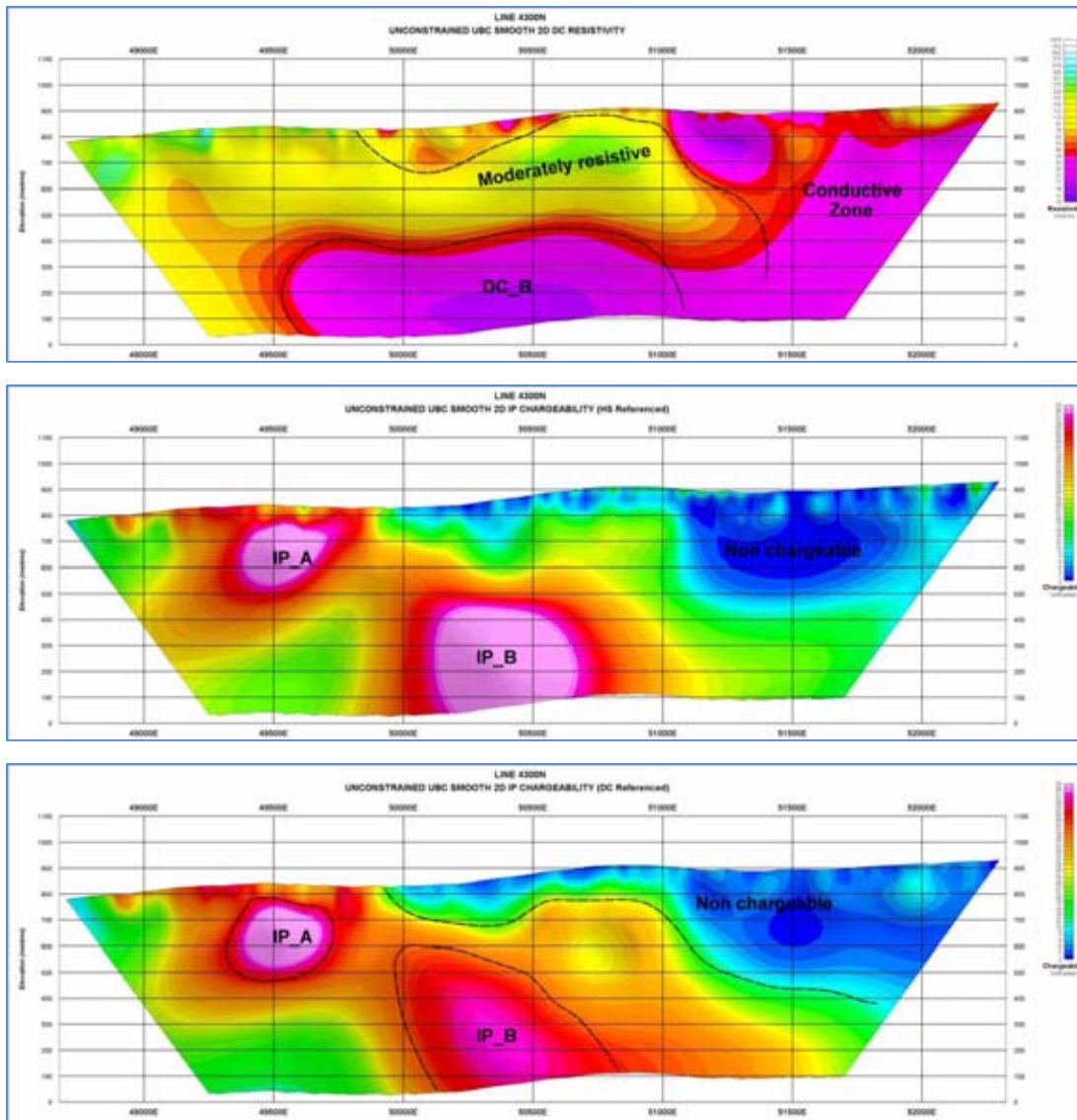
Figure 3-9: *2D MT inversion results for line 4600N*

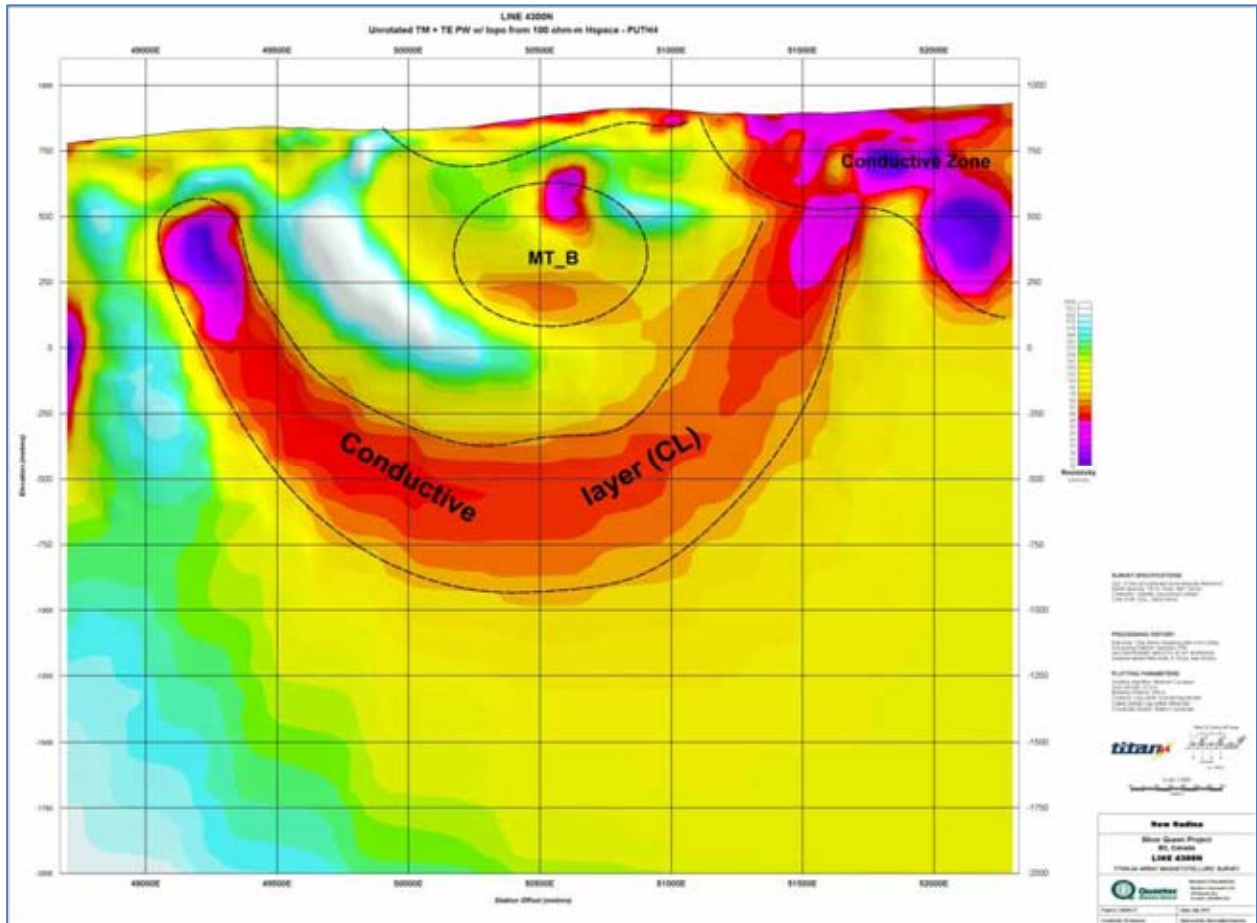**Figure 3-10:** *2D DCIP inversion results for line 4300N*

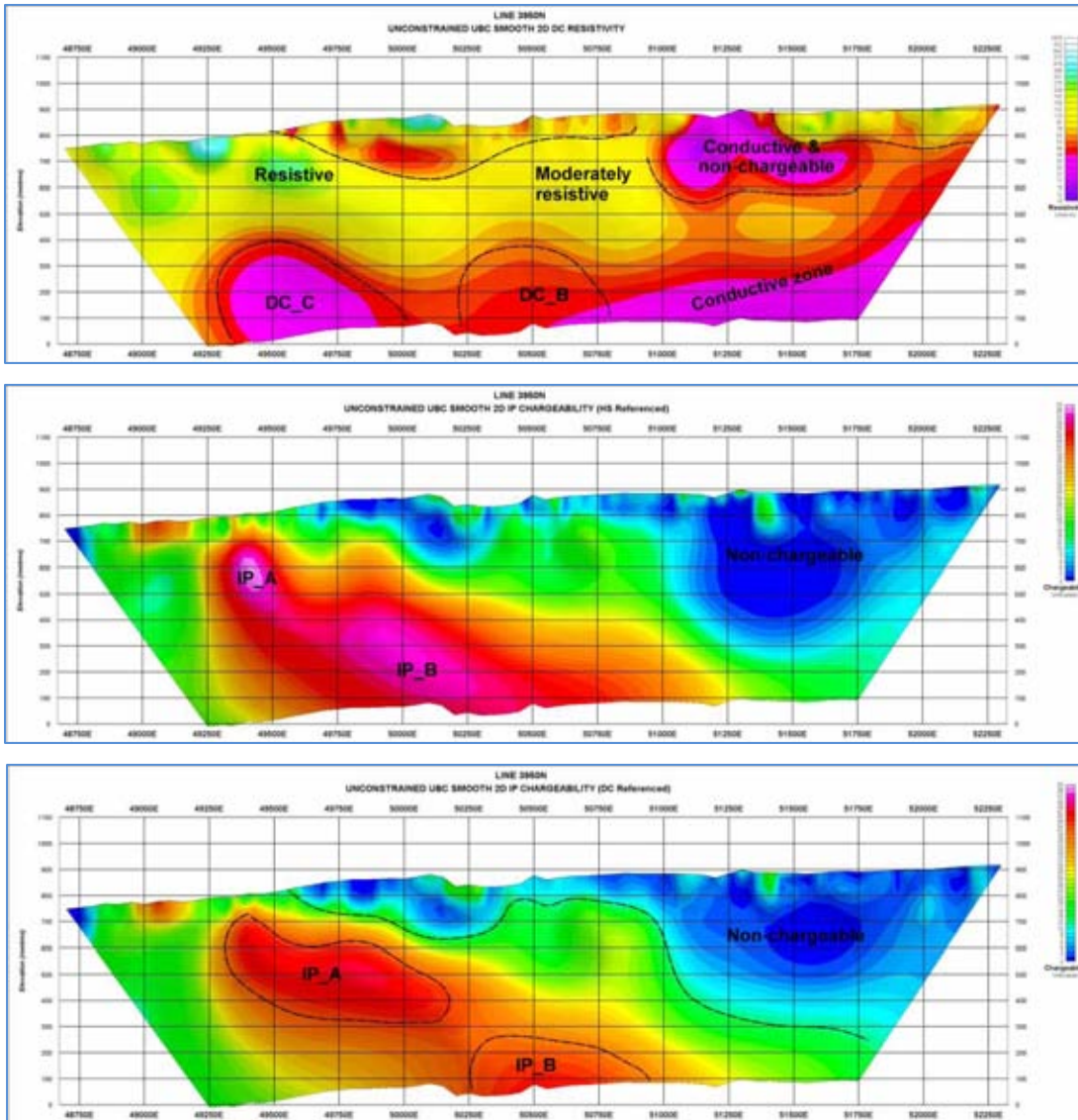**Figure 3-11:** *2D MT inversion results for line 4300N*

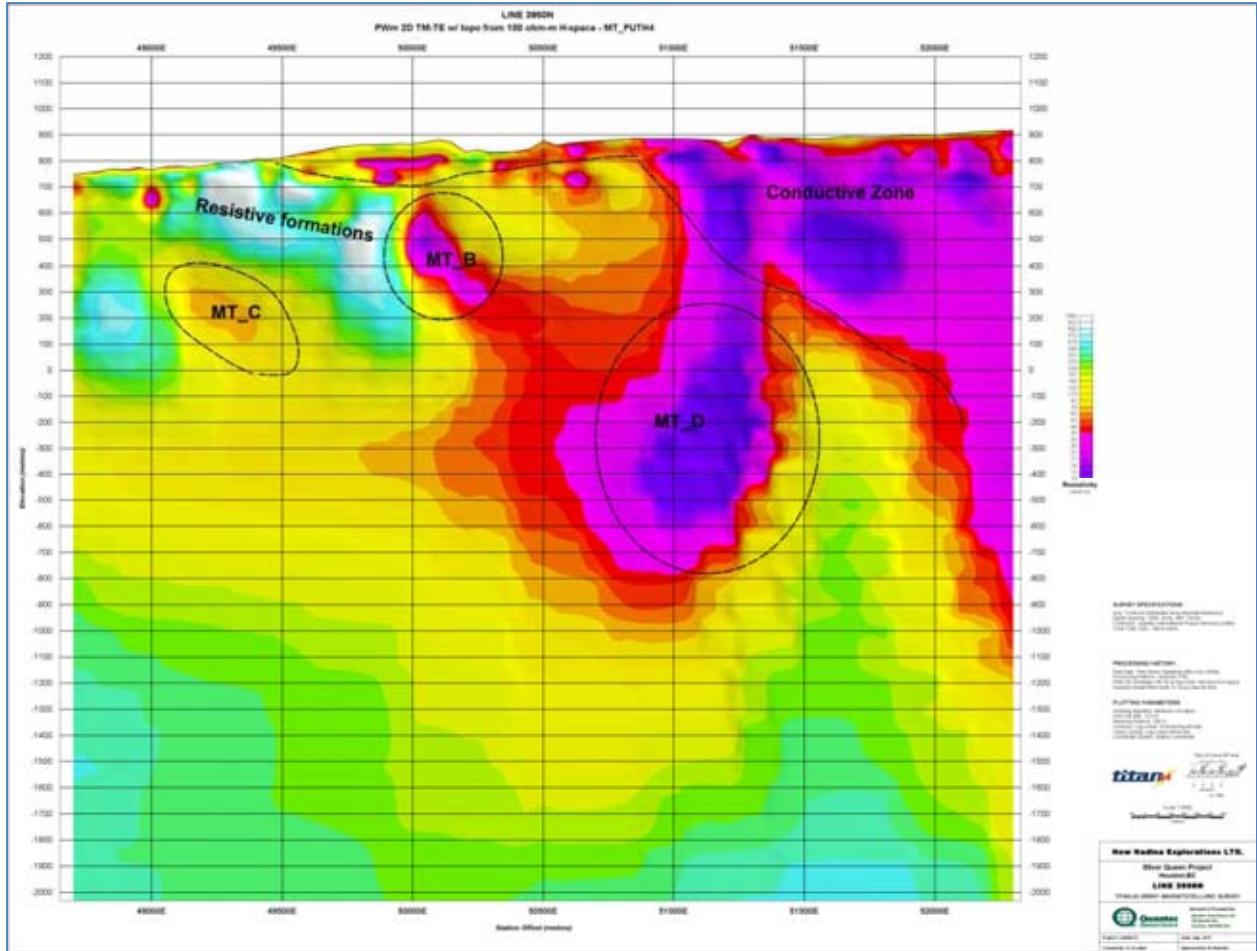**Figure 3-12:** *2D DCIP inversion results for line 3950N*

Figure 3-13: *2D MT inversion results for line 3950N*

Line 2200N

Line 2200N is located in the southern portion of the property. The DCIP and MT model sections for this line are illustrated in Figures 3-14 and 3-15 below. The DC-resistivity model section is dominated by a flat lying and very large conductive feature associated with non-chargeable formations that are likely associated with mafic volcanic formations (basaltic flows and sills). No noticeable IP responses are to be mentioned except for the near the surface weakly-chargeable features that appear to be associated with either conductive or moderately conductive features.

The MT model section highlights conductive features occurring at depth range of 0-1000 m approximately and dominating mainly the central and eastern portions of the section. These feature as mentioned above are likely attributed to conductive volcanic flows. The deeper portion of the section is dominated by resistive formations that could indicate the presence of resistive intrusive bodies. Moreover, the MT model suggests the existence of a westward steeply dipping deep fault.

Line 1900N

DCIP and MT model section for this southernmost line are illustrated in Figures 3-16 and 3-17 below. Similarly to the previous line, the DC model section highlights a broad and flat lying conductive feature dominating the deeper portion of the section. This anomalous zone, which corresponds to non-chargeable feature, appears to be associated with deep seated mafic volcanic flows and sills. The top of the DC sections is marked by either conductive or resistive feature reflecting the conductive overburden and other surficial resistive formations. Weakly chargeable and moderately resistive formations are indicated under the overburden formations. They are probably associated with felsic volcanic rocks.

The MT model section illustrated in Figure 3-17 highlights the same conductive feature as the DC model section within the depth range of 0-800 m approximately. However, the MT data indicates the presence of deep-seated conductive anomalous zone located in the eastern portion of the section that could represent a deep alteration zone or deep conductor. The Central area is however, dominated by resistive formations that are likely associated with a large resistive intrusive body. In addition, the MT section suggests a westward dipping fault in the western portion of the section.
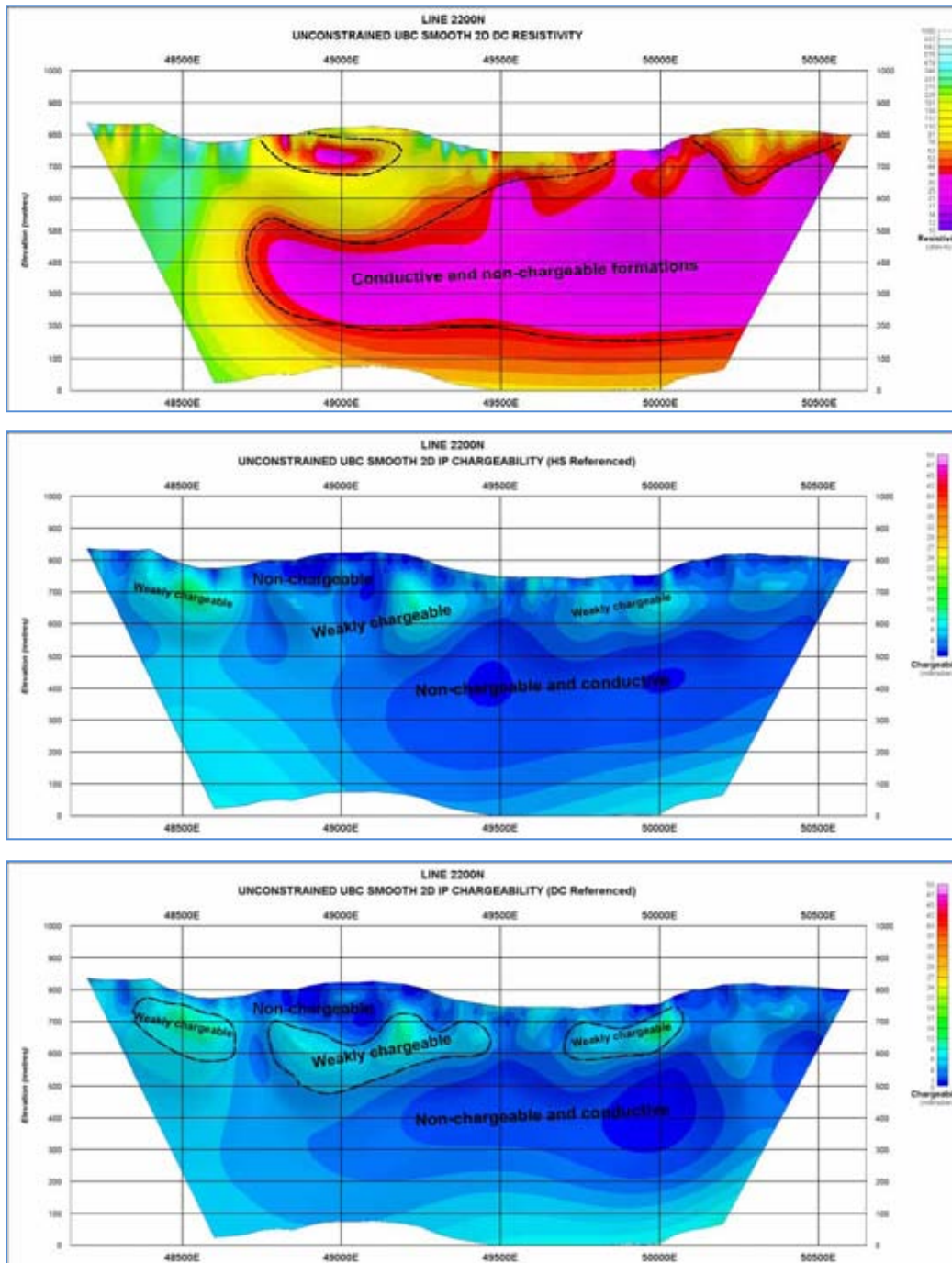
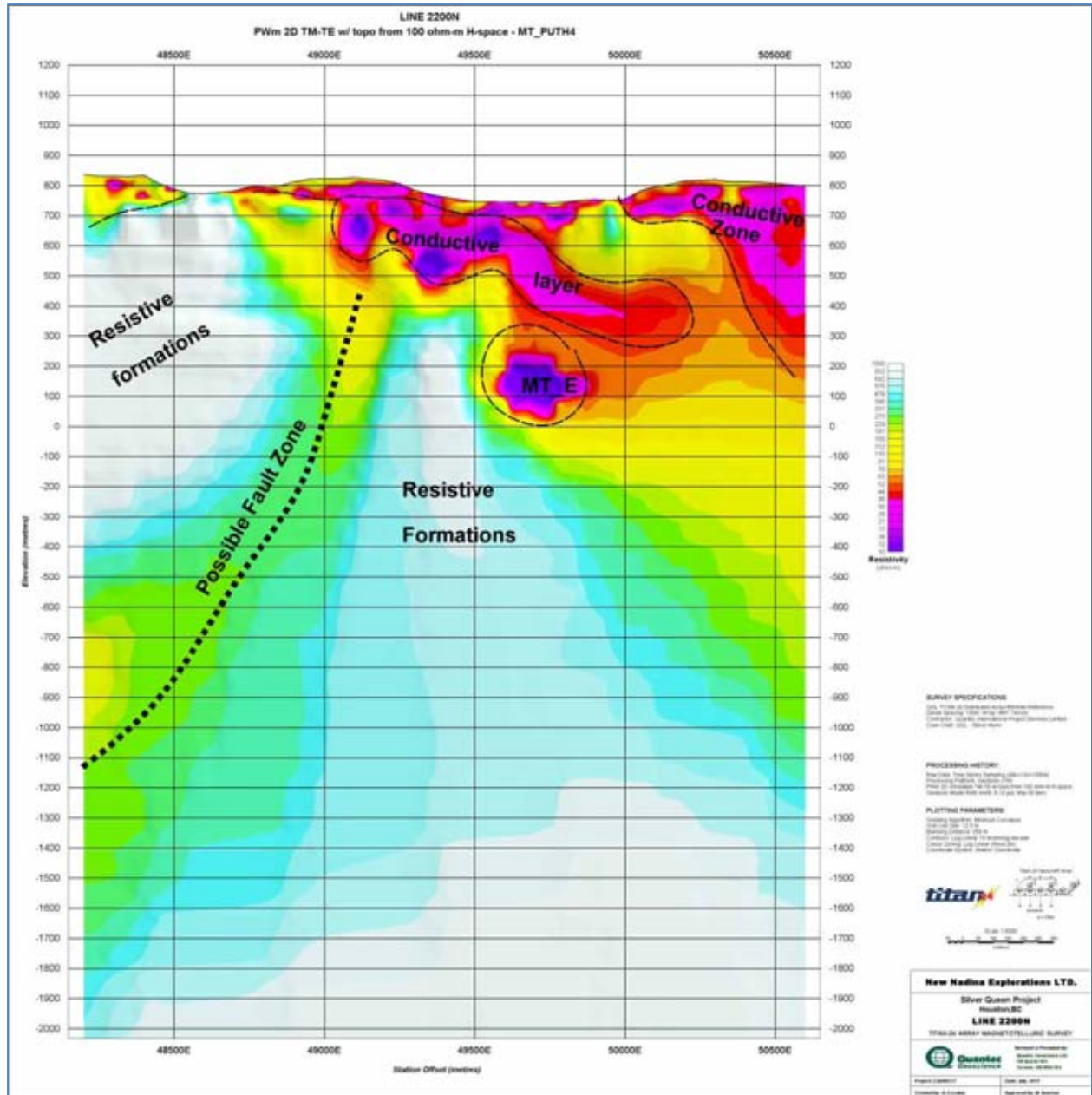**Figure 3-14:** *2D DCIP inversion results for line 2200N*

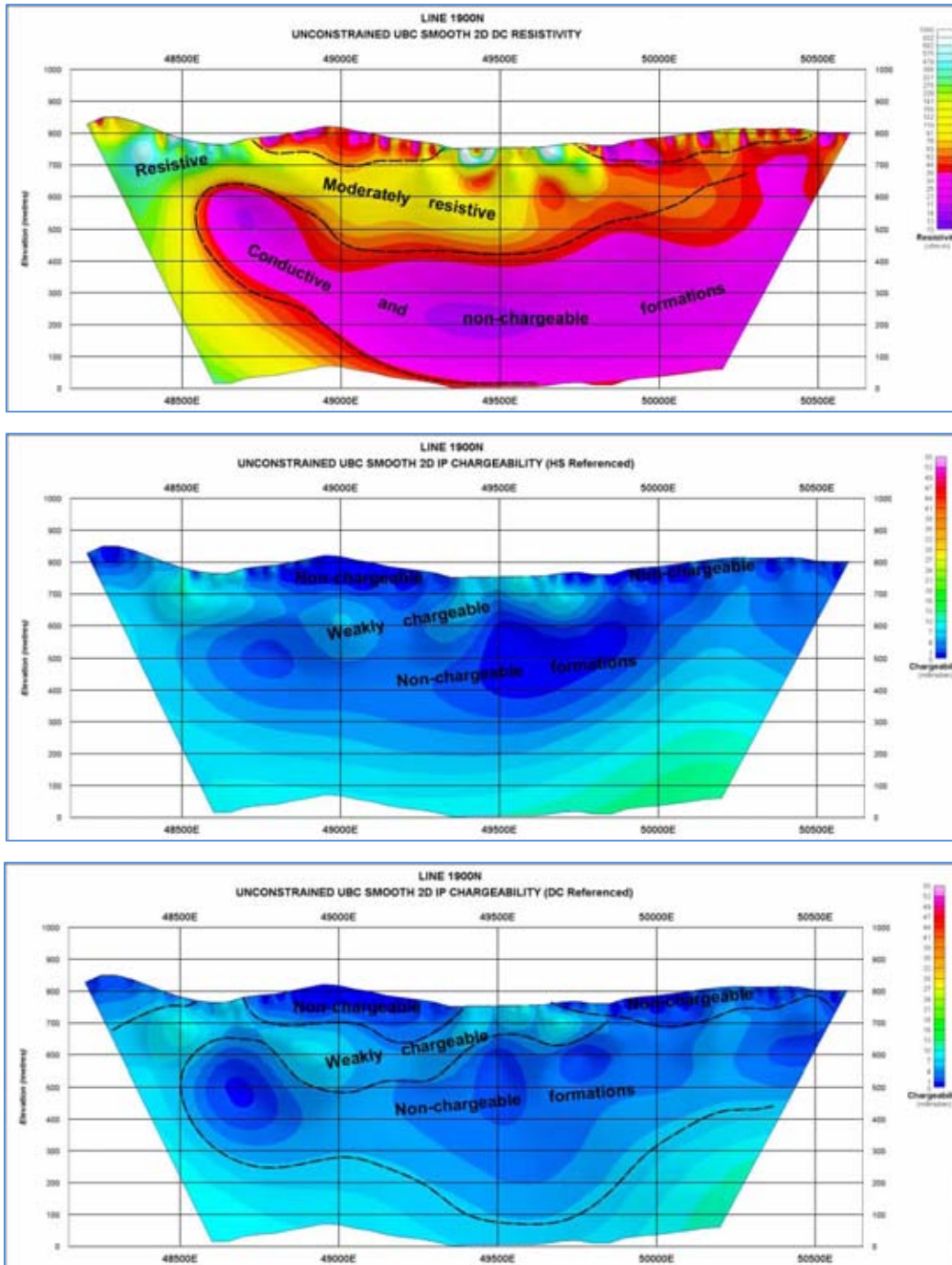**Figure 3-15:** *2D MT inversion results for line 2200N*

Figure 3-16: *2D DCIP inversion results for line 1900N*

Figure 3-17: *2D MT inversion results for line 1900N*

PLAN MAPS

Plan maps provide useful information to characterize resistivity and chargeability distribution obtained at the same depth or elevation levels (depth slices). They are also used to correlate between lines the information obtained from sections in order to estimate the lateral extents of anomalous features. They are particularly useful in the case of multi-spread (multi-line) surveys to detect major trends and direction of the anomalies and structures, and to have an idea about how the detected anomalies correlate from line to line. A series of plan maps were generated in Geosoft using the data obtained from sections by gridding the data corresponding to the same elevation (depth slice) using the available spreads. 8 plan maps for resistivities and chargeabilities for elevations starting from 800m to 100m at 100 m interval were generated and presented in this report. On the other hand and in order to have an insight of the resistivity distribution at great depths 9 MT plan maps for elevations staring from 750m to -1250m at 250m interval were generated and discussed in this report.

DCIP Plan Maps

Plan Map at 800m ASL

The DCIP plan maps obtained at elevation of 800m ASL are presented in Figure 3-18. The DC resistivity map is divided into 3 areas trending roughly in the NS direction, which are from east to west, conductive, moderately resistive and resistive. The conductive features are coincident with non-chargeable formations and are likely associated with basaltic flows. The IP maps depict a moderately chargeable confined anomalous zone (Target A) associated with relatively resistive formations. As indicated above in the model sections, this Target is potentially associated with a vein type mineralization.

Plan Map at 700m ASL

The IP target A appears to be better defined at this elevation level by exhibiting a more pronounced IP response (Figure 3-19). Moreover, the target A seems to have an NE orientation. Conductive and non-chargeable features attributed likely to basaltic formations are marking the eastern portion of the area.

Plan Map at 600m ASL

At elevation of 600m ASL, the IP maps highlight two anomalous zones (A and B), Figure 3-20. Target A was described above as being potentially associated with vein type mineralization, whereas Target B, which occurs in coincidence with a D resistivity low (DC_B) might indicate an alteration mineralization of Porphyry style as mentioned above. Target A appears however, to be trending in the NNE direction. It is worth mentioning that known mineralized veins within the Silver Queen prospect are striking in the NW direction, in general. Therefore, Target A might belong to a new vein system (NNE). Similarly, Target B seems to have a NS or roughly NNE direction. Conductive and non-chargeable formations occurring in

the eastern portion of the area indicate the existence of basalts.

Plan Map at 500m ASL

At elevation of 500m ASL, Target B seems to be well defined. It is striking in the NNE direction, whereas Target A has less pronounced response (Figure 3-21). The latter is striking in the same direction NNE. IP Target B is clearly centred on resistivity low (DC_B) confirming the possible association with a Porphyry target. To the east of Target B, there is a large conductive and non-chargeable zone trending in the NE direction roughly. This large zone is likely associated with basaltic flows.

Plan Map at 400m ASL

Target B exhibits a more pronounced IP response with a NE strike, whereas Target A seems to yield a weaker response (Figure 3-22). The DC map clearly highlights a resistivity low (Target B) centred on IP_B, which appears to have an elongate shape trending in the NE direction roughly. On the other hand, a large conductive and non-chargeable zone is dominating the eastern and southern areas. This zone as mentioned above is likely attributed to mafic volcanic formations.

Plan Map at 300m ASL

The IP response of Target B becomes more pronounced at this elevation level (Figure 3-23). The IP maps show also that this Target is striking in the NE direction roughly. The DC map is dominated by a wide conductive zone, the central part of which is associated with Target B, whereas the eastern and southern areas are related to basaltic formations. On the other hand, the IP response of Target A seems to vanish.

Plan Map at 200m ASL

Target B exhibits a moderately strong IP response coincident with a resistivity low (Figure 3-24). No noticeable IP response is however, provided by Target A. The DC map is dominated by large conductive area attributed likely to deep-seated mafic volcanics.

Plan Map at 100m ASL

At this elevation level the IP maps highlight mainly the response associated with Target B, which is suggested to represent a favourable target associated with a deep-seated Porphyry system (Figure 3-25). The DC map depicts however, a large anomalous zone associated with the potential Porphyry system (central area) and mafic volcanics elsewhere.
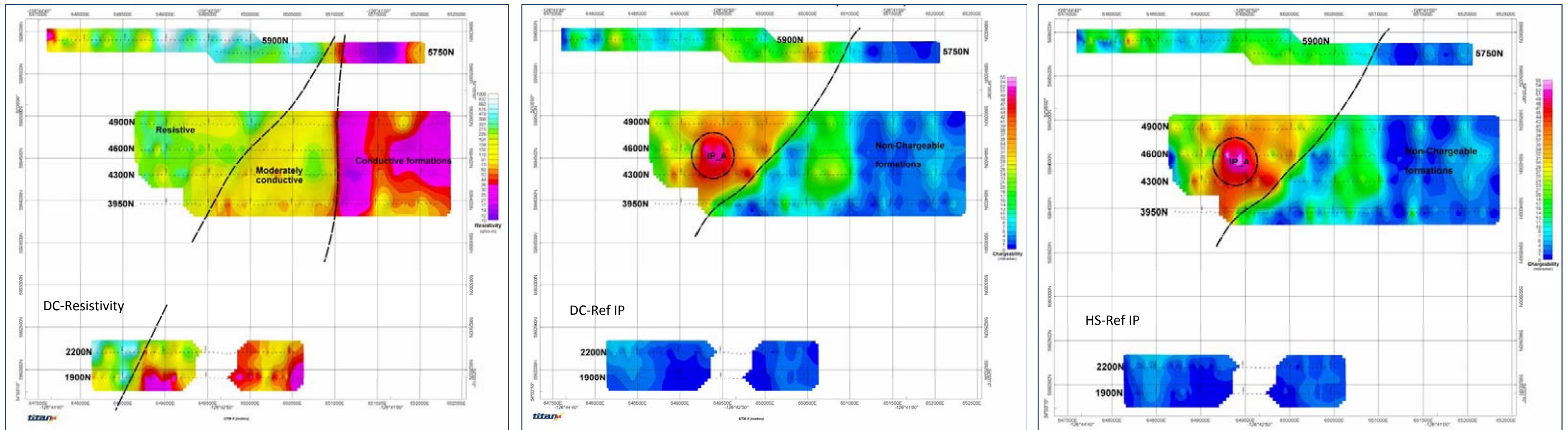
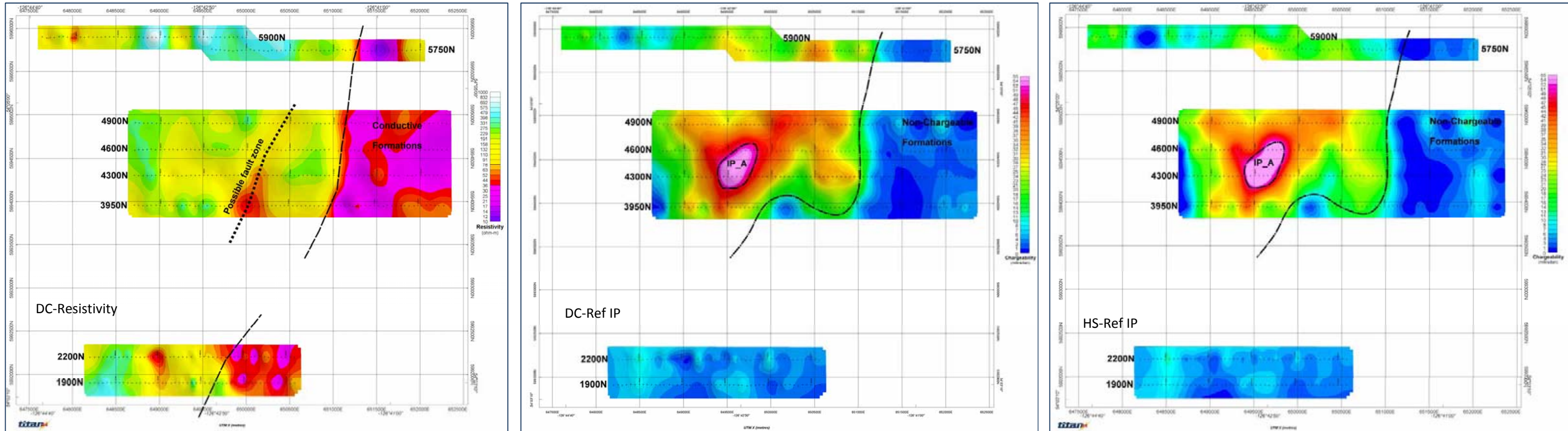**Figure 3-18: _DCIP Plan Maps at elevation=800m ASL_**
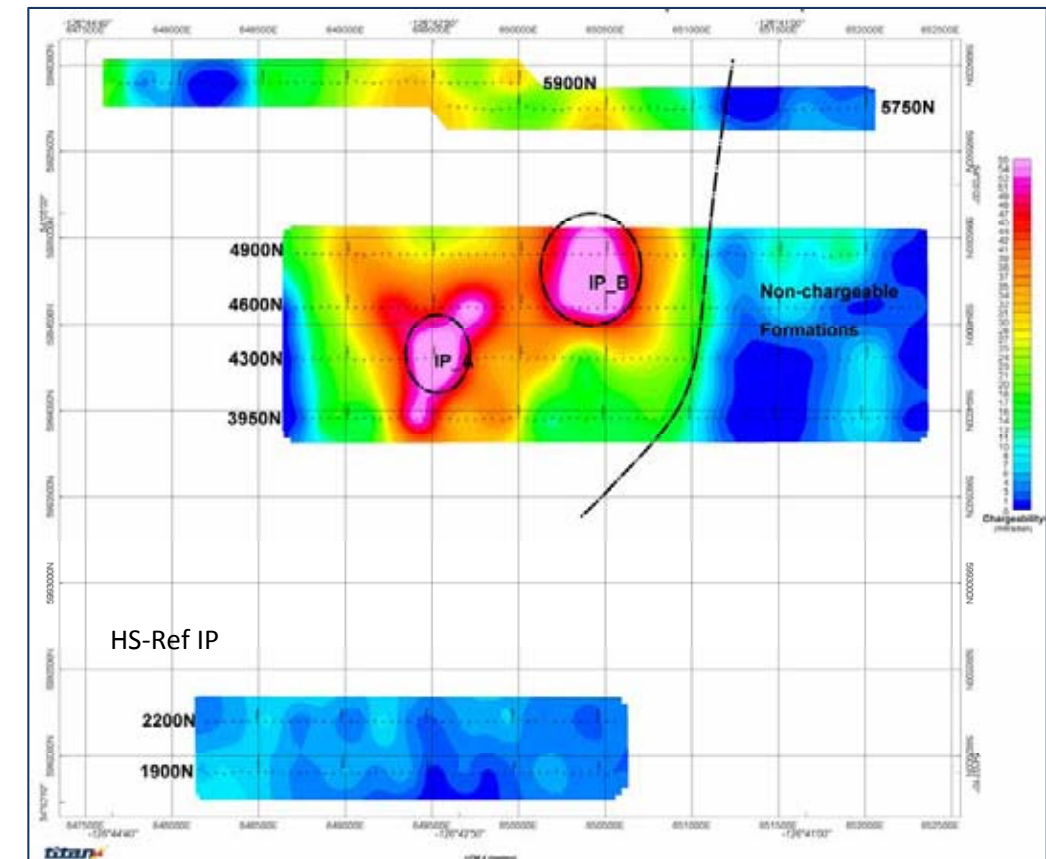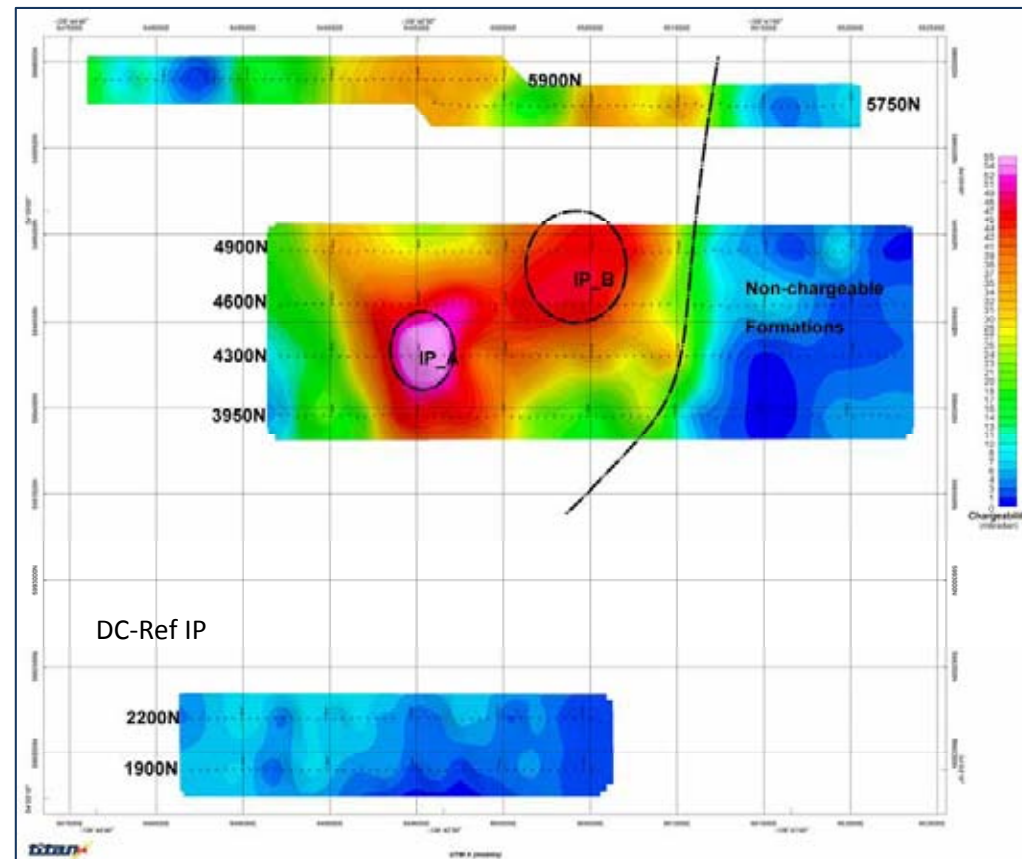
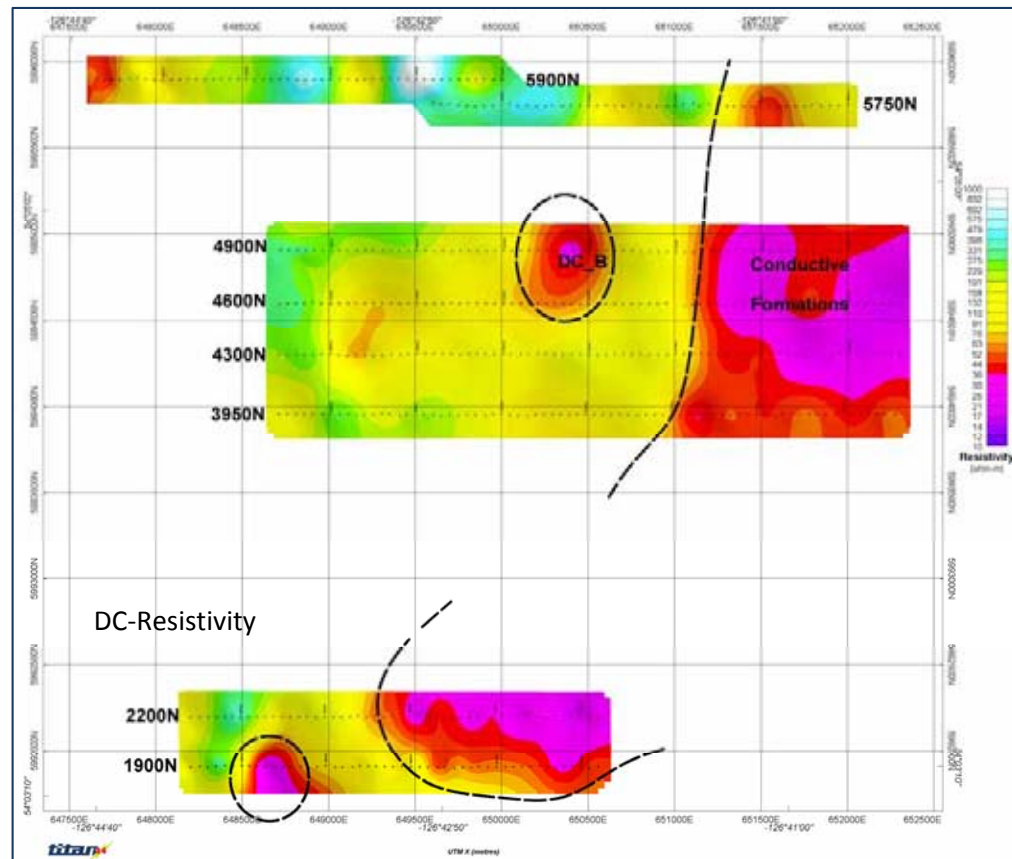**Figure 3-19:** *DCIP Plan Maps at elevation=700m ASL*
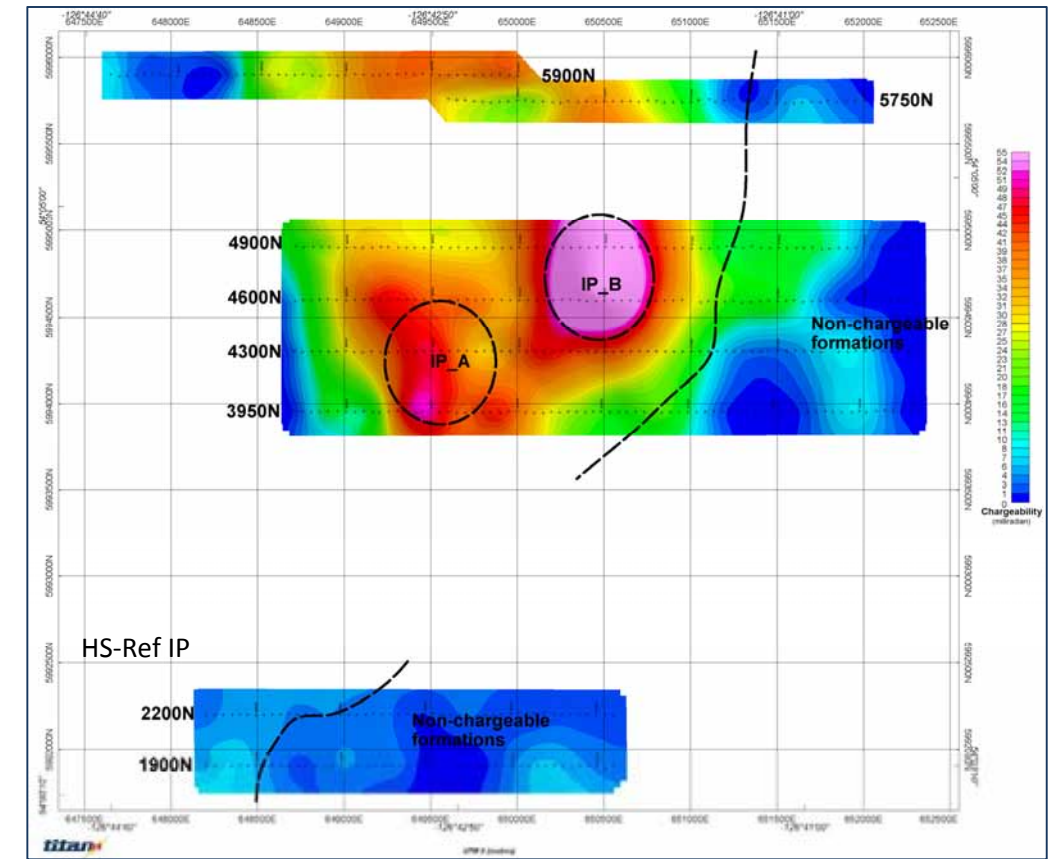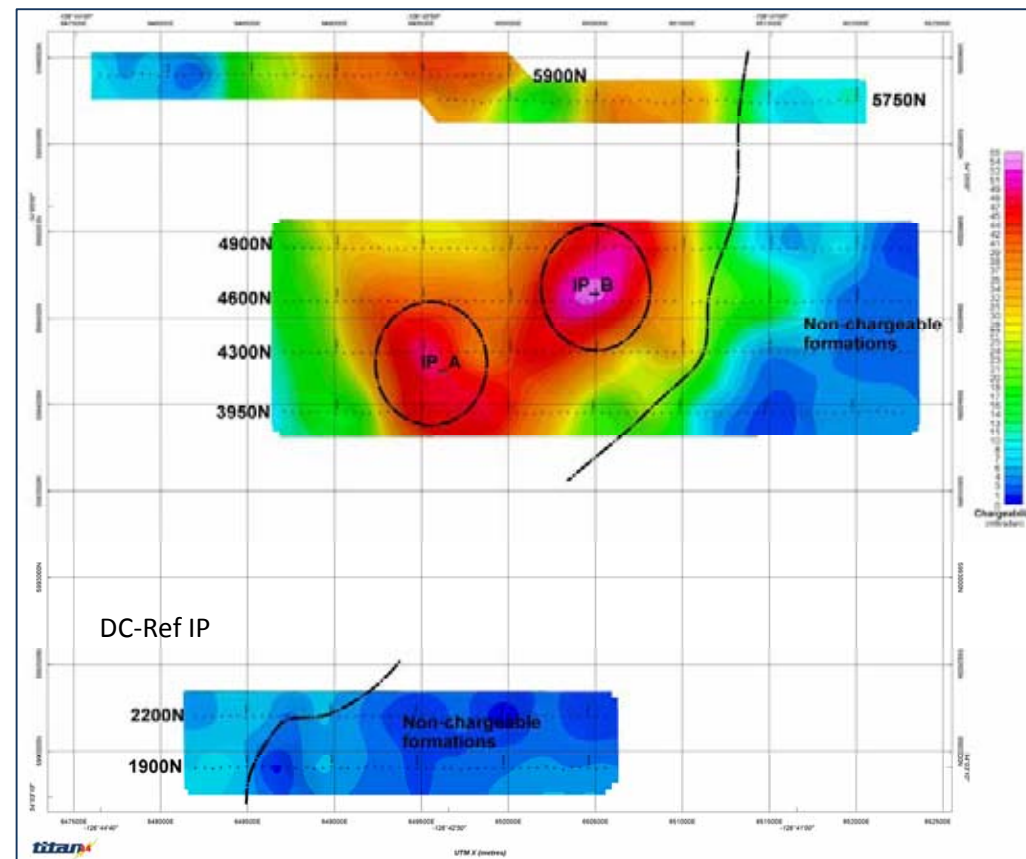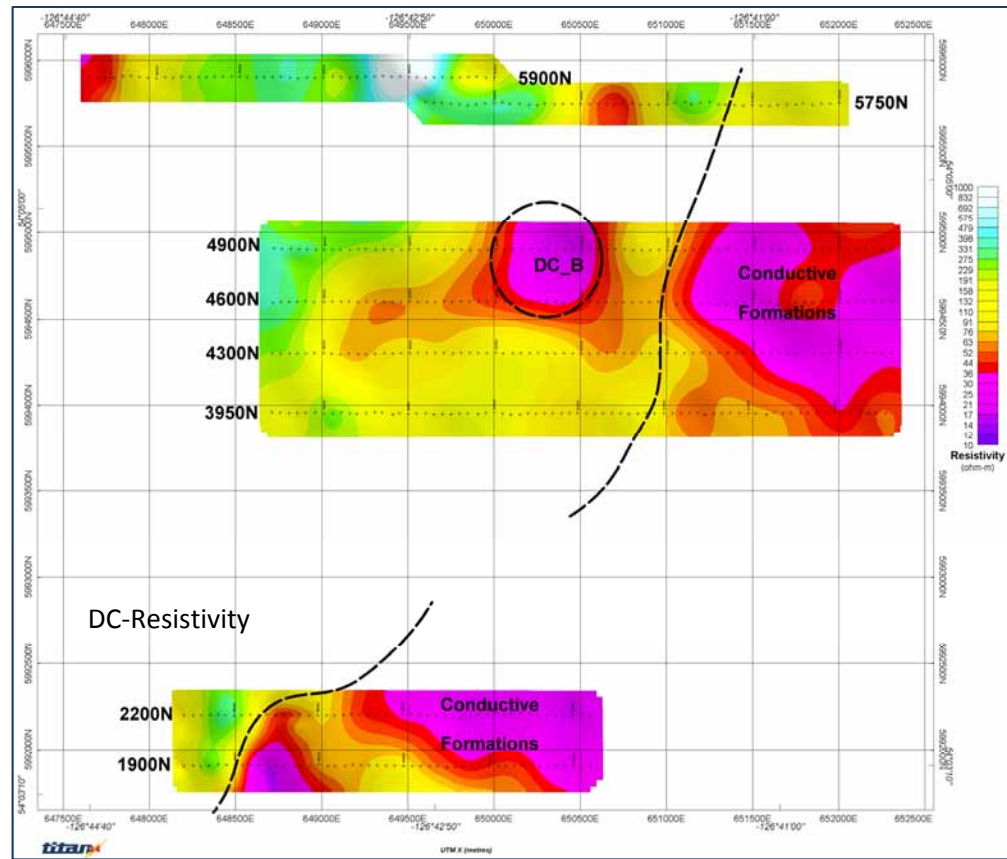
Figure 3-20: *DCIP Plan Maps at elevation=600m ASL*

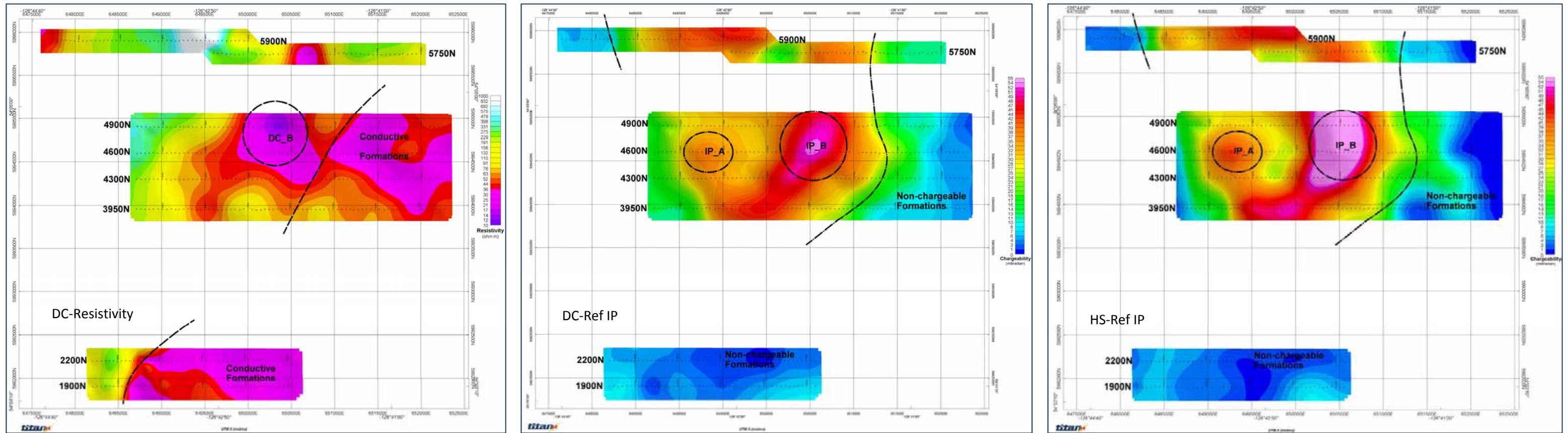**Figure 3-21:** *DCIP Plan Maps at elevation=500m ASL*

Figure 3-22: _DCIP Plan Maps at elevation=400m ASL_
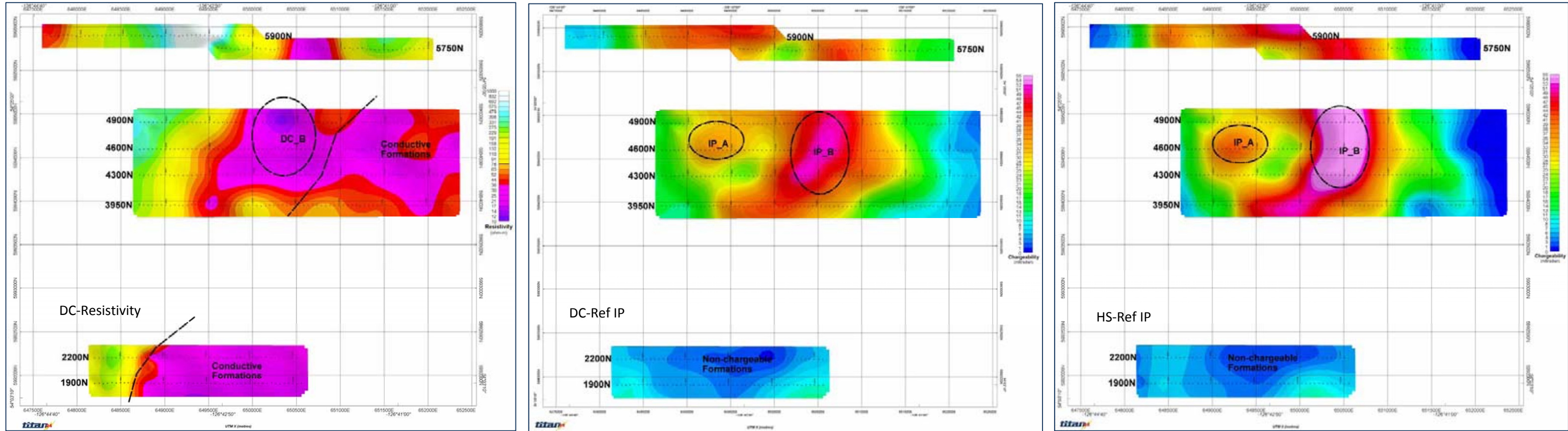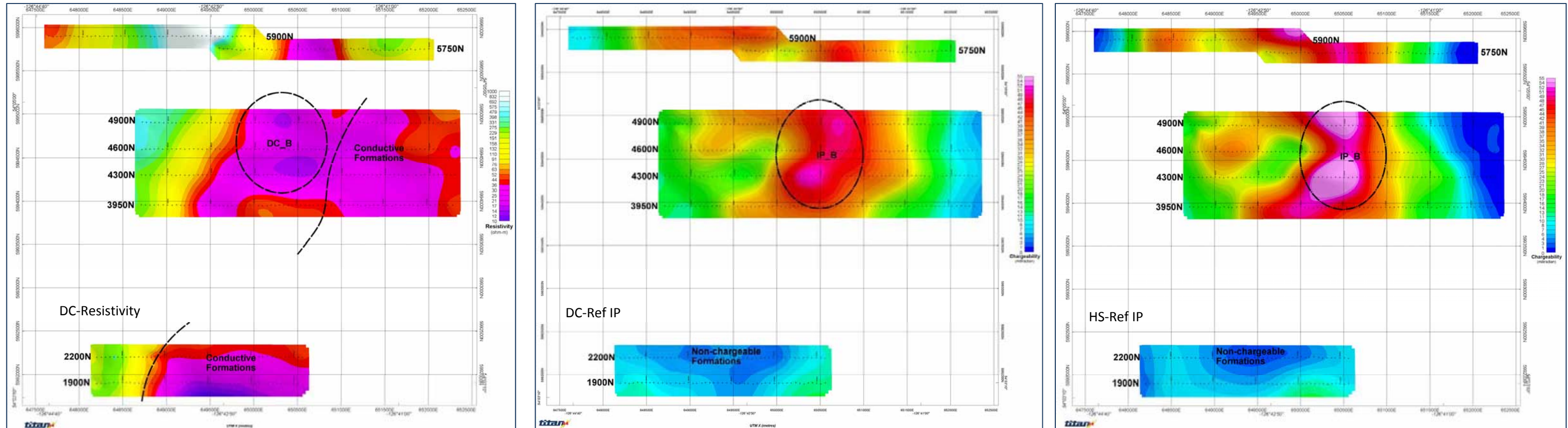
Figure 3-23: _DCIP Plan Maps at elevation=300m ASL_

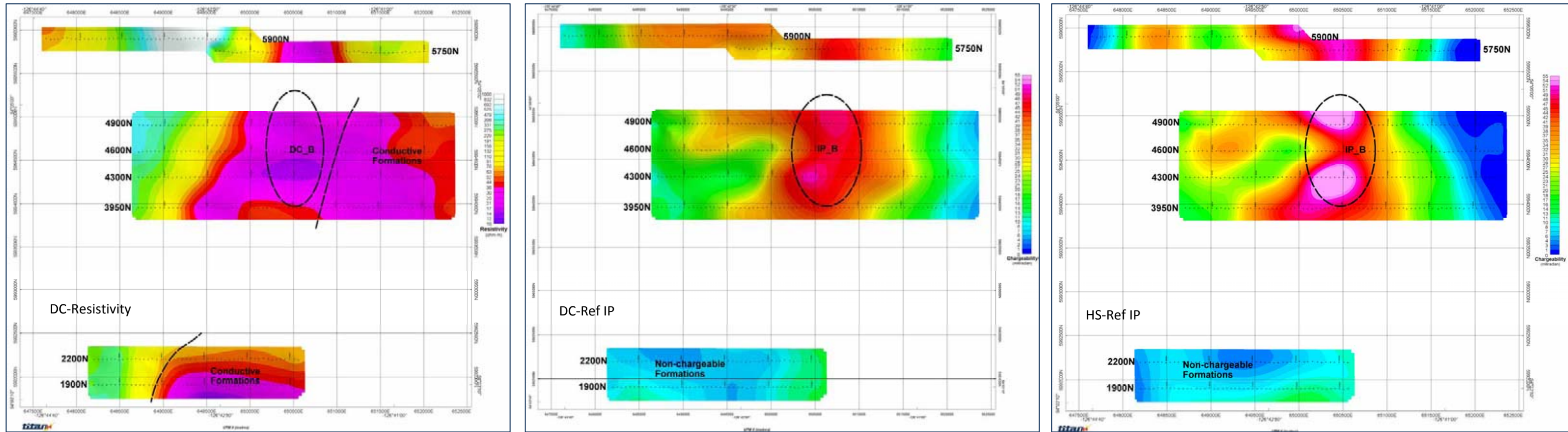**Figure 3-24:** _DCIP Plan Maps at elevation=200m ASL_

Figure 3-25: *DCIP Plan Maps at elevation=100m ASL*

B-MT Plan Maps

MT resistivity plan maps were generated for several elevations starting from 750m ASL to -1250 m ASL at 250 m interval. The elevation maps are presented in Figures 3-26 to 3-28. In general the MT plan maps are in good agreement with the corresponding DC-resistivity maps. The plan map at elevation of 750 m highlights shallow conductive features which, are consisting of broad anomalous zones trending generally in the NE direction (Figure 3-26). These conductive zones are likely related to near surface conductive formations (mafic volcanic flows). The plan map at elevations of 500m and 250m ASL depict mainly the same conductive features as indicated in 750m elevation map, with however, the appearance of the central anomaly MT_B which seems to be related to potential Porphyry Target B which was described above in the DCIP maps. Elevations maps of 0m to -500m ASL show the same anomalous features consisting mainly of the central anomaly B, which appears to be more pronounced as the depth increases indicating the deep nature of the associated source, and the southern anomaly MT_D, which seems to be associated with a deep-seated source (alteration zone?). As the depth increases the DC response of Target B appears to be more persistent. This indicates that the Target extends to greater depths confirming its association with a potential Porphyry system. On the other hand, as the depth increases (starting from elevation level of -250m ASL) a resistive area depicted in the southern portion of the area tends to appear and become more highlighted in the deeper levels. This resistive zone is suggested to be associated with a resistive intrusive body that could represent the stock of the porphyry system.
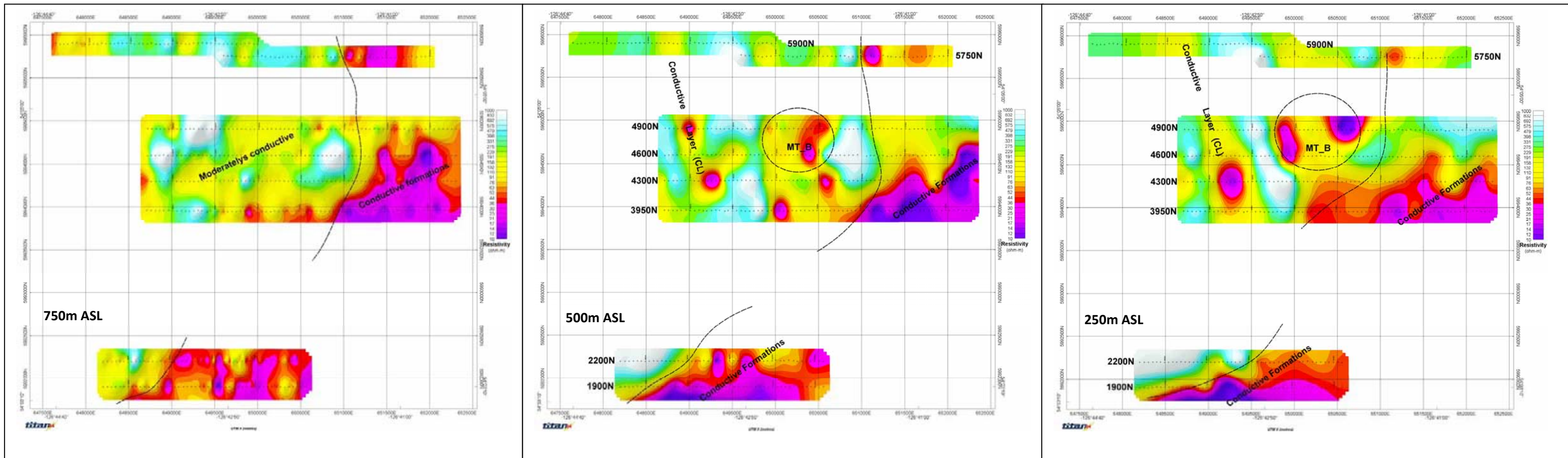
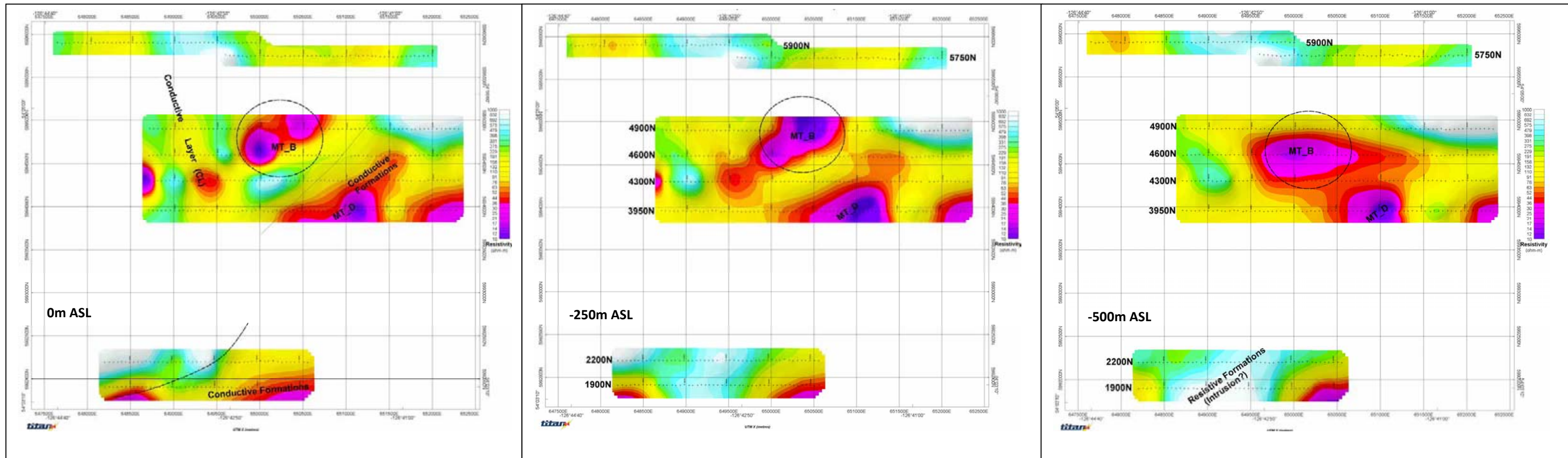**Figure 3-26:** _MT Plan Maps at elevations of 750,500 &250m ASL_

Figure 3-27: _MT Plan Maps at elevations of 0,-250 & -500m ASL_
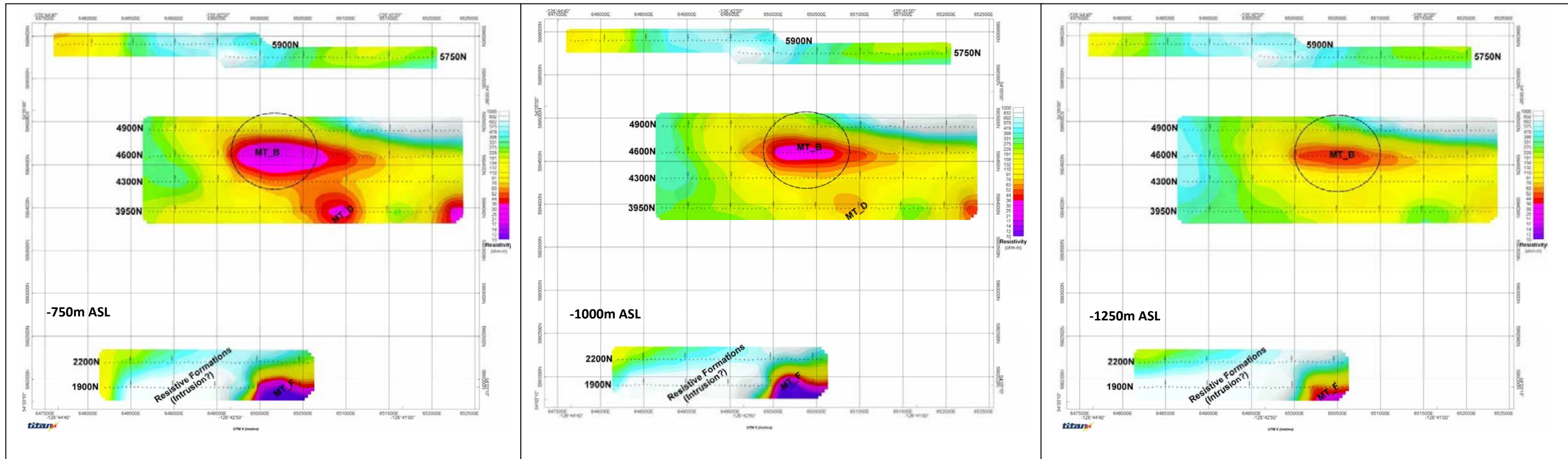
Figure 3-28: _MT Plan Maps at elevations of -750,1000 & -1250m ASL_

IP TARGETS

Based on the 2D DCIP and MT inversion results two new Targets have been identified. Target A is a shallow seated NW trending feature with chargeability moderately high and resistivity high and it is suggested to be associated with a new vein type of mineralization (NNE). Target B appears to be a deep-seated NE to NS trending feature with chargeability high and resistivity low and is suggested to represent a potential Target for Porphyry deposit.

Figure 3-29: *IP Targets A and B (IsoSurfaces) & DC sections (clipped at 800mASL)*

Figure 3-30: *IP Targets A and B (IsoSurfaces) & DC sections (clipped at 700mASL)*

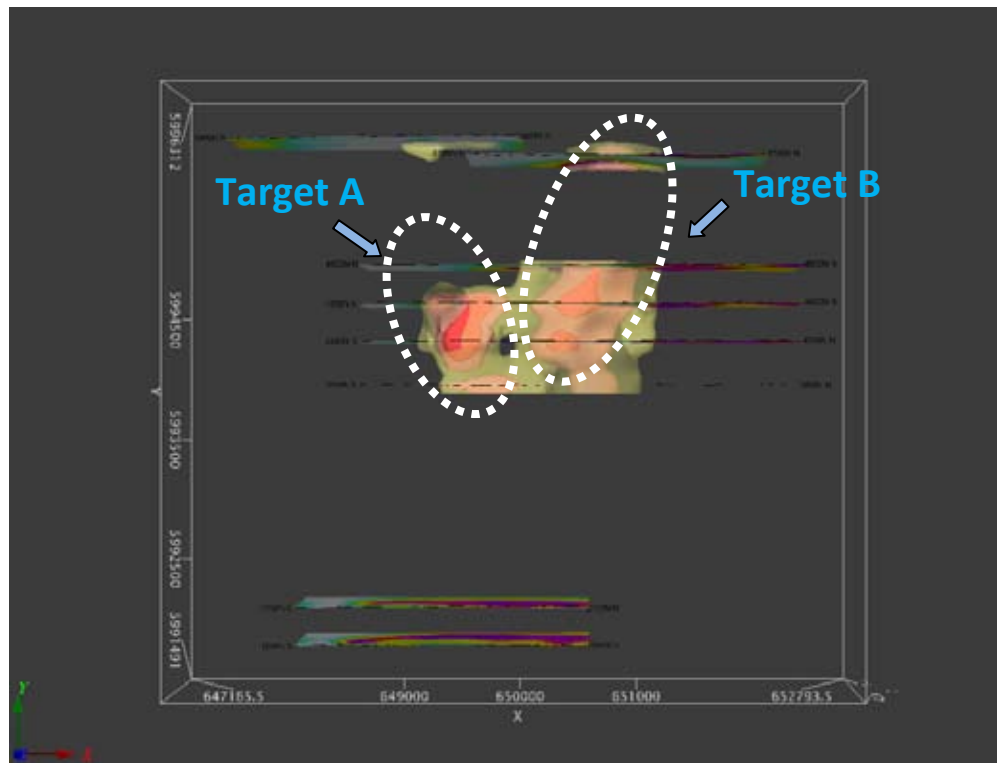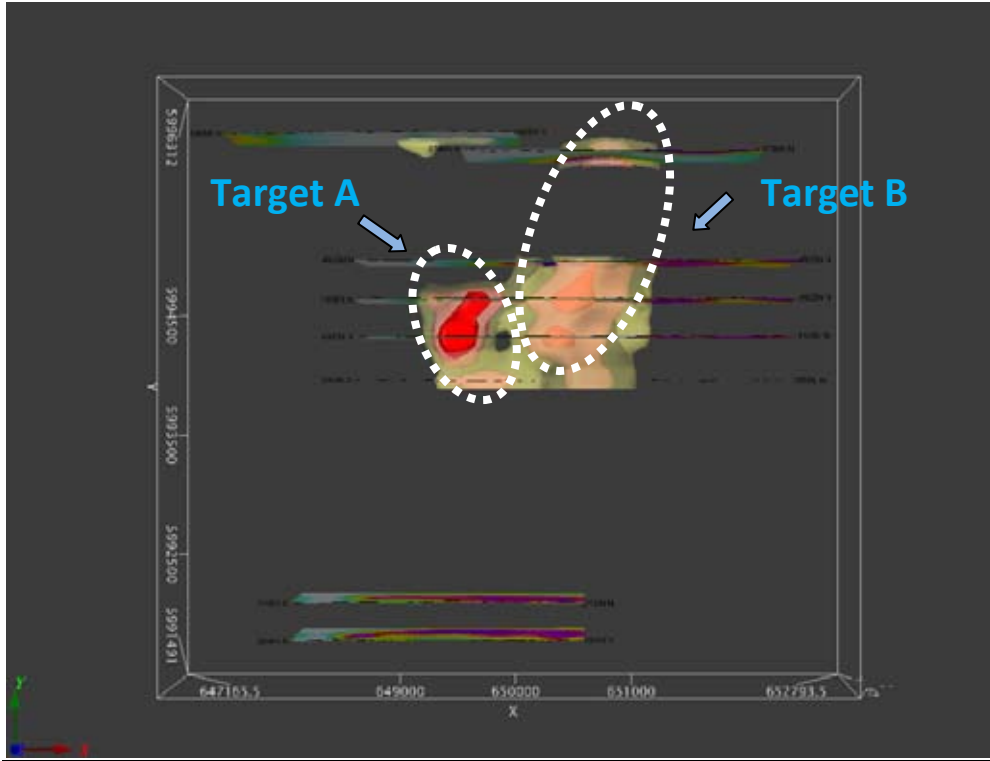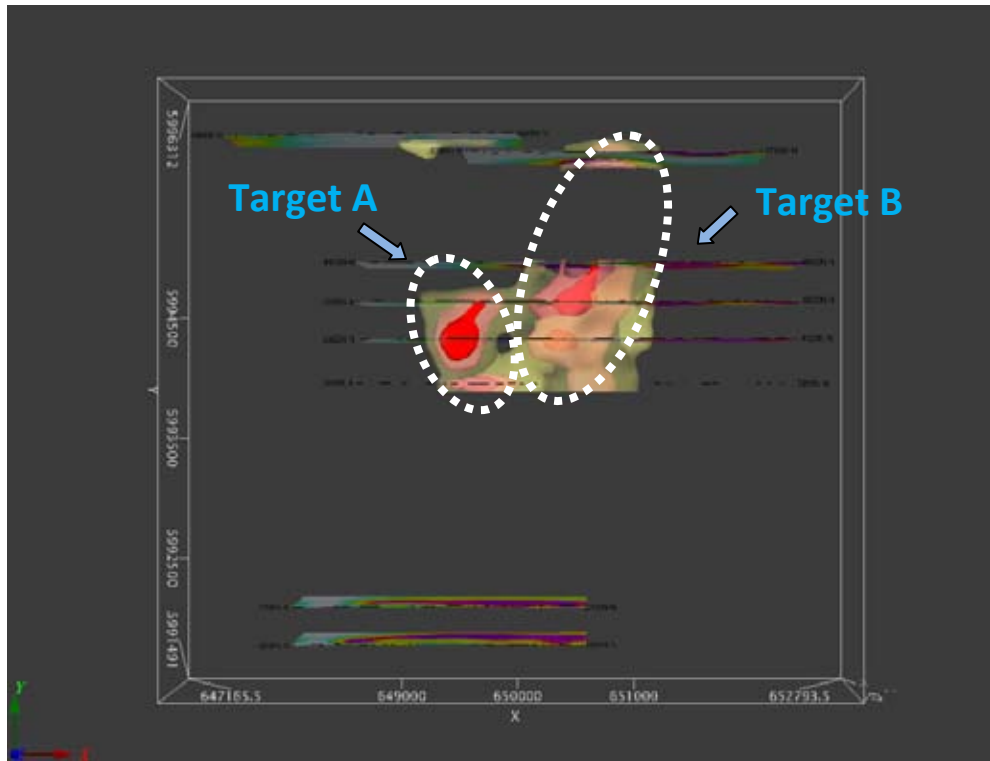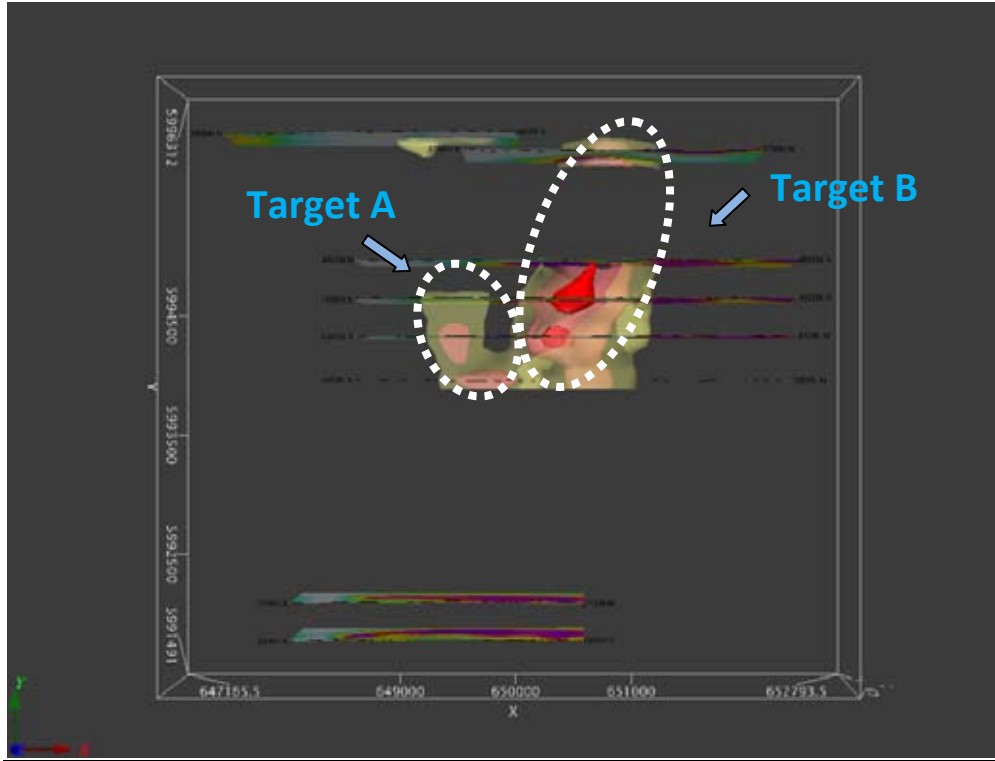**Figure 3-31:** *IP Targets A and B (IsoSurfaces) & DC sections (clipped at 600mASL)*

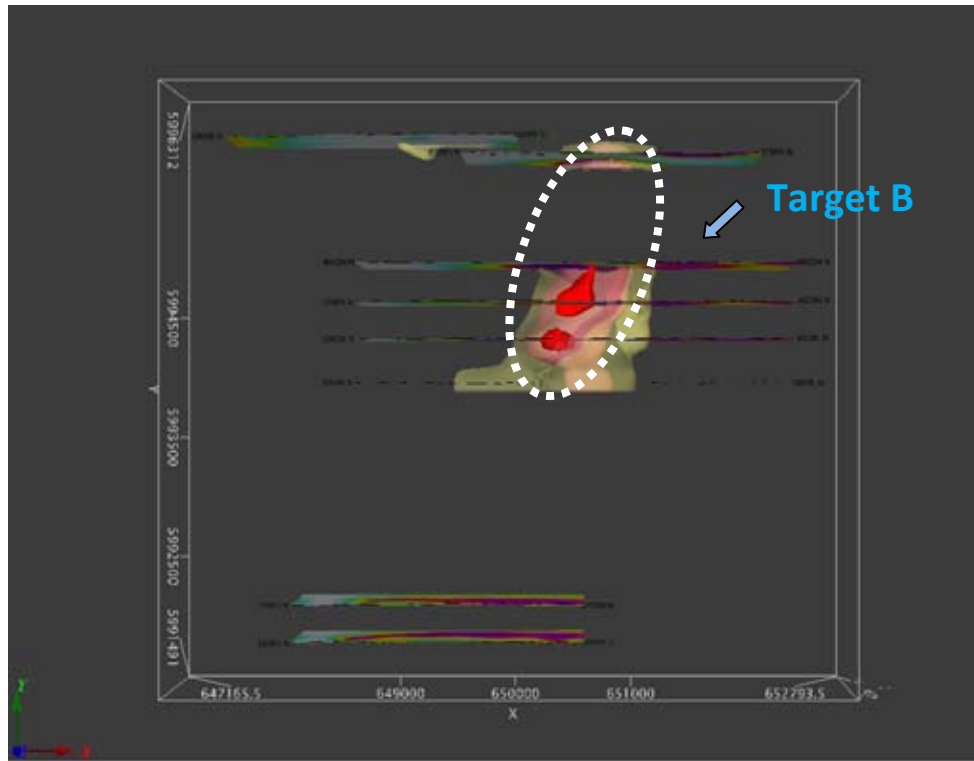**Figure 3-32** *IP Targets A and B (IsoSurfaces) & DC sections (clipped at 500mASL)*

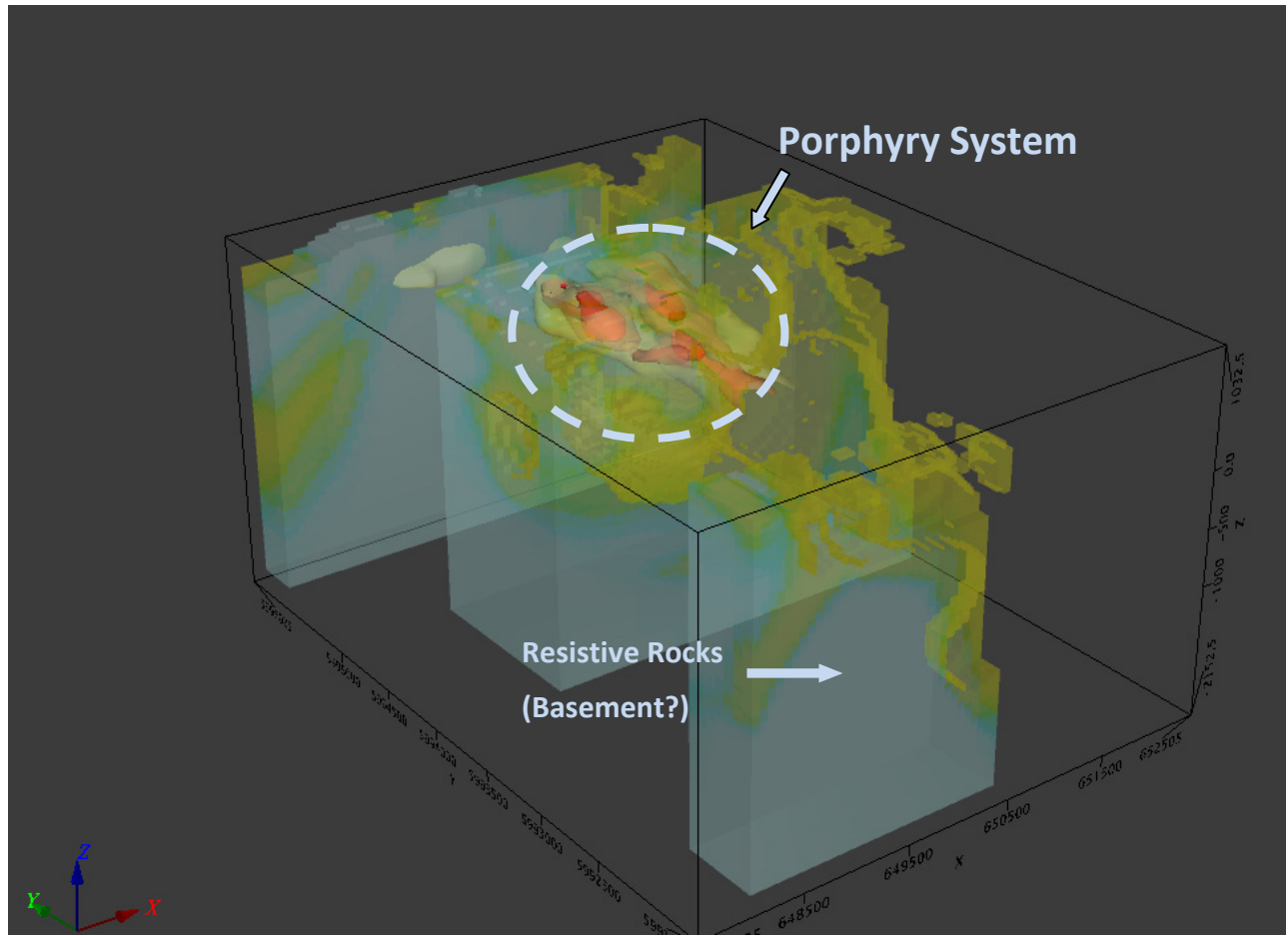**Figure 3-33:** *IP Targets A and B (IsoSurfaces) & DC sections (clipped at 400mASL)*

Figure 3-34: *IP Targets A and B (IsoSurfaces) & MT voxel model (NE looking)*

4 CONCLUSIONS AND RECOMMENDATIONS

Conclusions

A Titan-24 DCIP and MT survey was successfully conducted by Quantec Geoscience Ltd. over Silver Queen project area, near Houston in BC on behalf of New Nadina Explorations Ltd. during the period from 2011/07/07 to 2011/07/20. The DCIP and MT survey was aimed to map and define chargeable and low resistivity anomalous zones that could represent a potential target for the exploration of Porphyry system and related Silver and Copper deposits. The survey consisted of 8 lines oriented in the EW direction and spaced at an average distance of 300 metres. The total length of the survey was 24.6 line kilometres approximately. The DCIP dipoles were 100m in length and the MT sites were spaced at an equal distance of 100m, as well. The tensor magnetotelluric data were acquired over the frequency range of 10 kHz to 0.01 Hz.

The Titan-24 DCIP and MT survey was successful at identifying and delineating two new targets based on their chargeability and conductivity properties. The shallow-seated Target A exhibits a moderately strong IP response associated with a resistivity high. This target is suggested to be related to new vein type mineralization (NNE striking). The second Target (B) exhibits however, a large and strong IP response occurring in coincidence with a large conductive zone consistent with the possible existence of Porphyry style mineralization and related alteration. In addition, the MT results suggest that the presumed Porphyry Target has substantial depth extension.

As a result of the DCIP and MT inversion results, several drill-holes are underway to drill test the new identified targets, and two of them have encountered significant stockwork and Porphyry style mineralization considered as being a major Discovery within the Project Area.

Recommendations

The main recommendations for further follow-up actions are summarized in the following points.

- It is recommended to carry out a full interpretation and data integration of all available geophysical data in the light of the new DCIP and MT results, including 3D inversions of DCIP and MT data.
- It is recommended to perform drill-testing and other follow-up actions to test the newly identified IP anomalies (moderate and strong response) representing potential targets for Porphyry and related mineralisation.
- It is recommended to extend Titan DCIP and MT surveying to the north of the central area to better define the outlines of the Porphyry system. This can be arranged and managed by Quantec Geoscience.

Respectfully Submitted

Toronto, ON, the 03/10/2011,

Nasreddine Bournas   Joanne Cowburn

Quantec Geoscience Ltd   Quantec Geoscience Ltd

5 STATEMENT OF QUALIFICATIONS

NASREDDINE BOURNAS

I, Nasreddine Bournas, declare that

I am a Senior Geophysicist with residence in Aurora, Ontario and am presently employed in this capacity with Quantec Geoscience Ltd., Toronto, Ontario.

I obtained an Engineer Degree in Geophysics, from the Mining Institute of Saint-Petersburg, Russia in 1986, a Master of Science Degree (M.Sc.), Geophysics, from Houari Boumediene University, Algiers in 1998, and a Doctor of Philosophy Degree (Ph.D.), Geophysics, from the Houari Boumediene University of Algiers in 2001.

I am a registered practicing geophysicist, since 2008, with license to practice in the Province of Ontario (APGO member # 1614), a registered geoscientist, since 2008 with a license to practice in the Province of Quebec (OGQ #1235), and a member of SEG, since 2006.

I have been practicing my profession continuously in the mining industry since 1987, in Africa, Asia, Europe, and North-America.

I have no interest, nor do I expect to receive any interest in the properties or securities of **New Nadina Explorations Ltd.**, its subsidiaries or its joint-venture partners;

I was in charge of data acquisition quality control, I have reviewed the survey results and can attest that these accurately and faithfully reflect the data acquired on site. I undertook the 2D DC/IP/MT inversions and the interpretation, I oversaw the preparation and have reviewed this report, and the statements made in this report represent my professional opinion in consideration of the information available to me at the time of writing this report.

Toronto, Ontario

October, 2011

Nasreddine Bournas, PhD, PGeo

Quantec Geoscience Ltd.

JOANNE COWBURN

I, Joanne Cowburn, declare that

I am a data processor with residence in Toronto, Ontario and am presently employed in this capacity with Quantec Geoscience Ltd., Toronto, Ontario.

I obtained a Bachelor of Science Degree, with Honours, in Geophysics with Geology (B.Sc.) at Durham University, County Durham, England, in July, 2010.

I have practiced my profession continuously since October, 2010 in Canada.

I have no interest, nor do I expect to receive any interest in the properties or securities of **New Nadina Explorations Ltd.**, its subsidiaries or its joint-venture partners;

I was the data processor on site, responsible for the quality control of data acquired throughout the survey. I compiled and edited the logistics report. The statements made in this report represent my professional opinion based on my consideration of the information available to me at the time of writing this report.

Toronto, Ontario

07/20/2011

Joanne Cowburn, B.Sc (Hons).

Quantec Geoscience Ltd.

6   DIGITAL ARCHIVE

The CD or DVD attached to this report contains a copy of all the inversion results, final processed data, including the survey files, the daily processing (and field) notes, and an electronic copy of this report (with all appendices).

A PRODUCTION SUMMARY

Date	Field Activities and Observations	Processor Comments and Observations	Line Spread	IP Overlap (km)	MT Overlap (km)	Line Start	Line End	Tx Start	Tx End	Read MT (km)	Read IP (km)	Read IP Current Extension (km)
7/7/2011	Mob from Huckleberry Mine	Mod from Huckleberry Mine										
7/8/2011	Search for remote, setup infinite & started line setup	Search for remote, setup infinite & started line setup										
7/8/2011	PST	PST										
7/9/2011	Set Up line 4900N. Read MT		L4900N			48700	52300	48775	52225	3.6	3.6	
7/10/2011	Move to Line 4600, surveyed IP & MT		L4600N			48700	52300	48775	52225	3.6	3.6	
7/11/2011	Move to Line 4600, surveyed IP & MT.		L4300N			48700	52300	48775	52225	3.6	3.6	

Date	Field Activities and Observations	Processor Comments and Observations	Line Spread	IP Overlap (km)	MT Overlap (km)	Line Start	Line End	Tx Start	Tx End	Read MT (km)	Read IP (km)	Read IP Current Extension (km)
7/12/2011	Moved to line 3950, surveyed IP until there were 7 events left and had to disconnect the line due to lightning. MT crew re-connected line in the evening but were unable to acquire enough decent events.		L3950N			48700	52300	48775	52225	0	2.9	
7/13/2011	Took all day to acquire the 7 remaining IP events and troubleshoot the line for MT and surveyed MT		L3950N			48700	52300	48775	52225	3.6	0.7	
7/14/2011	Moved to L2200 -- long line change and rained heavily all day. Surveyed MT.		L2200N			48200	50600	48050	50750			
7/15/2011	Surveyed IP & re-acquired MT		L2200N			48200	50600	48050	50750	2.4	2.4	0.3

Date	Field Activities and Observations	Processor Comments and Observations	Line Spread	IP Overlap (km)	MT Overlap (km)	Line Start	Line End	Tx Start	Tx End	Read MT (km)	Read IP (km)	Read IP Current Extension (km)
7/16/2011	Move to line 1900, surveyed some IP & all of MT		L1900N			48200	50600	48050	50750	2.4	1.0	
7/17/2011	Finished reading IP on Line 1900N. Rained heavily all day. Had lots of problems. Picked up line in late afternoon and dried out the system. Too big of a line change. No MT.		L1900N			48200	50600	48050	50750	0	1.4	0.3
7/18/2011	Setup line 5750N. Surveyed IP & MT		L5750N			49600	52000	48950	52650	2.4	2.4	1.3
7/19/2011	Setup line 5900N. Surveyed IP & MT		L5900N			47600	50000	47150	50650	2.4	2.4	1.1
7/20/2011	Finish packing & demob to Smithers	Finish packing & demob to Smithers										
									TOTAL	24	24	3.0

B SURVEY LOGISTICS

B.1 ACCESS

Base of Operation:	Houston Motor Inn
	2940 Highway 16,
	Houston,
	British Columbia
	V0J 1Z0
Mode of Access to Grid:	4x4 Pickup Truck
Mode of Access to Lines:	Foot & Quads

B.2 SURVEY GRID AREA

Established by:	New Nadina Explorations Ltd.
Coordinate Reference System:	Grid referenced to UTM Coordinates
Datum & Projection:	WGS 84/Zone 9U
Grid Azimuth:	90°
Magnetic Declination:	22.5˚ East
Station Interval:	100 to 150 m
Method of Chaining:	pickets GPS surveyed

Surveyed Line-start and -end point coordinates.

Line	Grid Coordinate		UTM Coordinate Start		UTM Coordinate End	
	Start	End	Easting	Northing	Easting	Northing
1900	48200	50600	648201	5991900	650558	5991904
2200	48200	50600	648200	5992199	650554	5992195
3950	48700	52300	648711	5993959	652272	5993955
4300	48700	52300	648712	5994301	652303	5994302
4600	48700	52300	648717	5994594	652307	5994602
4900	48700	52300	648722	5994907	652306	5994898
5750	49600	52000	649602	5995764	652002	5995757
5900	47600	50000	647652	5995905	650002	5995900

B.3 **PRODUCTION AND COVERAGE**

Survey Period/days: July 7th to July 21st, 2011
                            15 days

Survey Days (read time):   12 days

Mob/Demob: 2 days

Safety Inductions: 0 days

Parallel Sensor Test: 2 days

Weather/Set-up Days: 1 day

Number of Lines surveyed: 8

DCIP Survey Coverage: 24 km (27.0 km with current extensions)

MT Survey Coverage: 24 km

Max and Min Pole (Tx) and Potential (P1-P2) Electrode Position.

Line	Min P1	Max P2	Min Tx	Max Tx	Coverage (km)
1900	48200	50600	48050	50750	2.4 (2.7)
2200	48200	50600	48050	50750	2.4 (2.7)
3950	48700	52300	48775	52225	3.6 (3.6)
4300	48700	52300	48775	52225	3.6 (3.6)
4600	48700	52300	48775	52225	3.6 (3.6)
4900	48700	52300	48775	52225	3.6 (3.6)
5750	49600	52000	48950	52650	2.4 (3.7)
5900	47600	50000	47150	50650	2.4 (3.5)
***note: values in parenthesis include current extensions**				**24.0 (27.0)**

MT Survey Coverage (Electrode to Electrode).

Line	Min Extent (m)	Max Extent (m)	Coverage (km)
1900	48200	50600	2.4
2200	48200	50600	2.4
3950	48700	52300	3.6
4300	48700	52300	3.6
4600	48700	52300	3.6
4900	48700	52300	3.6
5750	49600	52000	2.4
5900	47600	50000	2.4
		TOTAL	24

B.4 **PERSONNEL**

Project Manager:	Kevin Blackshaw
Responsible Geophysicist:	Nasreddine Bournas
Data Processing (in field):	Joanne Cowburn
Crew Chief:	Steve Wynn
IP operator:	Nick Hnotchuk
	John Spezeski
MT operator:	Warren Gregory
	Taylor Remme
Remote Operator:	Shelley Julio
	Matthew Cousineau
Field Technicians:	Brody Johnston
	Kristy Wabirk
	Luc Lafond
	John Spezeski
	John Mantyla
	Ryan Foyle
	Pikibo Daniel
	Steve Zuniga

B.5 INSTRUMENTATION

Receiver System:	Quantec Distributed Array Acquisition System:
	- 61 channels max. per system (55ch operationally with internal A/D conversion (24bit @120db / dual speed @120-48kHz), and buffer memory (6Mb).
	24 x 2-channel Acquisition Modules (AMs)
	13 x 1-channel Acquisition Modules (AMs)
	AM data transmission using LAN cabling
	- 2 Central Recording Units (CRU; 140 Gb data storage) at base & at MT remote reference (MT survey)
	- 2 GPS synchronization clocks (10nsec precision /12.3MHz clock-speed), at base & at MT remote reference (MT survey)
	- 2 PC-based Central Processing Units (CPU) at base & at MT remote reference (MT survey)

Transmitter (DCIP Surveys):   GDD (5kW) with frequency/waveform
control, using CRU and Current Monitor (CM)

Power Supply (DCIP Surveys):   Honda 6500W generator

Transmit Electrodes   4 x 1.2cm diameter 1 meter long stainless steel rods

Receiver Electrodes: Ground contacts using stainless steel rods

Receiver Coils (MT Surveys):   Low Frequency Range (0.0001Hz to 1kHz):
    4 Magnetometers (P50 model)
        {2 at base & 2 at remote}
Mid to High Frequency Range (1Hz to 25kHz)
    4 Magnetometers (BF-6 model)
        {2 at base & 2 at remote}
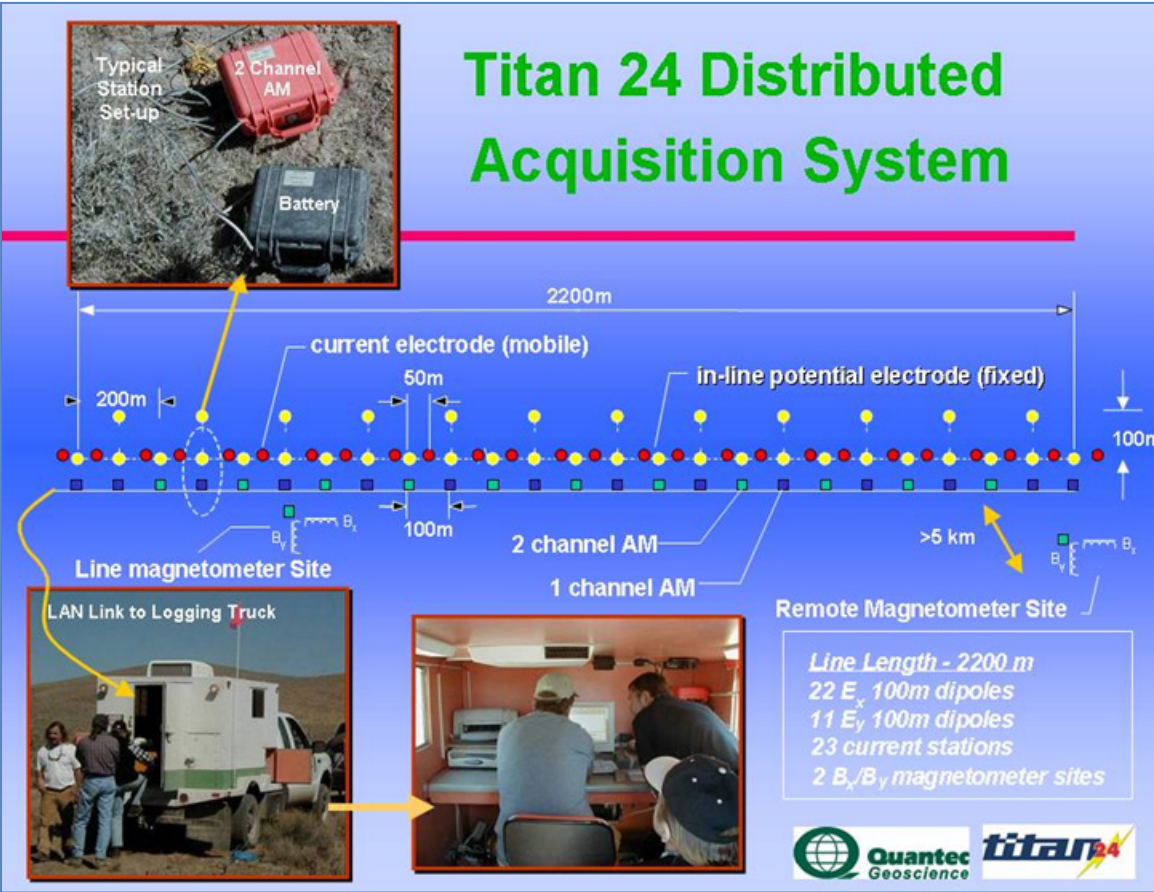
Titan-24 DCIP and MT Schematic Survey Layout.

B.6   DCIP SURVEY SPECIFICATION

B.6.1   GEOMETRY

Survey Array:	Dipole-Pole-Dipole Array
Receiver Configuration:	24 Ex = Continuous In-line voltages, 13 Ey = Alternating (2-stations) cross-line voltages[7].
Array Length:	2.7 – 3.6 km
Number of Arrays/line:	1
Dipole length:	Ex = 100 metres Ey = 100metres
Sampling Interval:	Ex = 100 - 150 metres Ey = 200 - 300 metres
Rx-Tx Separation:	N-spacing (Pn-Cn min)[8] = 0.5 to 29.5
Infinite Pole Location:	<u>L1900N & L2200N:</u> UTM: 647567E, 5997007N (WGS 84/Zone 9U) Grid Coordinates: 47593E, 7009N

<u>L3950N, L4300N, L4600N & L4900N:</u>
UTM: 652816E, 5989499N (WGS 84/Zone 9U)
Grid Coordinates: 52813E, -496N

<u>L5750N:</u>
UTM: 652816E, 5989499N (WGS 84/Zone 9U)
Grid Coordinates: L5750N:52814E, -508N

<u>L5900N:</u>
UTM: 650846E, 5991305N (WGS 84/Zone 9U)
Grid Coordinates: 50794E, 1300N
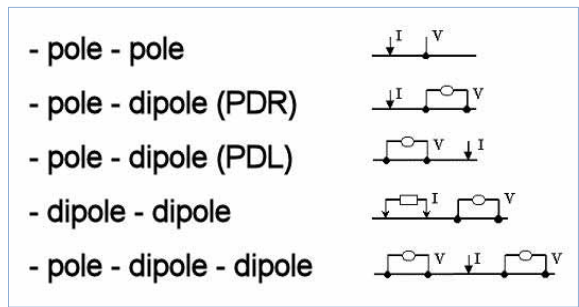
Common DCIP Survey Layouts.

---

[7] Note: Cross-Line (Ey) voltages obtained for future reference purposes – not presented in cross-sectional plots.
[8] Current electrodes at midpoints between potential electrodes.

B.6.2 **ACQUISITION & PROCESSING**

Spectral Domain:	Tx = Frequency-domain square-wave current
	Rx = Full waveform time-series acquisition
	Data processing/output in frequency-domain.
Spectral Chargeability Model[9]:	Halverson-Wait
Transmitter Waveform:	30/256 Hz square waves at 100% duty cycle
	(~4sec Pos./Neg.)
Transmitter Output Current:	min ~0.9 Amperes to max ~7.0 Amperes
Receiver Sampling Speed:	240 samples/second
	(24 bit A/D @ 120 db dynamic range)
Tx-Rx Synchronization:	using current monitor (10 μsec time-accuracy)
Time-Series Stacking:	20 cycles (full-waveform)
Read Time:	approx 3.0 minutes per event
Time-Domain Decay Window:	**Integration Start Time:** T_O = 0.8 seconds
	Integration End Time: T_F = 0.2 seconds
Post-Processing:	using Quantec proprietary QuickLay v.2.30.14
	1) Time-series stacking
	2) Robust statistics
	3) Current waveform deconvolution
	4) Digital filtering (60Hz + harmonics)
	5) Spectral model decay-curve fitting

---

[9] The Halverson-Wait model chargeability (Halverson et al., 1981) is similar to and improves upon the frequency-domain Cole-Cole model (Pelton et el., 1978) described in the time-domain by Johnson (1984).
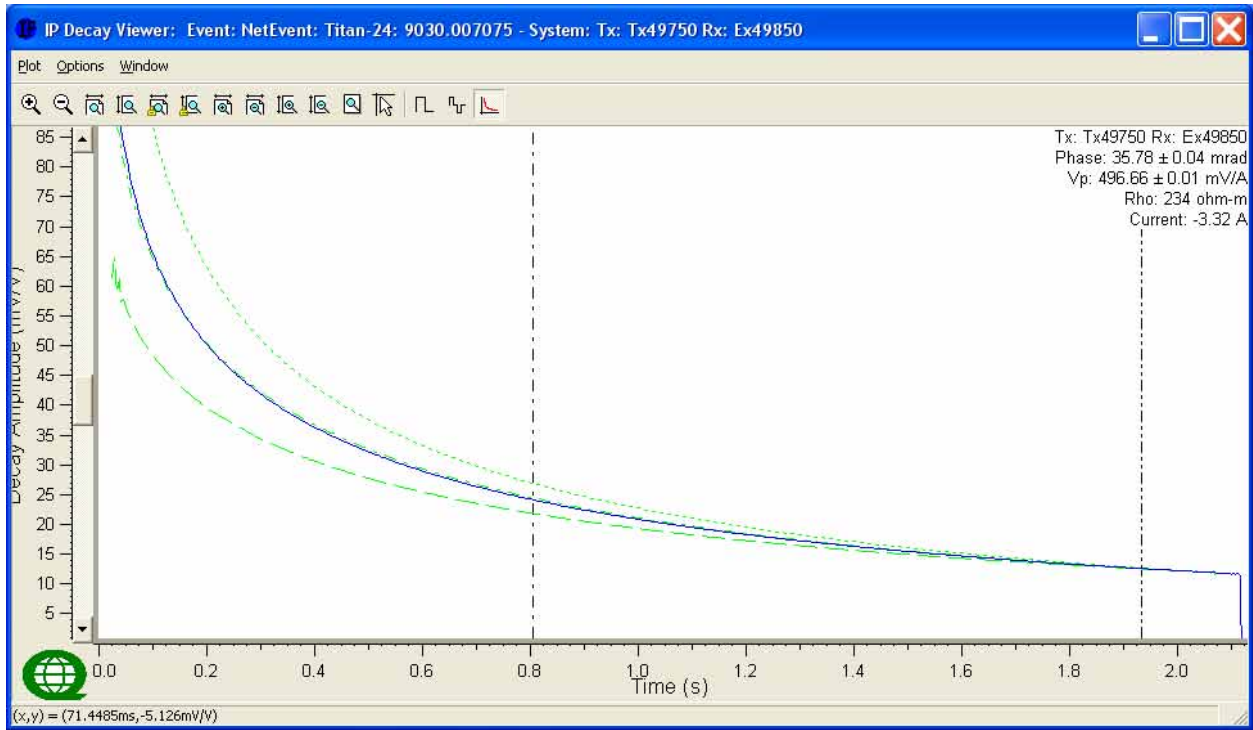
Spectral Chargeability Model and Calculated Halverson-Wait Decays[10].

---

[10] Halverson-Wait (HW) model parameters calculated in frequency domain, with hatched green lines corresponding to theoretical HW decay with spectral r-factors of 0.1, 1.0 (default) & 10, k-factor of 0.2 (default).

B.6.3 DATA PRESENTATION

Accuracy and Repeatability

Measured Data average error (from CSV files)
using Halverson-Wait model calculation:
Voltage Errors   0.00289 mV/V (average)
Phase Errors   90% less than 3.0 mrad

Pseudo-Section Plots:

In-line[11] DC Resistivity and IP Chargeability
pseudo sections, posted, contoured (equal area zoning)
and plotted in ground units using QuickLay viewer.

Raw Data (digital):

(external Hard Drive)
Raw Event Log File Folders (eg. Eventxxxx.dat).
Also contains AU.txt and Event.log files which contain
information on the location and time of the event in
QuickLay digital format
(Raw data output to Matlab format upon request).

Processed Data (digital):

DC/IP Data in ASCII CSV (comma delimited) file format
from QuickLay, containing final processed voltage and
phase data.
CSV File Format:
Line 1:   Column headings
Column 1   Event name/number (e.g., Eventxxxx)
Column 2:   Transmitter site ID (e.g., Tx150)
Column 3:   Receiver site ID (e.g., Rx150)
Column 4-11:   C1-C2/P1-P2 positions in X and Y (m)
Column 12:   Current (Amperes)
Column 13:   Current error (Amperes)
Column 14:   Normalized voltage (Volts/Ampere)
Column 15:   Voltage error (Volts/Ampere)
Column 16:   Phase (milliradians)
Column 17:   Phase error (milliradians)
Column 18:   Apparent resistivity (Ohm-m)[12]

B.6.4 DATA QA/QC COMMENTS

Good quality data – productivity reduced due to current leaks in wet weather conditions.

---

[11] Cross-line (Ey) values not shown for presentation purposes.
[12] Apparent resistivity's are calculated in 2D space using the 4 electrodes general array configuration (as per XY electrode positioning in columns 4-11 of CSV file) – not based on pole-dipole calculations (K. Nurse, QGL, pers. comm., 07-2004).

B.7   MT SURVEY SPECIFICATION

B.7.1   GEOMETRY

Technique:	Tensor soundings, remote-referenced
Line Configuration:	24 Ex = Continuous In-line voltages, 13 Ey = Alternating (2-stations) cross-line E-fields 1 pair Low Frequency coils 1 pair High Frequency coils
Remote Configuration:	1 Ex = in line E-fields 1 Ey = cross-line E fields 1 pair Low Frequency coils 1 pair High Frequency coils
Array Length:	2.4 – 3.6 km
Number of Arrays/line:	1
Dipole size:	Ex = 100 metres Ey = 100 metres
Sampling Interval:	Ex = 100 - 150 metres Ey = 200 - 300 metres
Ex/Ey sampling Ratio	2/1
E/H sampling Ratio	Ex: 24/2 Ey: 13/2

Remote Reference Position:	UTM: 621372E, 5948930N (WGS 84/Zone 9U)
	Grid Coordinates:
	        L1900N: 21398E, -41068N
	        L2200N - L4900N: 21369E, -41065N
	        L5750N: 21370E, -41077N
	        L5900N: 21320E, -41075N

B.7.2 ACQUISITION & PROCESSING

Data Acquisition:	Full-waveform time-series acquisition Data processing/output in frequency-domain.
Remote-Base Synchronization:	GPS clocks (10μsec time-accuracy)

Frequency Bandwidth:

Operating:	0.01 to 48000 Hz
Effective:	0.1 to 20000 Hz

Time-series Sampling:

High Range:	48000 samples/sec
Mid-Range:	12000 samples/sec
Low Range:	120 samples/sec

Time-Series Stacking:

High Range:	1,534,999 samples
Mid-Range:	2^{20} (1,048,576) samples
Low Range:	2^{19} (524,288) samples

Sample/Record Time:

High Range:	min. 2 events @ 30 seconds per event
Mid Range:	min. 2 events @ 2.0 minutes per event
Low Range:	1.5 - 3 events @ 80 minutes for a full event (total recording and retrieving time approx. 7 hrs)

Post-Processing: using Quantec proprietary QuickLay v.4.00.10
1) Coherent noise rejection using remote-reference
2) Proprietary digital filtering (scrubbing)
3) Coherency sorting
4) Impedance estimate stacking

B.7.3 DATA PRESENTATION

Parallel Sensor Test:	Result of the test of the equipment (PST) is presented in detail in Appendix Parallel Sensor Test.

Data Error:

Apparent Resistivity	= <1/20TH decade average.
Phase	= <3 degrees average

Sounding Curves:	Apparent resistivity and phase (XY and YX) sounding curves versus the frequency (8 pts. per decade) using Geotools™ viewer.
Pseudo-Section Plots:	MT Apparent Resistivity and Phase Pseudo-Sections (XY, and YX) posted, contoured (equal area zoning) and plotted in grid units using Geotools™ viewer.
Raw Data (digital):	(external Hard Drive) Base and Remote Raw Event Log File Folders (i.e. Base-Eventxxx.dat; Remote-Eventxxxx.dat). Also contains AU.txt and Event.log files, which contain information on the location and time of the event in QuickLay digital format (external Hard Drive). (Raw data output to Matlab format upon request)

Processed Data (digital): MT DATA in EDI (Electronic Data Interchange) file created in Geotools™ containing Auto and Cross-power Spectral estimates for individual stations (sites) and profiles (site-sets);
Spectra are in Right Hand positive down co-ordinate system, and for profiles, EDI files are created with X as the profile direction.

For this study, final EDI have X at 90deg (ROTSPEC= 90)

EDI is a format conforming to SEG standard for the storage of magnetotelluric (MT) data
(Wight, D. E., 1987).

B.7.4   DATA QA/QC COMMENTS

Clean data with phase pull downs at western stations and phase pull ups at eastern stations.
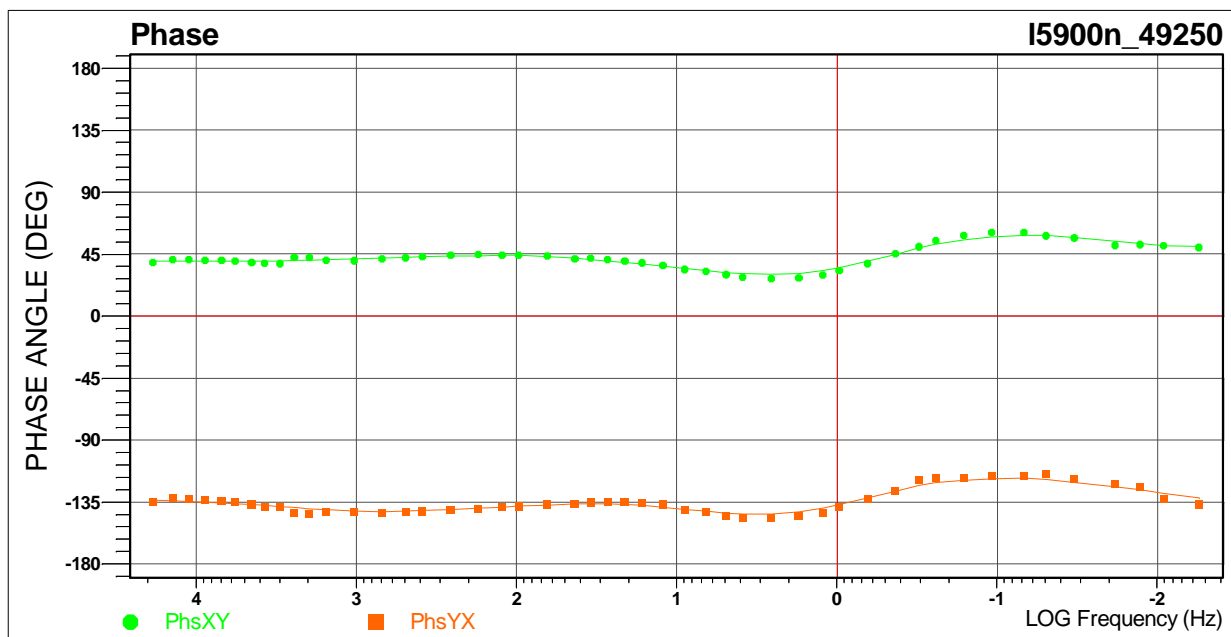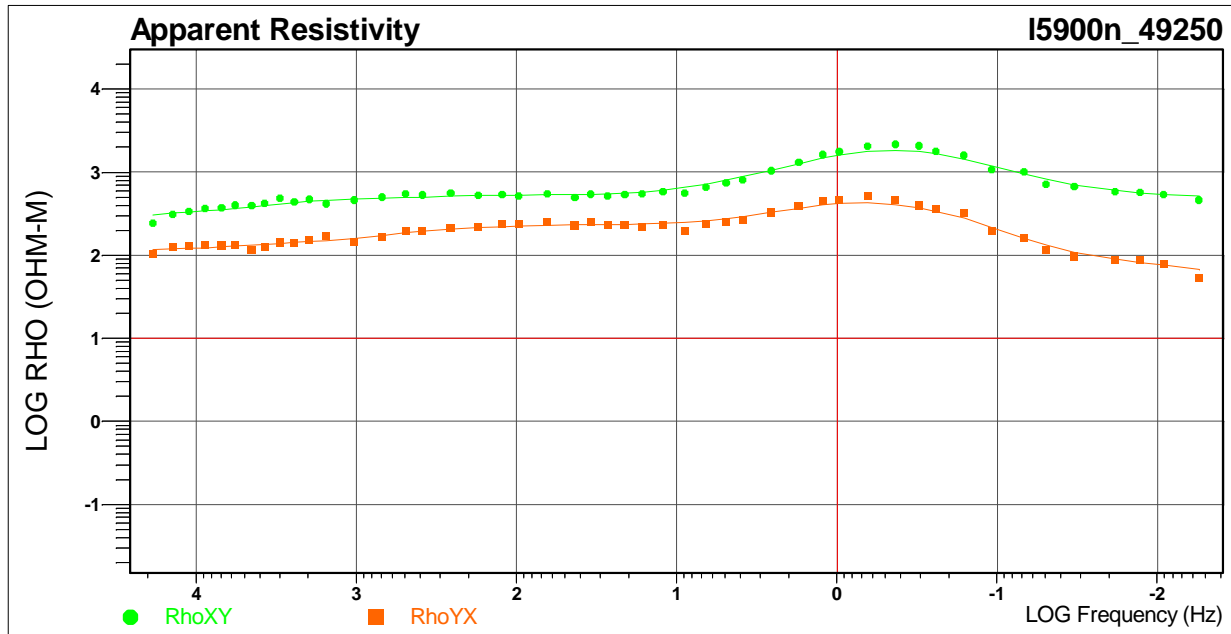
Example of Apparent Resistivity and Phase (XY and YX) Sounding Curves.

C DC – IP PSEUDO-SECTIONS OF FINAL PROCESSED DATA

C.1 LINE 1900N
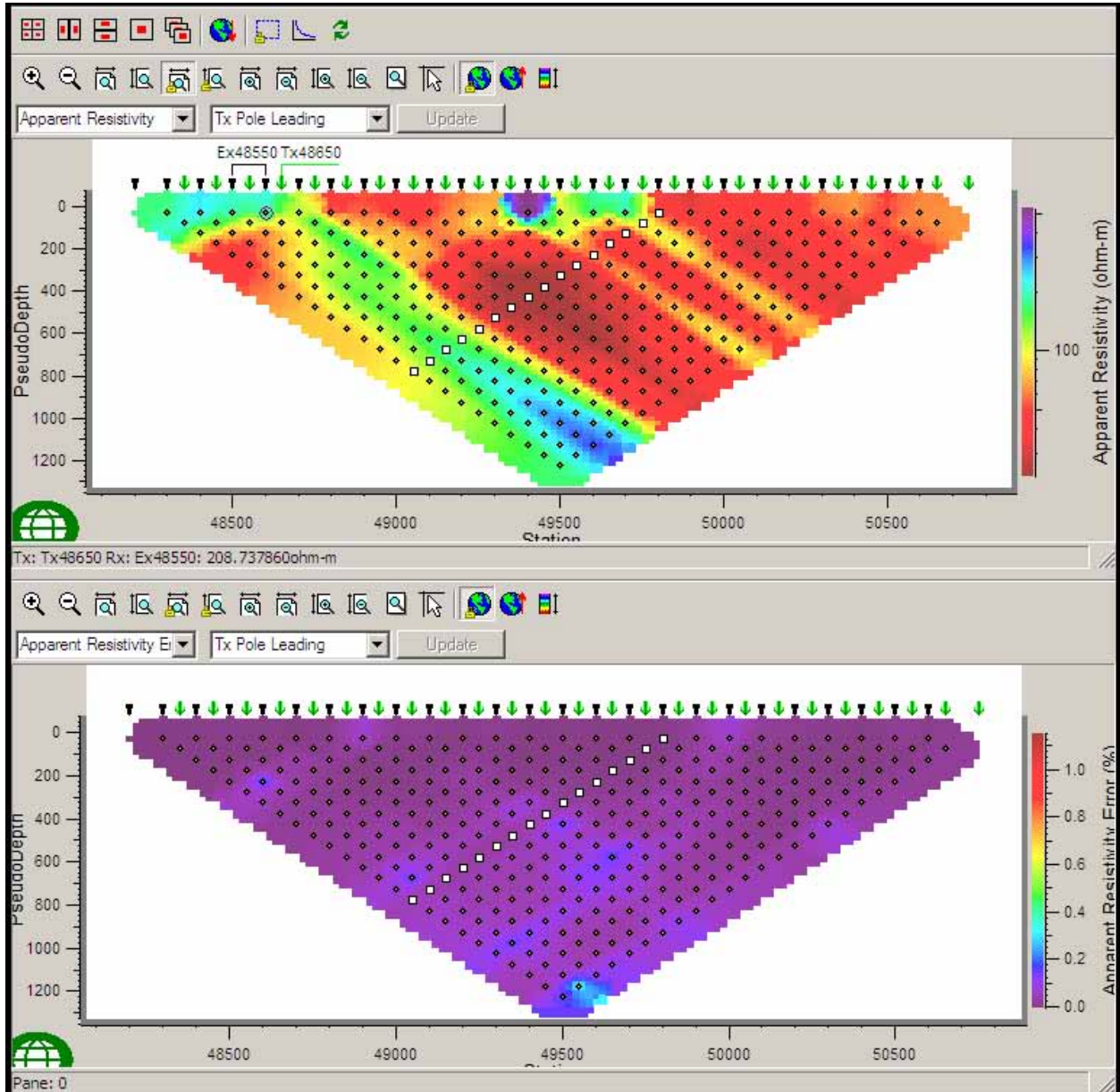
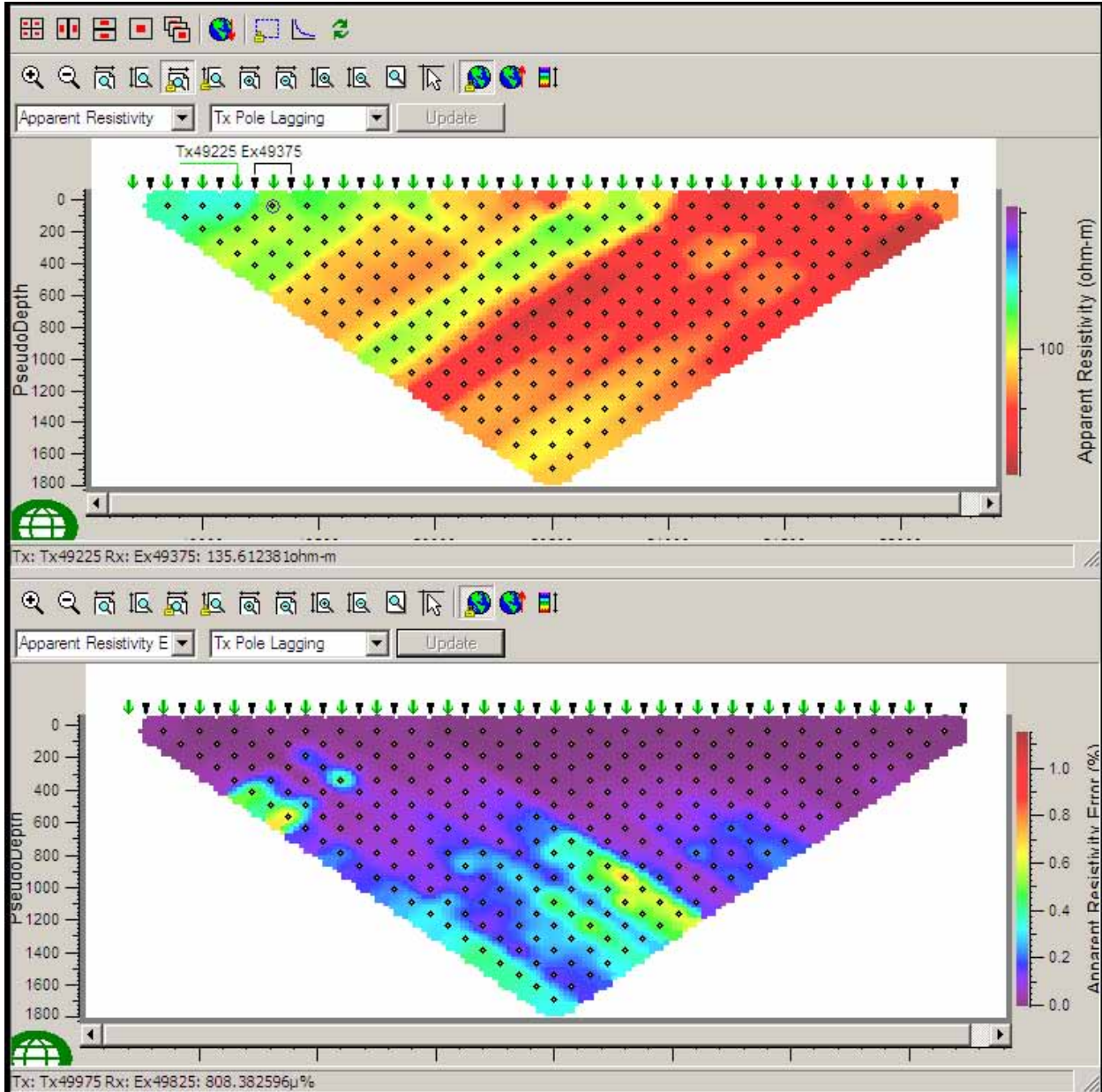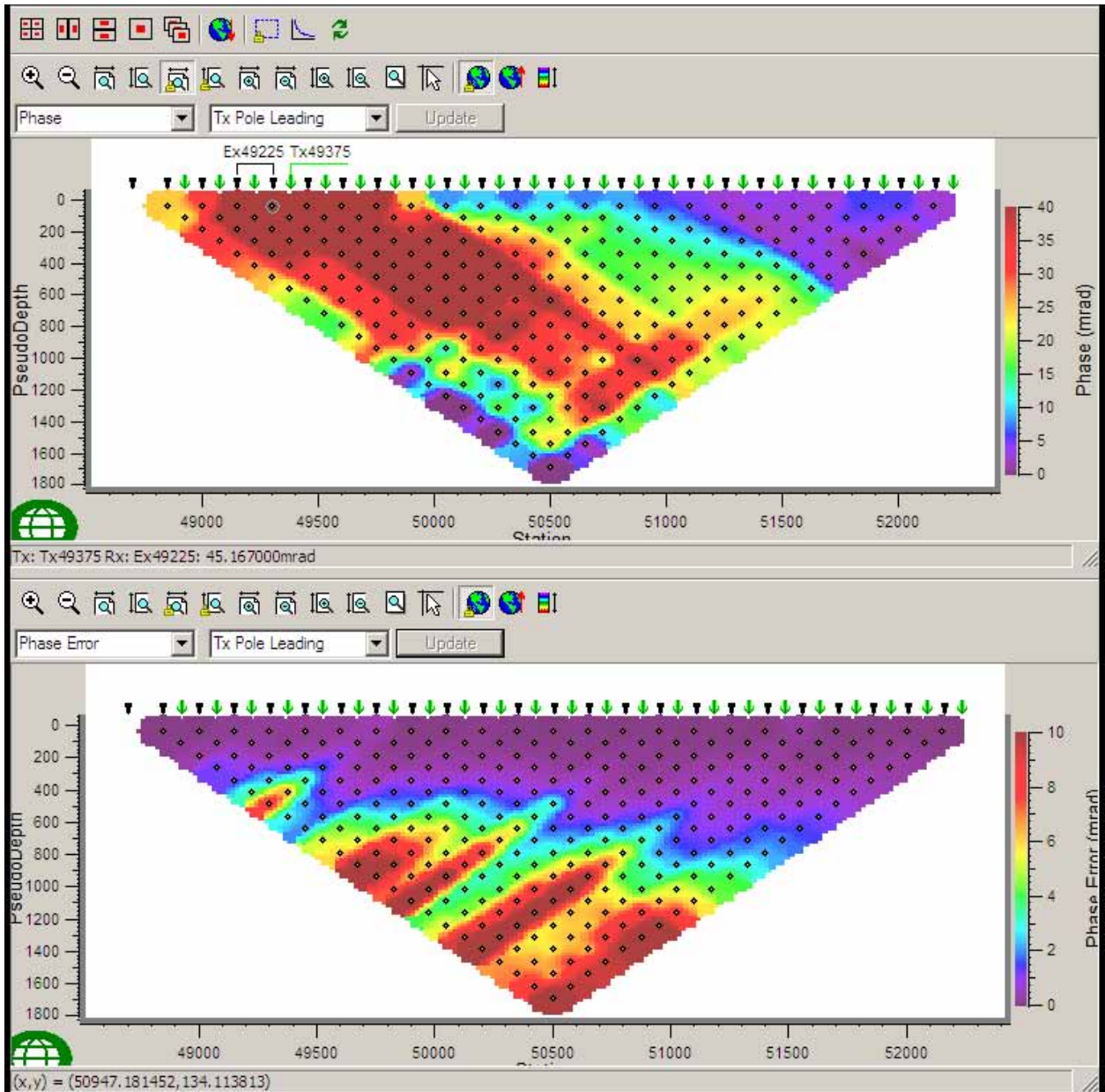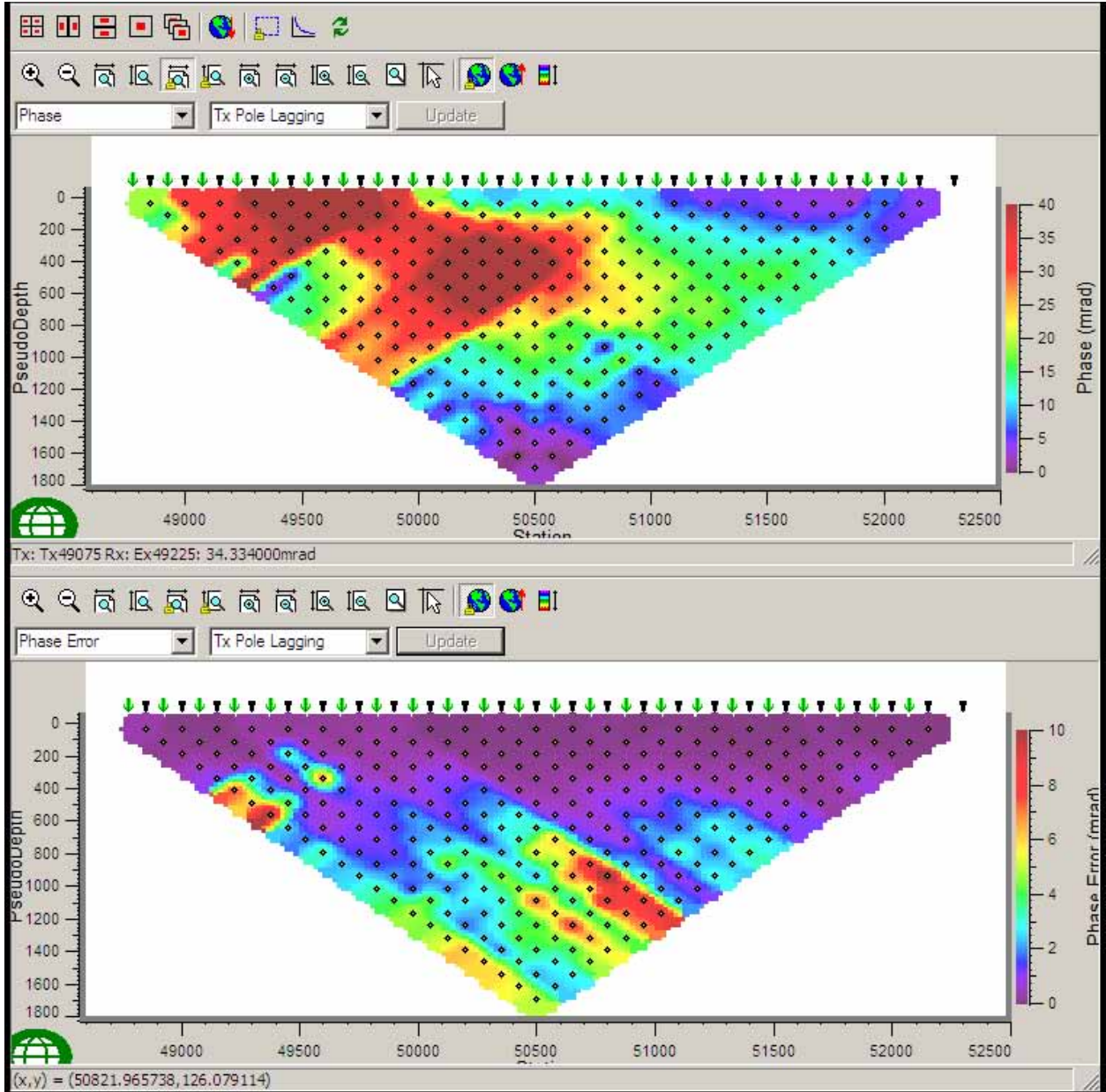*Line 1900N – Observed Apparent Resistivity Raw Data (Ohm.m) & Voltage Errors (%)-Tx Pole Leading.*

☐ Tx with more than one event
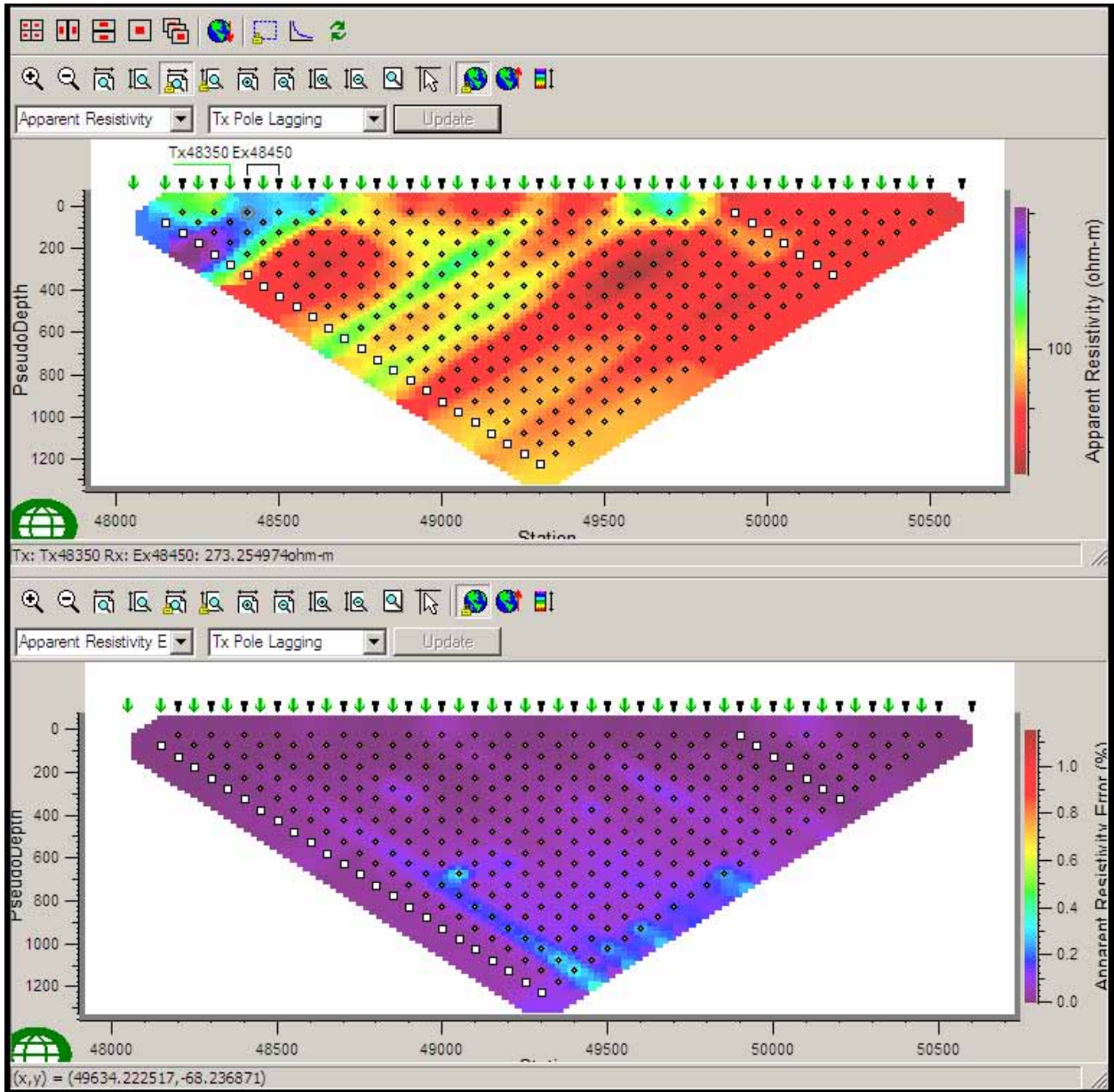
Line 1900N – Observed Apparent Resistivity Raw Data (Ohm.m) & Voltage Errors (%)-
Tx Pole Lagging.

☐ Tx with more than one event
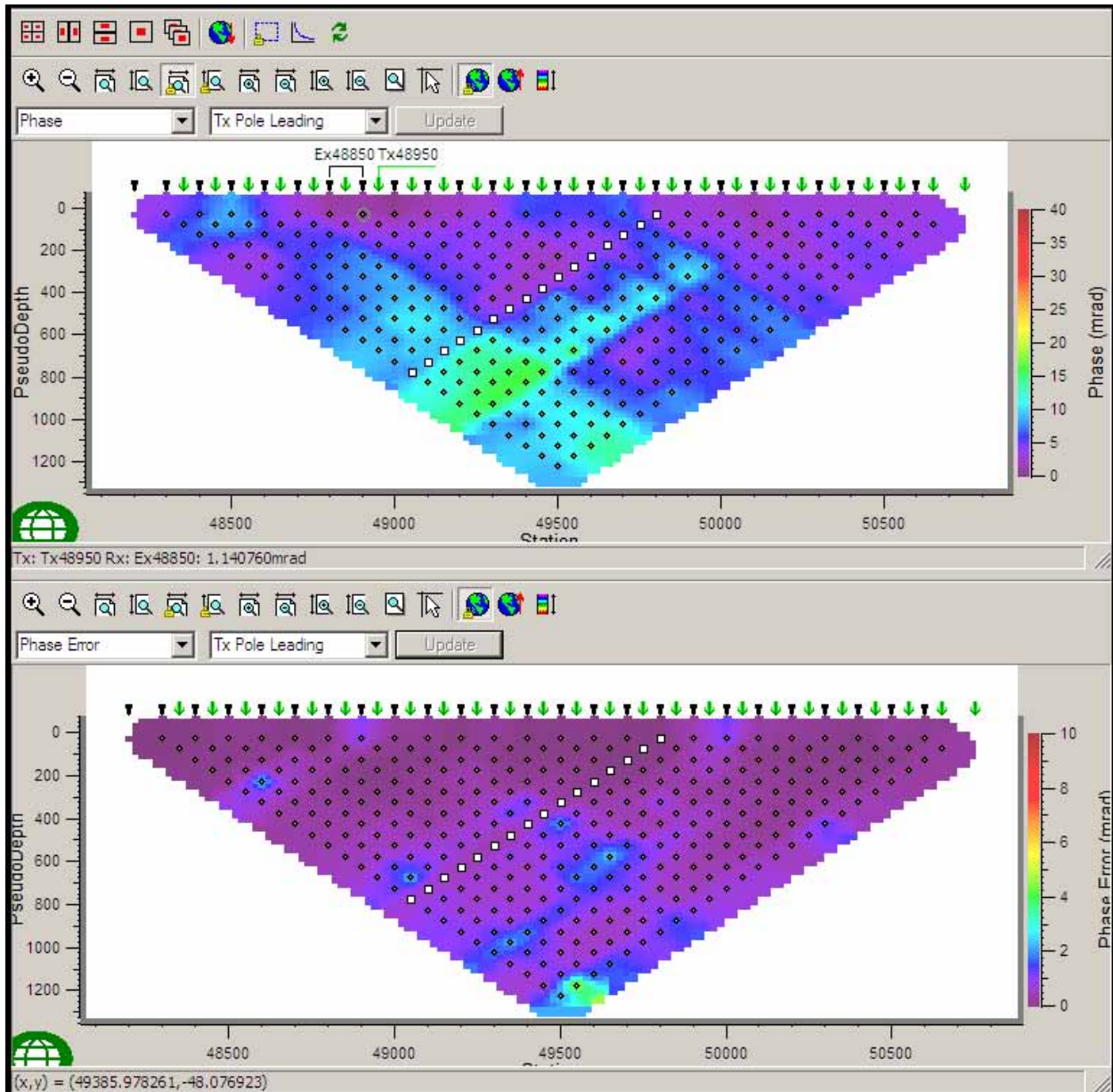
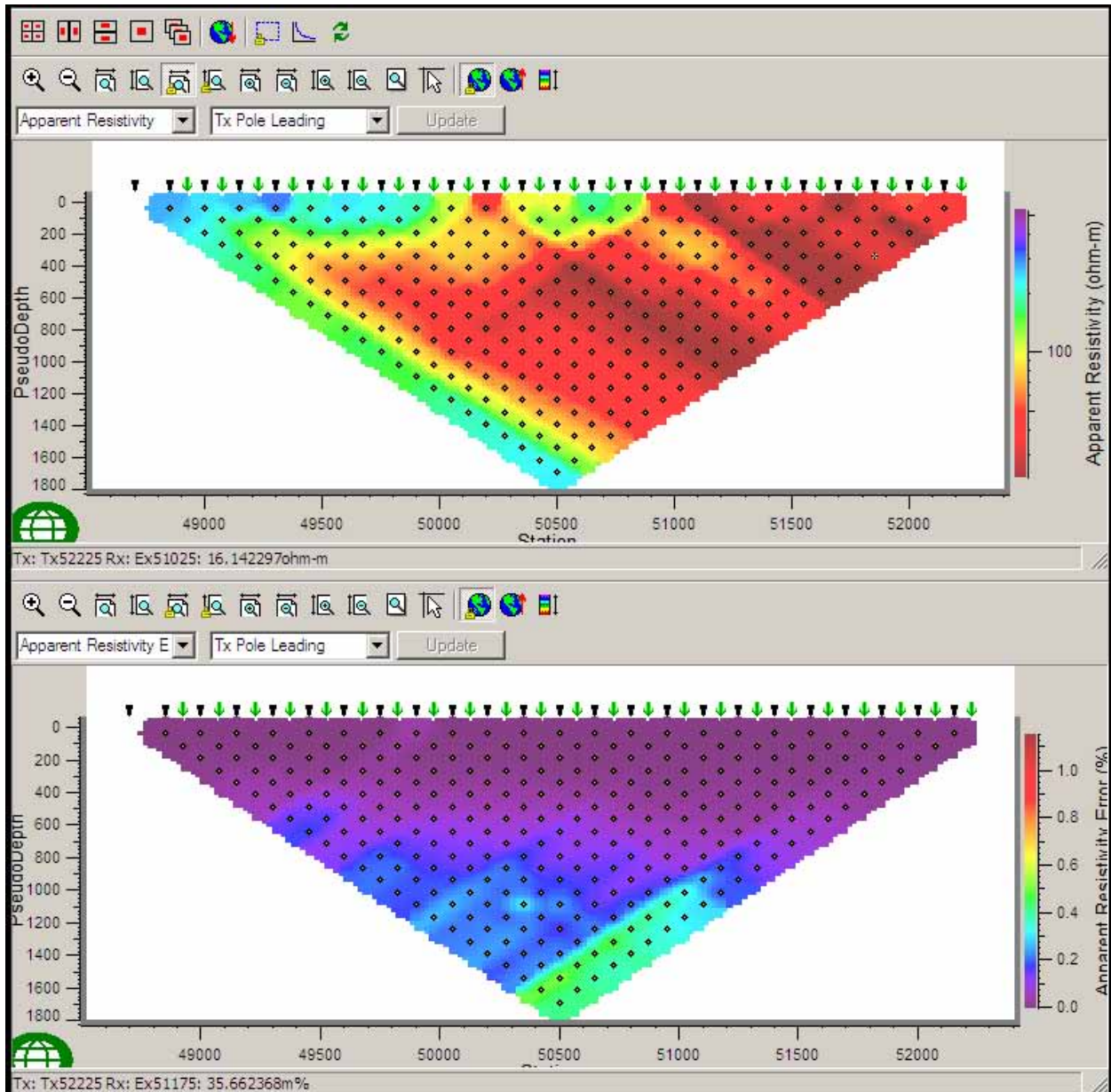*Line 1900N – Observed IP Raw Data (mrad) & IP Errors (mrads)-Tx Pole Leading.*

☐ Tx with more than one event
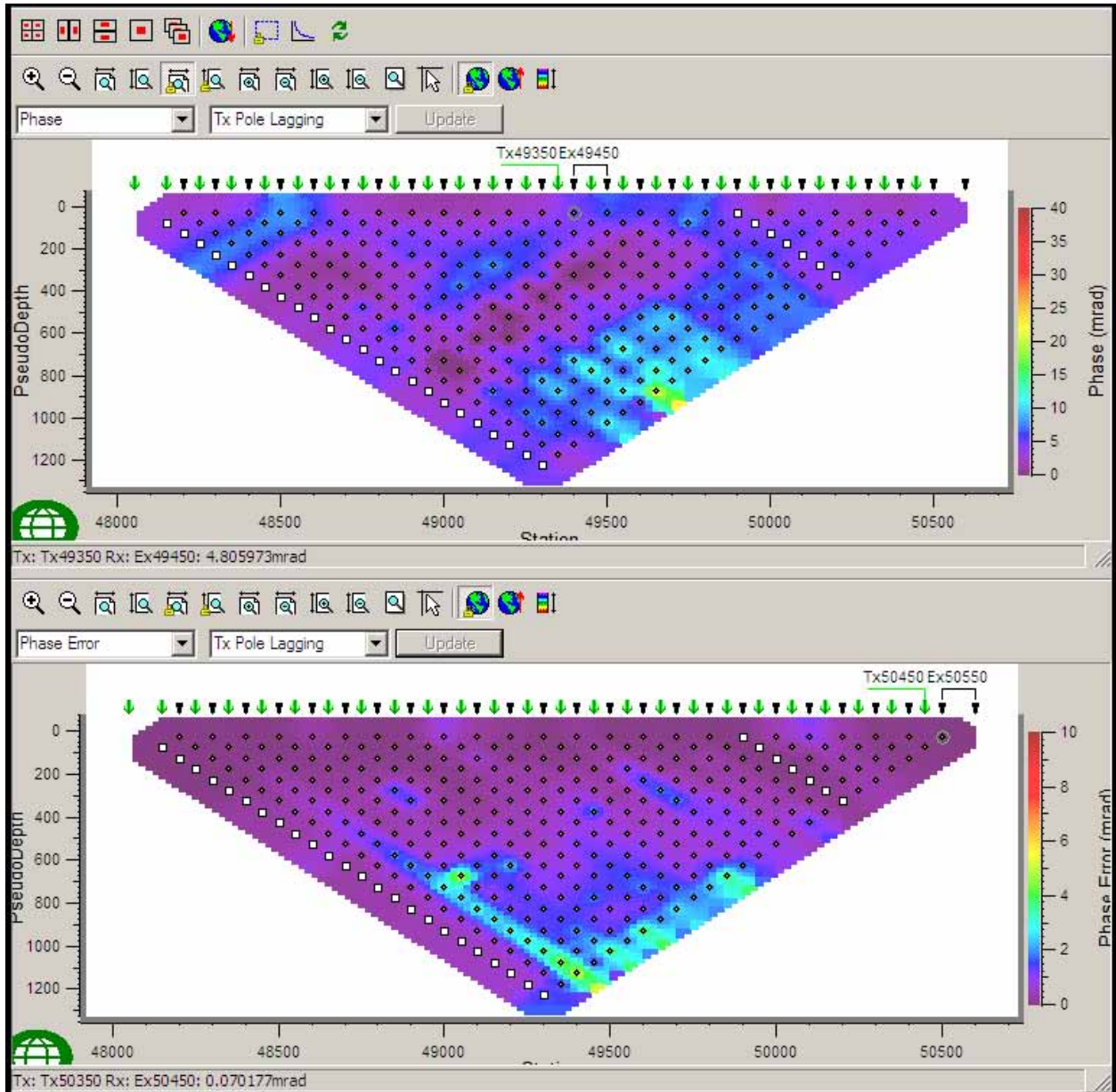
Line 1900N – Observed IP Raw Data (mrad) & IP Errors (mrads)-Tx Pole Lagging.
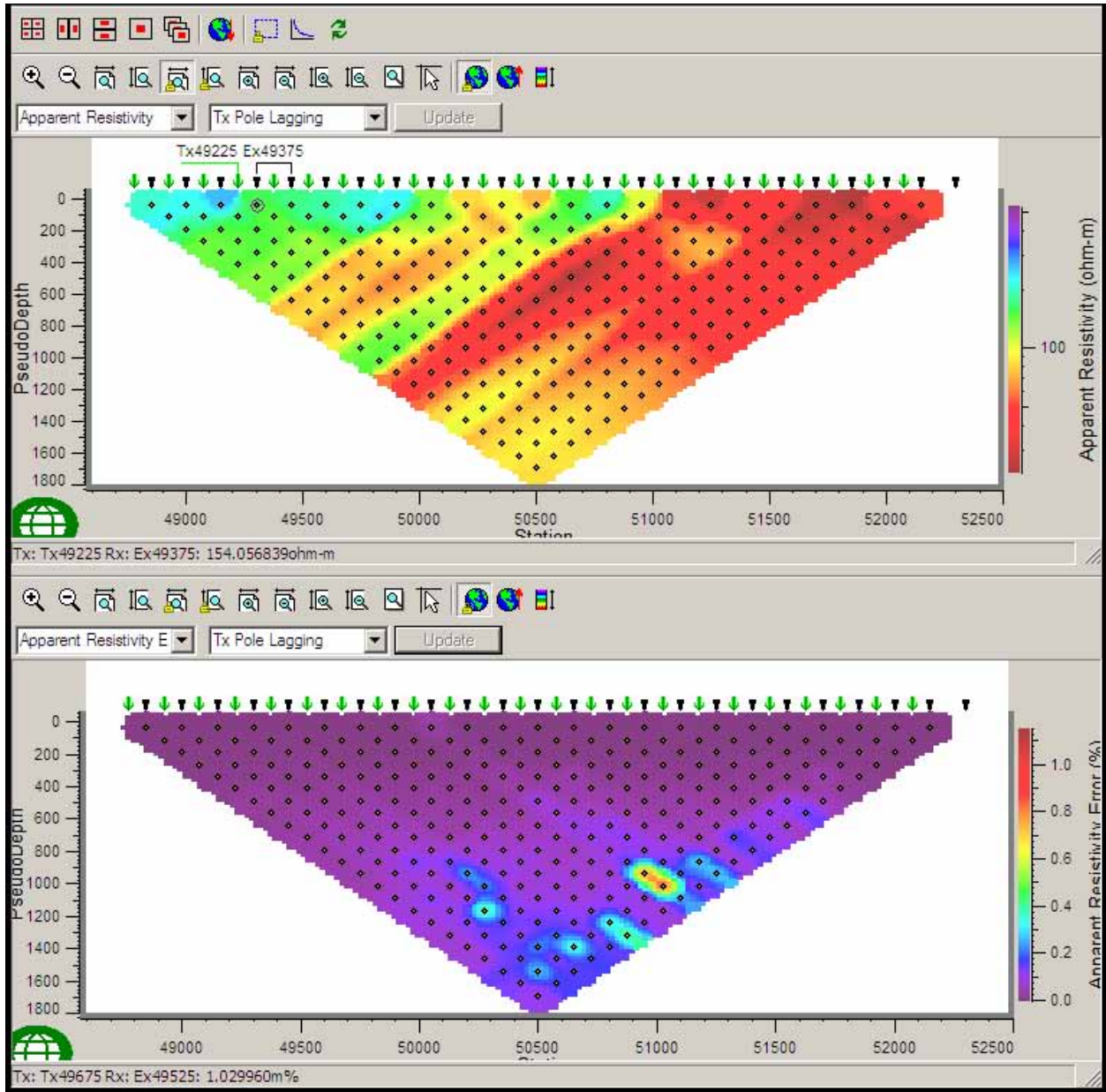
☐ Tx with more than one event
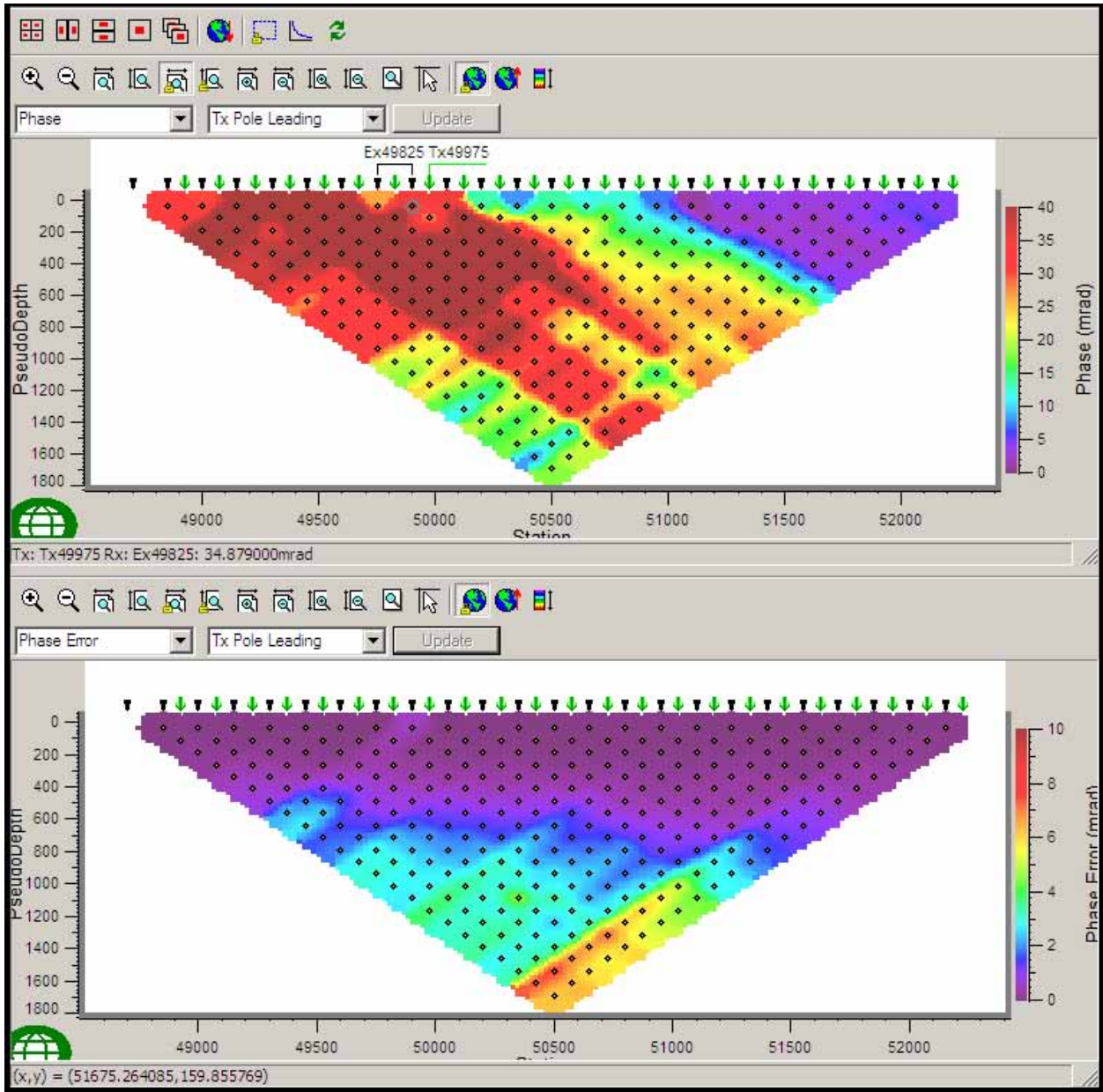
C.2 LINE 2200N
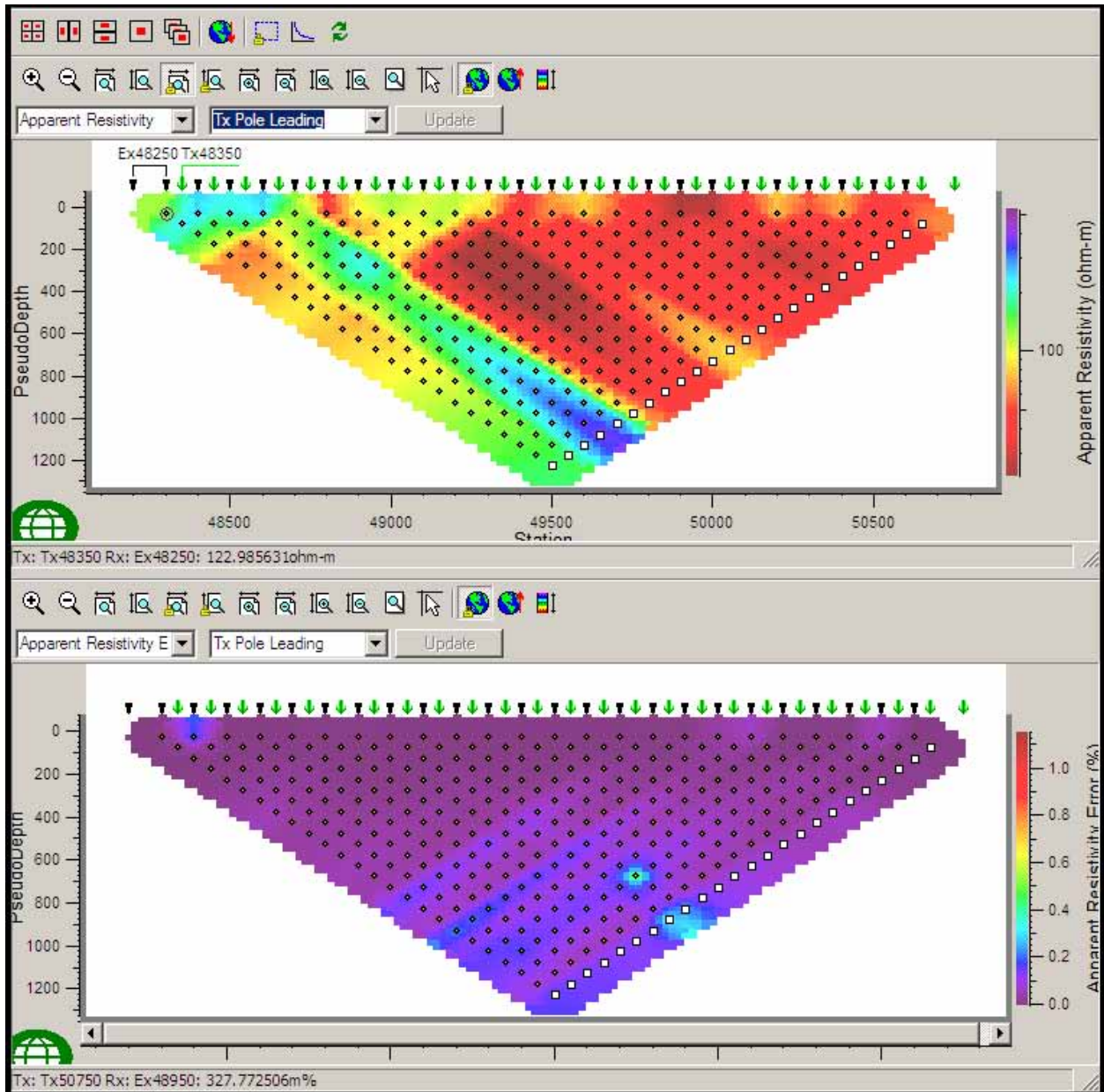
Line 2200N – Observed Apparent Resistivity Raw Data (Ohm.m) & Voltage Errors (%)-
Tx Pole Leading.
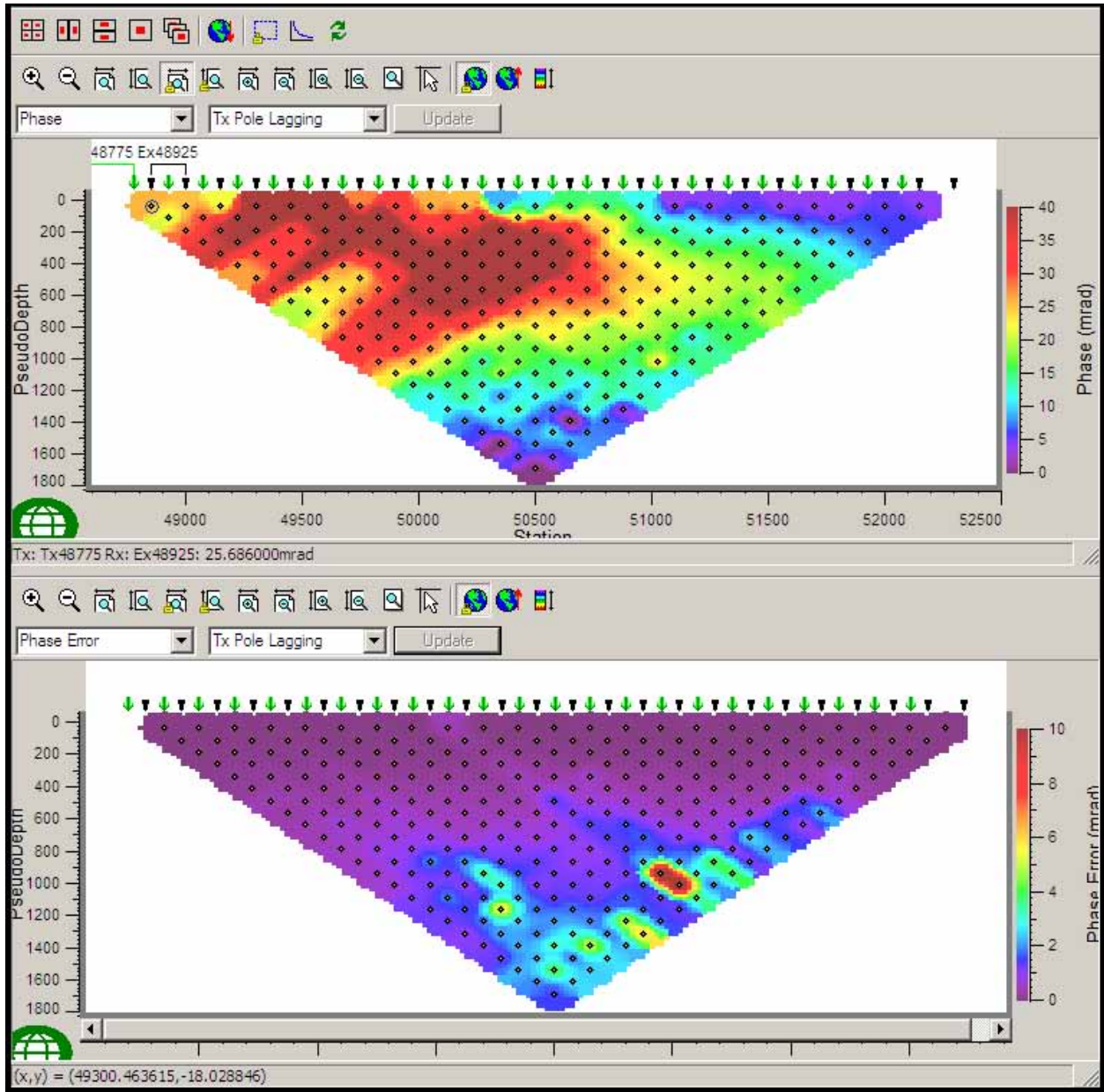
☐ Tx with more than one event

***Line 2200N – Observed Apparent Resistivity Raw Data (Ohm.m) & Voltage Errors (%)-
Tx Pole Lagging.***

☐ Tx with more than one event

=
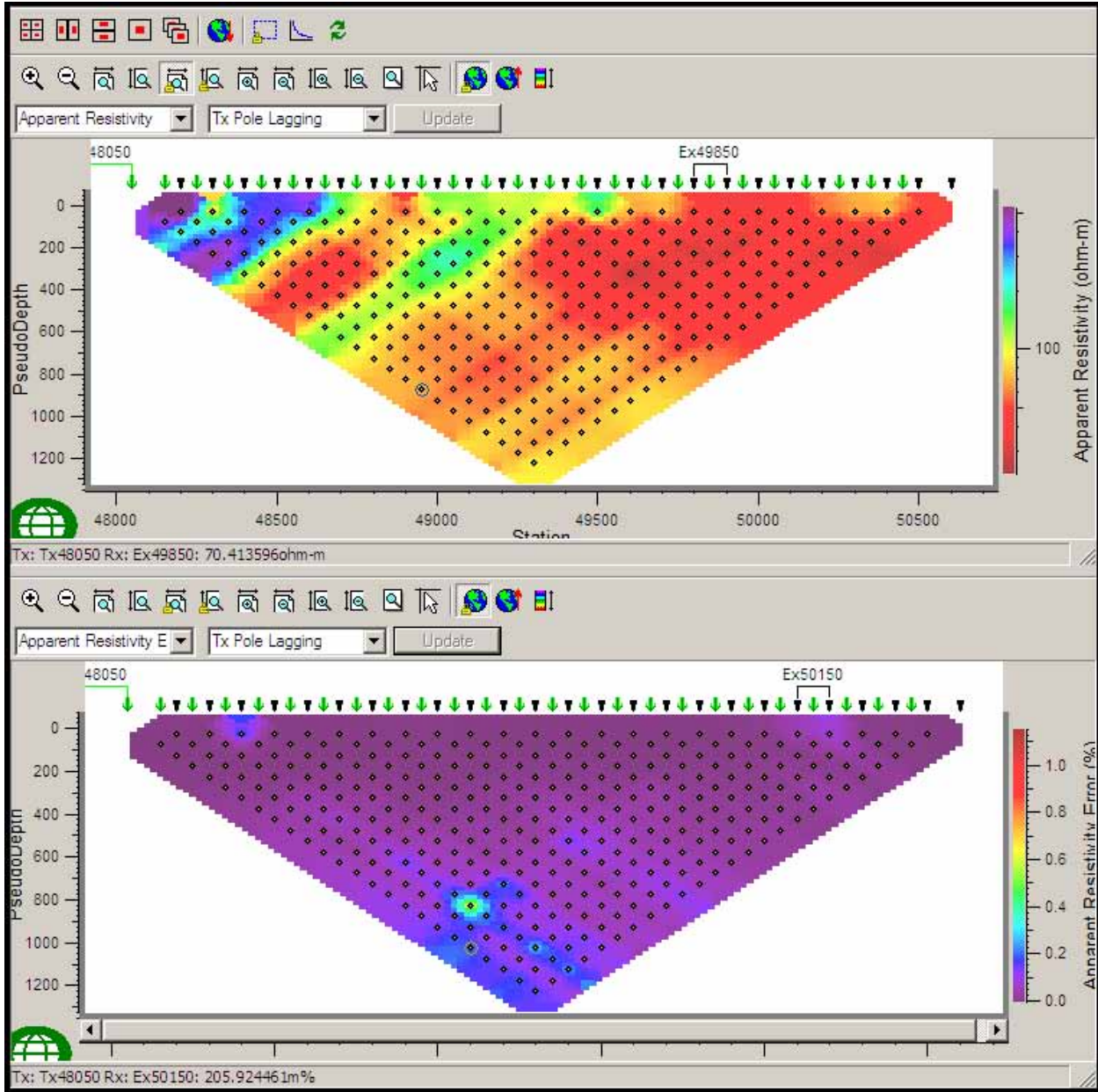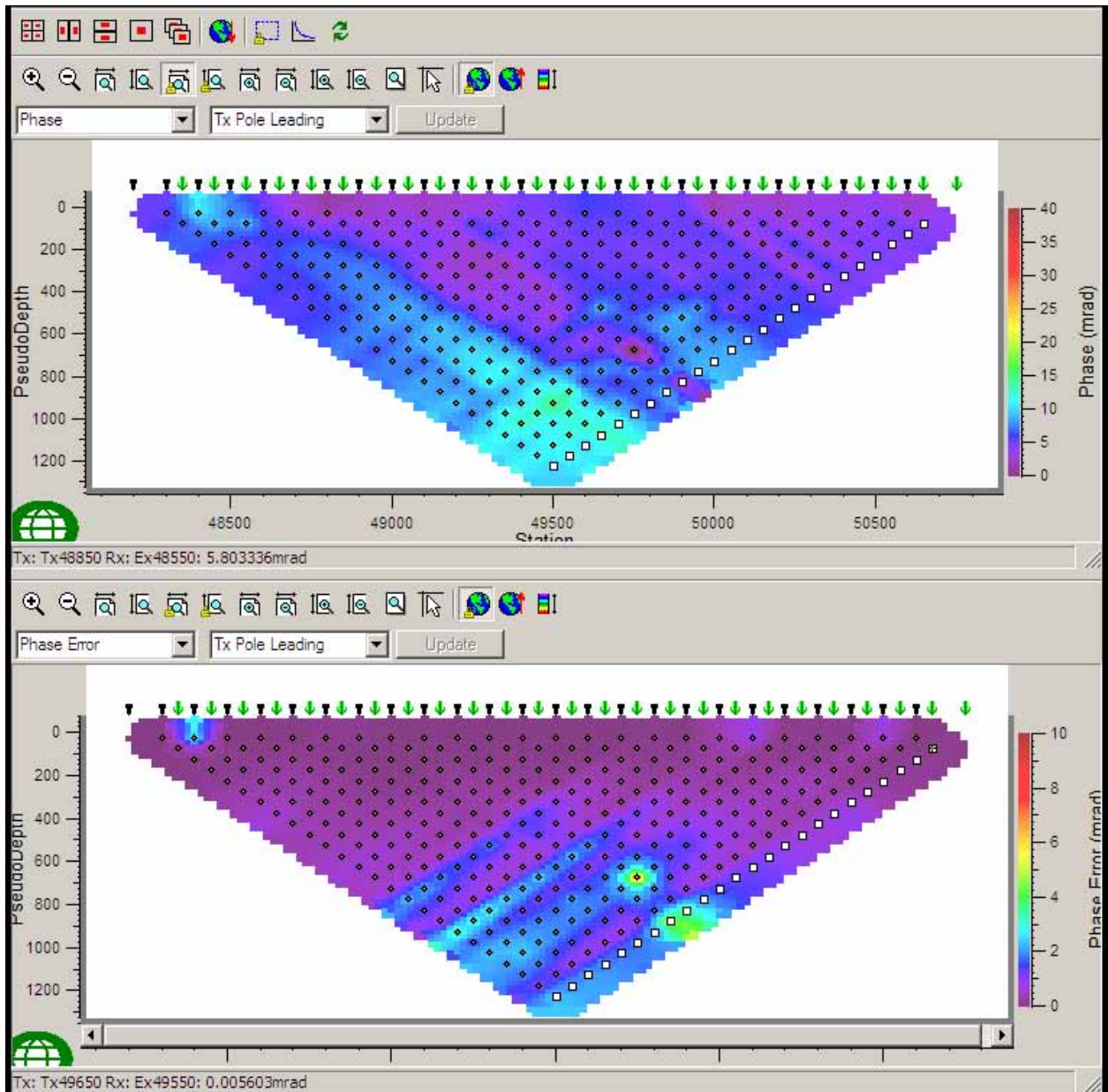
Line 2200N – Observed IP Raw Data (mrad) & IP Errors (mrads)-Tx Pole Leading.
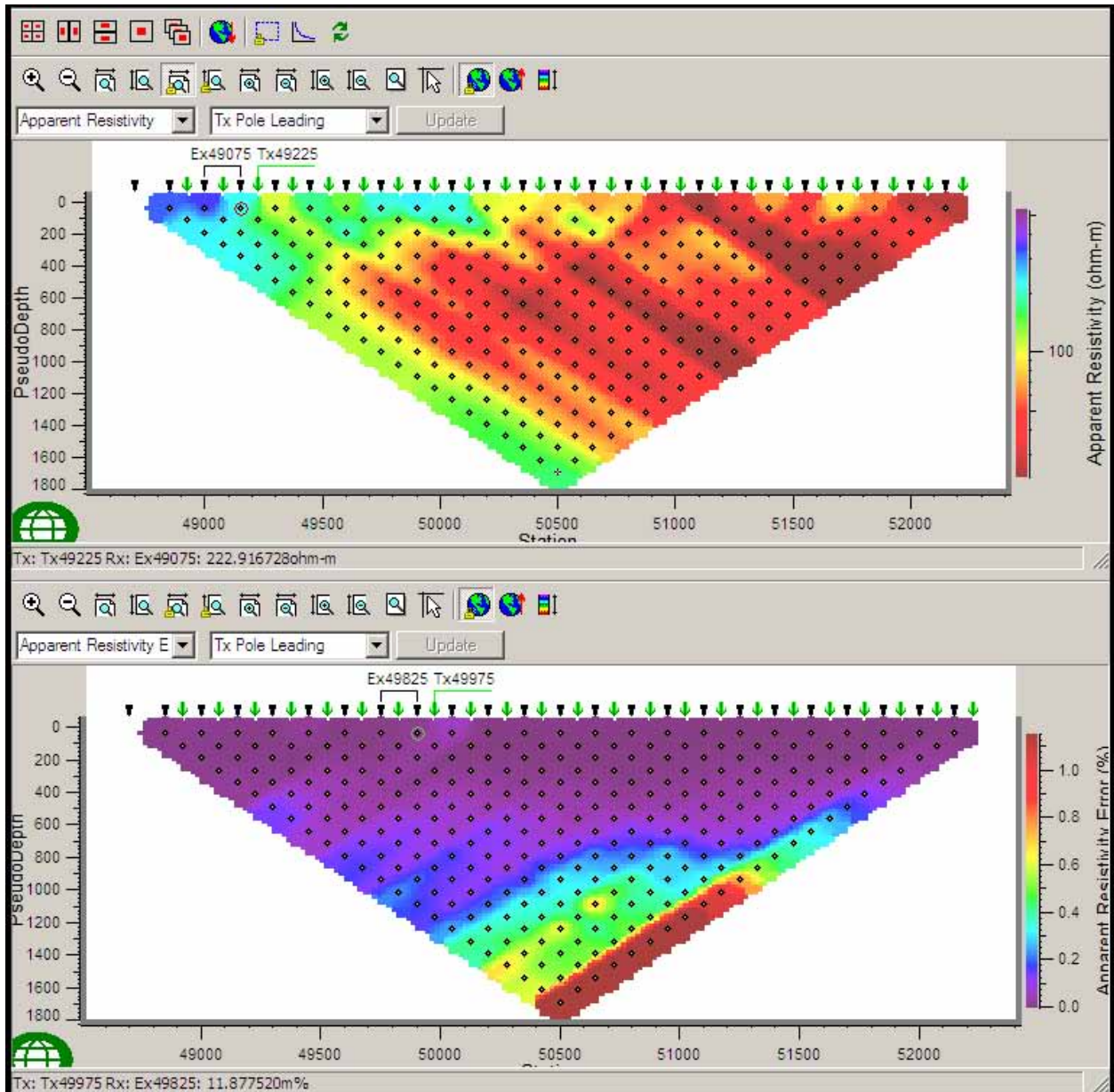
☐ Tx with more than one event
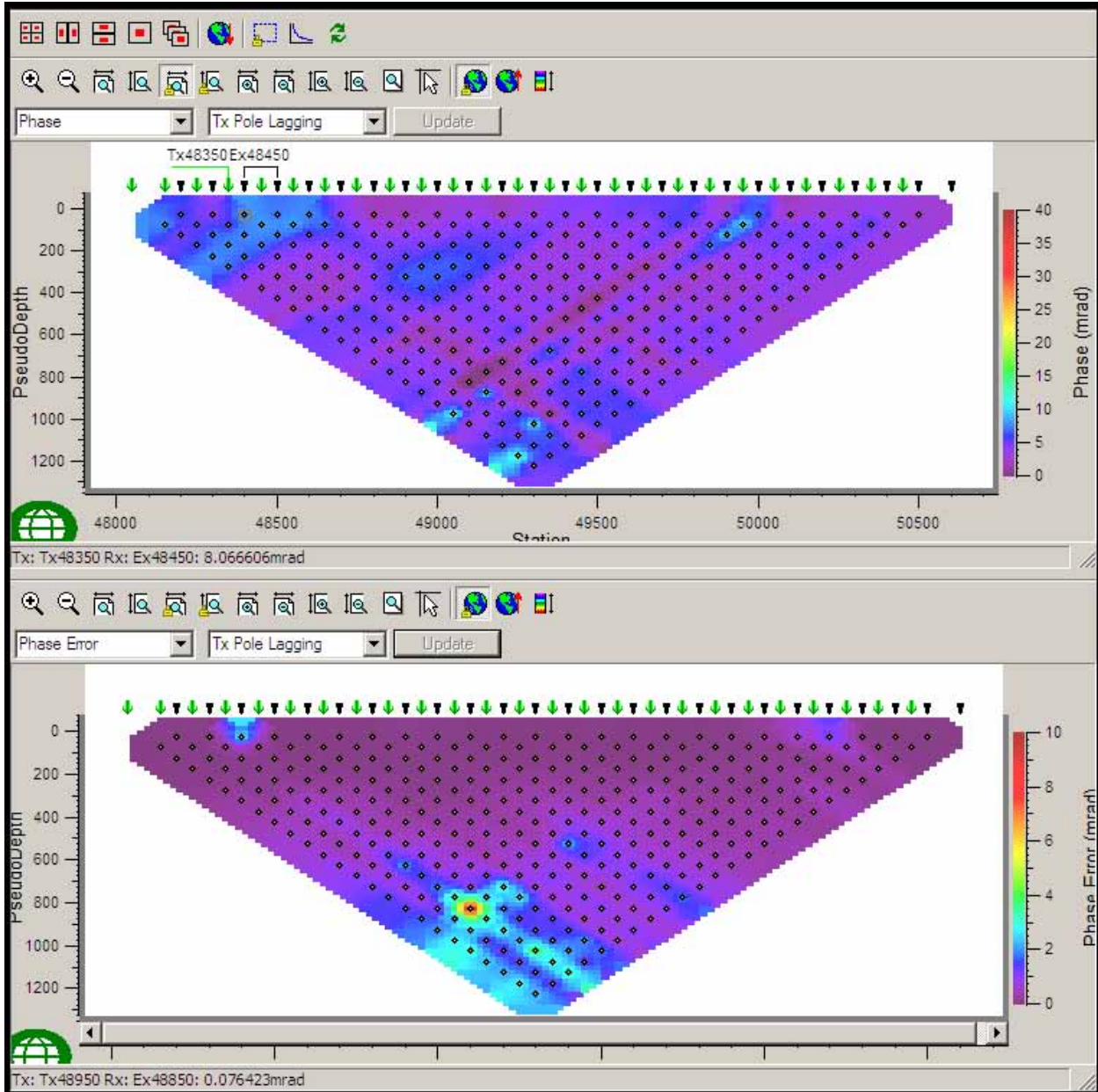
Line 2200N – Observed IP Raw Data (mrad) & IP Errors (mrads)-Tx Pole Lagging.

☐ Tx with more than one event

C.3   LINE 3950N
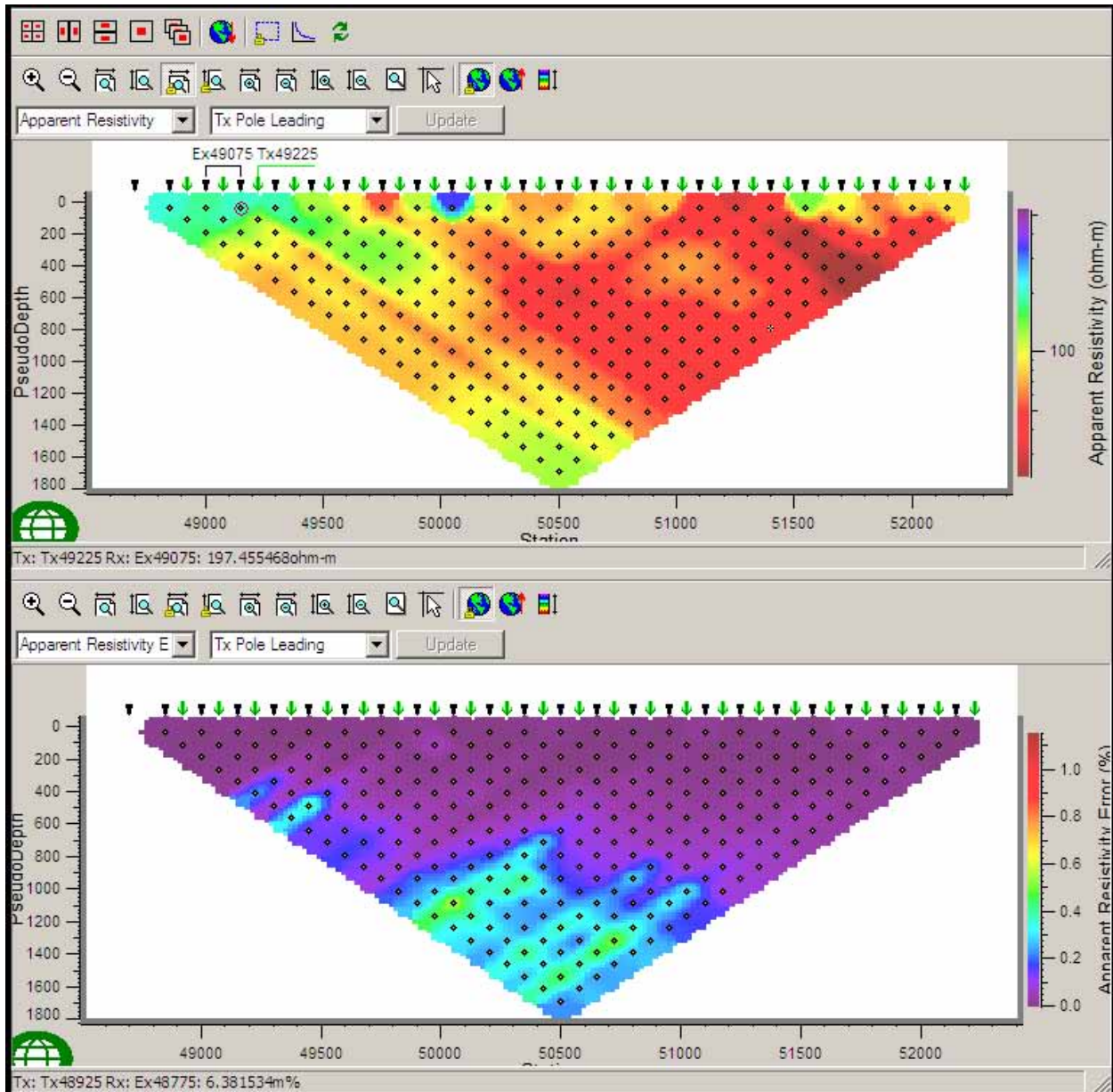
Line 3950N – Observed Apparent Resistivity Raw Data (Ohm.m) & Voltage Errors (%)-
Tx Pole Leading.

☐ Tx with more than one event
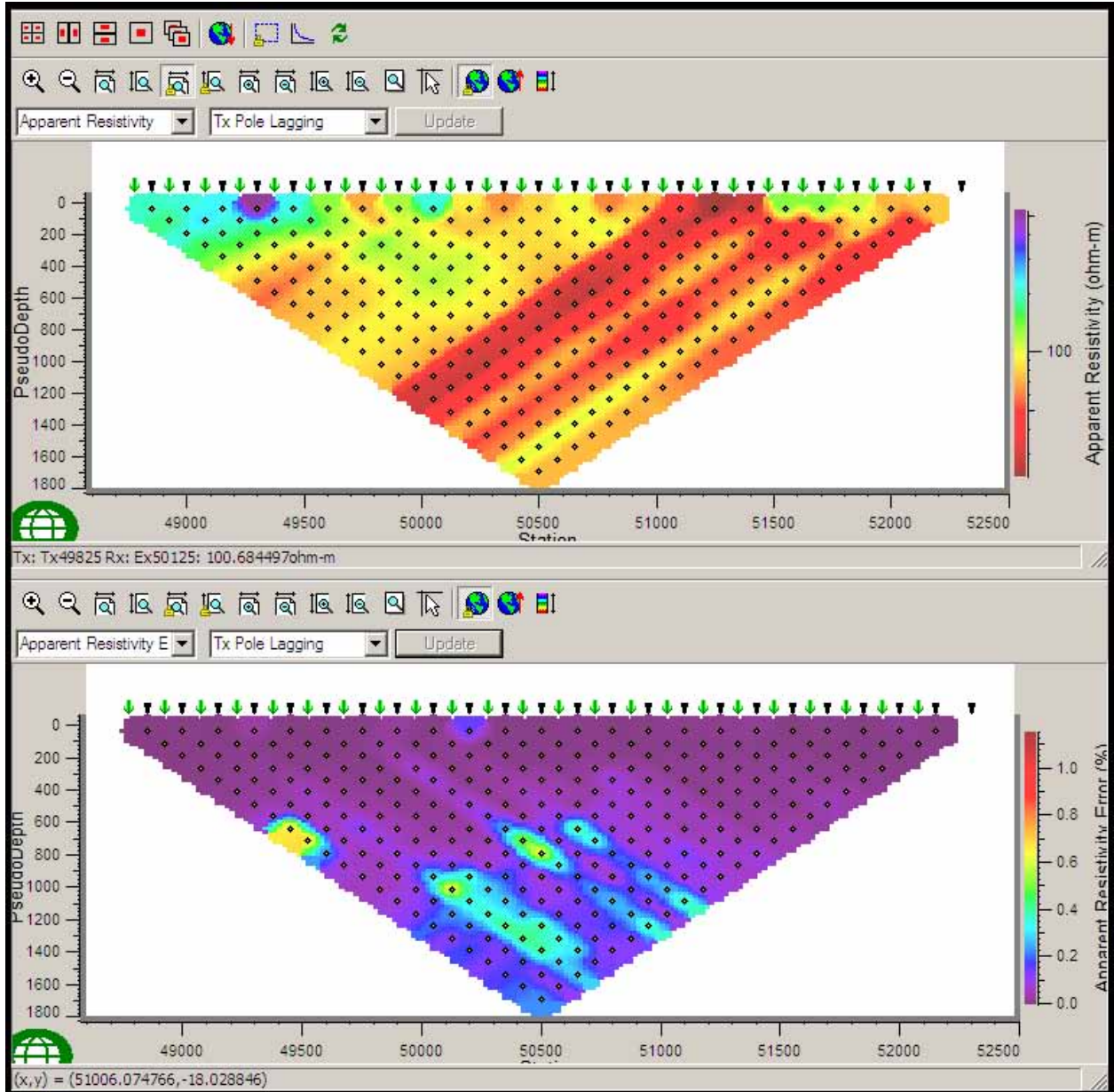
Line 3950N – Observed Apparent Resistivity Raw Data (Ohm.m) & Voltage Errors (%)-
Tx Pole Lagging.

☐ Tx with more than one event
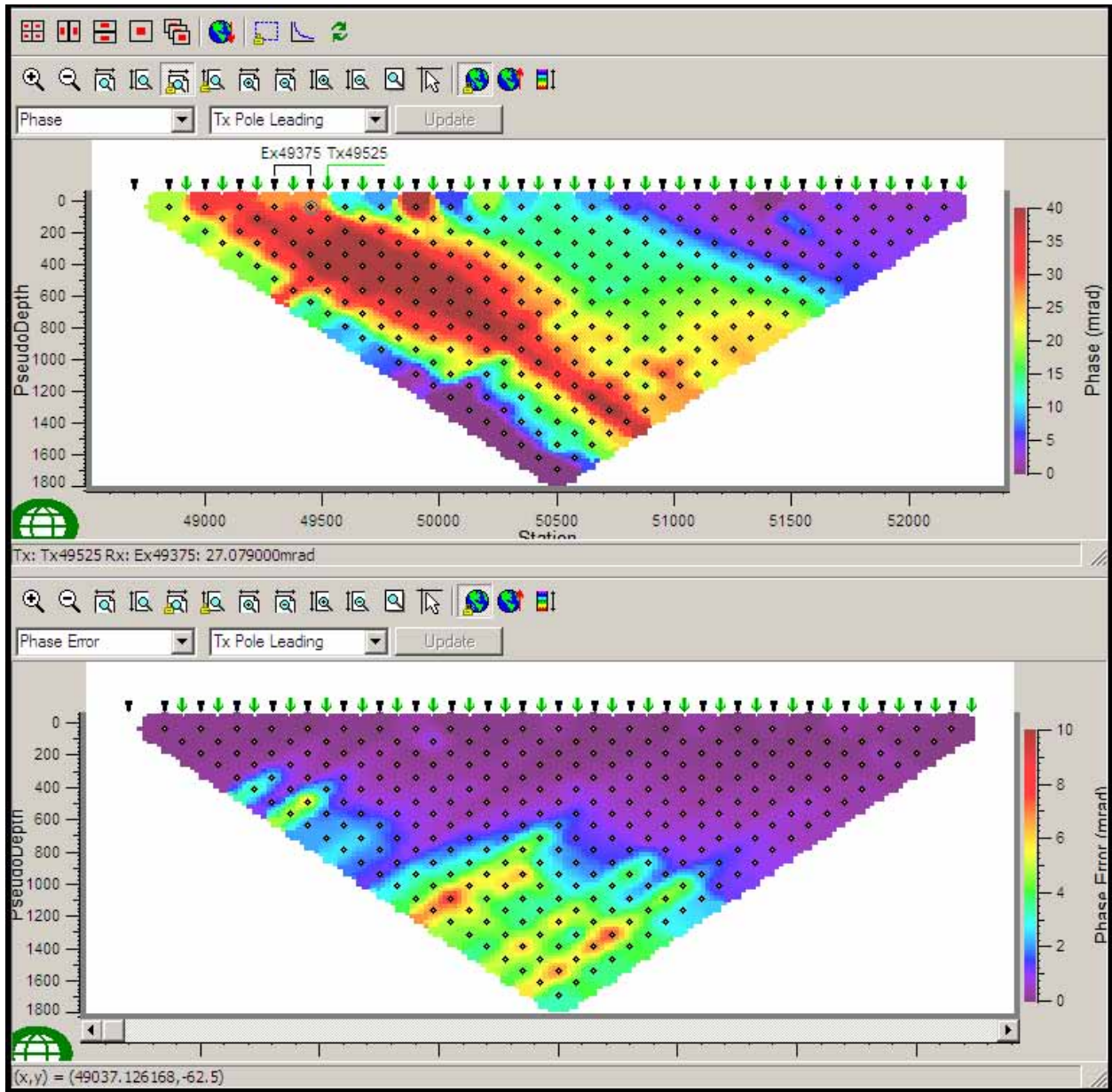
Line 3950N – Observed IP Raw Data (mrad) & IP Errors (mrads)-Tx Pole Leading.

☐ Tx with more than one event
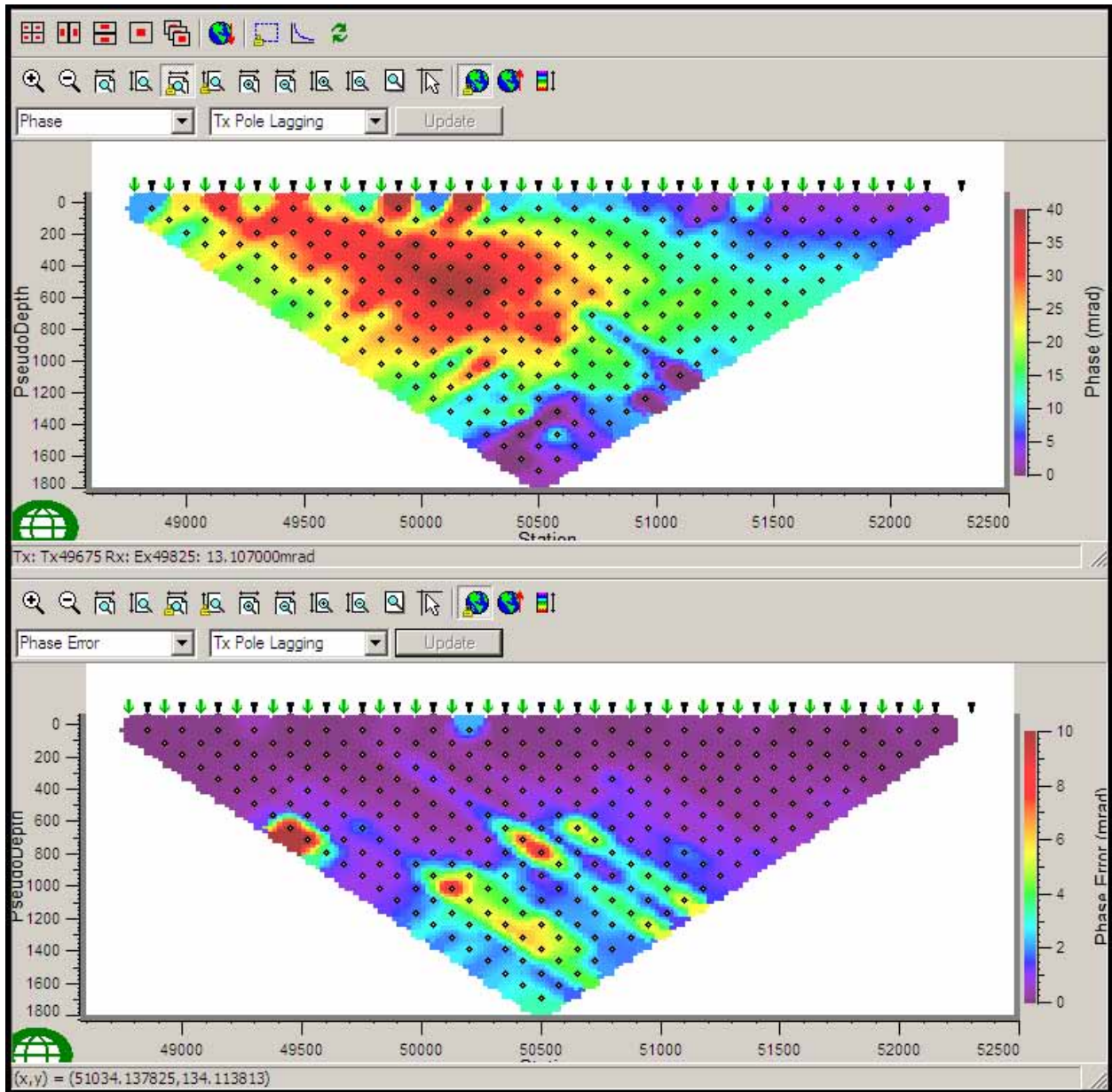
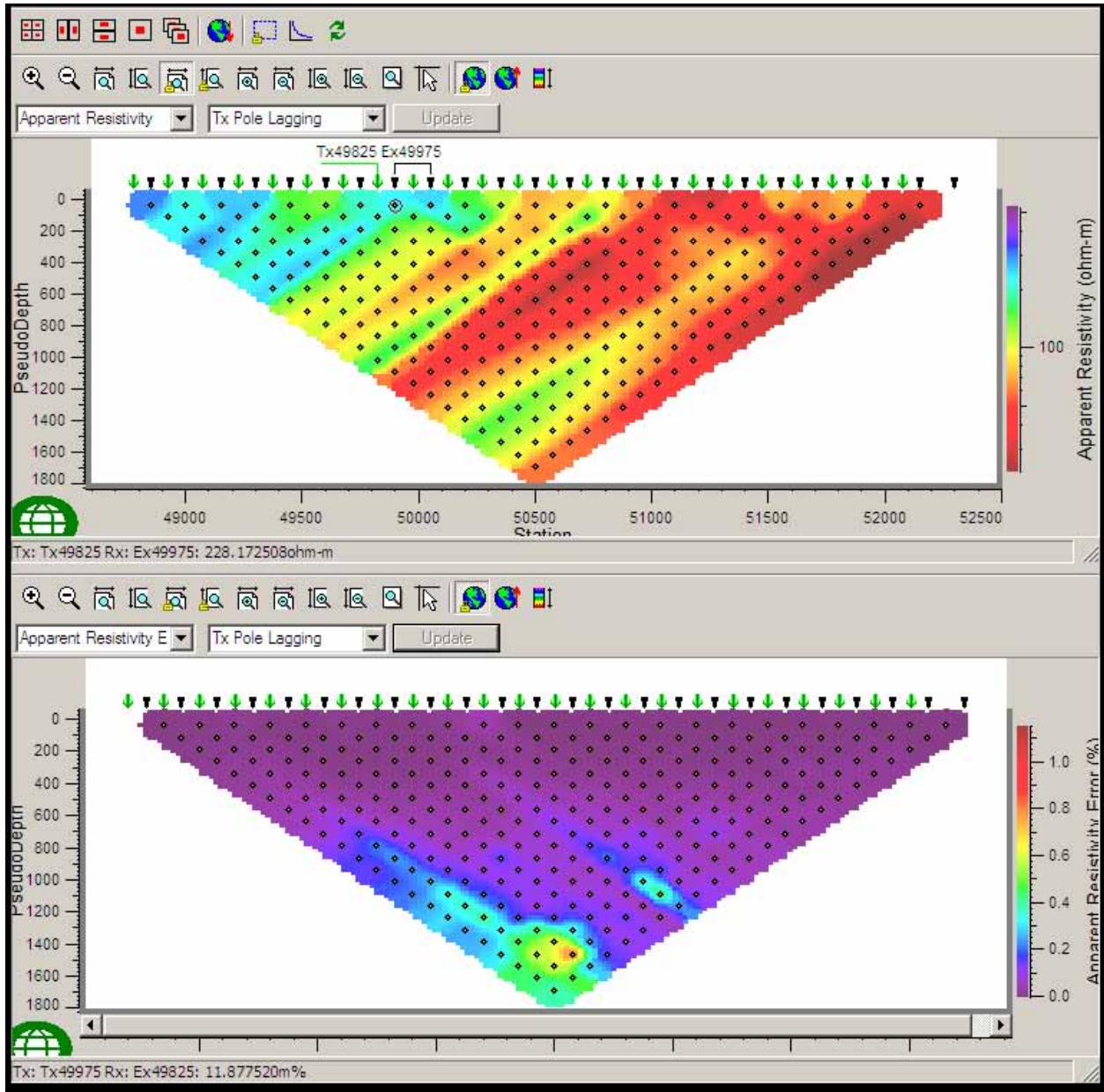*__Line 3950N – Observed IP Raw Data (mrad) & IP Errors (mrads)-Tx Pole Lagging.__*
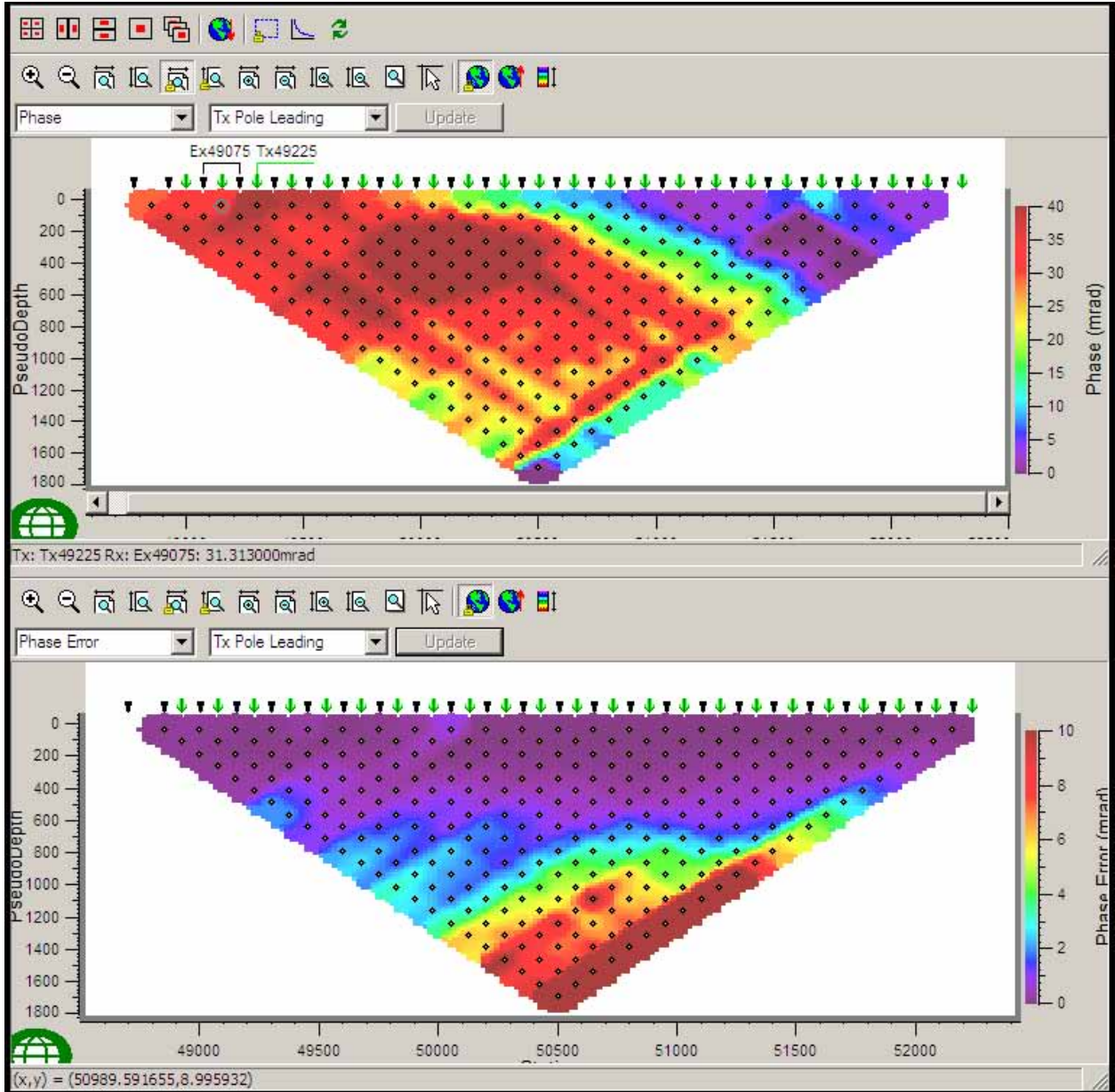
☐ Tx with more than one event

C.4 LINE 4300N
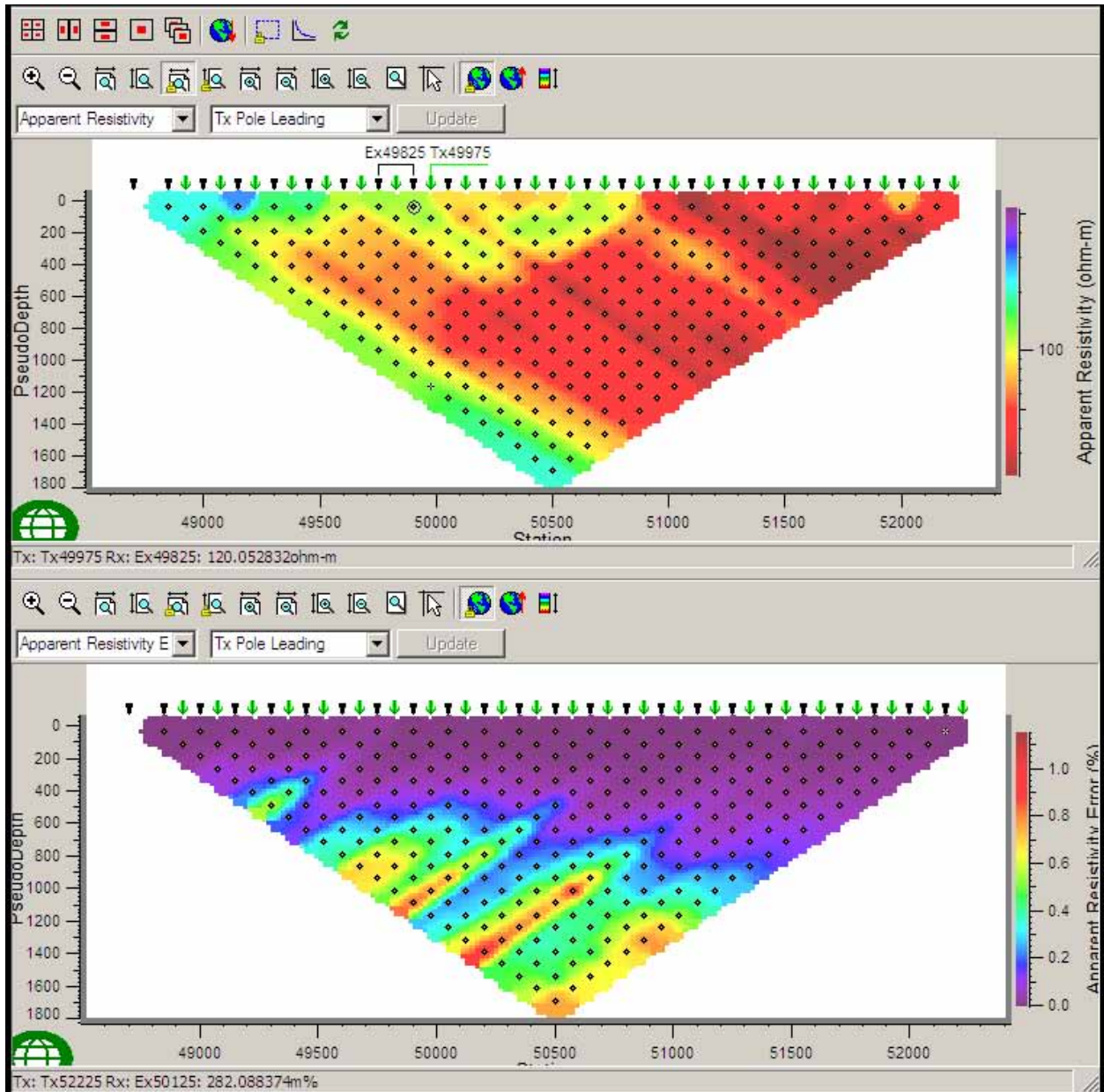
Line 4300N – Observed Apparent Resistivity Raw Data (Ohm.m) & Voltage Errors (%)- Tx Pole Leading.
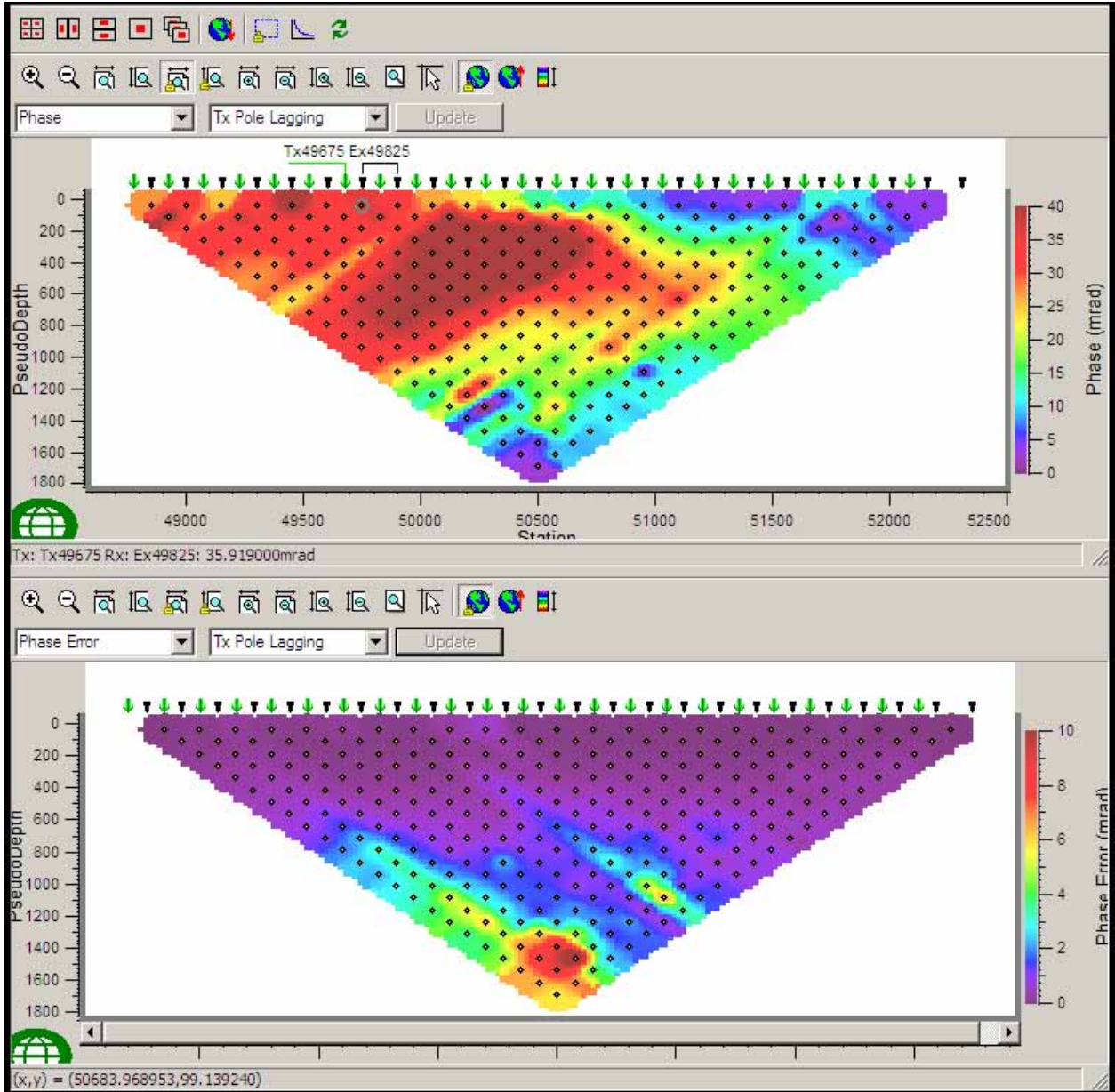
☐ Tx with more than one event

***Line 4300N – Observed Apparent Resistivity Raw Data (Ohm.m) & Voltage Errors (%)-
Tx Pole Lagging.***

☐ Tx with more than one event

Line 4300N – Observed IP Raw Data (mrad) & IP Errors (mrads)-Tx Pole Leading.

☐ Tx with more than one event

Line 4300N – Observed IP Raw Data (mrad) & IP Errors (mrads)-Tx Pole Lagging.

☐ Tx with more than one event

C.5   LINE 4600N

Line 4600N – Observed Apparent Resistivity Raw Data (Ohm.m) & Voltage Errors (%)- Tx Pole Leading.

☐ Tx with more than one event

***Line 4600N – Observed Apparent Resistivity Raw Data (Ohm.m) & Voltage Errors (%)-
Tx Pole Lagging.***

☐ Tx with more than one event

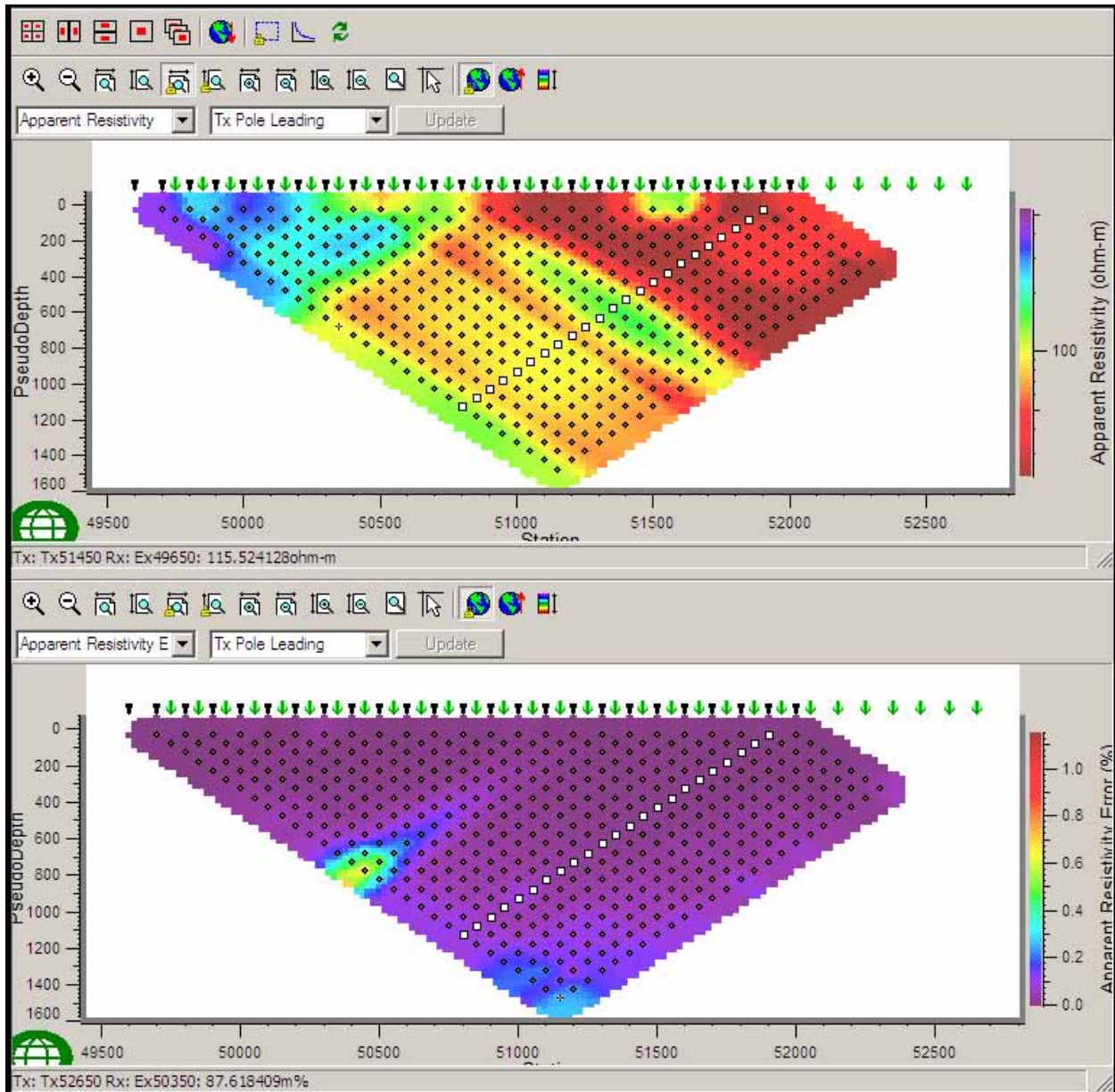*Line 4600N – Observed IP Raw Data (mrad) & IP Errors (mrads)-Tx Pole Leading.*

☐ Tx with more than one event

97

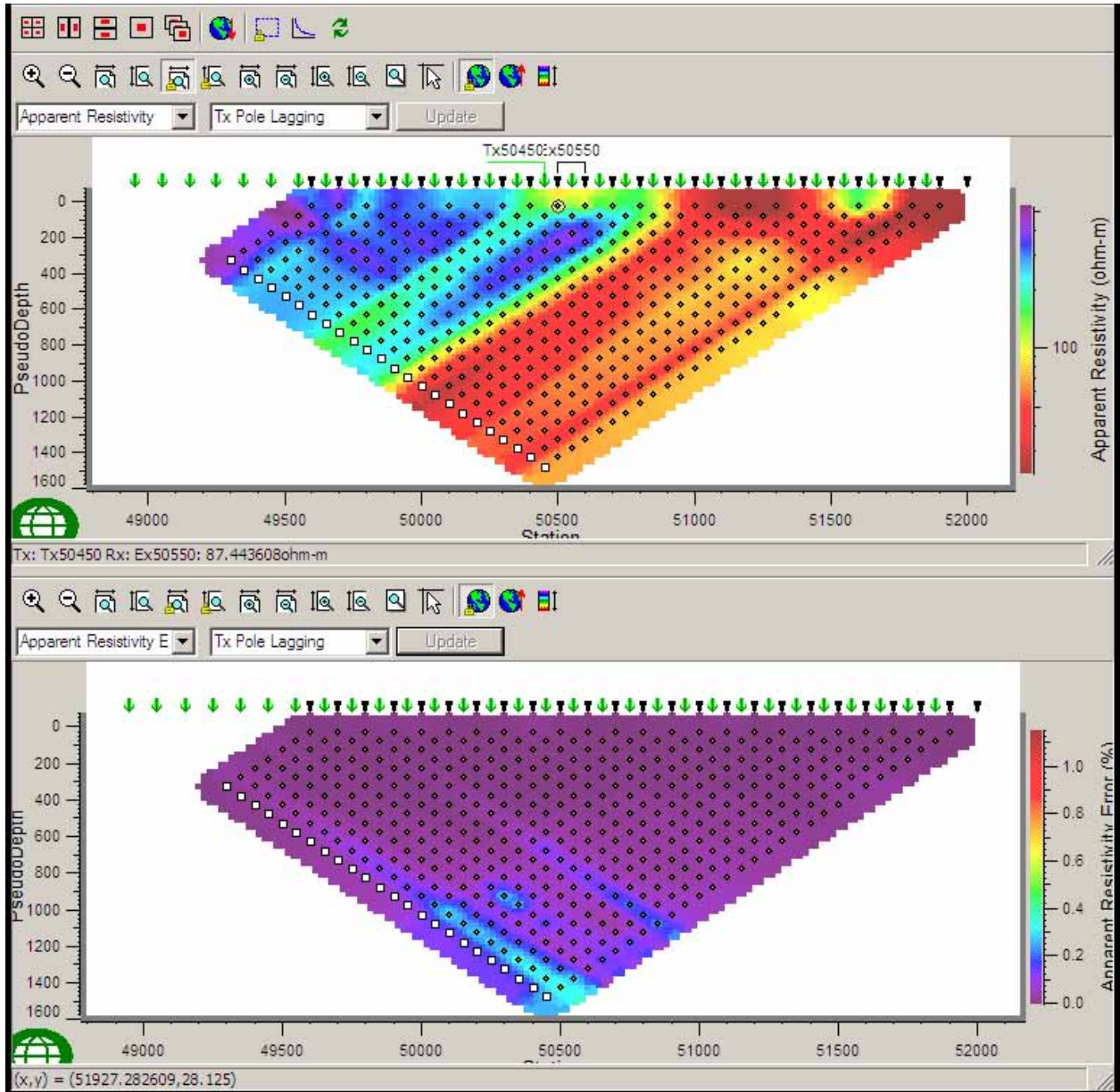***Line 4600N – Observed IP Raw Data (mrad) & IP Errors (mrads)-Tx Pole Lagging.***

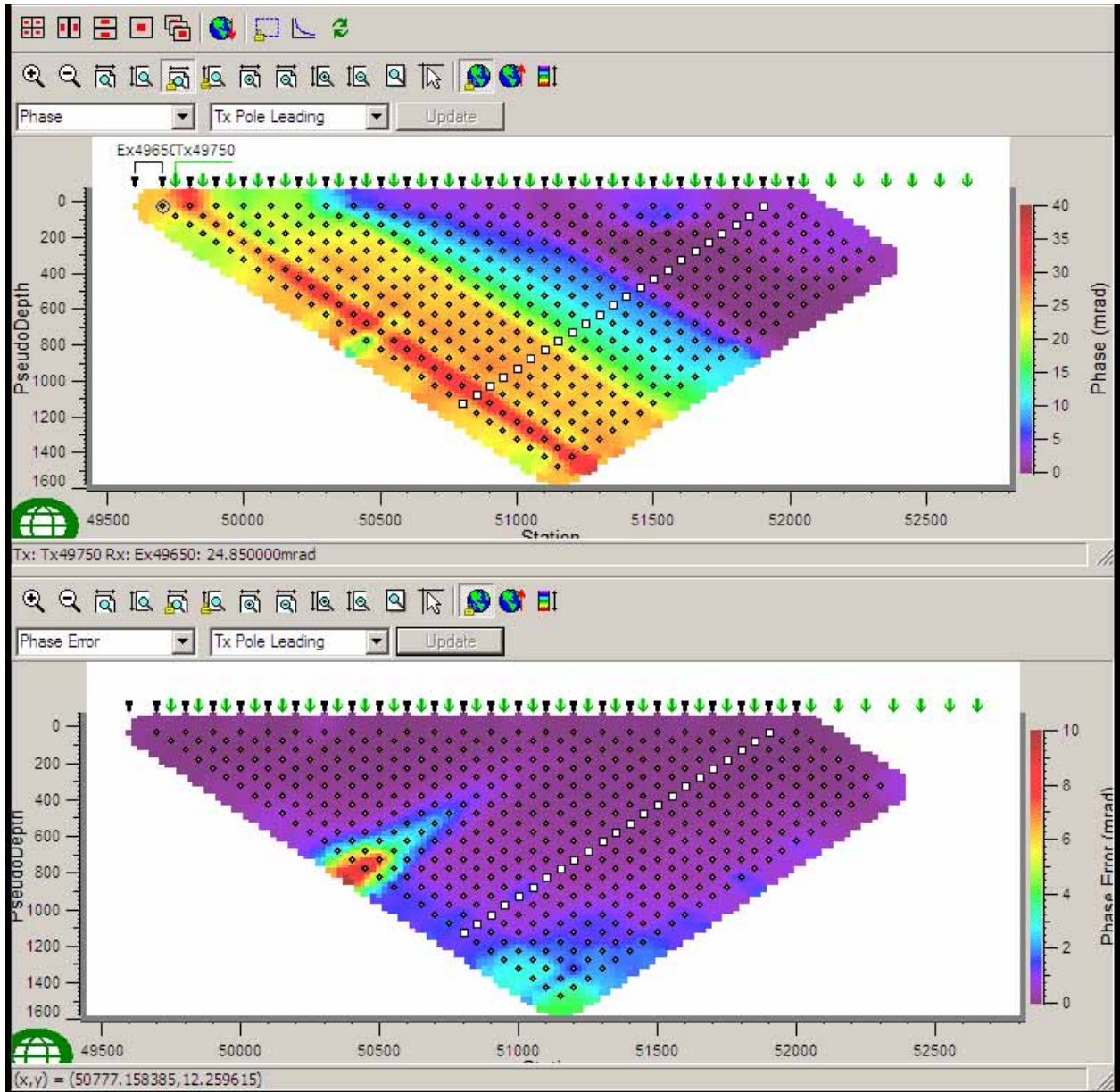☐ Tx with more than one event

C.6   LINE 4900N

Line 4900N – Observed Apparent Resistivity Raw Data (Ohm.m) & Voltage Errors (%)-
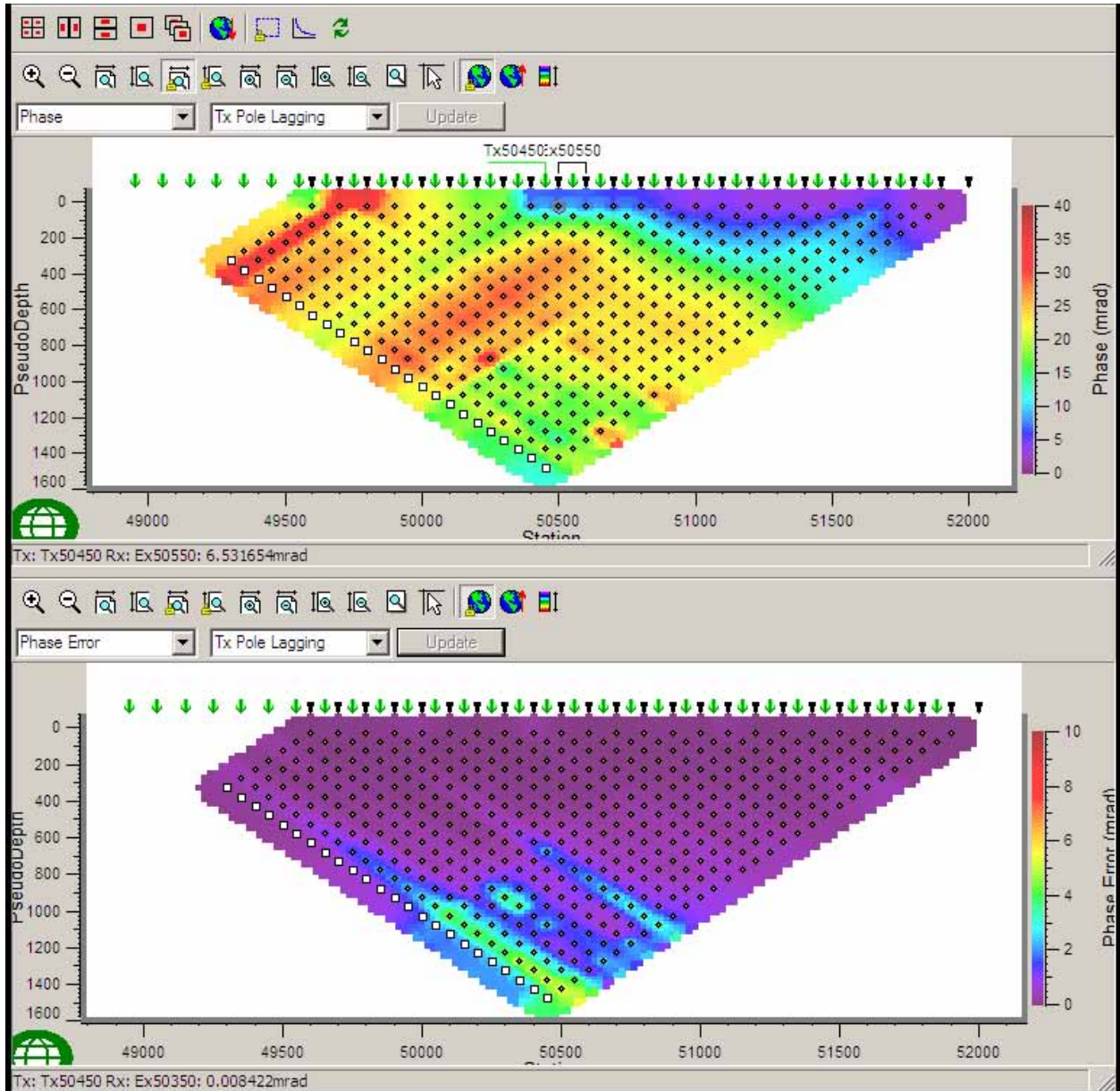*Tx Pole Leading.*

☐ Tx with more than one event

***Line 4900N – Observed Apparent Resistivity Raw Data (Ohm.m) & Voltage Errors (%)-
Tx Pole Lagging.***

☐ Tx with more than one event

Line 4900N – Observed IP Raw Data (mrad) & IP Errors (mrads)-Tx Pole Leading.
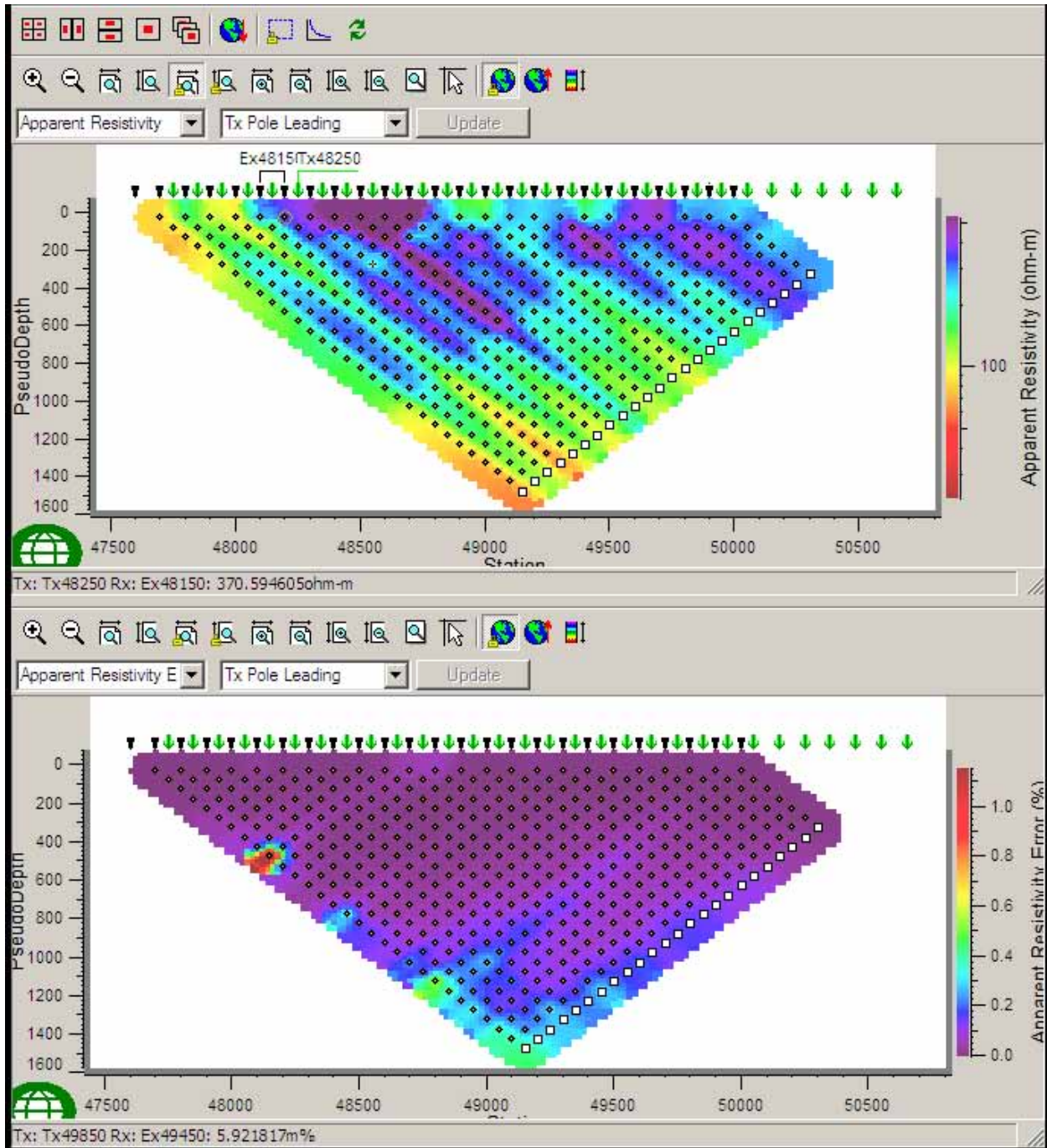
☐ Tx with more than one event

Line 4900N – Observed IP Raw Data (mrad) & IP Errors (mrads)-Tx Pole Lagging.

□ Tx with more than one event

C.7 LINE 5750N

*Line 5750N – Observed Apparent Resistivity Raw Data (Ohm.m) & Voltage Errors (%)-
Tx Pole Leading.*

□ Tx with more than one event

Line 5750N – Observed Apparent Resistivity Raw Data (Ohm.m) & Voltage Errors (%)-
Tx Pole Lagging.

☐ Tx with more than one event

Line 5750N – Observed IP Raw Data (mrad) & IP Errors (mrads)-Tx Pole Leading.

☐ Tx with more than one event

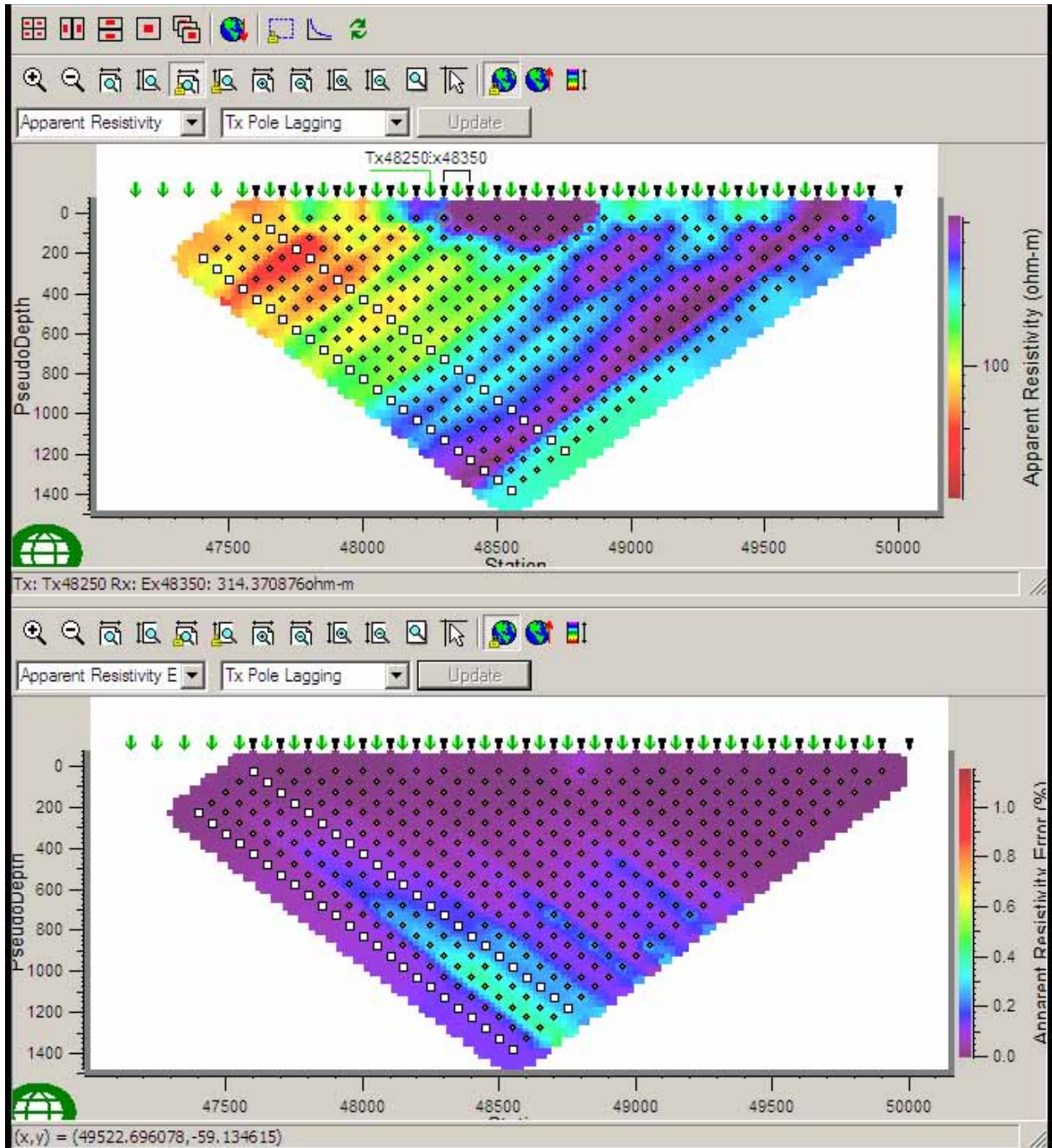*Line 5750N – Observed IP Raw Data (mrad) & IP Errors (mrads)-Tx Pole Lagging.*

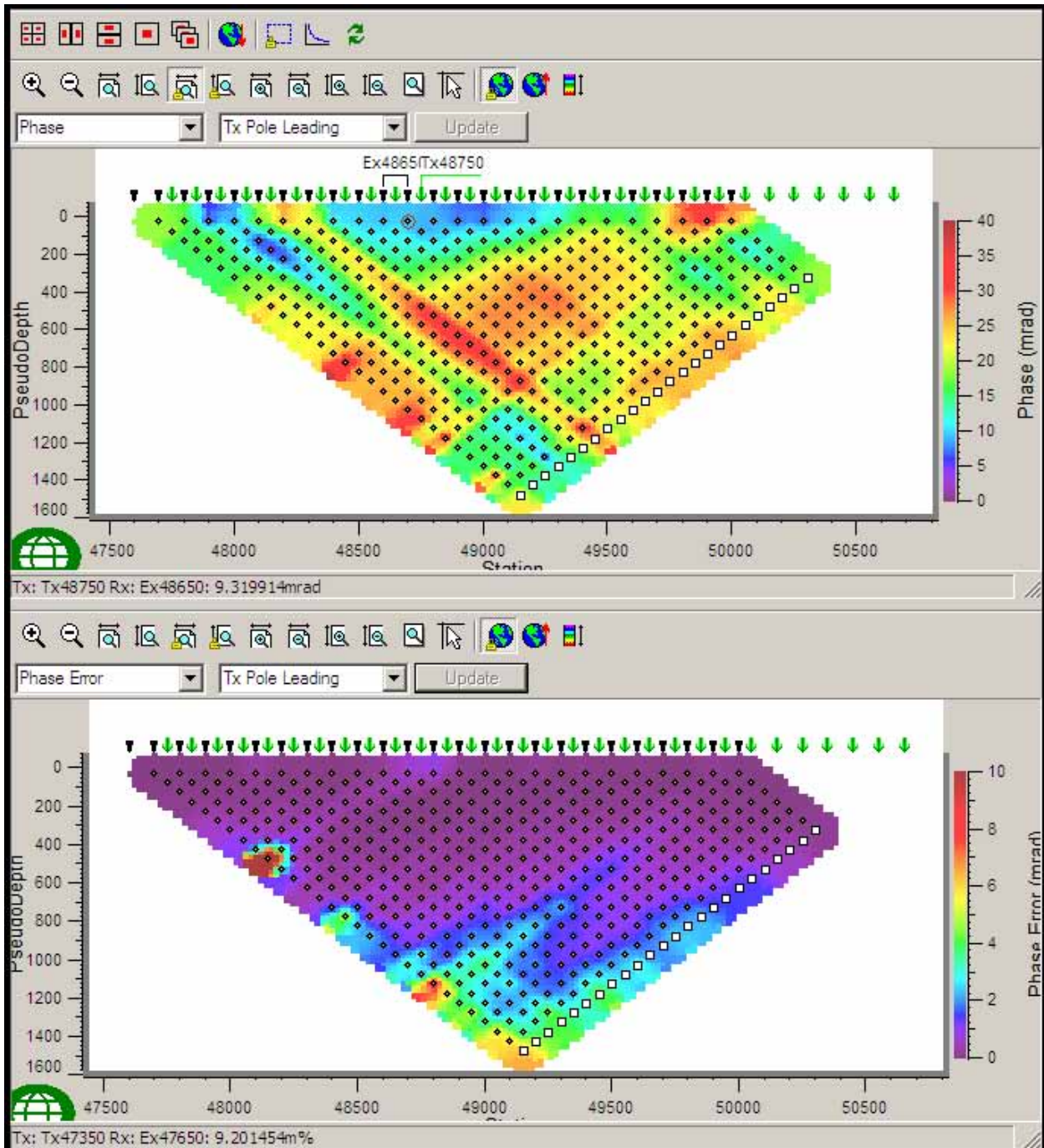☐ Tx with more than one event
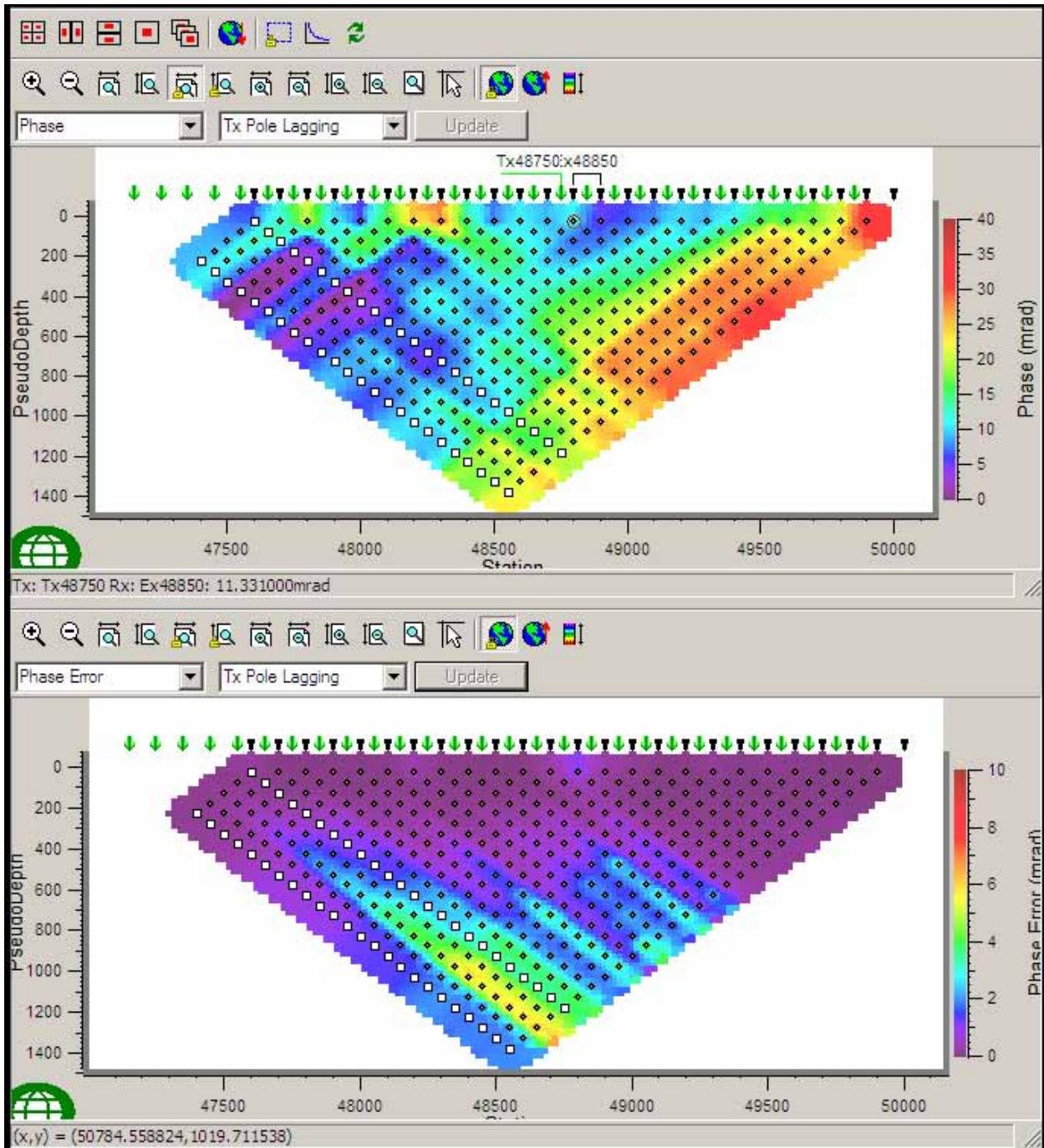
C.8   LINE 5900N

*Line 5900N – Observed Apparent Resistivity Raw Data (Ohm.m) & Voltage Errors (%)-
Tx Pole Leading.*

☐ Tx with more than one event

Line 5900N – Observed Apparent Resistivity Raw Data (Ohm.m) & Voltage Errors (%)-
Tx Pole Lagging.

☐ Tx with more than one event

Line 5900N – Observed IP Raw Data (mrad) & IP Errors (mrads)-Tx Pole Leading.

☐ Tx with more than one event

Line 5900N – Observed IP Raw Data (mrad) & IP Errors (mrads)-Tx Pole Lagging.

☐ Tx with more than one event