

**Frontier Resources Ltd  
Annual Report on Exploration  
EL20/1996 – “Elliott Bay”  
June 2011 to June 2012**

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## 1.0 Summary

Field exploration of EL 20/1996 Elliott Bay in the 2011/2012 reporting year focused on the flying of a new generation helicopter borne EM survey over all of the prospective Mt Read Volcanics in both the EL 20/1996 "Elliott Bay" and newly granted EL 33/2010 "Wanderer River" tenements.

Whilst the survey did not locate any first order conductors in the area of EL 20/1996, it did recognize and define a broader zone of very subtly elevated conductivity over a strike length of 1km and 300-500m depth.

Whilst the anomalous zone appears lithological and corresponds with the Waterloo Creek Group shales on the surface, the shales are not conductive to the north and south along strike. Further, the west dipping anomaly lies physically beneath but stratigraphically above the South Wart zone of highly anomalous Zn and Pb in soils (which would correspond to the footwall alteration zone).

The Wart Hill massive sulphide deposit is considered to be the product of an ongoing hydrothermal system in a high energy depositional environment, not giving massive sulphides time to accumulate before the next influx of volcanic material. A period of quiescence is required and black shale represents such an environment.

The anomaly is probably due to shales but the possibility of a large massive sulphide deposit remains a possibility.

A JORC compliant Inferred Resource has been estimated for the Wart Hill massive sulphide deposit. An overall model incorporating clastic and disseminated sulphide as well as in-situ massive sulphide mineralization has been generated with two discrete zones – Central Zone and South Zone estimated.

In addition the arguably coherent massive sulphide lens (lying near the top of the deeper South Zone) defined by intersections in DDH's WH10, WD009, WD012, WD019 and WD025 was modeled and estimated as a discrete resource.

The resource estimate for the Wart Hill massive sulphide deposit has been classified as Inferred Mineral Resources in accordance with the guidelines as set out in the Joint Ore Reserves Committee (JORC) Code (2004).

At a 0g/t Au equivalent cut-off (i.e. including all material within wireframes) stands at:

**Central Zone 309,200t @ 0.12g/t Au, 25g/t Ag, 0.03% Cu, 1.03% Pb and 2.16% Zn (= 1.8g/t Au equivalent)**

**South Zone 356,200t @ 0.74g/t Au, 48g/t Ag, 0.14% Cu, 2.29% Pb and 4.44% Zn (= 4.33g/t Au equivalent)**

**Total Resource 665,400t @ 0.45g/t Au, 37g/t Ag, 0.09% Cu, 1.7% Pb and 3.38% Zn (= 3.15g/t Au equivalent)**

**At a 5g/t Au equivalent cutoff the total resource is 167,300t @ 1.14g/t Au, 74g/t Ag, 0.22% Cu, 3.9% Pb and 7.7% Zn (= 7.1g/t Au equivalent).**

The South Lens resource is wholly contained within the South Zone. The resource contained within the South Lens is presented in table 8.5. At a 0g/t Au equivalent cutoff the resource in the South Lens (wholly contained within South Zone) is:

**South Lens 46,500t @ 1.45g/t Au, 70g/t Ag, 0.27% Cu, 4.1% Pb and 8.03% Zn (= 3.15g/t Au equivalent)**

The third body of work completed was a reappraisal of the 3D IP data over the Wart Hill area. That work, carried out by geophysicist Peter Swiriduk, has defined 5 near surface targets for drilling on the western and northern flanks of Wart Hill.

## **2.0 Introduction**

### **2.1 Tenure**

EL 20/1996, was first granted to EMC Consultants (EMC) in June 1996. EMC vended 90% into new listing Tasex. Tasex, subsequently changed its name to Tasgold and then again to Frontier. The licence was renewed, on an annual basis, until June 2011. In April 2012 Frontier's 90% share in the tenement was transferred to a new entity named Torque Mining Ltd., as yet unlisted.

Application is being made to renew the licence for a further year to June 2013.

### **2.2 Location**

EL 20/96 is located very near to the remote southwestern coast of Tasmania (see Figure 2.1) around 40 kilometres west of Strathgordon and 80 kilometres south of Strahan.

### **2.3 Access**

Access to the area is difficult with no continuous road access to the rest of the state. The only vehicular track to the area, a rough 4WD track known as the Low Rocky Point Track, commences at the southern end of Birch's Inlet off the southeastern corner of Macquarie Harbour and thus requires boat transport.

Various modes of access have been utilized by various exploration companies in the past. Frontier initially mobilized its drilling gear, crawler, excavator and larger camping gear in 2005 by sea barging gear from Hobart into the mouth of the Lewis River from where it was driven to the Wart Hill camp over the open heath country. Demobilisation in June 2011 used this same methodology.

Access within the licence is by 4wd bikes or by foot. Frontier has also utilized a rubber tracked crawler for access which has proven to have minimal impact.

### **2.4 Topography and Vegetation**

The country is quite flat, being part of the coastal plain, though with some excising creeks. The significant exception in the licence area is Wart Hill.

The majority of the licence is covered with low standing, open coastal heath and button grass. Creek gullies and some of the areas in the western and easternmost parts have wet sclerophyll vegetation.

### **2.5 Land Use**

The Elliott Bay area is crown land and is classified as part of the South West Conservation Area. As such it is open to mineral exploration.

The Tasmanian Government proclaimed the prospective rocks south of Macquarie Harbour to be within the Sorell Peninsula Prospectivity Zone, recognition of the mineral potential of the area. Under this act any change in the status of the land within the zone requires the approval of both houses of the Tasmanian parliament with any affected party entitled to compensation (this does not cover any decisions of the Federal government).

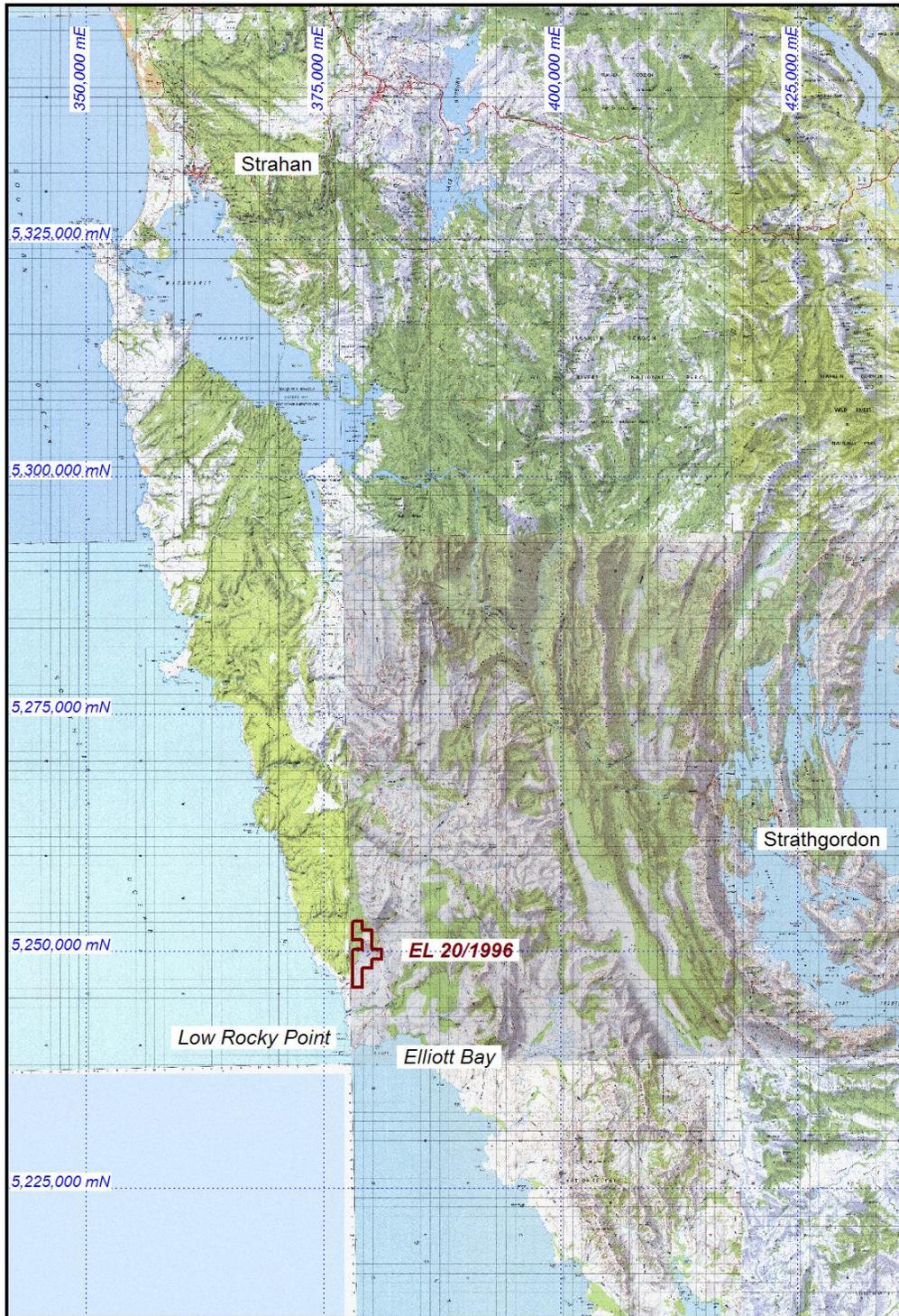


Figure 2.1: Location of EL 20/1996 Elliott Bay on Tasmania's southwest coast.

### 3.0 Geology

EL 20/1996 covers a highly significant portion of the southernmost land extent of the Mt Read Volcanics.

The reader is referred to (almost all) previous reporting for high quality geological descriptions and fieldwork for details (see fairly comprehensive list of references at end). However, there are a number of contentious issues regarding the geology of the Wart Hill area which warrant comment.

Essentially, the prospective Mt Read Volcanic rocks in the Wart Hill area consist of felsic volcanoclastic mass flows, commonly pumiceous, with lesser finer sediments, coherent, brecciated felsic lavas/intrusives, minor basalt intrusives and occasional shale, limestone and chert.

The volcanics include both dacitic i.e. feldspar phyric volcanoclastics and lavas and more rhyolitic quartz+feldspar phyric volcanoclastics and lavas, the latter reportedly more common in the upper part of the sequence near the overlying Waterloo Creek Group shales and volcanoclastics.

Previous descriptions of the geology of the Elliott Bay region have correlated the quartz phyric rocks with the Eastern Quartz-Phyric Sequence from the base of the Mt Read sequence; however an interdigitating relationship with the overlying Waterloo Creek Group rocks is more suggestive of the Tyndall Group from the uppermost Mt Read Volcanics.

These are overlain by shales with minor interbedded felsic volcanics (in turn overlain by siliciclastics of the Owen Group). The contact between the two has been variously described as unconformable and interdigitating. Frontier's work on the eastern side of the syncline at Aldebaran/V34 has recognized a similar stratigraphic sequence to Wart Hill on the western side of the fold arguing for a conformable relationship. This also argues against earlier interpretations of separate volcanic units on either side of the Mt Osmund Syncline.

Inherent in this debate is the question of facing of the sequence which has been considered to be either westerly or easterly on an overturned limb. The amount of facing data evidence seen by Frontier geologists surpasses that seen by earlier geologists and strongly argues for an east facing, i.e. steeply overturned sequence.

Thus the current working hypothesis is that the sequence at Wart Hill is east facing and conformable with the Waterloo Creek Group on the steeply overturned western limb of the Mt Osmund Syncline. The sequence is from the upper Mt Read Volcanics and has similarities in part with the prospective Lynchford Member, holder of the "holy host" horizon.

The relationship between the sequence at Wart Hill and the west dipping/facing sequence along strike at East Camp and Sassy Creek is intriguing. It would be nice to correlate the hydrothermal alteration/mineralization at Sassy Creek with the Wart Hill footwall. This is perhaps more speculative.

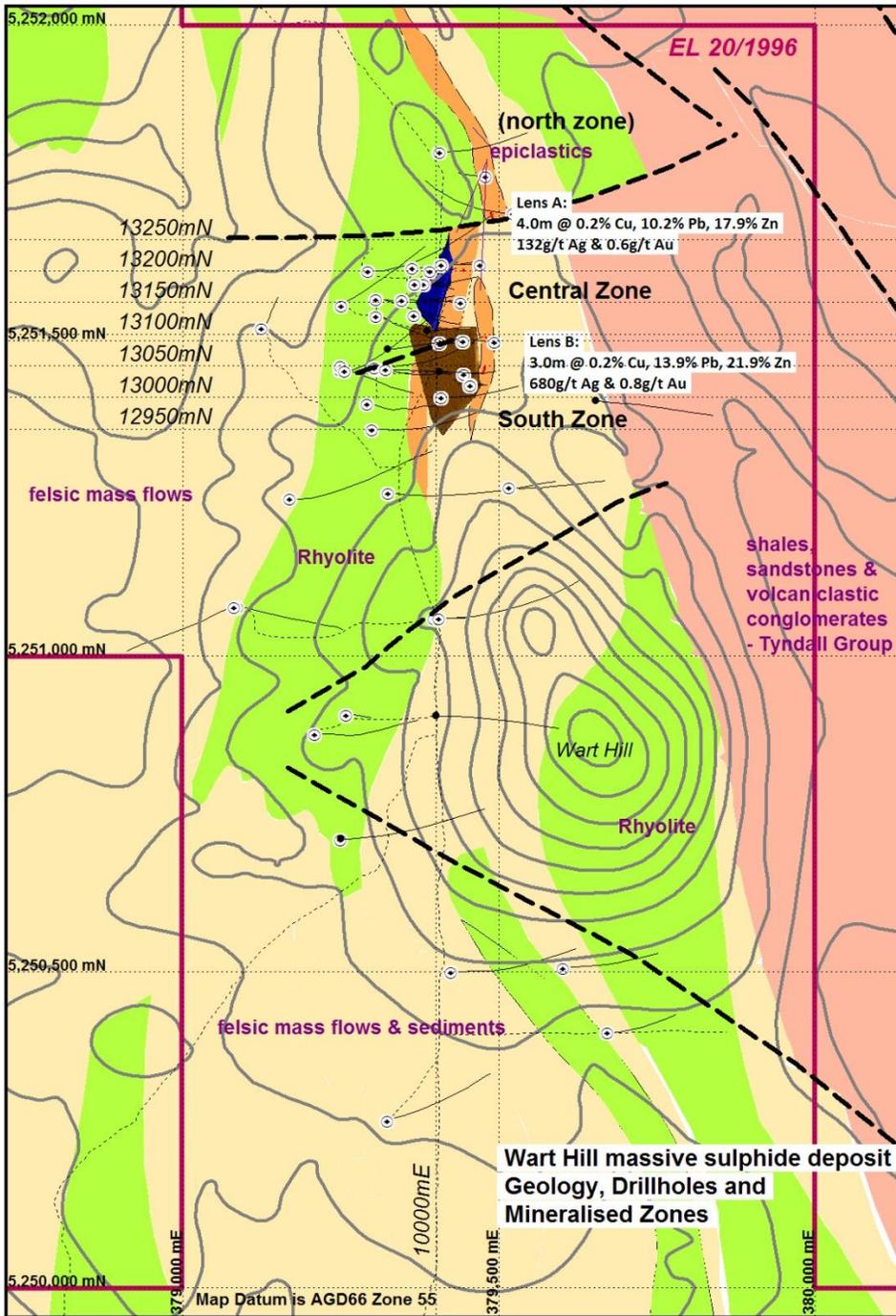


Figure 2.2: Wart Hill (Voyager 19) prospect showing the South and Central Zones resource shapes projected to surface.

#### **4.0 Exploration Philosophy**

Frontier is exploring for base and/or precious metals. Mineralisation styles targeted are VHMS (Volcanogenic Hosted Massive Sulphides) either as seafloor precipitates or shallow subseafloor replacement, and/or hybrid VHMS/epithermal precious metal rich vein and/or replacement deposits.

Frontier is aware of developments in the use of Short Wavelength Infra-Red and trace element analyses of hydrothermal alteration in defining vectors to mineralization. Frontier is aware that the massive sulphide mineralization is not necessarily conductive but sees downhole EM as a valid tool to screen for those bodies which may be conductive.

## **5.0 Previous Exploration**

Previous exploration has been summarized in previous reports and will not be detailed here.

## **6.0 Exploration Completed June 2011 to June 2012**

### **6.1 Introduction**

Three bodies of work were completed in the 2011/12 year.

- In February 2012 a new generation helicopter borne EM survey, VTEM by Geotech, was flown over EL 20/1996 and the newly granted EL 33/2010 "Wanderer River".
- A JORC compliant Inferred Resource was estimated for the Wart Hill massive sulphide deposit.
- Existing 3D IP was reappraised and drill targets defined.

### **6.2 VTEM Survey**

A new generation helicopter borne EM survey – VTEM – was flown by Geotech over all prospective rocks within Frontier's two tenements in the Southern Mt. Read Volcanics area.

The survey was flown in mid-February to fit between nesting Wedge Tailed Eagles and Orange Bellied Parrots.

The base used was Strathgordon with the helipad at The Knob above the Lake Gordon damsite.

The survey was flown AMG east-west with 150m spacings between flightlines.

The full survey report is included as appendix A. The report covers the whole survey which was flown as three discrete blocks. EL 20/1996 "Elliott Bay" lies at the southern end of the Wart Hill block. The following is reproduced from the Executive Summary section of the report:

"During February 1st to 23rd 2012 Geotech Airborne Pty Ltd. carried out a helicopter-borne geophysical survey over the Daguiar, Moores and WartHill Blocks situated approximately 33 kilometres west of Strathgordon, Tasmania.

Principal geophysical sensors included a versatile time domain electromagnetic (VTEMplus) system, and a caesium magnetometer. Ancillary equipment included a GPS navigation system and a radar altimeter. A total of 955 line-kilometres of geophysical data were acquired during the survey.

In-field data quality assurance and preliminary processing were carried out on a daily basis during the acquisition phase. Preliminary and final data processing, including generation of final digital data and map products were undertaken from the office of Geotech Ltd. in Aurora, Ontario.

The processed survey results are presented as the following maps:

- Electromagnetic stacked profiles of the B-field Z Component,
- Electromagnetic stacked profiles of dB/dt Z Components,
- Colour grids of a B-Field Z Component Channel,
- Total Magnetic Intensity (TMI), and
- EM Time-constant dB/dt Z Component (Tau), are presented.

Digital data includes all electromagnetic and magnetic products, plus ancillary data including the waveform.

The survey report describes the procedures for data acquisition, processing, final image presentation and the specifications for the digital data set."

Flightlines over EL 20/1996 are shown in figure 6.1. Raw data was supplied by Geotech in a DVD covering the whole survey. The data for the whole survey has been given to Mineral Resources Tasmania. Data for the area covered by EL 20/1996 has been supplied by Phil Muir of Southern Mineral Exploration Geophysics, Hobart (Appendix A1) who processed and imaged the data. Phil supplied the following notes to explain his approach.

#### Conductivity Depth Image (CDI) Processing – Phil Muir

The original VTEM field data has been processed to generate CDI data using EmaxAIR software written by Fullagar Geophysics. EmaxAIR calculates conductivity versus depth pseudosections from the transient electromagnetic (TEM) data of various airborne EM systems. Conductivity-depth pseudosections are a convenient form of presentation of EM profiles for first-pass interpretation. These sections are included in this report as Appendix A2 and stacked sections are shown in figures 6.2 to 6.6.

The EmaxAIR transformation proceeds in two stages: off-time data are first converted to apparent conductivity, and the depth assigned to each delay time is the depth of the induced current maximum in a half-space with conductivity equal to the apparent conductivity at that time.

The purpose of EmaxAIR's conductivity-depth processing is to quickly and reliably transform raw data into a useful form for presentation of conductivity at a true depth scale, and to allow for a fast initial interpretation of the data.

The basic method of CDI data presentation is in cross-section plots with one section per flightline. Appendix A1 contains the CDI data in ASCII format that can be used to create these section plots.

Another useful way to summarise CDI data over an area is to create plan-view "depth slice" images. In these plots the CDI data between arbitrary depth ranges are presented as images. Depth ranges can be generated using either Depth-below-surface or Relative-level (RL) limits. In this report the depth slices are based on RL intervals of 100 metres. These consistently coloured images are included as Appendix A3. Colours here are consistent with the sections in Appendix A2.

Colour enhanced depth slice CDI images are included in this report in Appendix A4. In these figures the colour stretch used for each slice is tailored to that individual slice; each slice has a different colour stretch and this must be remembered when comparing conductivities from one depth slice image to another.

As noted figures 6.2 to 6.5 are stacked conductivity depth image sections for every second flightline with the southernmost section at the bottom of figure 6.2, the uppermost at the top of figure 6.6. The colours on these sections are consistent with images in Appendix A2.

Colour enhanced depth slices enhance subtle features. Images for 100m to 600m in figures 6.7 to 6.11 are included in text. The full set of these images is included in Appendix A4.



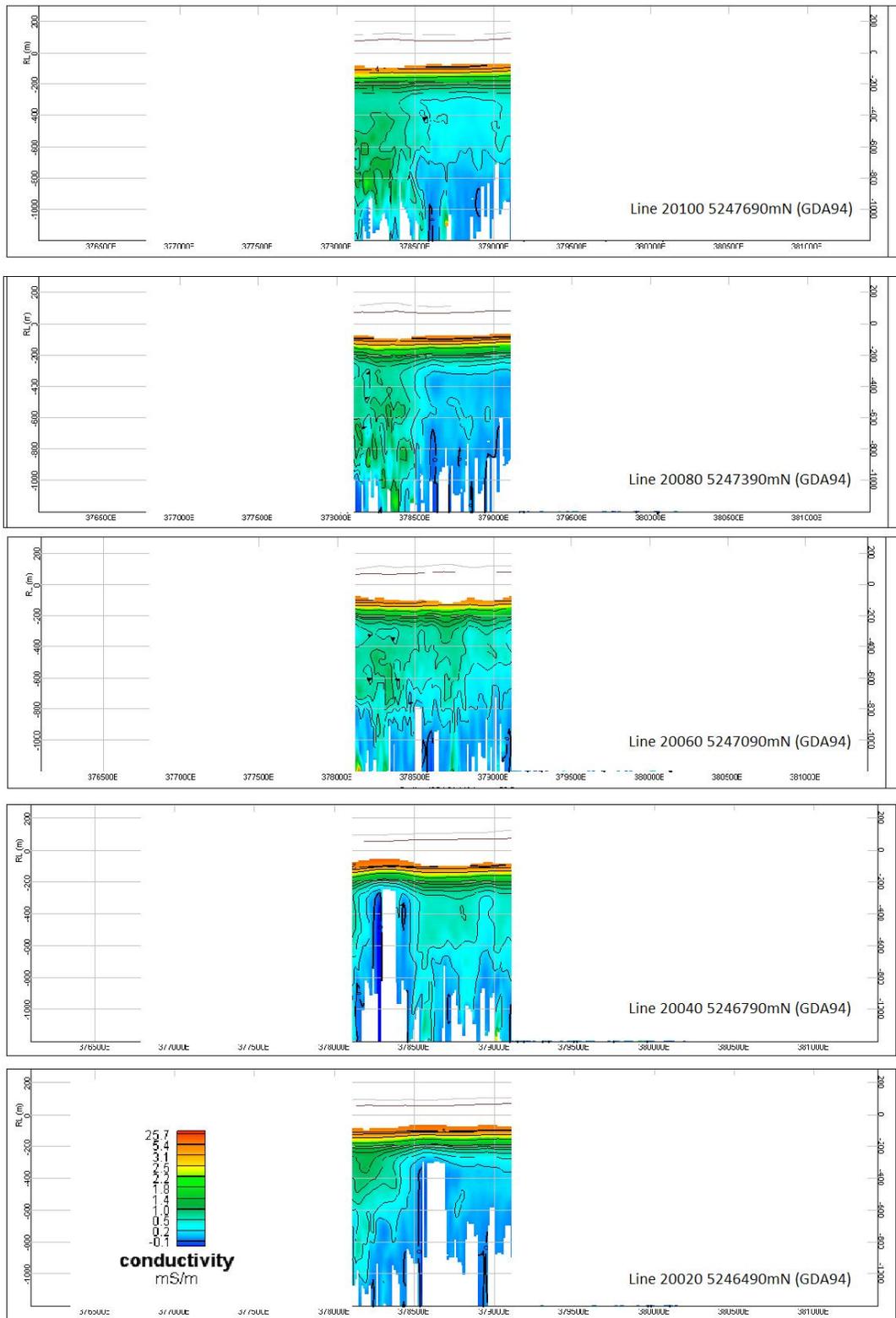


Figure 6.2: VTEM Conductivity Depth Image stacked sections lines 20020 = 5246490mN (AGD66) (bottom) to 20100 = 5247690mN (AGD66) (top).

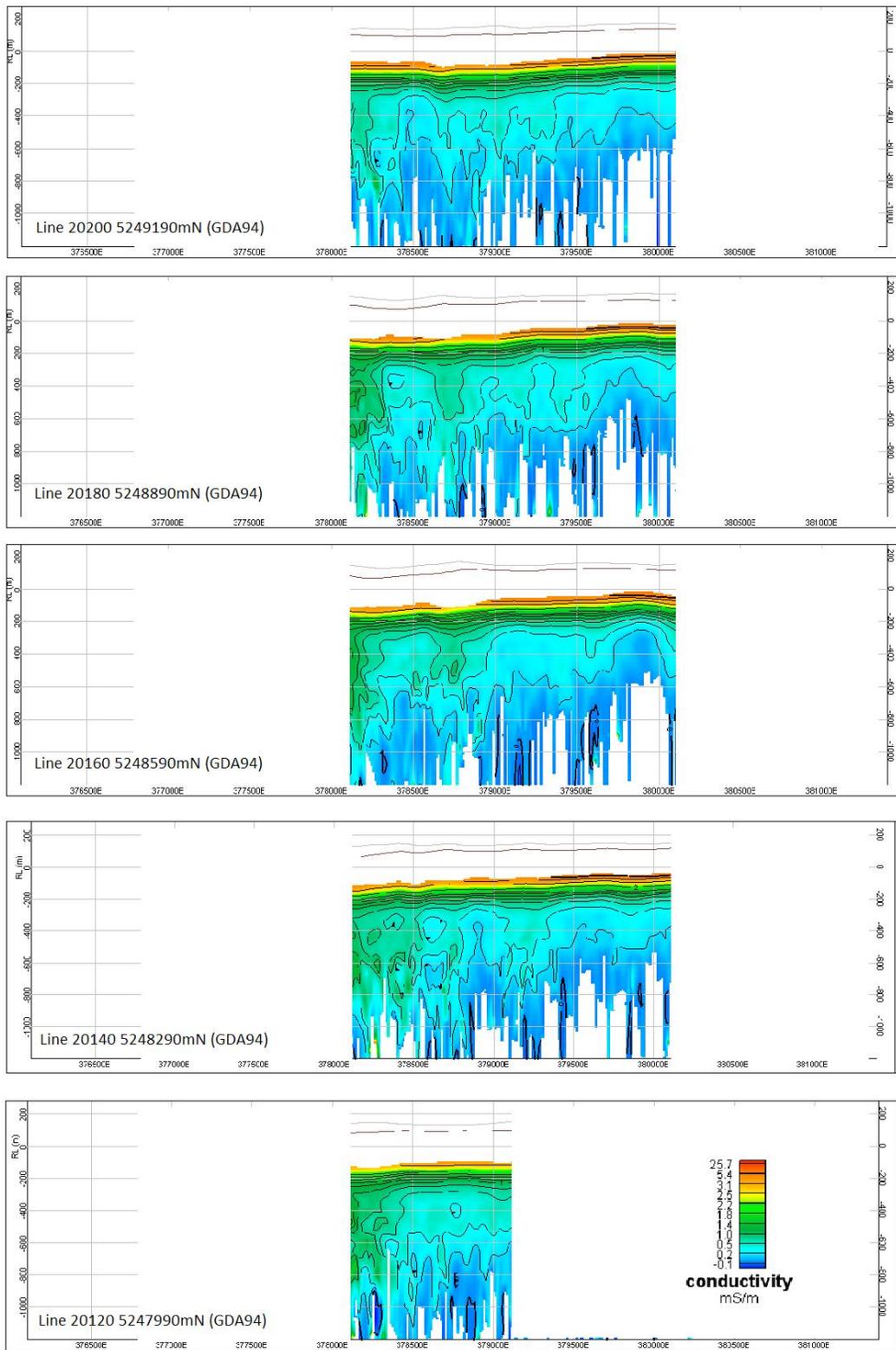


Figure 6.3: VTEM Conductivity Depth Image stacked sections lines 20120 = 5247990mN (AGD66) (bottom) to 20200 = 5249190mN (AGD66) (top).

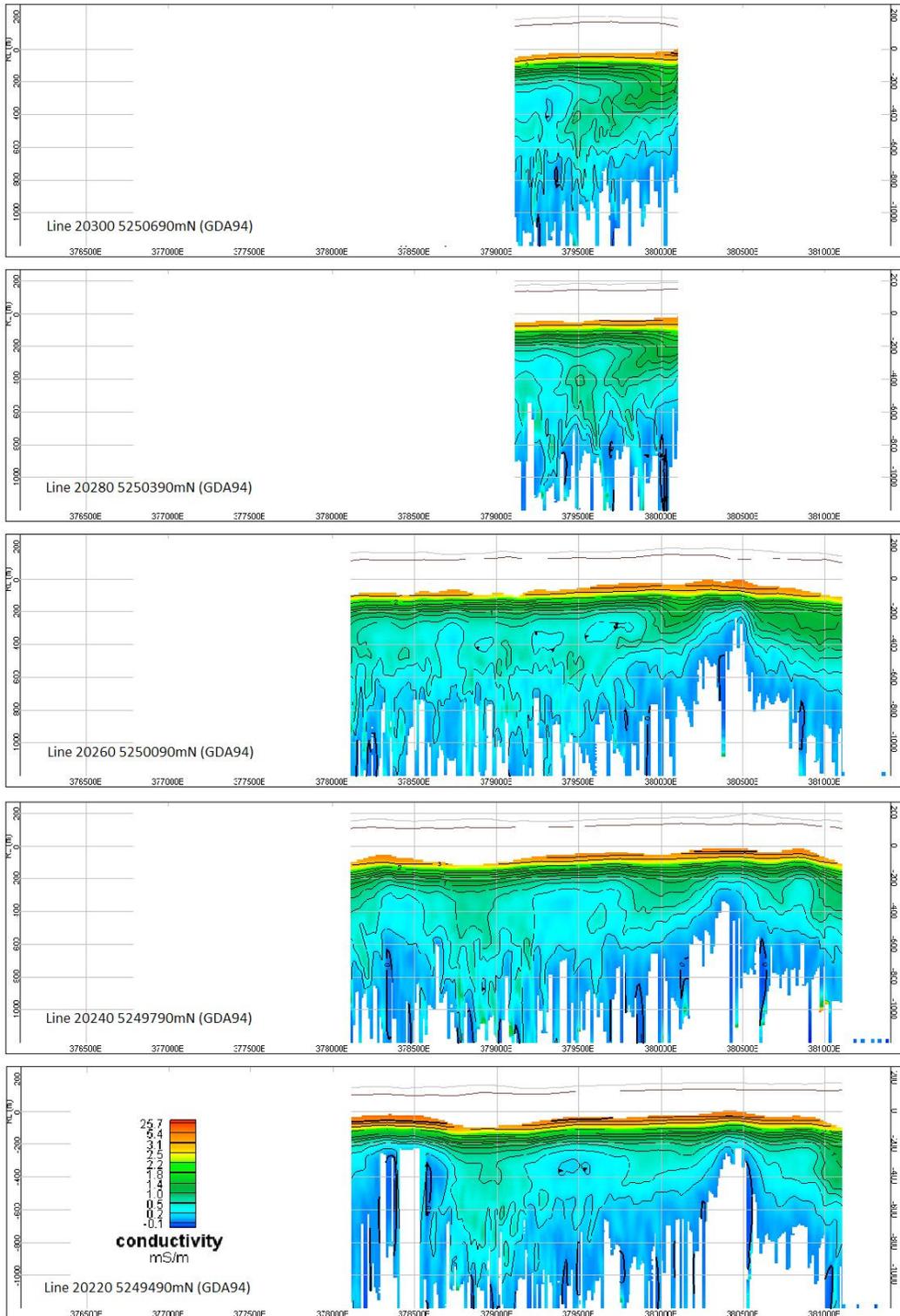


Figure 6.4: VTEM Conductivity Depth Image stacked sections lines 20220 = 5249490mN (AGD66) (bottom) to 20300 = 5250690mN (AGD66) (top).

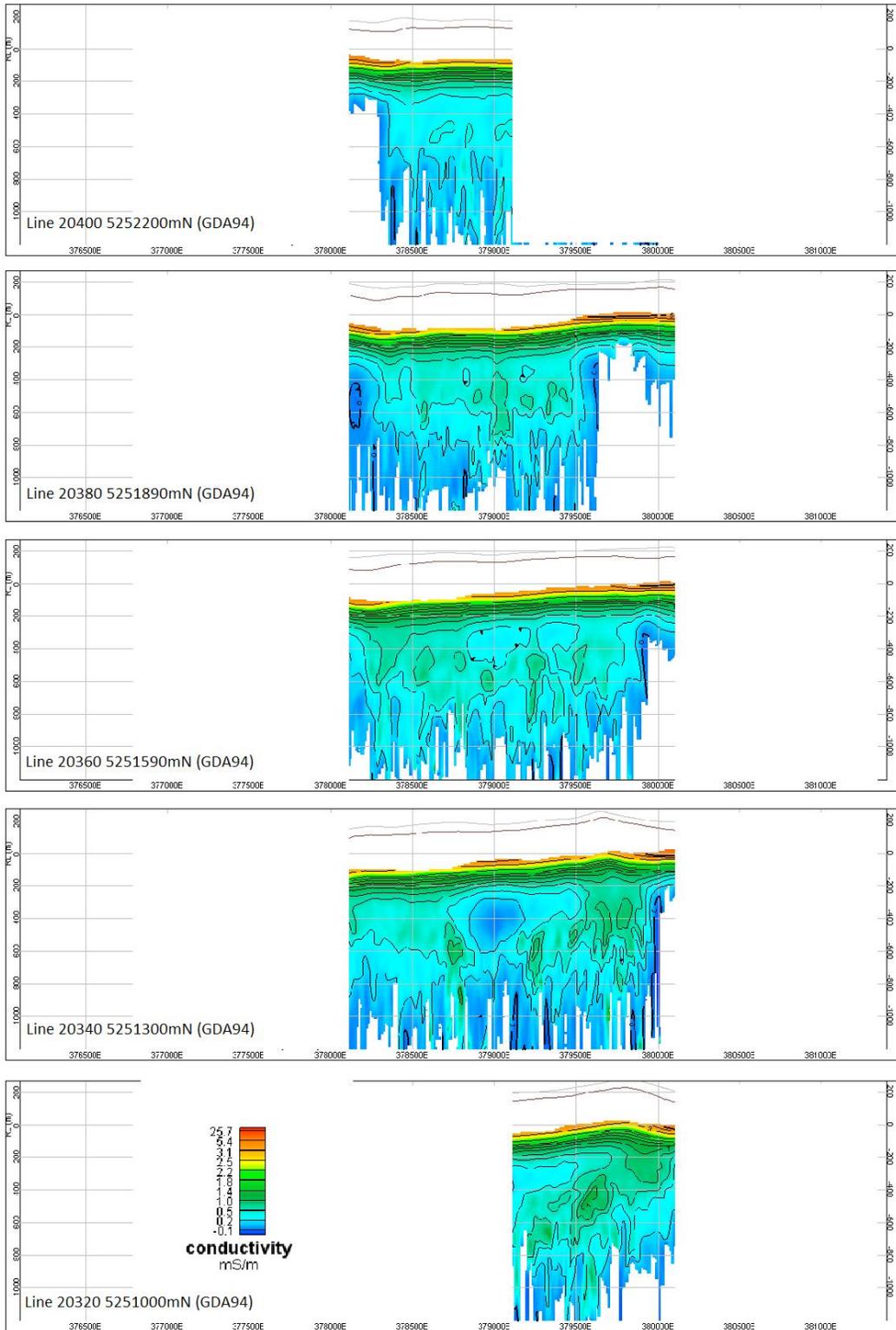


Figure 6.5: VTEM Conductivity Depth Image stacked sections lines 20320 = 5251000mN (AGD66) (bottom) to 20400 = 5252200mN (AGD66) (top).

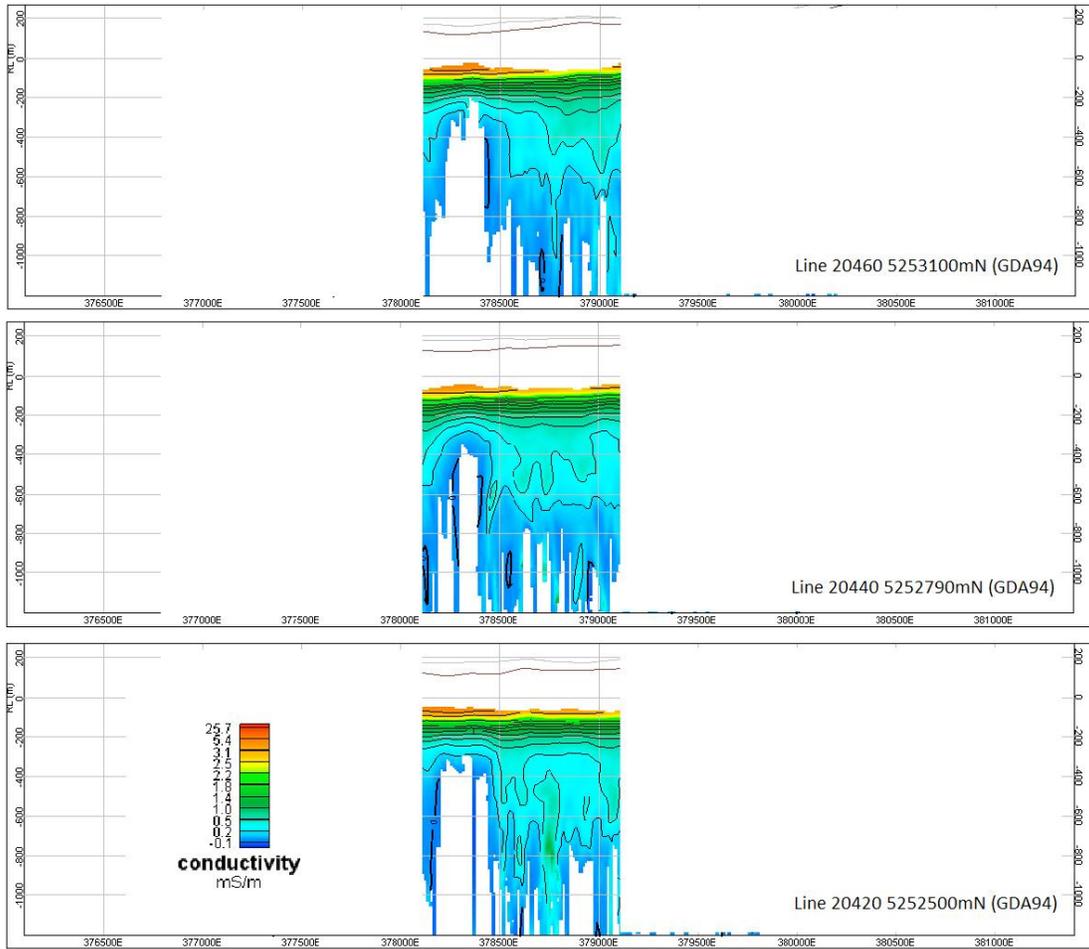


Figure 6.6: VTEM Conductivity Depth Image stacked sections lines 20420 = 5252500mN (AGD66) (bottom) to 20460 = 5253100mN (AGD66) (top).

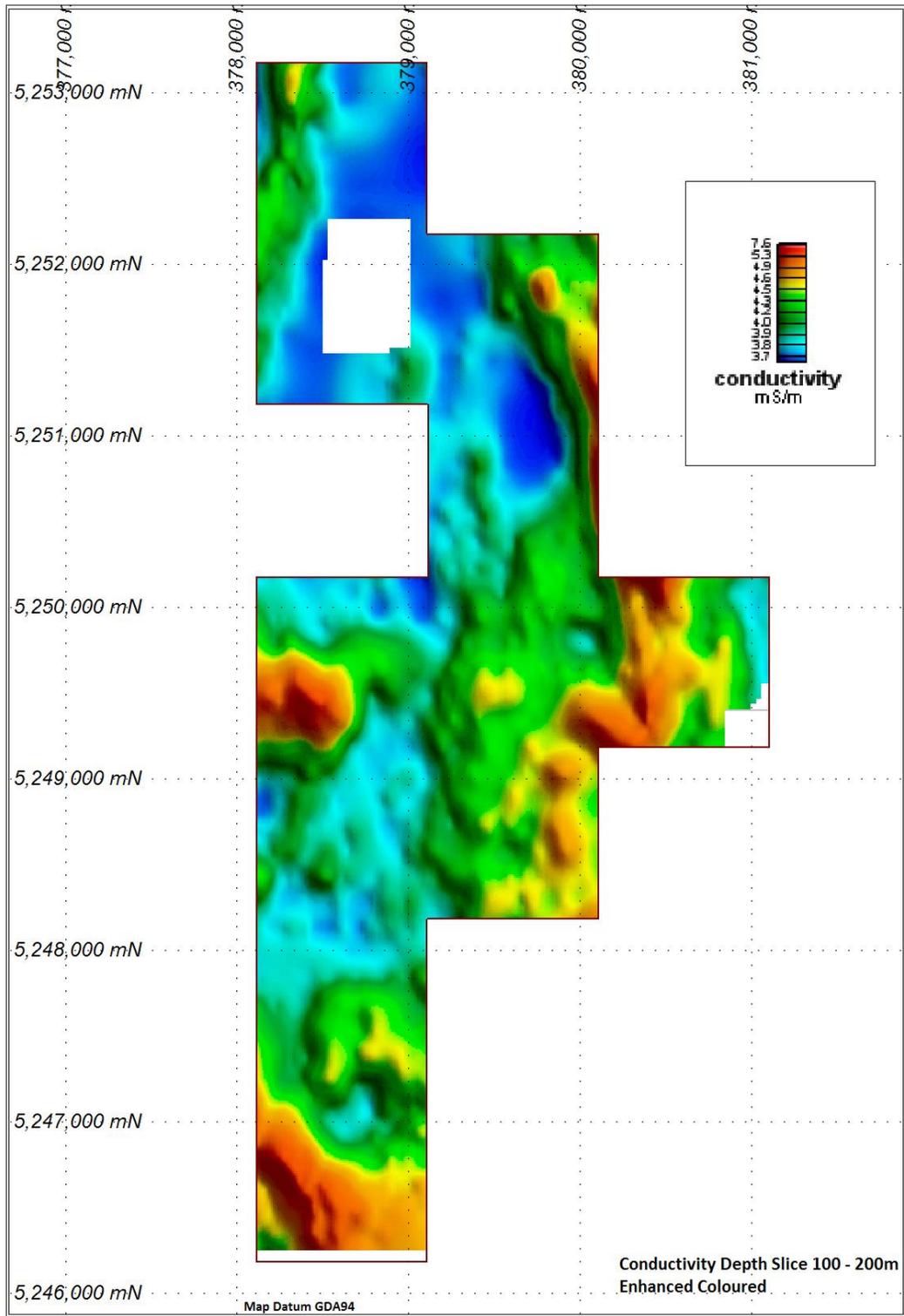


Figure 6.7: Conductivity depth slice 100m – 200m with enhanced colours.

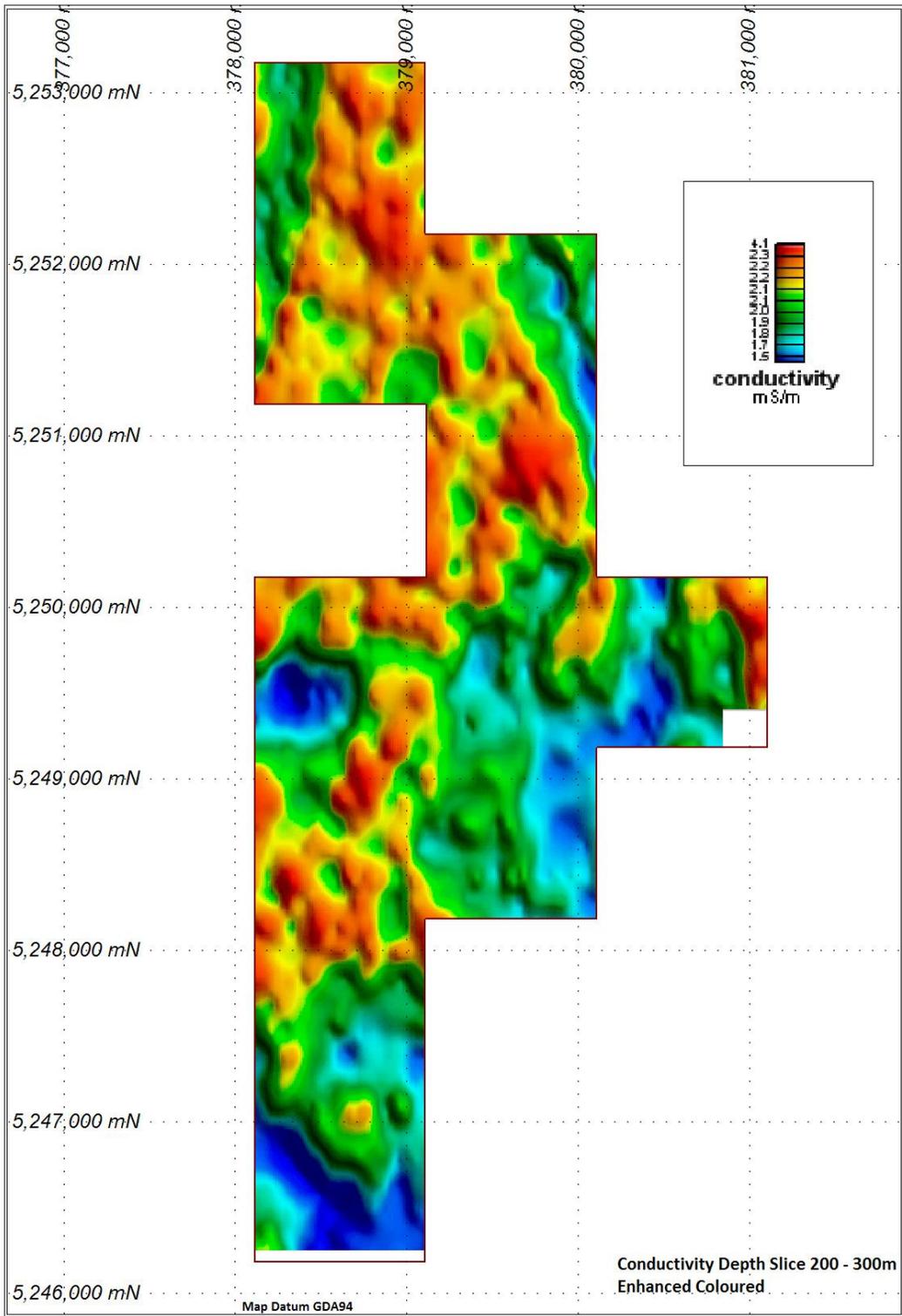


Figure 6.8: Conductivity depth slice 200m – 300m with enhanced colours.

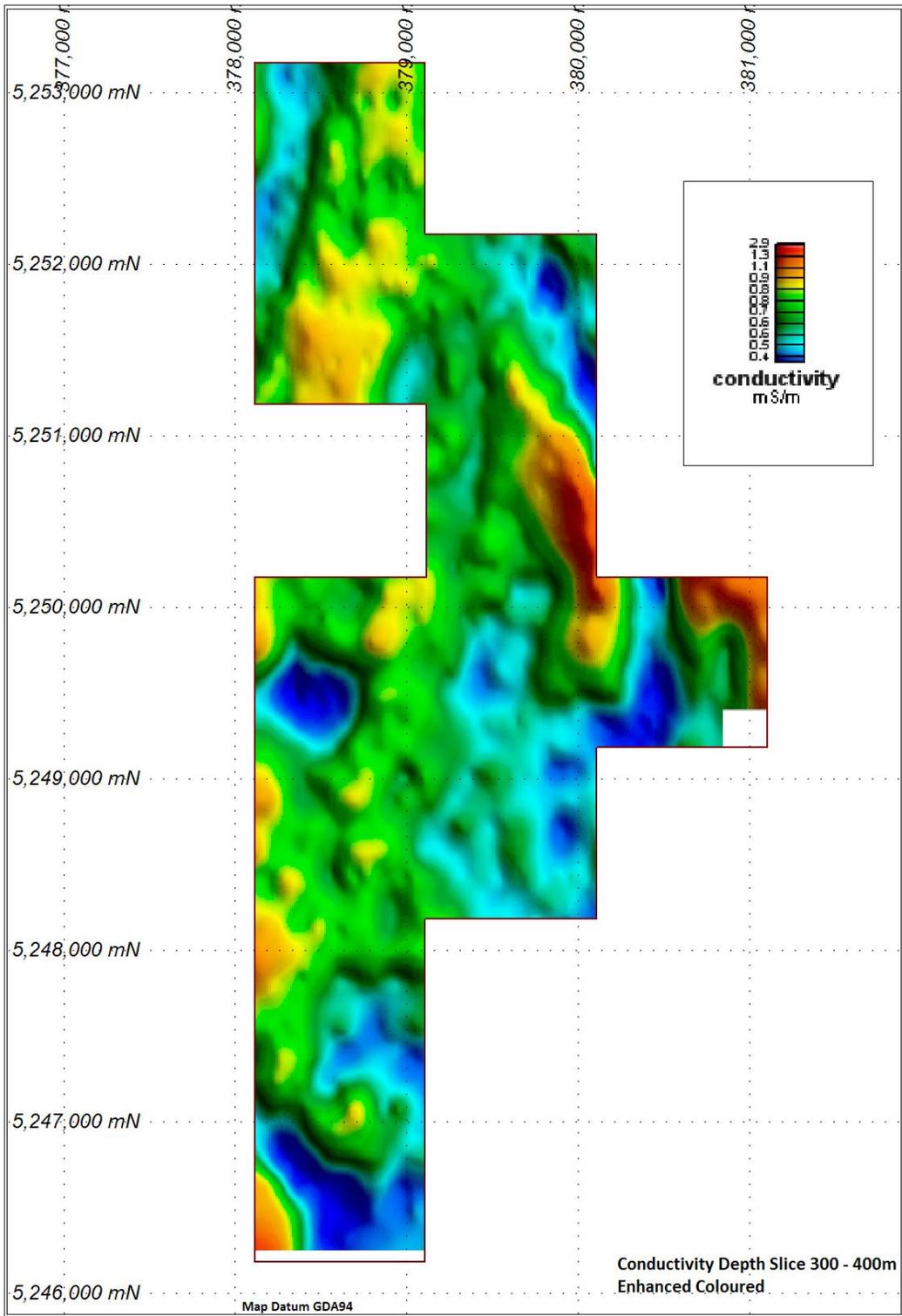


Figure 6.9: Conductivity depth slice 300m – 400m with enhanced colours.

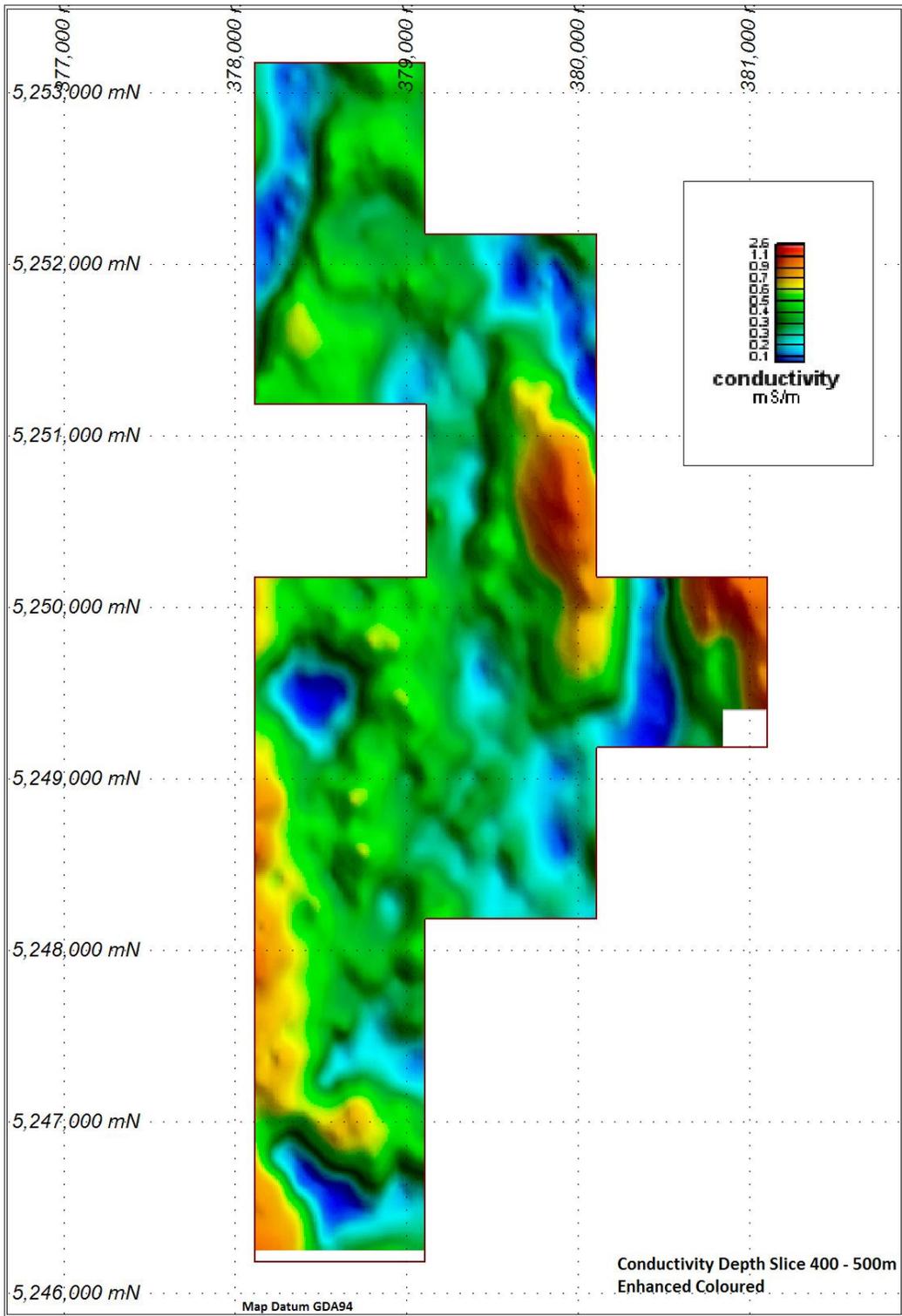


Figure 6.10: Conductivity depth slice 400m – 500m with enhanced colours.

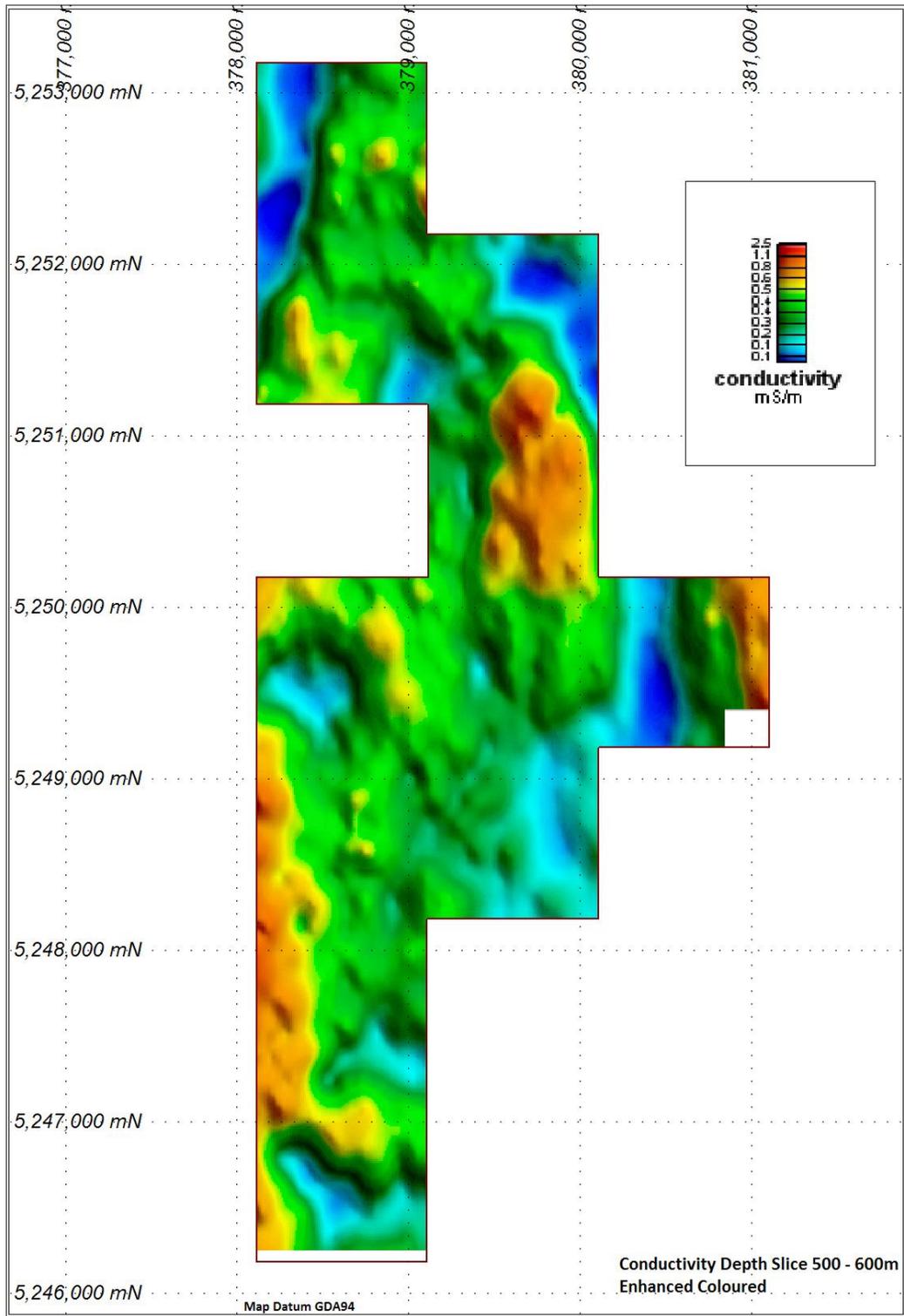


Figure 6.11: Conductivity depth slice 500m – 600m with enhanced colours.

The colour enhanced depth slices emphasise very subtle features as shown by the comparison between the two sets of images in Appendix A2 and A3.

A very low tenor but recognizably anomalous feature can be seen on depth slices 300m to 500m in figures 6.9 and 6.10 between 5,250,000mN and 5,251,000mN just west of 380,000mE. The can be seen in its true low tenor form on sections 5,250,690mN, 5,250,390mN and 5,250,090mN on figure 6.14 (top three sections) where a weak green zone can be seen dipping westwards. It is clearly shown on figure 6.12 below where it is circled.

Geologically the anomaly corresponds with the western limb of the Mt Osmund Syncline and most likely corresponds to the black shale of the Waterloo Creek Group, however, these shales continue to the north and south yet don't show elevated conductivity.

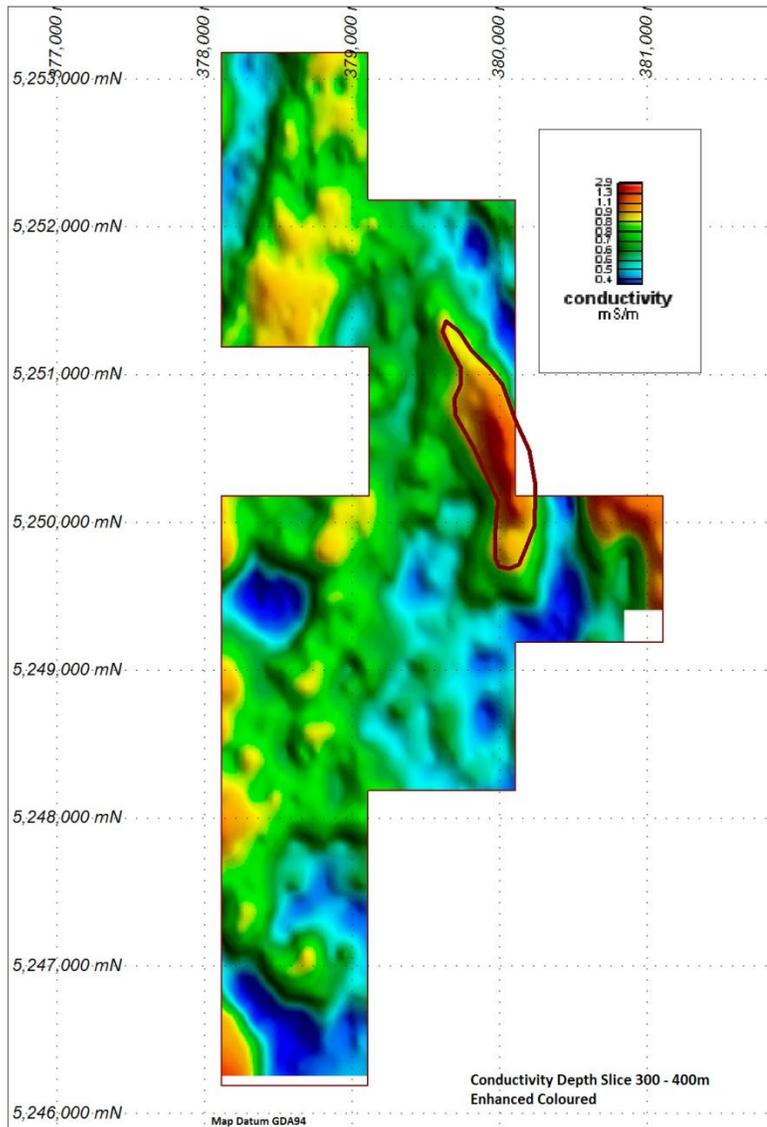
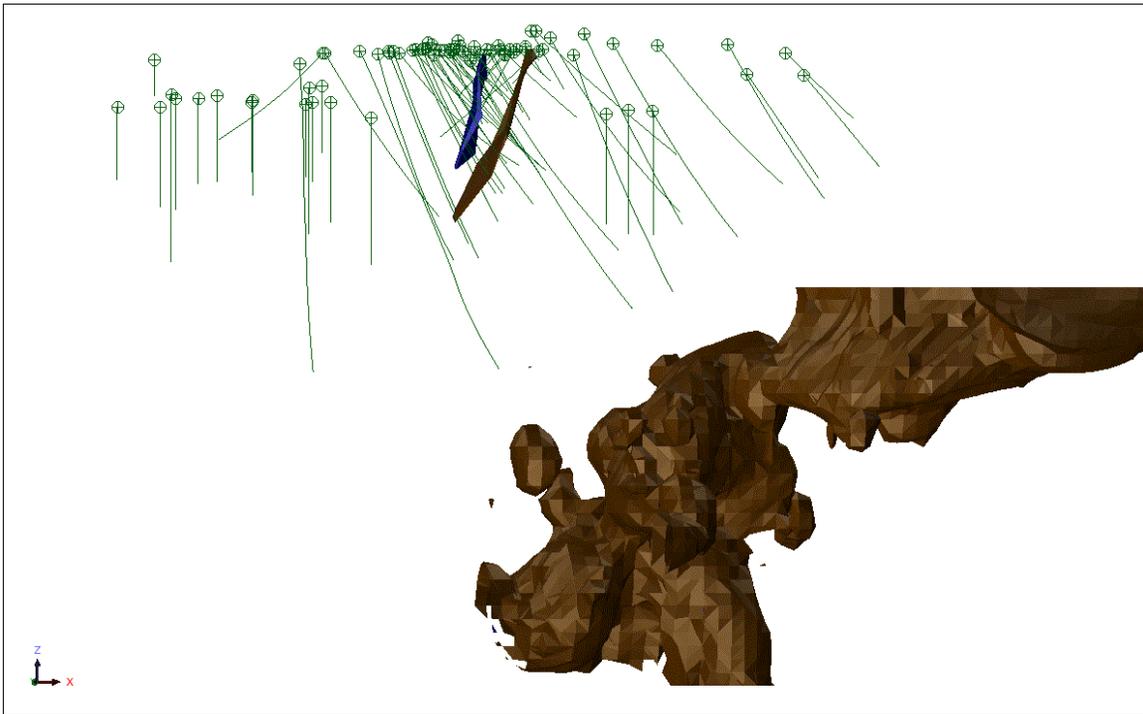


Figure 6.12: Conductivity depth slice 300m – 400m with anomalous zone circled.



**Figure 6.13: Anomalous conductivity zone and Central and South Zone wireframes looking to 010 true. Most drillholes shown lie to the immediate north of the anomaly.**

The anomaly underlies the most extensive zone of anomalous Zn and Pb in soils (see figure 6.14). With an east facing to the west dipping sequence, these soils would be reflecting the footwall alteration/stringer zone stratigraphically below (physically above) the conductive zone.

Whilst the source is likely to be ultimately due to the shale, it is precisely a shale or some other evidence of quiescent depositional conditions which the high energy Wart Hill massive sulphide system needs in order to accumulate massive sulphides.

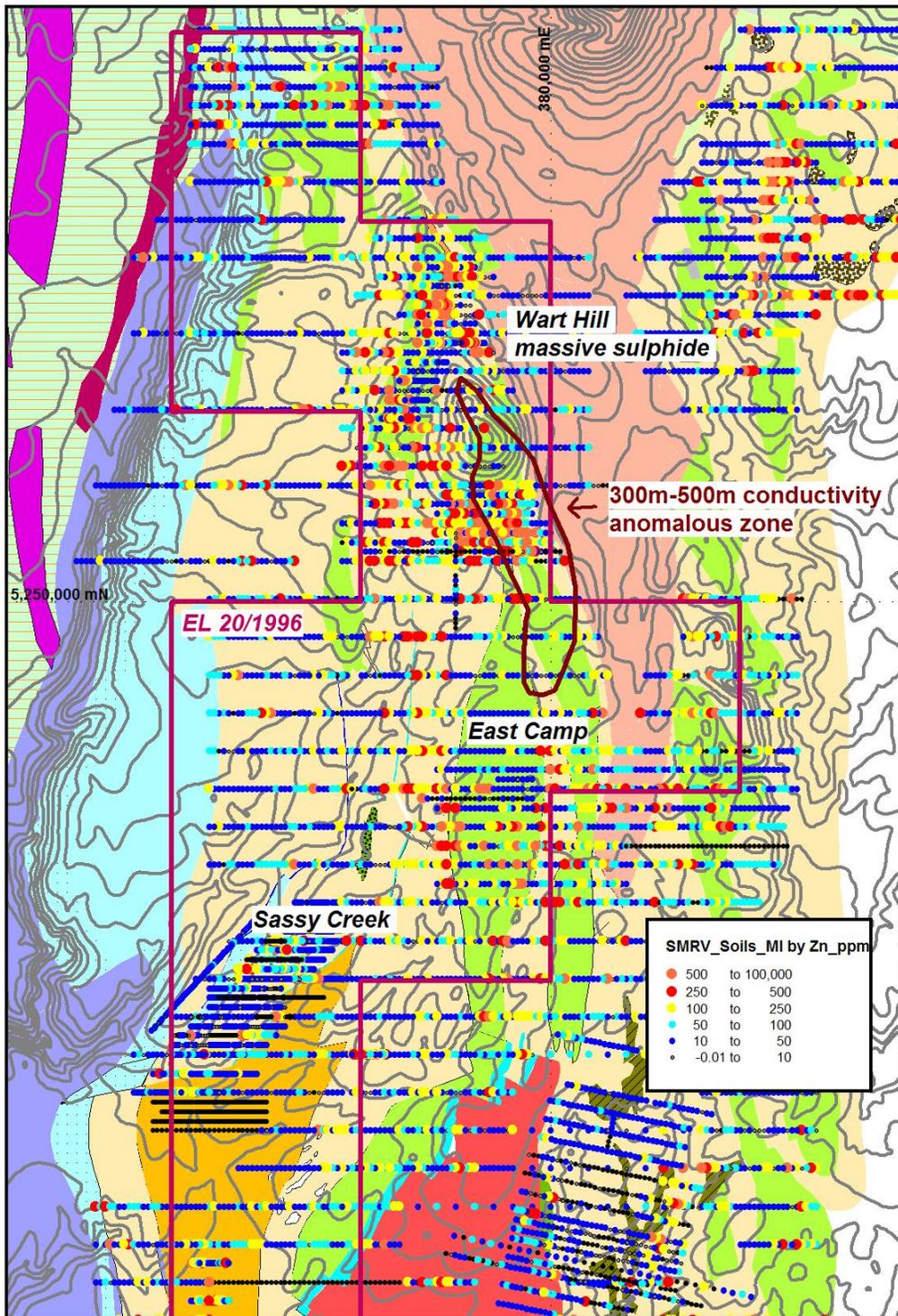


Figure 6.14: Anomalous conductivity zone.at 300m – 400m with Zn soils.

### 6.3 Resource Estimation

A JORC compliant resource estimate was completed for the Wart Hill massive sulphide deposit. It had been intended to carry out a thorough re-logging of all holes, however, this was not possible and so the resource was built around existing geological logging and interpretations.

The full resource report is included as appendix B. The following is taken from the executive summary.

Mineralisation at the Wart Hill massive sulphide deposit consists of disseminated sulphides, allochthonous clasts and in-situ pods of high grade massive sulphide of Volcanic Hosted Massive Sulphide (VHMS) style hosted within a largely volcanoclastic sequence.

The mineralised zone consists of two separate zones, offset at around 5,251,520mN, with the southern end of the Central Zone between 30m-60m west of the northern end of the South Zone (the North Zone was not modeled and is uneconomic) (see figures 6.15 and 6.16)

The Central Zone outcrops over a short strike length and has dimensions of 170m vertically x 155m horizontally, dips -70 degrees to the west and ranges in thickness from a few metres to about 10m in thickness.

The South Zone also outcrops over a short strike. It has dimensions of 260m vertical x 165m horizontal and ranges in thickness from less than 0.5m up to 7m in thickness. It too dips at around -70 degrees to the west.

(Wholly) within the South Zone a discrete lens of massive sulphide can be recognised which is named the South Lens. The South Lens is 90m x 90m and varies in thickness from less than 0.2m up to 5m.

The resource estimate for the Wart Hill massive sulphide deposit has been classified as Inferred Mineral Resources in accordance with the guidelines as set out in the Joint Ore Reserves Committee (JORC) Code (2004). The resource category is based on the robustness of the various data sources and particularly the level of geological knowledge and confidence in interpretation coupled with the overall drilling density. The resource is shown in figures 6.17 to 6.19 with an example section (remaining sections are included in the resource report) in figure 6.20.

At a 0g/t Au equivalent cut-off (i.e. including all material within wireframes) stands at:

**Central Zone 309,200t @ 0.12g/t Au, 25g/t Ag, 0.03% Cu, 1.03% Pb and 2.16% Zn (= 1.8g/t Au equivalent)**

**South Zone 356,200t @ 0.74g/t Au, 48g/t Ag, 0.14% Cu, 2.29% Pb and 4.44% Zn (= 4.33g/t Au equivalent)**

**Total Resource 665,400t @ 0.45g/t Au, 37g/t Ag, 0.09% Cu, 1.7% Pb and 3.38% Zn (= 3.15g/t Au equivalent)**

At a 5g/t Au equivalent cutoff the total resource is

**167,300t @ 1.14g/t Au, 74g/t Ag, 0.22% Cu, 3.9% Pb and 7.7% Zn (= 7.1g/t Au equivalent).**

The South Lens resource is wholly contained within the South Zone. The resource contained within the South Lens is presented in table 8.5. At a 0g/t Au equivalent cutoff the resource in the South Lens (wholly contained within South Zone) is;

**South Lens      46,500t @ 1.45g/t Au, 70g/t Ag, 0.27% Cu, 4.1% Pb and 8.03% Zn (= 3.15g/t Au equivalent)**

## Geological Model

### Block Model

Two block models were created with the larger model, *wart\_hill\_zones.mdl*, incorporating the Central and South Zones and a smaller separate model created for the South lens, *south\_lens.mdl*.

Both models used 5m x 5m x 5m blocks with sub-blocking to 0.625m in order to capture narrow zones.

Both models orientations are AMG north-south and east west which accords with the drill grid which is AMG east-west.

The estimation used Surpac's inverse distance squared methodology. A spherical search ellipse with radius of 100m, minimum samples 2 and maximum samples 20 was used.

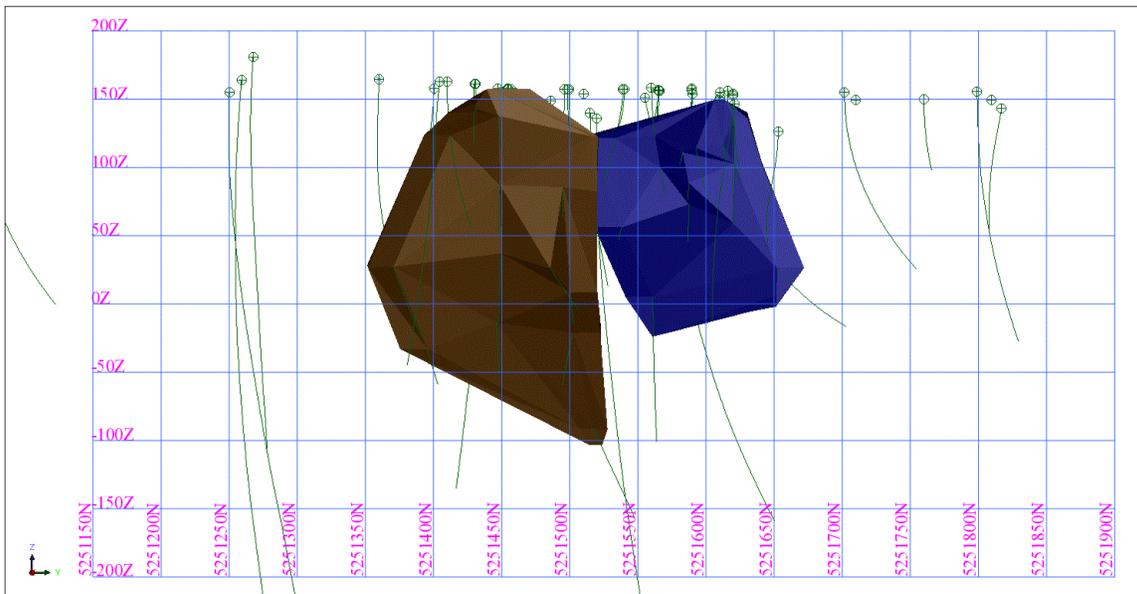
Au, Ag, Cu, Pb and Zn were all estimated in this way. Au equivalent was calculated using the following metal prices as of 21<sup>st</sup> May 2012 i.e. Au equivalent (g/t) = [0.0178273 x Ag (ppm)] + [0.0001524 x Cu (ppm)] + [0.0000379 x Pb (ppm)] + [0.000372 x Zn (ppm)].

### Recommendations

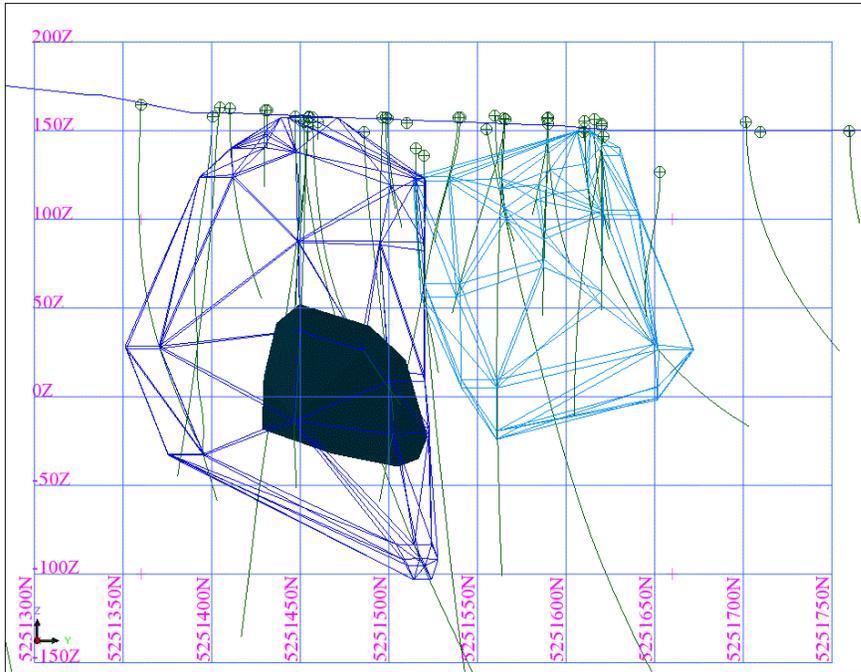
Upgrading the resource category would require;

- thorough drillcore relogging and geological interpretation
- infill drilling in strategic positions to unequivocally demonstrate the strike continuity of the mineralised zones

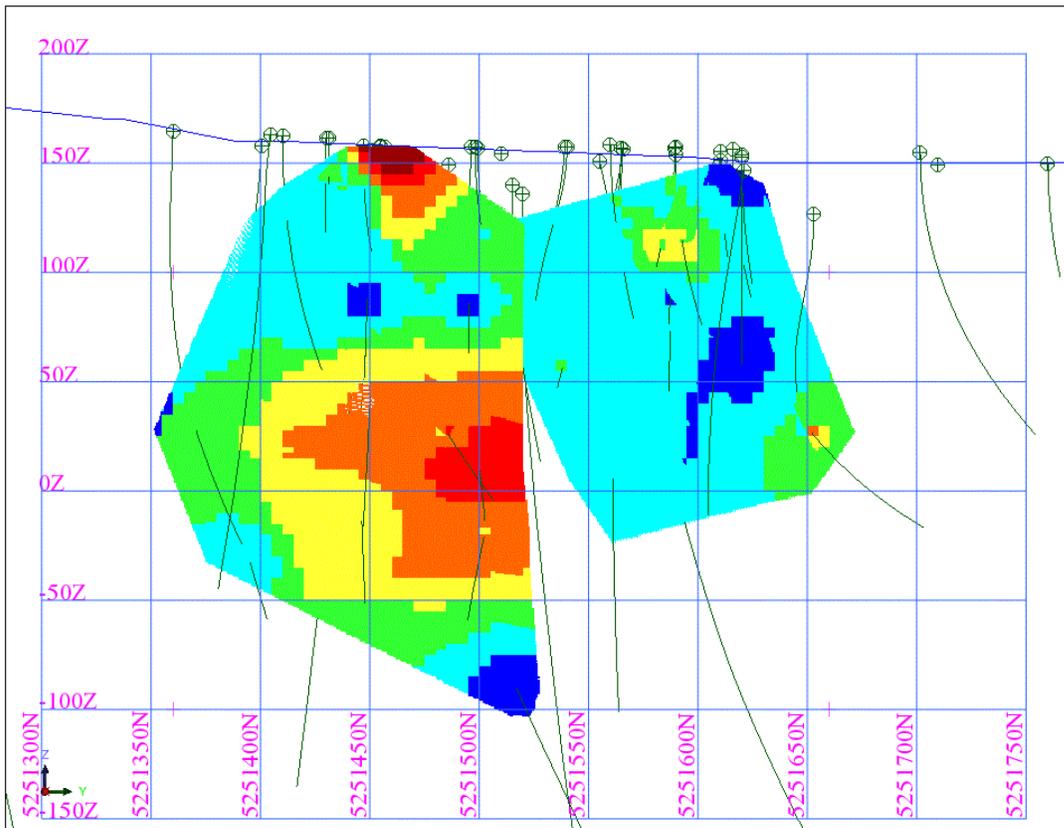
The best potential to extend the current resource zones are at depth to the south of the South Zone and again at depth to the north of the Central Zone.



**Figure 6.15: Wart Hill massive sulphide deposit showing South (brown) and Central (blue) Zone wireframes and drillhole traces. Grid is AGD66.**



**Figure 6.16: Wart Hill massive sulphide deposit showing South Lens wireframe inside South (blue) and Central (aqua) Zones framework and showing drillhole traces. Grid is AGD66.**



**Figure 6.17: Wart Hill massive sulphide deposit long section view showing gold equivalent grade looking west. Grid is AGD66.**

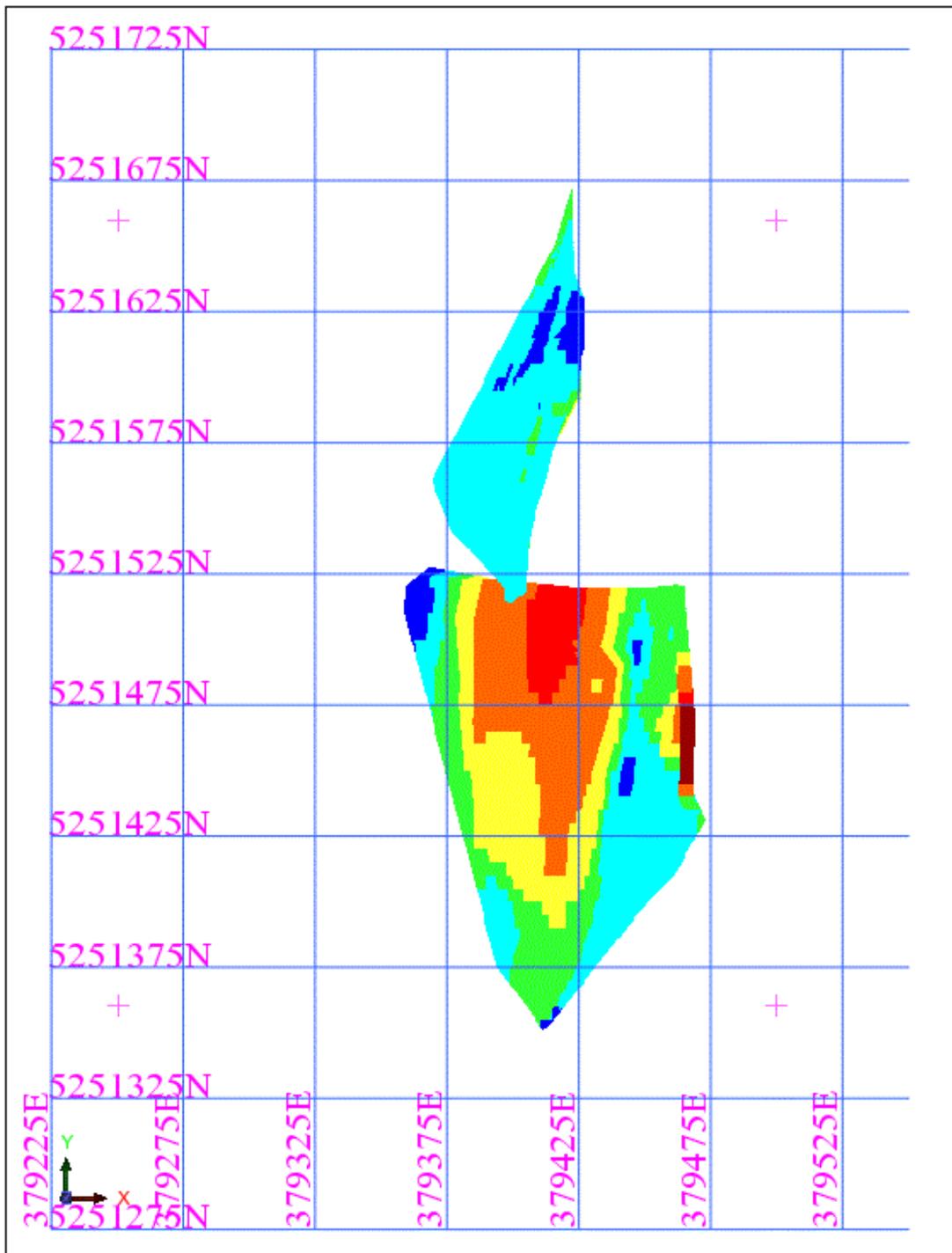
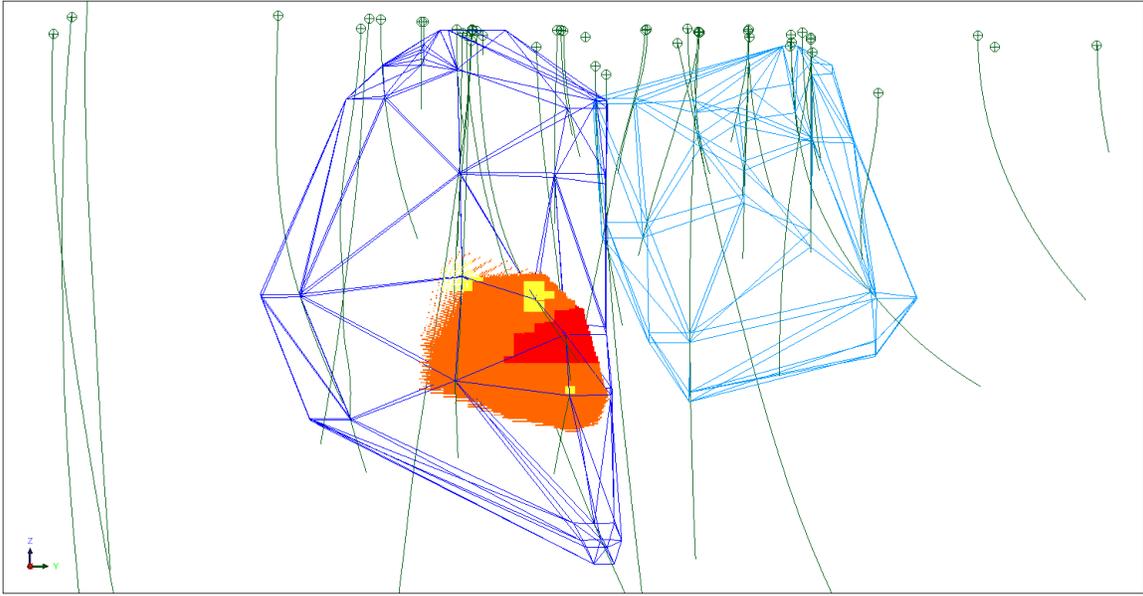


Figure 6.18: Wart Hill massive sulphide deposit plan view showing gold equivalent grade looking west. Grid is AGD66.



**Figure 6.19: Wart Hill massive sulphide deposit South Lens long section view showing gold equivalent grade looking west. Grid is AGD66.**

The estimated resource is best expressed in tons and grade graphs. These are included below as tables 6.1 (total resource) and 6.2 (South Lens alone) and figure 6.20.

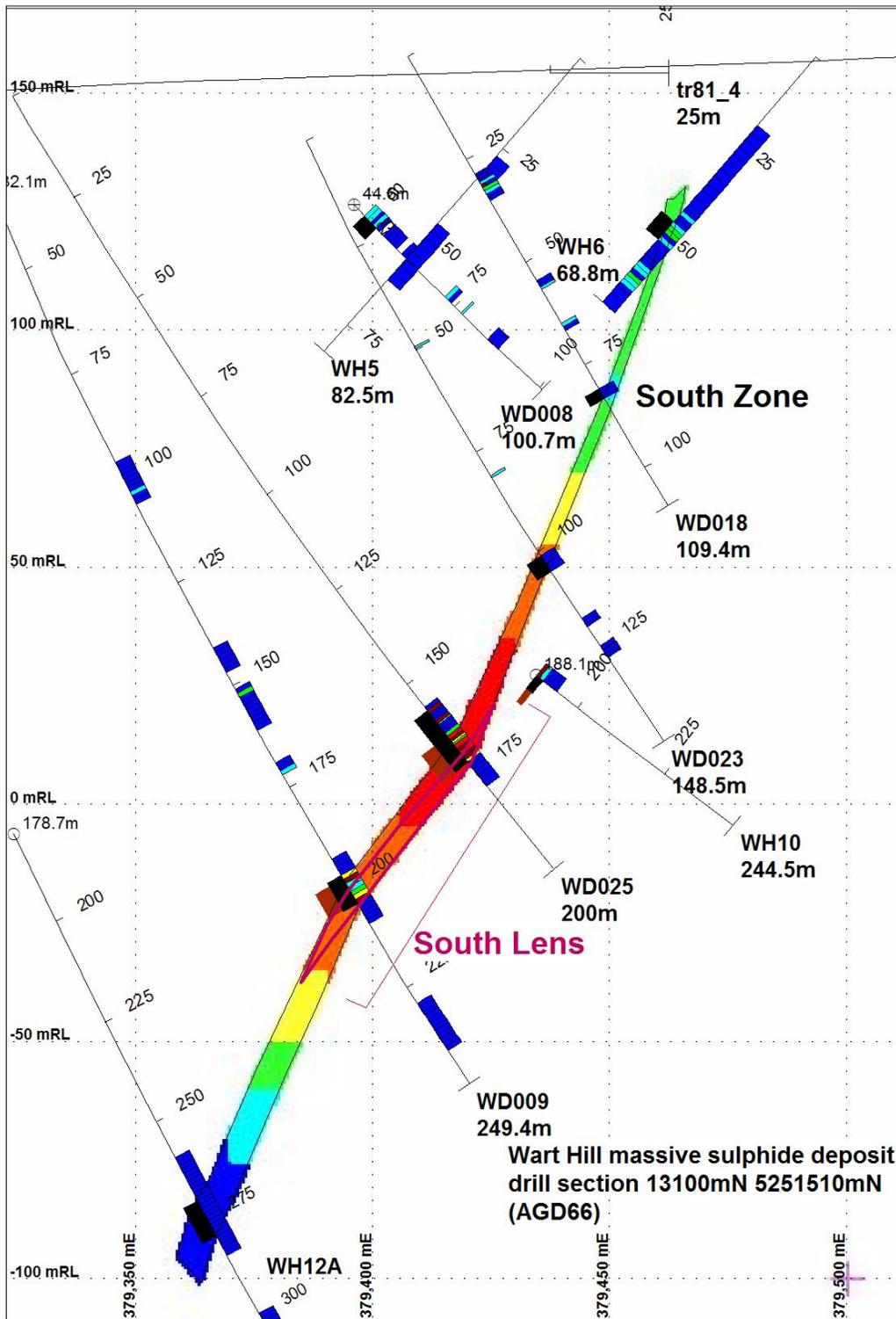
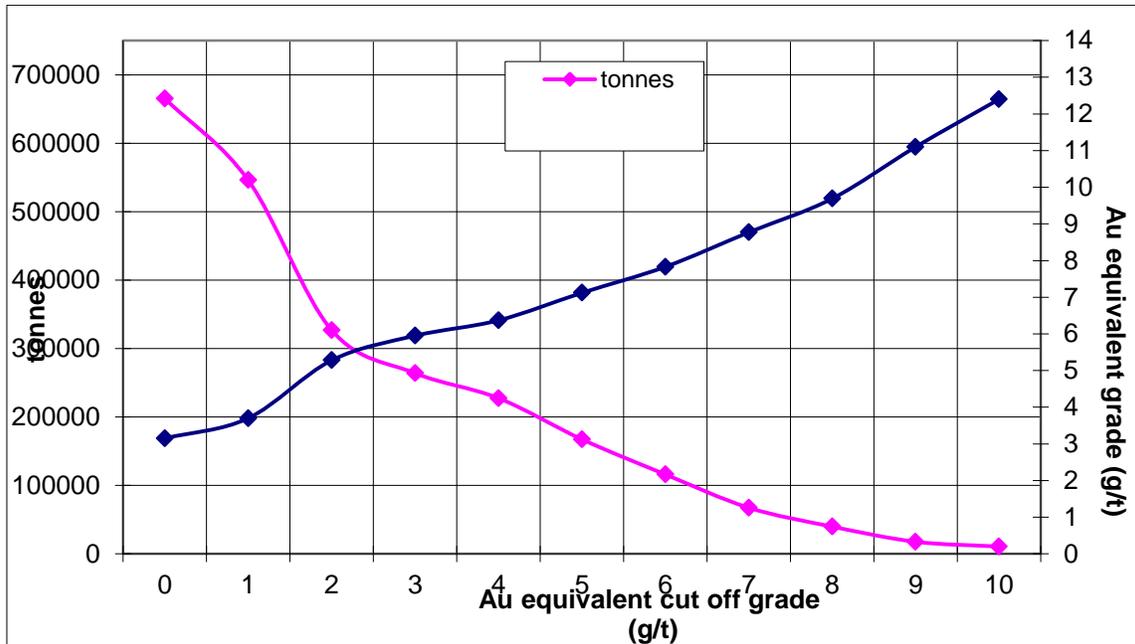


Figure 6.20: Wart Hill massive sulphide deposit cross section 13100mN 5251510mN view showing gold equivalent grade looking north. Grid is AGD66.

**Table 6.1: Combined Central and South Zones Tons and Grades.**

Au_equ_cutoff	Volume (m3)	Mass (t)	Au g/t	Ag g/t	Cu %	Pb %	Zn %	Au equivalent g/t
0	237643	665401	0.45	37	0.088	1.7	3.38	3.15
1	195005	546013	0.54	42	0.103	2.02	3.99	3.7
2	116750	326899	0.82	57	0.154	2.89	5.72	5.28
3	94325	264111	0.93	63	0.176	3.26	6.44	5.95
4	81253	227508	1.01	67	0.191	3.49	6.88	6.37
5	59773	167364	1.14	74	0.215	3.88	7.7	7.12
6	41461	116093	1.23	83	0.23	4.29	8.5	7.83
7	24092	67459	1.15	98.5	0.241	4.9	9.79	8.77
8	14231	39847	1.02	117	0.239	5.51	11.1	9.69
9	6327	17715	0.68	152	0.195	6.56	13.4	11.1
10	3813	10676	0.46	176	0.163	7.42	15.5	12.4



**Figure 6.21: Tonnage vs grade (gold equivalent) curves for combined South and Central Zones resource.**

**Table 6.2: South Lens Tons and Grades based on Au Equivalent Cut-off**

Au_equ_cutoff	Volume (m3)	Mass (t)	Au g/t	Ag g/t	Cu %	Pb %	Zn %	Au equivalent g/t
0	16596	46469	1.45	70	0.27	4.09	8.03	7.64
5	16596	46469	1.45	70	0.27	4.09	8.03	7.64
6	16035	44897	1.45	71	0.27	4.12	8.1	7.7
7	12517	35049	1.43	75	0.28	4.33	8.53	8.01
8	5310	14867	1.4	87	0.3	4.76	9.42	8.71
9	1306	3656	1.41	96	0.32	5.19	10.3	9.43
10	259	724	1.63	97	0.35	5.51	11	10.08

#### 6.4 3D IP Reappraisal

3D IP data collected by Frontier previously was reappraised in the light of recent drilling results to see if it could help targeting drilling in the more immediate vicinity of the Wart Hill massive sulphide deposit.

Geophysicist Peter Swiriduk, who has had significant experience with the 3D IP method, reappraised the data. His report consists of 14 .gif screen dumped images showing 5 target zones in and around Wart Hill with the collars, azimuths, depths and dips of holes required to test the targets. Targets generated by Peter S lie on the western and northern flanks of Wart Hill

Proposed holes are:

<b>Proposed hole</b>	<b>East (AGD66)</b>	<b>North (AGD66)</b>	<b>Azimuth (TN)</b>	<b>Dip</b>	<b>Depth (m)</b>
#1	379260	5251850	90	-60	150
#2	379560	5251550	90	-60	80
#3	379050	5250788	90	-60	80
#4	379219	5250988	90	-60	80
#5	379232	5251200	90	-60	50

The two plans showing target zones are shown in figures 6.22 and 6.23. The full set of 14 figures are included as appendix C.

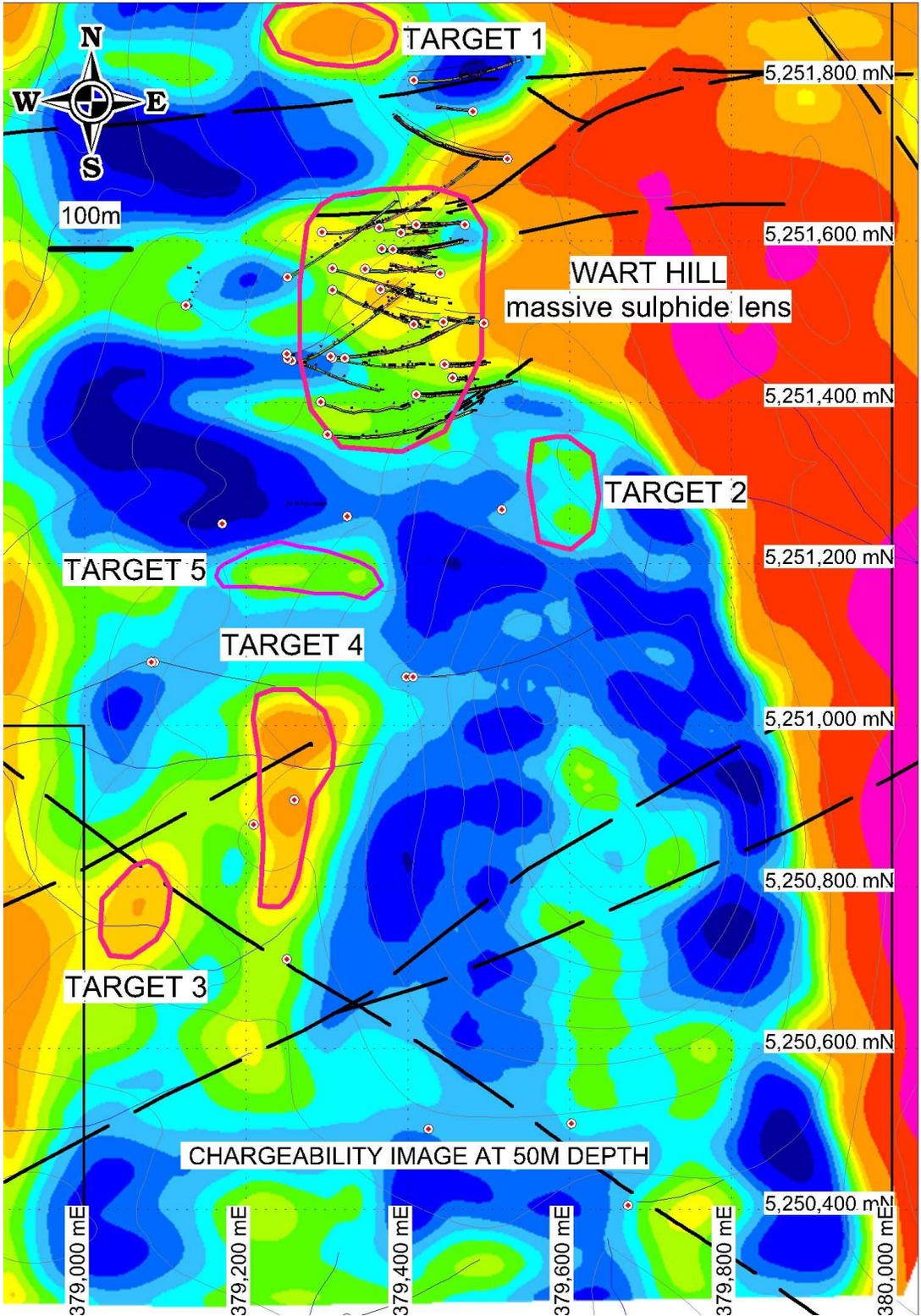


Figure 6.22: Peter Swiriduk 3D IP target zones on 50m chargeability. Grid is AGD66.

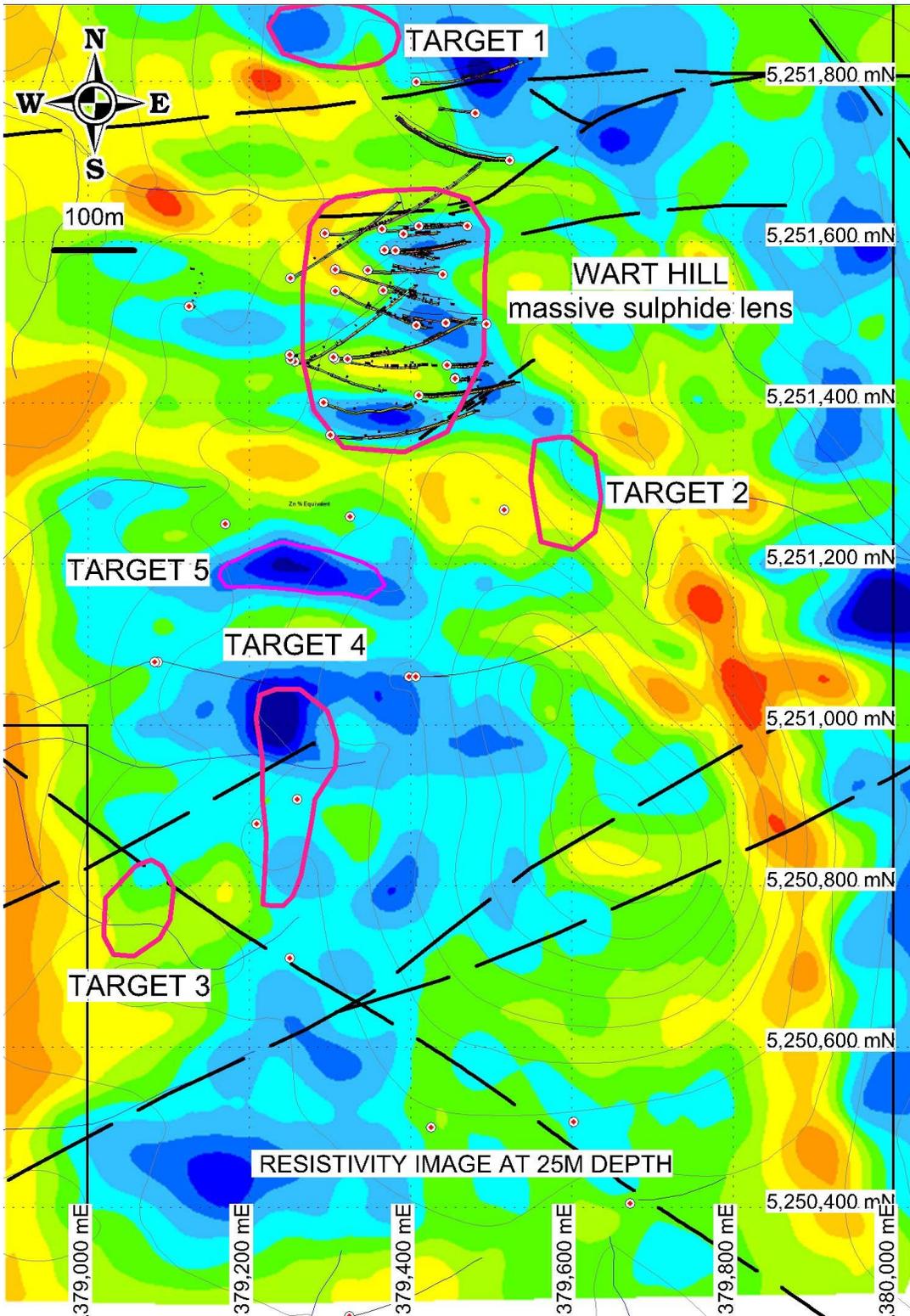


Figure 6.23: Peter Swiriduk 3D IP target zones on 25m resistivity. Grid is AGD66.

## **7.0 Proposed work June 2012 to June 2013**

Frontier Resources Ltd. has transferred its 90% equity in EL 20/1996 to a new entity to be called Torque Mining Ltd. Torque is currently in discussion with a significant major who is interested in the base metal potential of the two tenements which constitute the Southern Mt. Read's Volcanics project and may fund a major exploration programme over the next 12-24 months.

Drilling in the 2010/11 season has confirmed the interpretation of the presence of an exhalative horizon which remains incompletely tested, particularly to the south. Torque Mining Ltd wishes to continue pursuing this horizon and expand on the knowledge it has gained over the project in recent years.

To this end Torque Mining Ltd wishes to carry out a 3D IP survey over the southern and western parts of the tenement covering prospects East Camp (V29), V29W and Sassy Creek (V24/V30). This work will cost well over \$150,000. Other work which will be completed includes further geological relogging and reinterpretation of drillcore and a more thorough appraisal of the VTEM conductivity anomaly.

Should the major's interest be maintained the exploration programme will consist of substantial drilling south of Wart Hill, in the East Camp (V29) and V29W areas though this work may need to extend over two field seasons.

## 8.0 Expenditure

\$202,486 was spent on the tenement in the reporting year. Of this some of the demobilization in early June 2011 have carried over.

Frontier have now spent a total of \$3,558,934 on exploration of EL 20/1996.

Geology	\$44,081
Geophysics	\$26,652
Drilling	\$4,577
Assaying	\$360
Mobilisation/demobilization	\$121,239
Tenement costs	\$419
Safety	\$1,477
Vehicles	\$1,717
Administration	\$1,964
<b>Total</b>	<b>\$202,486</b>

## **9.0 Environmental**

No work carried out in the reporting year had any environmental impact. A full report detailing rehabilitation of the Wart Hill area was provided in last year's annual report.

## 10.0 References

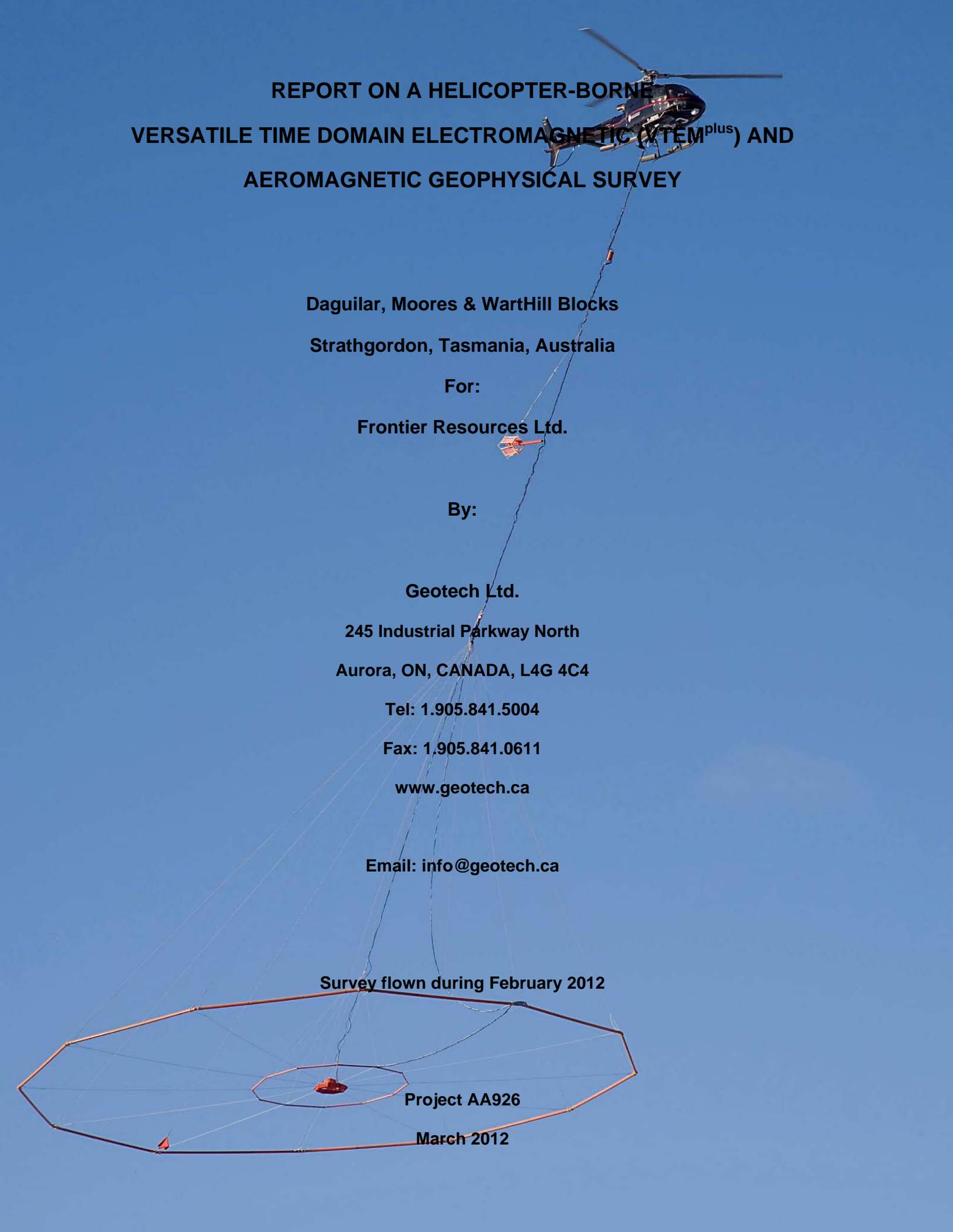
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**REPORT ON A HELICOPTER-BORNE  
VERSATILE TIME DOMAIN ELECTROMAGNETIC (VTEM<sup>plus</sup>) AND  
AEROMAGNETIC GEOPHYSICAL SURVEY**

**Daguilar, Moores & WartHill Blocks  
Strathgordon, Tasmania, Australia**

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**Frontier Resources Ltd.**

**By:**

**Geotech Ltd.**

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**Survey flown during February 2012**

**Project AA926**

**March 2012**

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# REPORT ON A HELICOPTER-BORNE VERSATILE TIME DOMAIN ELECTROMAGNETIC (VTEM<sup>plus</sup>) and AEROMAGNETIC SURVEY

Daguliar, Moores and WartHill Blocks  
Strathgordon, Tasmania

## EXECUTIVE SUMMARY

During February 1<sup>st</sup> to 23<sup>rd</sup> 2012 Geotech Airborne Pty Ltd. carried out a helicopter-borne geophysical survey over the Daguliar, Moores and WartHill Blocks situated approximately 33 kilometres west of Strathgordon, Tasmania.

Principal geophysical sensors included a versatile time domain electromagnetic (VTEM<sup>plus</sup>) system, and a caesium magnetometer. Ancillary equipment included a GPS navigation system and a radar altimeter. A total of 955 line-kilometres of geophysical data were acquired during the survey.

In-field data quality assurance and preliminary processing were carried out on a daily basis during the acquisition phase. Preliminary and final data processing, including generation of final digital data and map products were undertaken from the office of Geotech Ltd. in Aurora, Ontario.

The processed survey results are presented as the following maps:

- Electromagnetic stacked profiles of the B-field Z Component,
- Electromagnetic stacked profiles of dB/dt Z Components,
- Colour grids of a B-Field Z Component Channel,
- Total Magnetic Intensity (TMI), and
- EM Time-constant dB/dt Z Component (Tau), are presented.

Digital data includes all electromagnetic and magnetic products, plus ancillary data including the waveform.

The survey report describes the procedures for data acquisition, processing, final image presentation and the specifications for the digital data set.

# 1. INTRODUCTION

## 1.1 General Considerations

Geotech Airborne Pty Ltd. performed a helicopter-borne geophysical survey over the Daguliar, Moores and WartHill Blocks situated approximately 33 kilometres west of Strathgordon, Tasmania (Figure 1 & Figure 2).

Grant Macdonald represented Frontier Resources Ltd. during the data acquisition and data processing phases of this project.

The geophysical surveys consisted of helicopter borne EM using the versatile time-domain electromagnetic (VTEM plus) system with Z and X component measurements and aeromagnetics using a caesium magnetometer. A total of 955 line-km of geophysical data were acquired during the survey.

The crew was based out of Lake Pedder Lodge (Figure 2) in Strathgordon, Tasmania for the acquisition phase of the survey. Survey flying started on February 1<sup>st</sup> 2012 and was completed on February 23<sup>rd</sup> 2012.

Data quality control and quality assurance, and preliminary data processing were carried out on a daily basis during the acquisition phase of the project. Final data processing followed immediately after the end of the survey. Final reporting, data presentation and archiving were completed from the Aurora office of Geotech Ltd. in March and April, 2012.

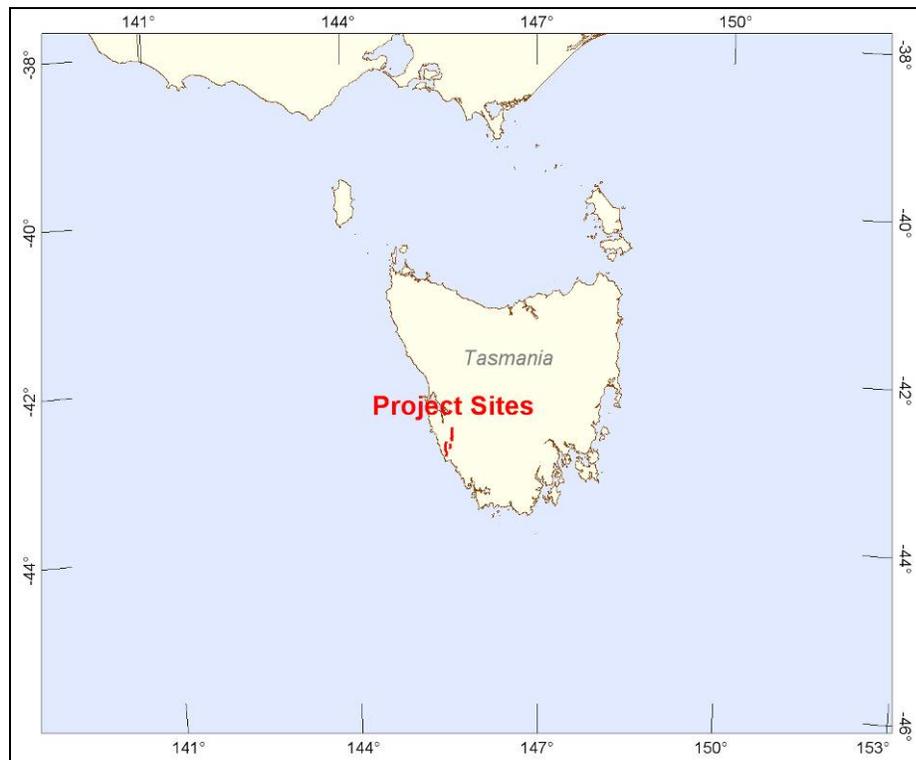


Figure 1: Property Location

## 1.2 Survey and System Specifications

The Daguilard, Moores and WartHill Blocks are located approximately 33 km west of Strathgordon, Tasmania, Australia (Figure 2).



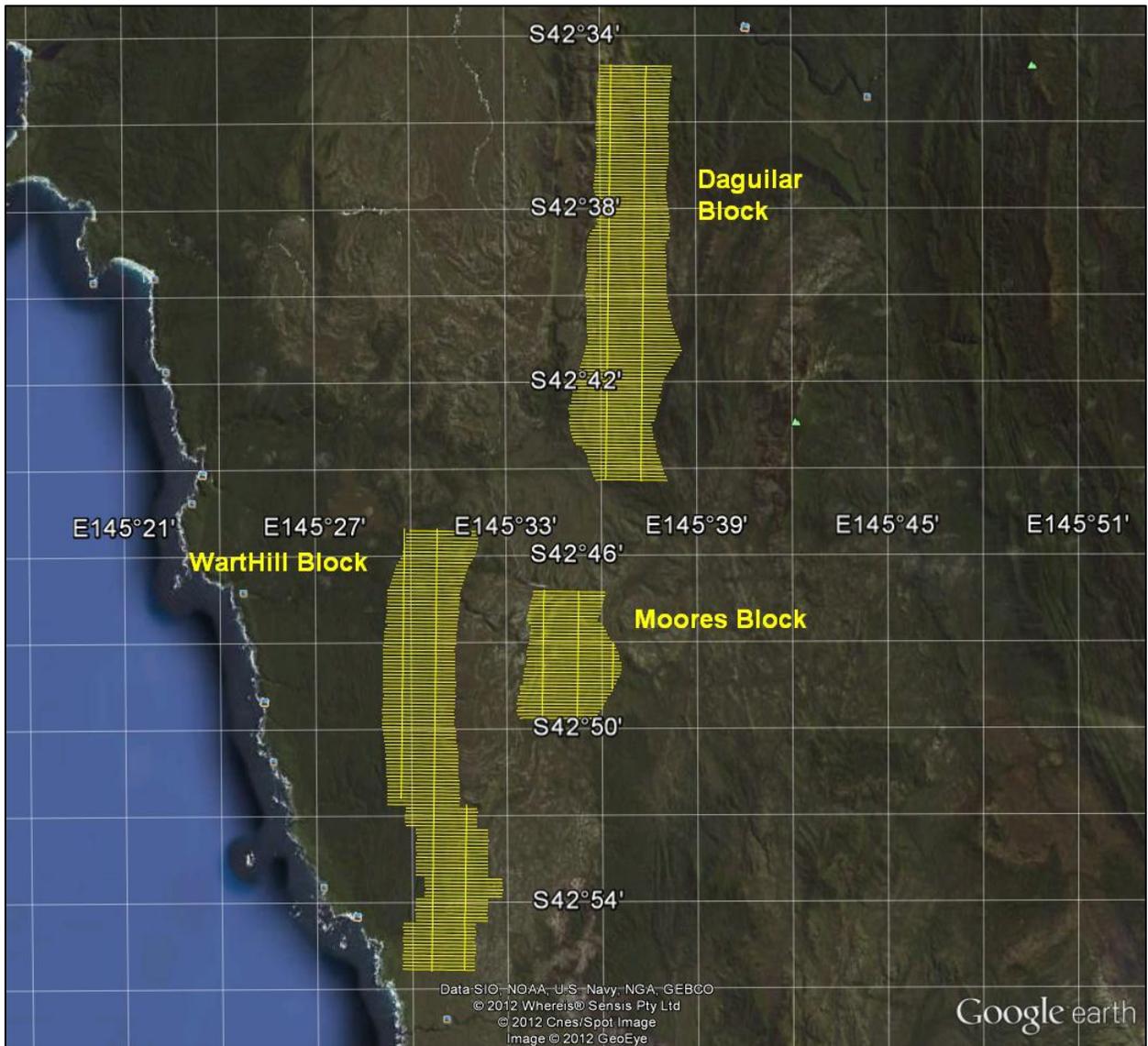
**Figure 2:** Survey areas location on Google Earth

The all the survey blocks were flown in an east to west ( $N 90^\circ E$  azimuth) direction, with traverse line spacing of 150 metres as depicted in Figure 3. Tie lines were flown perpendicular to the traverse lines ( $N 0^\circ E$  azimuth) at a spacing of 1400/1500 metres respectively. For more detailed information on the flight spacing and direction see Table 1.

### 1.3 Topographic Relief and Cultural Features

Topographically, the Daguiilar, Moores and WartHill Blocks exhibits a shallow relief with an elevation ranging from 23 to 723 metres above mean sea level over an area of 135 square kilometres (Figure 3).

The survey block has various rivers and streams running through the survey area which connect various lakes. There are a few visible signs of culture such as roads located throughout the survey areas.



**Figure 3:** Flight paths over a Google Earth Image

## 2. DATA ACQUISITION

### 2.1 Survey Area

The survey block (see Figure 3 and Appendix A) and general flight specifications are as follows:

**Table 1:** Survey Specifications

Survey block	Traverse Line spacing (m)	Area (Km <sup>2</sup> )	Planned <sup>1</sup> Line-km	Actual Line-km	Flight direction	Line numbers
Daguilar	Traverse: 150	59	403	403.2	N 90° E / N 270° E	L10010 – L11190
	Tie: 1500			35.6	N 0° E / N 180° E	T91010 – T91020
Moores	Traverse: 150	18	135	133.1	N 90° E / N 270° E	L30010 – L30370
	Tie: 1500			13	N 0° E / N 180° E	T93010 – T93030
WartHill	Traverse: 150	58	417	392.1	N 90° E / N 270° E	L20010 – L21260
	Tie: 1400			37.6	N 0° E / N 180° E	T92010– T92030
<b>TOTAL</b>		135	955	1014.6		

Survey block boundaries co-ordinates are provided in Appendix B.

### 2.2 Survey Operations

Survey operations were based out of Strathgordon, Tasmania from February 1<sup>st</sup> to February 23<sup>rd</sup> 2012. The following table shows the timing of the flying.

**Table 2:** Survey schedule

Date	Flight #	Flow km	Block	Crew location	Comments
1-Feb-2012				Strathgordon, Tasmania	Crew mobilized
2-Feb-2012				Strathgordon, Tasmania	Crew mobilized
3-Feb-2012				Strathgordon, Tasmania	Crew mobilized
4-Feb-2012				Strathgordon, Tasmania	Crew mobilized
5-Feb-2012				Strathgordon, Tasmania	Crew mobilized
6-Feb-2012				Strathgordon, Tasmania	System assembly
7-Feb-2012				Strathgordon, Tasmania	System assembly
8-Feb-2012				Strathgordon, Tasmania	System assembly
9-Feb-2012				Strathgordon, Tasmania	System assembly
10-Feb-2012	1			Strathgordon, Tasmania	Test flight
11-Feb-2012	2,3			Strathgordon, Tasmania	Test flights
12-Feb-2012	4	78	warthill	Strathgordon, Tasmania	78km flown limited production due to fuel
13-Feb-2012				Strathgordon, Tasmania	No production due to weather
14-Feb-2012	5,6,7	261	Daguilar/ moores	Strathgordon, Tasmania	261 km flown
15-Feb-2012	8,9,10	280	Daguilar/ moores	Strathgordon, Tasmania	280km flown

<sup>1</sup> Note: Actual Line kilometres represent the total line kilometres in the final database. These line-km normally exceed the Planned line-km, as indicated in the survey NAV files.

Date	Flight #	Flow km	Block	Crew location	Comments
16-Feb-2012				Strathgordon, Tasmania	No production due to weather
17-Feb-2012				Strathgordon, Tasmania	No production due to weather
18-Feb-2012	11,12,13	301	Daguilar/ moores/ warthill	Strathgordon, Tasmania	301km flown
19-Feb-2012				Strathgordon, Tasmania	No production due to weather
20-Feb-2012				Strathgordon, Tasmania	No production due to weather
21-Feb-2012				Strathgordon, Tasmania	No production due to weather
22-Feb-2012	14,15	146	Warthill/ moores	Strathgordon, Tasmania	146km flown
23-Feb-2012				Strathgordon, Tasmania	

## 2.3 Flight Specifications

During the survey the helicopter was maintained at a mean altitude of 79 metres above the ground with an average survey speed of 80 km/hour. This allowed for an actual average EM bird terrain clearance of 43 metres and a magnetic sensor clearance of 66 metres.

The on board operator was responsible for monitoring the system integrity. He also maintained a detailed flight log during the survey, tracking the times of the flight as well as any unusual geophysical or topographic features.

On return of the aircrew to the base camp the survey data was transferred from a compact flash card (PCMCIA) to the data processing computer. The data were then uploaded via ftp to the Geotech office in Aurora for daily quality assurance and quality control by qualified personnel.

## 2.4 Aircraft and Equipment

### 2.4.1 Survey Aircraft

The survey was flown using a Eurocopter Aerospatiale (Astar) 350 B3 helicopter, registration VH-VTN. The helicopter is owned and operated by United Aero Helicopters. Installation of the geophysical and ancillary equipment was carried out by a Geotech Ltd crew.

### 2.4.2 Electromagnetic System

The electromagnetic system was a Geotech Time Domain EM (VTEM<sup>plus</sup>) system. VTEM, with the serial number 12 had been used for the survey. The configuration is as indicated in Figure 5.

The VTEM<sup>plus</sup> Receiver and transmitter coils were in concentric-coplanar and Z-direction oriented configuration. The receiver system for the project also included a coincident-coaxial X-direction coil to measure the in-line dB/dt and calculate B-Field responses. The EM bird was towed at a mean distance of 35 metres below the aircraft as shown in Figure 5 and Figure 6. The receiver decay recording scheme is shown in

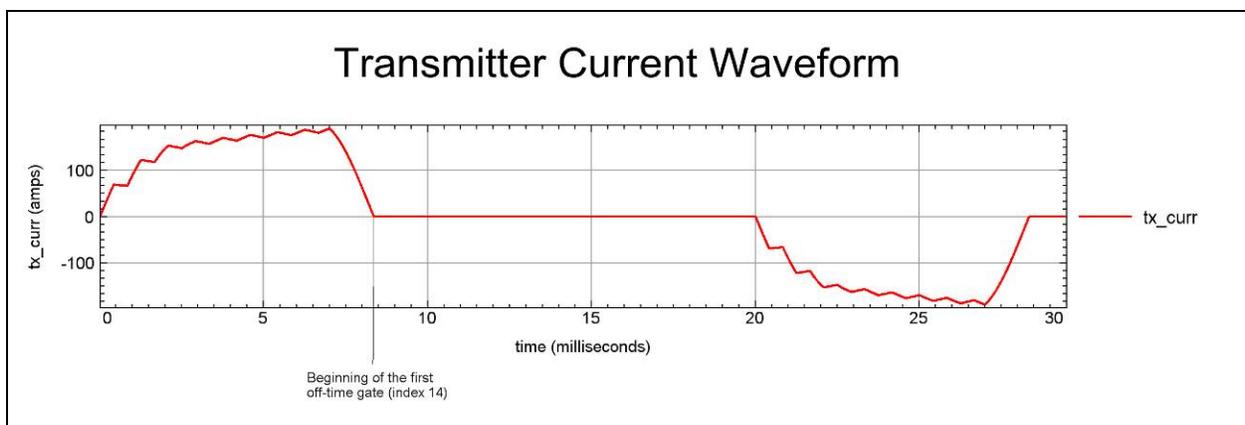


Figure 4: VTEM Waveform & Sample Times

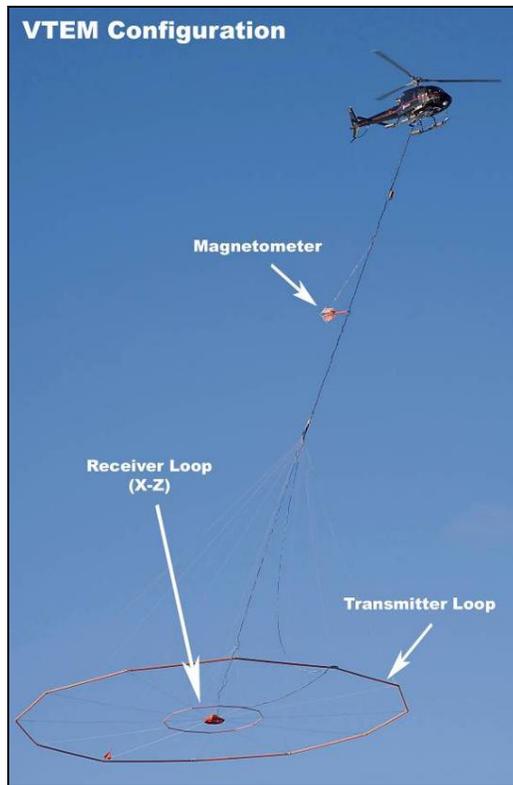


Figure 5: VTEM<sup>plus</sup> Configuration, with magnetometer.

The VTEM decay sampling scheme is shown in Table 3 below. Thirty-five time measurement gates were used for the final data processing in the range from 0.083 to 9.286  $\mu$  sec.

**Table 3:** Off-Time Decay Sampling Scheme

<b>VTEM Decay Sampling Scheme</b>			
<b>Index</b>	<b>Middle</b>	<b>Start</b>	<b>End</b>
<b>Milliseconds</b>			
13	0.083	0.078	0.090
14	0.096	0.090	0.103
15	0.110	0.103	0.118
16	0.126	0.118	0.136
17	0.145	0.136	0.156
18	0.167	0.156	0.179
19	0.192	0.179	0.206
20	0.220	0.206	0.236
21	0.253	0.236	0.271
22	0.290	0.271	0.312
23	0.333	0.312	0.358
24	0.383	0.358	0.411
25	0.440	0.411	0.472
26	0.505	0.472	0.543
27	0.580	0.543	0.623
28	0.667	0.623	0.716
29	0.766	0.716	0.823
30	0.880	0.823	0.945
31	1.010	0.945	1.086
32	1.161	1.086	1.247
33	1.333	1.247	1.432
34	1.531	1.432	1.646
35	1.760	1.646	1.891
36	2.021	1.891	2.172
37	2.323	2.172	2.495
38	2.667	2.495	2.865
39	3.063	2.865	3.292
40	3.521	3.292	3.781
41	4.042	3.781	4.341
42	4.641	4.341	4.987
43	5.333	4.987	5.729
44	6.125	5.729	6.581
45	7.036	6.581	7.560
46	8.083	7.560	8.685
47	9.286	8.685	9.977

Z Component: 13-47 time gates

X Component: 20-47 time gates.

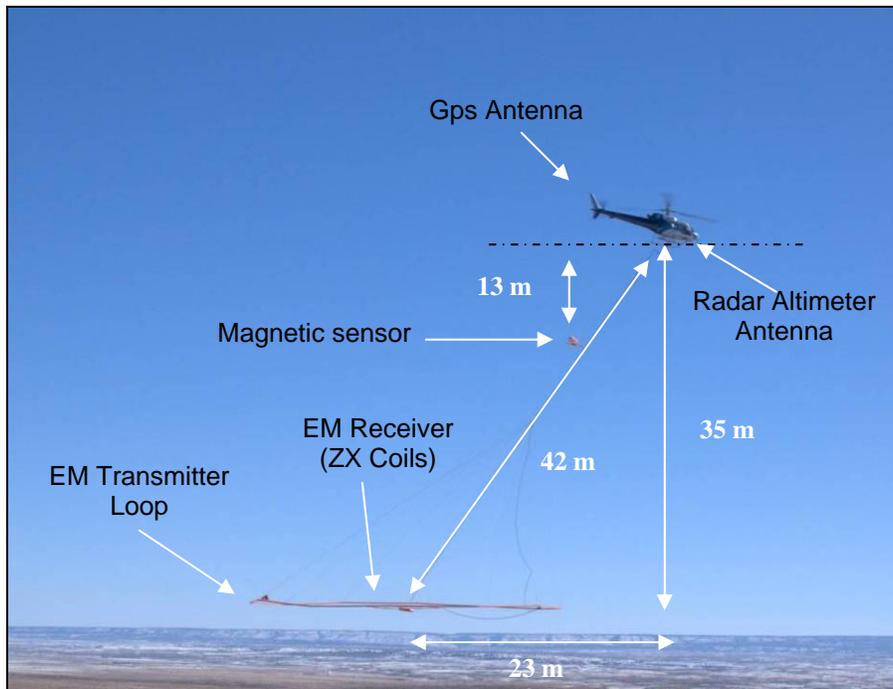
VTEM<sup>plus</sup> system specification:

Transmitter

- Transmitter loop diameter: 26 m
- Effective coil area: 2123 m<sup>2</sup>
- Number of turns: 4
- Transmitter base frequency: 25 Hz
- Peak current: 189 A
- Pulse width: 8.37 ms
- Wave form shape: trapezoid
- Peak dipole moment: 401,382 nIA
- Actual average EM Bird terrain clearance: 43 metres above the ground

Receiver

- X Coil diameter: 0.32 m
- Number of turns: 245
- Effective coil area: 19.69 m<sup>2</sup>
- Z-Coil coil diameter: 1.2 m
- Number of turns: 100
- Effective coil area: 113.04 m<sup>2</sup>



**Figure 6:** VTEM<sup>plus</sup> System Configuration

### 2.4.3 Airborne magnetometer

The magnetic sensor utilized for the survey was Geometrics optically pumped caesium vapour magnetic field sensor mounted 13 metres below the helicopter, as shown in Figure 6. The sensitivity of the magnetic sensor is 0.02 nanoTesla (nT) at a sampling interval of 0.1 seconds.

### 2.4.4 Radar Altimeter

A Terra TRA 3000/TRI 40 radar altimeter was used to record terrain clearance. The antenna was mounted beneath the bubble of the helicopter cockpit (Figure 6).

### 2.4.5 GPS Navigation System

The navigation system used was a Geotech PC104 based navigation system utilizing a NovAtel's WAAS (Wide Area Augmentation System) enable OEM4-G2-3151W GPS receiver, Geotech navigate software, a full screen display with controls in front of the pilot to direct the flight and an NovAtel GPS antenna mounted on the helicopter tail (Figure 6). As many as 11 GPS and two WAAS satellites may be monitored at any one time. The positional accuracy or circular error probability (CEP) is 1.8 m, with WAAS active, it is 1.0 m. The co-ordinates of the block were set-up prior to the survey and the information was fed into the airborne navigation system.

### 2.4.6 Digital Acquisition System

A Geotech data acquisition system recorded the digital survey data on an internal compact flash card. Data is displayed on an LCD screen as traces to allow the operator to monitor the integrity of the system. The data type and sampling interval as provided in Table 4.

**Table 4:** Acquisition Sampling Rates

Data Type	Sampling
TDEM	0.1 sec
Magnetometer	0.1 sec
GPS Position	0.2 sec
Radar Altimeter	0.2 sec

## 2.5 Base Station

A combined magnetometer/GPS base station was utilized on this project. A Geometrics Caesium vapour magnetometer was used as a magnetic sensor with a sensitivity of 0.001 nT. The base station was recording the magnetic field together with the GPS time at 1 Hz on a base station computer.

The base station magnetometer sensor was installed at a secure location adjacent to landing pad (42°43'56."S, 53°145'58.42"E); away from electric transmission lines and moving ferrous objects such as motor vehicles. The base station data were backed-up to the data processing computer at the end of each survey day.

### 3. PERSONNEL

The following Geotech Ltd. personnel were involved in the project.

Field:

Project Manager:	Adam Ellis (Office)
Data QC:	Peter Holbrook (Office)
Crew chief:	Leon Lovelock
Operator:	Jon Lambert

The survey pilot and the mechanical engineer were employed directly by the helicopter operator – United Aero Helicopters.

Pilot:	Colby Tyrrell
Mechanical Engineer:	n/a

Office:

Preliminary Data Processing:	Peter Helbrook
Final Data Processing:	Keeme Mokubung
Final Data QA/QC:	Alexander Prikhodko
Reporting/Mapping:	Corrie Laver

Data acquisition phase was carried out under the supervision of Andrei Bagrianski, P. Geo, Chief Operating Officer. The processing and interpretation phase was under the supervision of Alexander Prikhodko, P. Geo. The customer relations were looked after by Keith Fisk.

## 4. DATA PROCESSING AND PRESENTATION

Data compilation and processing were carried out by the application of Geosoft OASIS Montaj and programs proprietary to Geotech Ltd.

### 4.1 Flight Path

The flight path, recorded by the acquisition program as WGS 84 latitude/longitude, was converted into the GDA94, UTM Zone 55 South coordinate system in Oasis Montaj.

The flight path was drawn using linear interpolation between x, y positions from the navigation system. Positions are updated every second and expressed as UTM easting's (x) and UTM northing's (y).

### 4.2 Electromagnetic Data

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

The signal to noise ratio was further improved by the application of a low pass linear digital filter. This filter has zero phase shift which prevents any lag or peak displacement from occurring, and it suppresses only variations with a wavelength less than about 1 second or 15 metres. This filter is a symmetrical 1 sec linear filter.

The results are presented as stacked profiles of EM voltages for the time gates, in linear - logarithmic scale for the B-field Z component and dB/dt responses in the Z and X components. B-field Z component time channel recorded at 2.021 and 0.880 milliseconds after the termination of the impulse is also presented as contour colour images. Fraser Filter X component is also presented as a colour image. Calculated Time Constant (TAU) with anomaly contours of Calculated Vertical Derivative of TMI is presented in Appendix C and E. Resistivity Depth Image (RDI) is also presented in Appendix C and F.

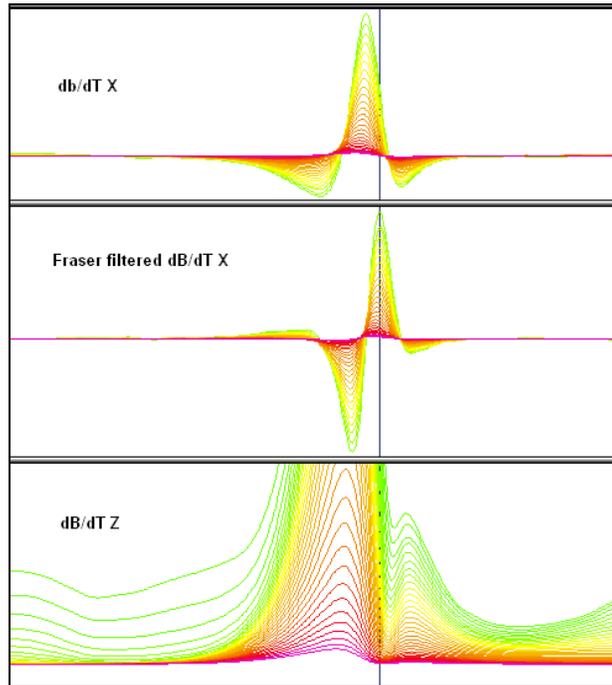
VTEM plus has two receiver coil orientations. Z-axis coil is oriented parallel to the transmitter coil axis and both are horizontal to the ground. The X-axis coil is oriented parallel to the ground and along the line-of-flight. This combined two coil configuration provides information on the position, depth, dip and thickness of a conductor. Generalized modeling results of VTEM plus data are shown in Appendix D.

In general X-component data produce cross-over type anomalies: from "+ to -" in flight direction of flight for "thin" sub vertical targets and from "- to +" in direction of flight for "thick" targets. Z component data produce double peak type anomalies for "thin" sub vertical targets and single peak for "thick" targets.

The limits and change-over of "thin-thick" depends on dimensions of a TEM system.

Because of X component polarity is under line-of-flight, convolution Fraser filter (FF, Figure 7) is applied to X component data to represent axes of conductors in the form of

grid map. In this case positive FF anomalies always correspond to “plus-to-minus” X data crossovers independently of direction of flight.



**Figure 7:** Z, X and Fraser filtered X (FFx) components for “thin” target

### 4.3 Magnetic Data

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

Tie line levelling was carried out by adjusting intersection points along traverse lines. A micro-levelling procedure was applied to remove persistent low-amplitude components of flight-line noise remaining in the data.

The corrected magnetic data was interpolated between survey lines using a random point gridding method to yield x-y grid values for a standard grid cell size of approximately 37.5 metres at the mapping scale. The Minimum Curvature algorithm was used to interpolate values onto a rectangular regular spaced grid.

## 5. DELIVERABLES

### 5.1 Survey Report

The survey report describes the data acquisition, processing, and final presentation of the survey results. The survey report is provided in two paper copies and digitally in PDF format.

### 5.2 Maps

Final maps were produced at a scale of 1:10,000 for Moores Block & 1:25,000 for Daguilar and Warthill blocks, for best representation of the survey size and line spacing. The coordinate/projection system used was GDA94 Datum, Map Grid of Australia 55 South. All maps show the mining claims, flight path trace and topographic data; latitude and longitude are also noted on maps.

The preliminary and final results of the survey are presented as EM profiles, a late-time gate gridded EM channel, and a color magnetic TMI contour map. The following maps are presented on paper;

- VTEM dB/dt profiles Z Component, Time Gates 0.220 – 7.036 ms in linear – logarithmic scale.
- VTEM B-Field profiles Z Component, Time Gates 0.220 – 7.036 ms in linear – logarithmic scale.
- VTEM B-field late time Z Component colour image.
- VTEM dB/dt Calculated Time Constant (TAU) with contours of anomaly areas of the Calculated Vertical Derivative of TMI
- Reduced to Pole of TMI colour image and contours.

### 5.3 Digital Data

- Two copies of the data and maps on DVD were prepared to accompany the report. Each DVD contains a digital file of the line data in GDB Geosoft Montaj format as well as the maps in Geosoft Montaj Map and PDF format.
- DVD structure.

<b>Data</b>	contains databases, grids and maps, as described below.
<b>Report</b>	contains a copy of the report and appendices in PDF format.

Databases in Geosoft GDB format, containing the channels listed in Table 5.

**Table 5: Geosoft GDB Data Format**

Channel name	Units	Description
X_UTM:	metres	UTM Easting WGS84 Zone 55 South
Y_UTM:	metres	UTM Northing WGS84 Zone 55 South
X_MGA:	metres	Map Grid of Australia zone 55 - GDA94
Y_MGA:	metres	Map Grid of Australia zone 55 - GDA94
Z:	metres	GPS antenna elevation (above Geoid)
Longitude:	Decimal Degrees	WGS 84 Longitude data
Latitude:	Decimal Degrees	WGS 84 Latitude data
Radar:	metres	helicopter terrain clearance from radar altimeter
Radarb:	metres	Calculated EM bird terrain clearance from radar altimeter
DEM:	metres	Digital Elevation Model
Gtime:	Seconds of the day	GPS time
Mag1:	nT	Raw Total Magnetic field data
Basemag:	nT	Magnetic diurnal variation data
Mag2:	nT	Diurnal corrected Total Magnetic field data
Mag3:	nT	Levelled Total Magnetic field data
CVG	nT/m	Calculated Vertical Derivative of TMI
RTP	nT	Reduced To Pole of TMI
RTP_CVG	nT/m	Calculated Vertical Derivative of Reduced To Pole of TMI
SFz[13]:	pV/(A*m <sup>4</sup> )	Z dB/dt 0.083 millisecond time channel
SFz[14]:	pV/(A*m <sup>4</sup> )	Z dB/dt 0.096 millisecond time channel
SFz[15]:	pV/(A*m <sup>4</sup> )	Z dB/dt 0.110 millisecond time channel
SFz[16]:	pV/(A*m <sup>4</sup> )	Z dB/dt 0.126 millisecond time channel
SFz[17]:	pV/(A*m <sup>4</sup> )	Z dB/dt 0.145 millisecond time channel
SFz[18]:	pV/(A*m <sup>4</sup> )	Z dB/dt 0.167 millisecond time channel
SFz[19]:	pV/(A*m <sup>4</sup> )	Z dB/dt 0.192 millisecond time channel
SFz[20]:	pV/(A*m <sup>4</sup> )	Z dB/dt 0.220 millisecond time channel
SFz[21]:	pV/(A*m <sup>4</sup> )	Z dB/dt 0.253 millisecond time channel
SFz[22]:	pV/(A*m <sup>4</sup> )	Z dB/dt 0.290 millisecond time channel
SFz[23]:	pV/(A*m <sup>4</sup> )	Z dB/dt 0.333 millisecond time channel
SFz[24]:	pV/(A*m <sup>4</sup> )	Z dB/dt 0.383 millisecond time channel
SFz[25]:	pV/(A*m <sup>4</sup> )	Z dB/dt 0.440 millisecond time channel
SFz[26]:	pV/(A*m <sup>4</sup> )	Z dB/dt 0.505 millisecond time channel
SFz[27]:	pV/(A*m <sup>4</sup> )	Z dB/dt 0.580 millisecond time channel
SFz[28]:	pV/(A*m <sup>4</sup> )	Z dB/dt 0.667 millisecond time channel
SFz[29]:	pV/(A*m <sup>4</sup> )	Z dB/dt 0.766 millisecond time channel
SFz[30]:	pV/(A*m <sup>4</sup> )	Z dB/dt 0.880 millisecond time channel
SFz[31]:	pV/(A*m <sup>4</sup> )	Z dB/dt 1.010 millisecond time channel
SFz[32]:	pV/(A*m <sup>4</sup> )	Z dB/dt 1.161 millisecond time channel
SFz[33]:	pV/(A*m <sup>4</sup> )	Z dB/dt 1.333 millisecond time channel
SFz[34]:	pV/(A*m <sup>4</sup> )	Z dB/dt 1.531 millisecond time channel
SFz[35]:	pV/(A*m <sup>4</sup> )	Z dB/dt 1.760 millisecond time channel
SFz[36]:	pV/(A*m <sup>4</sup> )	Z dB/dt 2.021 millisecond time channel
SFz[37]:	pV/(A*m <sup>4</sup> )	Z dB/dt 2.323 millisecond time channel
SFz[38]:	pV/(A*m <sup>4</sup> )	Z dB/dt 2.667 millisecond time channel
SFz[39]:	pV/(A*m <sup>4</sup> )	Z dB/dt 3.063 millisecond time channel
SFz[40]:	pV/(A*m <sup>4</sup> )	Z dB/dt 3.521 millisecond time channel
SFz[41]:	pV/(A*m <sup>4</sup> )	Z dB/dt 4.042 millisecond time channel
SFz[42]:	pV/(A*m <sup>4</sup> )	Z dB/dt 4.641 millisecond time channel
SFz[43]:	pV/(A*m <sup>4</sup> )	Z dB/dt 5.333 millisecond time channel
SFz[44]:	pV/(A*m <sup>4</sup> )	Z dB/dt 6.125 millisecond time channel

Channel name	Units	Description
SFz[45]:	$\mu\text{V}/(\text{A}\cdot\text{m}^4)$	Z dB/dt 7.036 millisecond time channel
SFz[46]:	$\mu\text{V}/(\text{A}\cdot\text{m}^4)$	Z dB/dt 8.083 millisecond time channel
SFz[47]:	$\mu\text{V}/(\text{A}\cdot\text{m}^4)$	Z dB/dt 9.286 millisecond time channel
BFz	$(\mu\text{V}\cdot\text{ms})/(\text{A}\cdot\text{m}^4)$	Z B-Field data for time channels 14 to 47
NchanBF		Latest time channels of TAU calculation
NchanSF		Latest time channels of TAU calculation
TauBF	milliseconds	Time constant B-Field
TauSF	milliseconds	Time constant dB/dt
PLM		60 Hz power line monitor

Electromagnetic B-field and dB/dt Z component data is found in array channel format between indexes 14 – 45, and X component data from 20 – 45, as described above.

- Database of the VTEM Waveform “AA926\_waveform\_final.gdb” in Geosoft GDB format, containing the following channels:

Time: Sampling rate interval, 5.2083 microseconds  
Rx\_Volt: Output voltage of the receiver coil (Volt)  
Tx\_Current: Output current of the transmitter (Amp)

- Grids in Geosoft GRD format, as follows:

BFz\*\*: B-Field Z Component  
Mag3: Total Magnetic Intensity (nT)  
RTP: Reduced To Pole of TMI (nT)  
CVG\_RTP: Calculated Vertical Derivative of TMI (nT/m)  
TauBF: B-Field Calculated Time (ms)  
TauSF: dB/dt Calculated Time Constant (ms)  
SFxFF\*\*: Fraser Filter X Component dB/dt  
AS: Analytic Signal

A Geosoft .GRD file has a .GI metadata file associated with it, containing grid projection information. A grid cell size of 37.5 metres was used.

- Maps at 1:10,000 and 1:25,000 in Geosoft MAP format, as follows:

AA926\_scalek\_dBdtz\_bb: dB/dt profiles Z Component, Time Gates 0.220 – 7.036 ms in linear – logarithmic scale.  
AA926\_scalek\_Bfield\_bb: B-field profiles Z Component, Time Gates 0.220 – 7.036 ms in linear – logarithmic scale over total magnetic intensity.  
AA926\_scalek\_BFz\_bb: B-field late time Z Component color image.  
AA926\_scalek\_SFxFF\_bb: dB/dt early time X Component Fraser Filter color image.  
AA926\_scalek\_RTP\_bb: Reduced To Pole of TMI (RTP) color image.  
AA926\_scalek\_TauSF\_bb: dB/dt Calculated Time Constant (TAU) with contours of anomaly areas of the Calculated Vertical Derivative of TMI  
AA926\_scalek\_AS\_bb: Analytic Signal

Where *scalek* represents the scale for that block and *bb* represents the block name.

Maps are also presented in PDF format.

1:50,000 topographic vectors were taken from the NRCAN Geogratis database at;  
<http://geogratis.gc.ca/geogratis/en/index.html>.

- A Google Earth file *AA926\_FlightPath.kml* showing the flight path of the block is included. Free versions of Google Earth software from:  
<http://earth.google.com/download-earth.html>

## 6. CONCLUSIONS AND RECOMMENDATIONS

A helicopter-borne versatile time domain electromagnetic (VTEM plus) geophysical survey has been completed over the Daquilar, Moores and Warthill Blocks near Strathgordon, Tasmania,

The total area coverage for all properties is 135 km<sup>2</sup>. Total survey line coverage is 1014.6 line kilometres. The principal sensors included a Time Domain EM system and a magnetometer. Results have been presented as stacked profiles, and contour color images at a scale of 1:10,000 & 1:25,000.

### **Daquilar Block**

The total area coverage is 59km<sup>2</sup>. Total survey line coverage is 438.8 line kilometres.

Based on the geophysical results obtained, the area has several conductive zones. Some of these zones are considered as sub-horizontal lithological conductors, some as steeply dipping structural conductors, and some as local targets (*reference in Appendix C: L10020, L10840 10400 RDI*).

If the conductors correspond to an exploration model on the area it is recommended picking anomalies with conductance grading and center localization of the targets, detail resistivity depth imaging and plate Maxwell modelling for some of the anomalies prior to ground follow up and drill testing are recommended.

### **WartHill Block**

The total area coverage is 58 km<sup>2</sup>. Total survey line coverage is 429.7 line kilometres.

Based on the geophysical results obtained, the area has several conductive zones which are considered as gently to steeply dipping structural conductors mostly along the S-N oriented dyke similar magnetic anomalies.

Conductive zone in the SW corner of the block is a linear conductive structure of about 1800m length. The structure is gently dipping to the west, and according to detail resistivity depth section, the top of the EM response is near surface (*reference in Appendix C: L20130 RDI*).

The resistivity depth section for L20520 (*reference in Appendix C: L20520 RDI*) represents a long structural conductor in the centre of the block.

On the northern part of the block there is a broad but linear conductive zone oriented N-S as well. conductive structure is about 5km long and associated with the magnetic anomaly (*reference in Appendix C: L21250 RDI*).

### **Moores Block**

The total area coverage is 18 km<sup>2</sup>. Total survey line coverage is 146.1 line kilometres.

Based on the geophysical results obtained, the area consists of conductive zones which are considered as sub-horizontal lithological conductors. Some of them are gently dipping layer-similar conductors (North-East zone), some can be considered as an alteration zone (central part of the block). The local anomaly in the center of the block is crossed by one line (L30150) and must be checked if the anomaly is from man-made source.

(reference in Appendix C: L30150, L30260 & L30350 RDI).

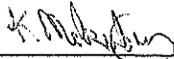
Respectfully submitted<sup>5</sup>,



Alexander Prihodko, P. Geo.  
**Geotech Ltd.**



Peter Holbrook.  
**Geotech Airborne Pty Ltd.**



Keeme Mokubung  
**Geotech Ltd.**

April 2012

<sup>5</sup>Final data processing of the EM and magnetic data were carried out by Keeme Mokubung, from the office of Geotech Ltd. in Aurora, Ontario, under the supervision of Alexander Prihodko, P. Geo., PhD, Senior Geophysicist, VTEM Interpretation Supervisor.

# APPENDIX A

## SURVEY BLOCK LOCATION MAP



**Survey Overview of the Blocks**

## APPENDIX B

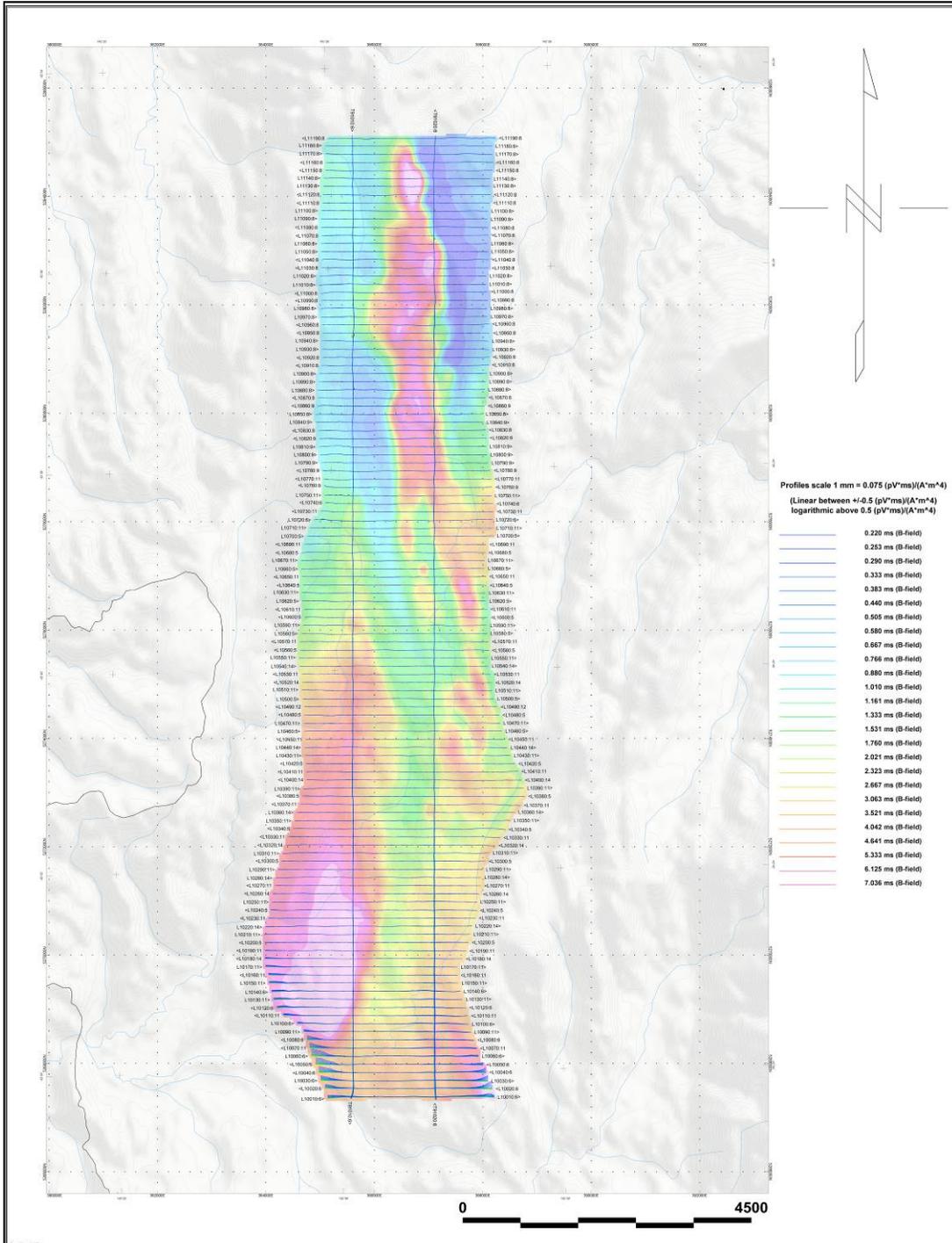
### SURVEY BLOCK COORDINATES

Easting UTM55S	Northing UTM55S
<b>AA926-Daguilar</b>	
385849.2	5267384
387506.5	5267384
387331.2	5268343
387404.2	5269600
387623.3	5270023
387813.2	5270666
387988.4	5271733
388704.2	5272872
388748	5273018
388368.2	5273939
388046.7	5275268
387783.7	5277708
388163.5	5277708
388017.4	5278672
387608.4	5279928
387798.2	5281199
387520.6	5282938
387285.2	5283466
386981.5	5284786
386829.7	5285101
386432.6	5285078
385731.9	5283256
385451.7	5282415
385183.2	5277778
385101.5	5275349
385195	5273270
384412.6	5270420
384412.7	5269848
<b>AA926-Moores</b>	
382344.1	5257166
382299.2	5257795
382859.7	5260691
383793.9	5262607
384401.2	5262607
384424.6	5261392
385872.7	5260528
386316.5	5259734
386316.5	5259080
385264.9	5257166
382344.1	5257166

<b>AA926-WartHill</b>	
377074.8	5253355
376787	5254852
376763.5	5259850
377464.1	5263588
378421.7	5265223
378912.2	5265223
379262.6	5264265
378491.8	5262537
378678.9	5258028
378585.5	5256907
378982.6	5255249
378932.3	5254166
378859	5253369
379326.4	5253369
379326.5	5252361
380305.2	5252347
380305.3	5250360
381327.8	5250360
381327.9	5249352
380349.1	5249352
380320	5248340
379312	5248340
379297.5	5246342
378085	5246342
378106.7	5253355

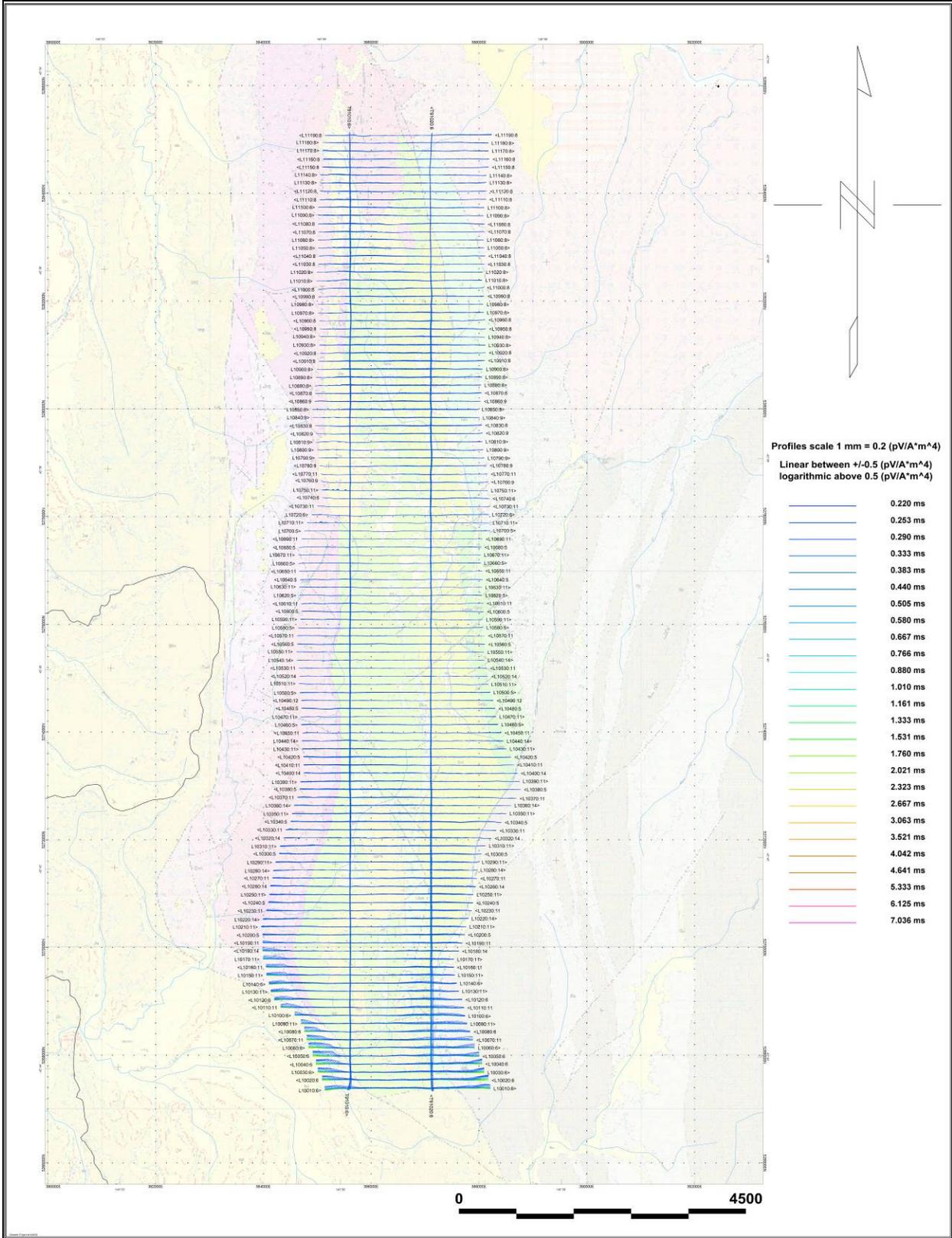
# APPENDIX C

## GEOPHYSICAL MAPS<sup>1</sup>

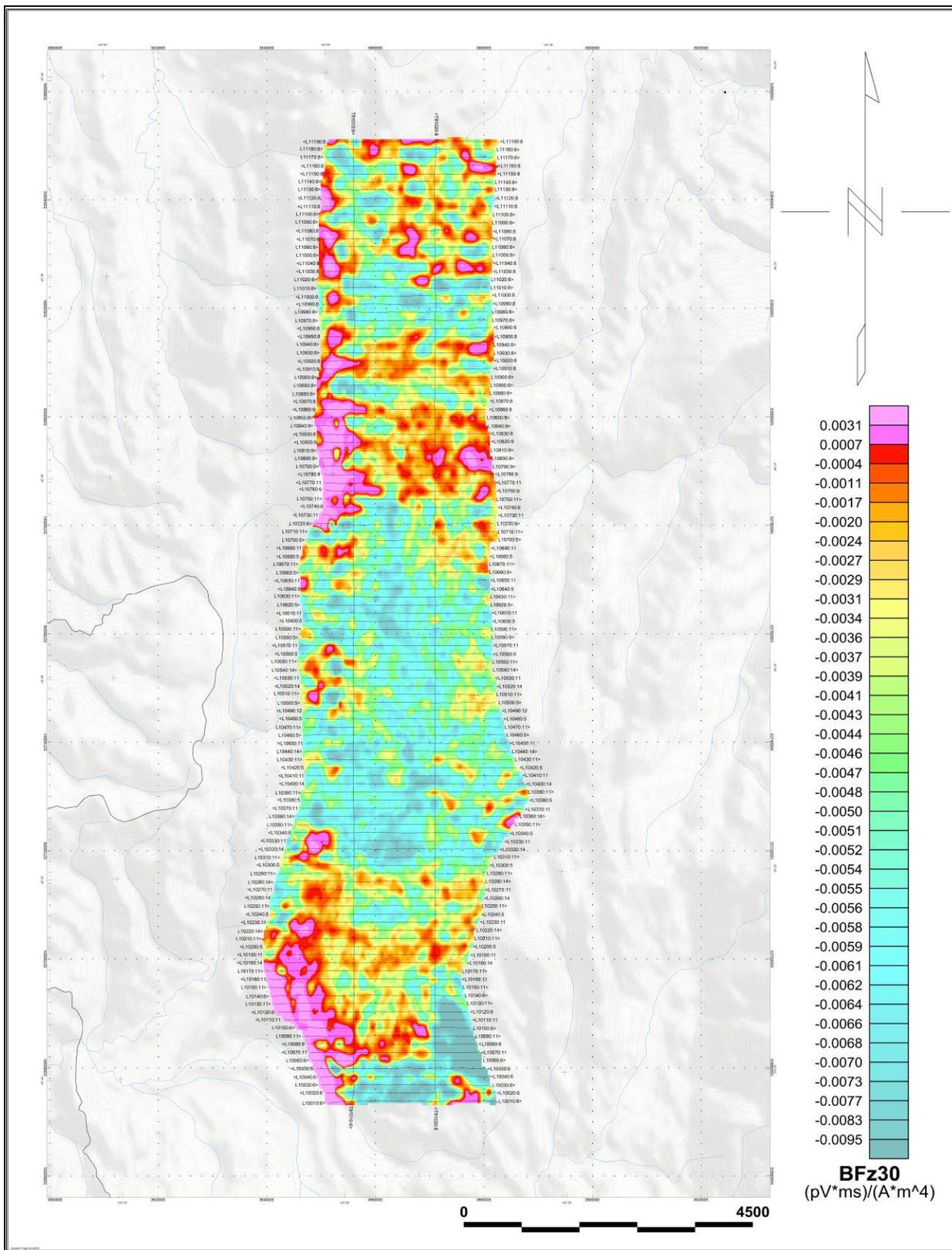


Daguilar Block - VTEM B-Field Z Component Profiles, Time Gates 0.220 to 7.036 ms

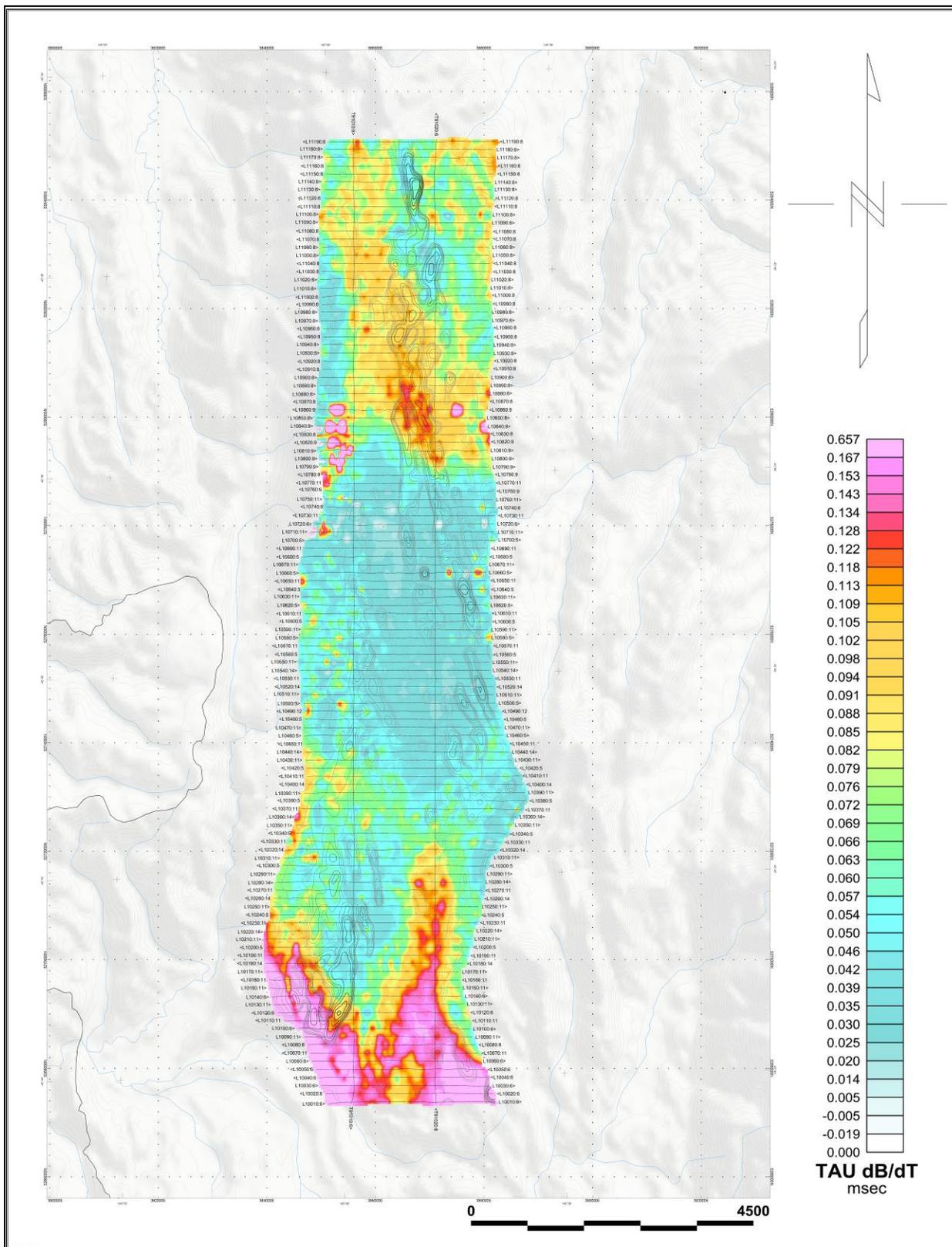
<sup>1</sup> Full size geophysical maps are also available in PDF format on the final DVD



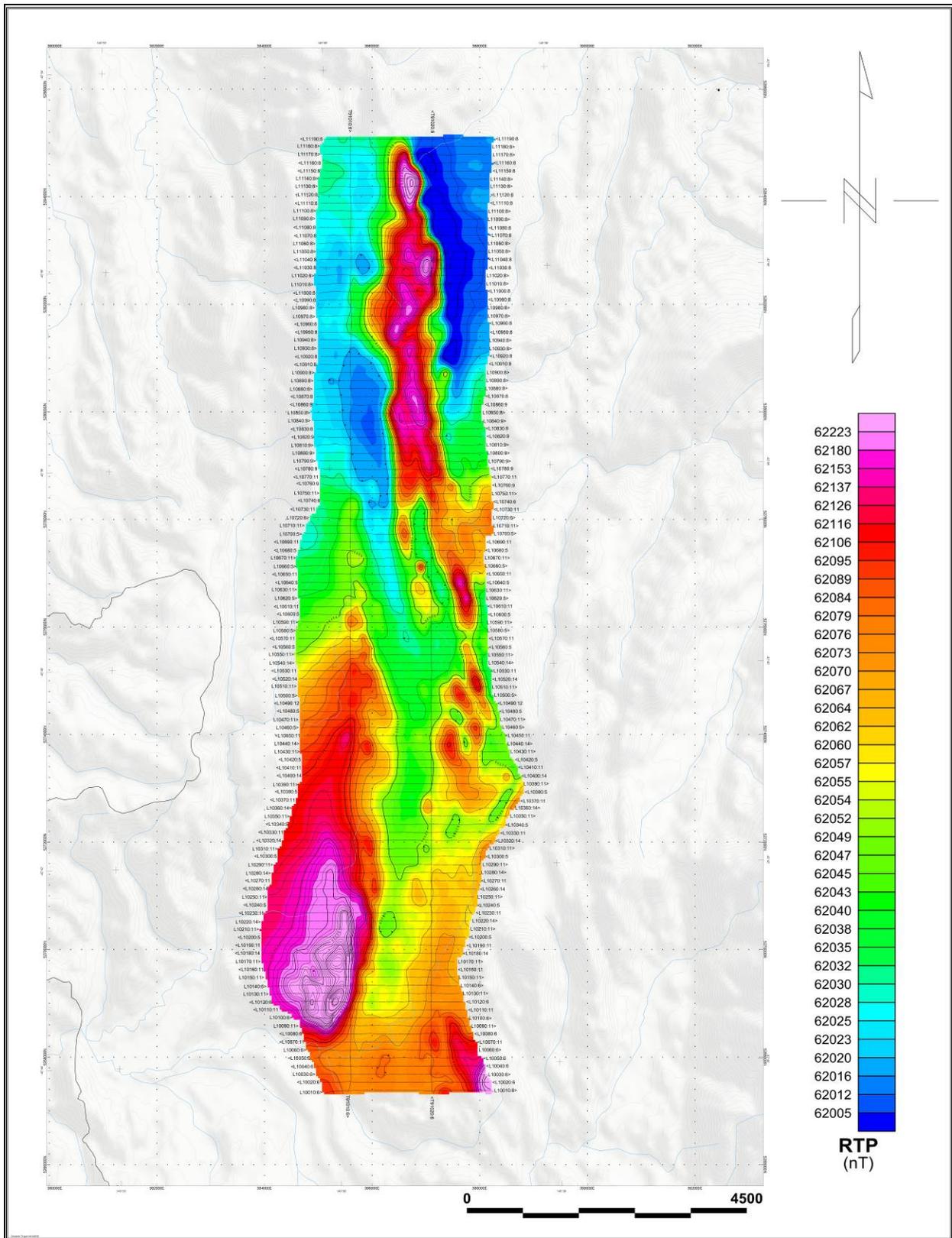
**Daguiar Block - VTEM dB/dt Z Component Profiles, Time Gates 0.220 to 7.036 ms**



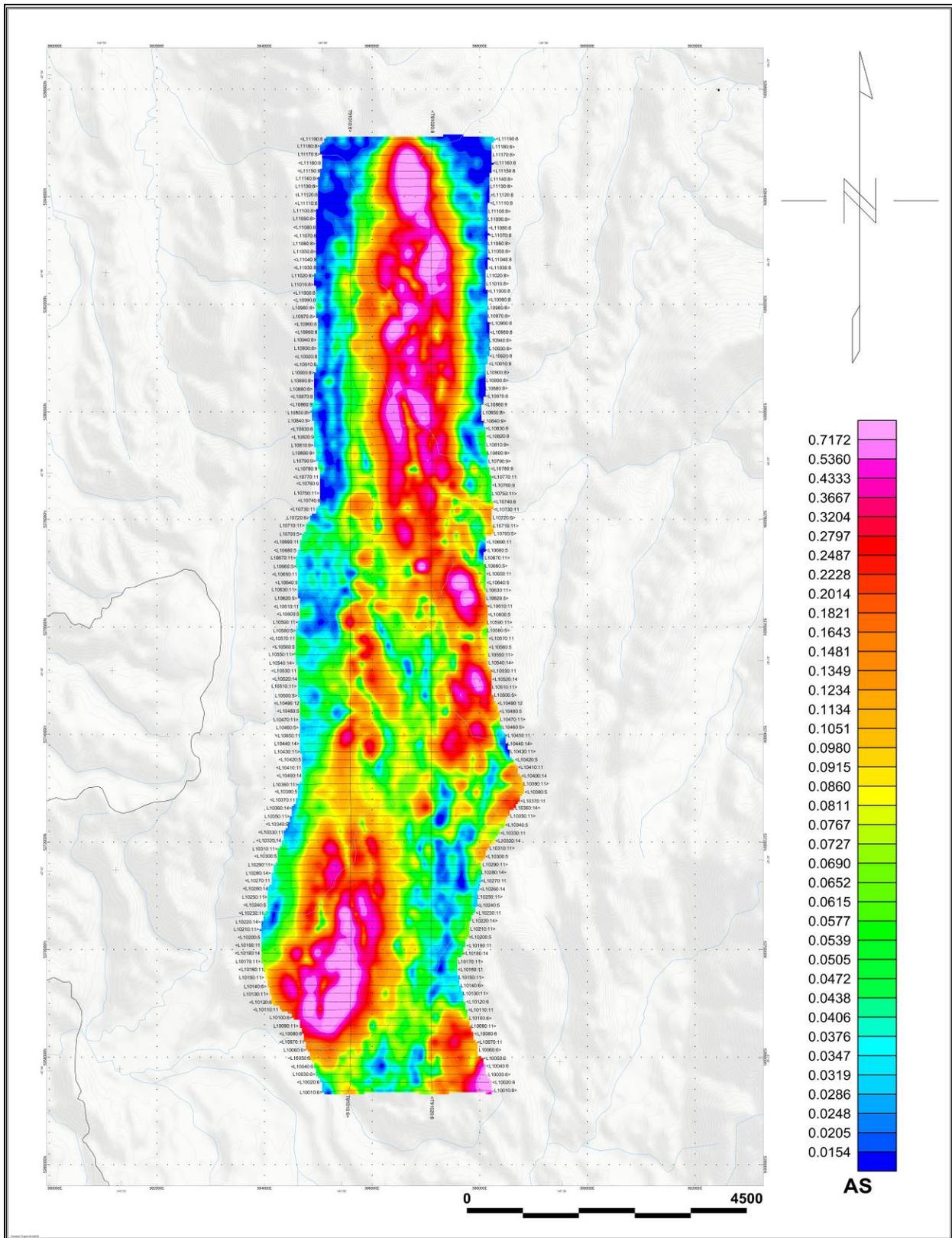
**Daguiar Block - VTEM B-Field Z Component Channel 30, Time Gate 0.880 ms**



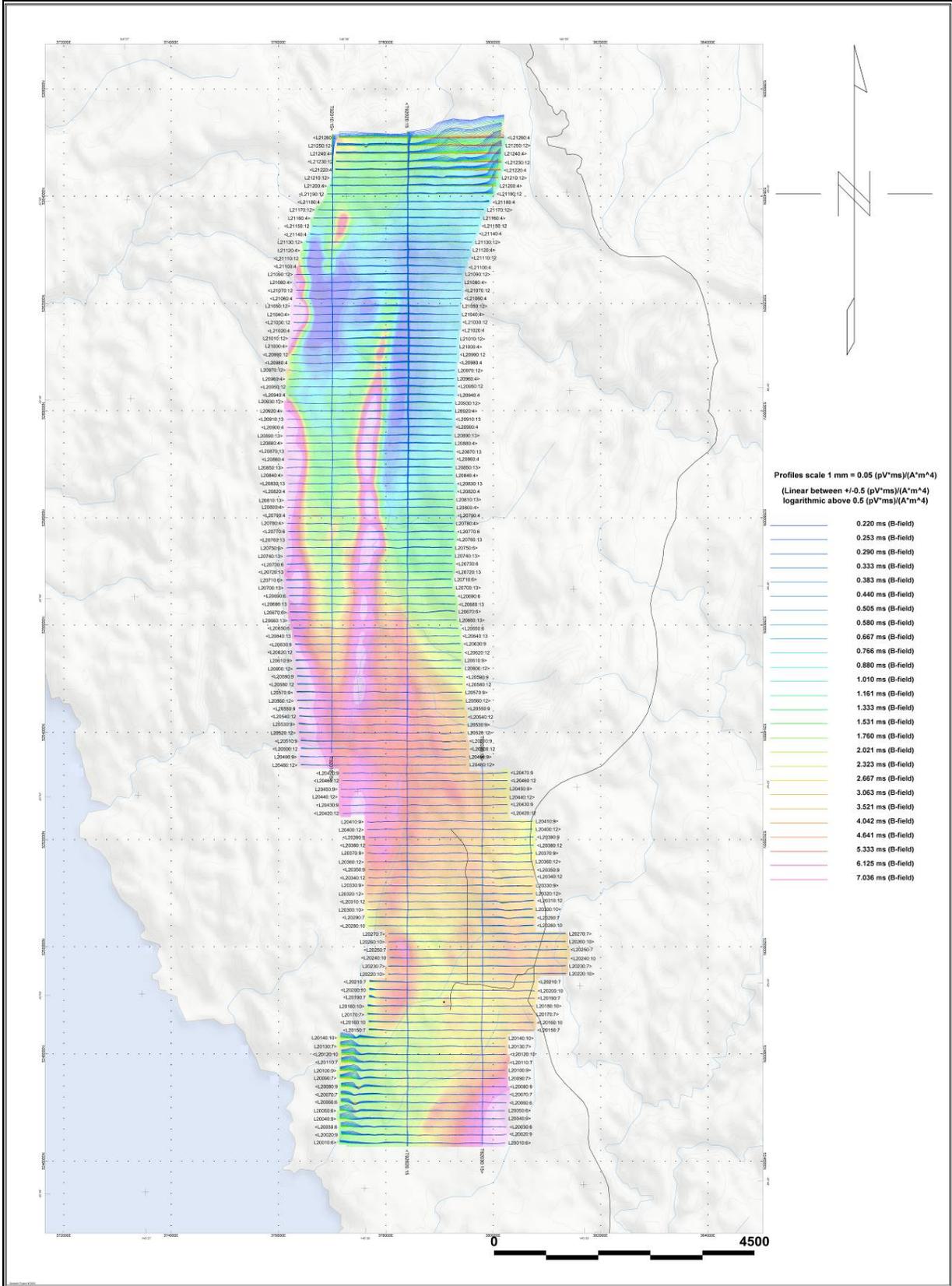
**Dagular Block - dB/dt Calculated Time Constant (Tau) with contours of anomaly areas of the Calculated Vertical Derivative of TMI**



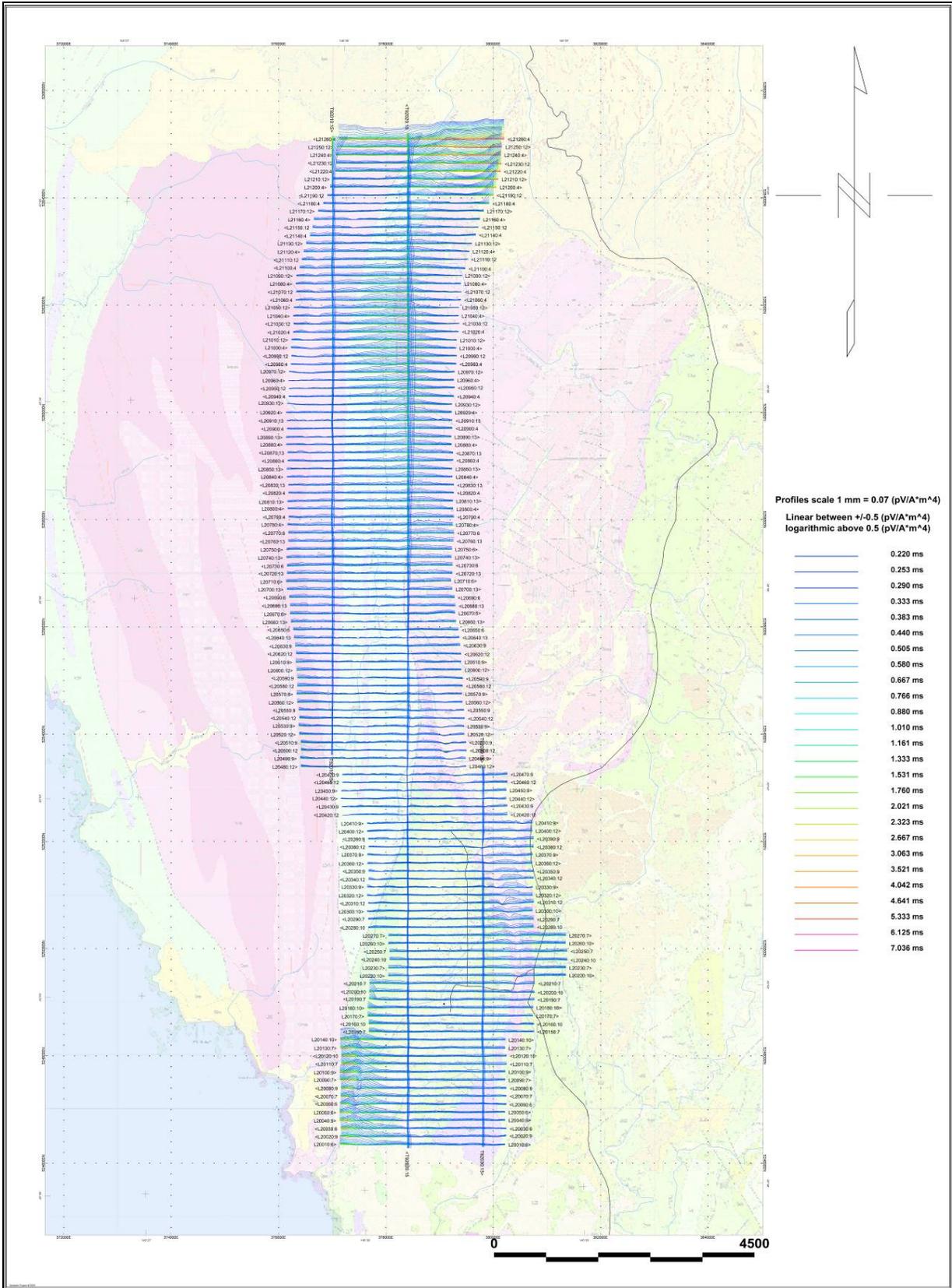
**Dagualar Block - Reduced to Pole of TMI (RTP)**



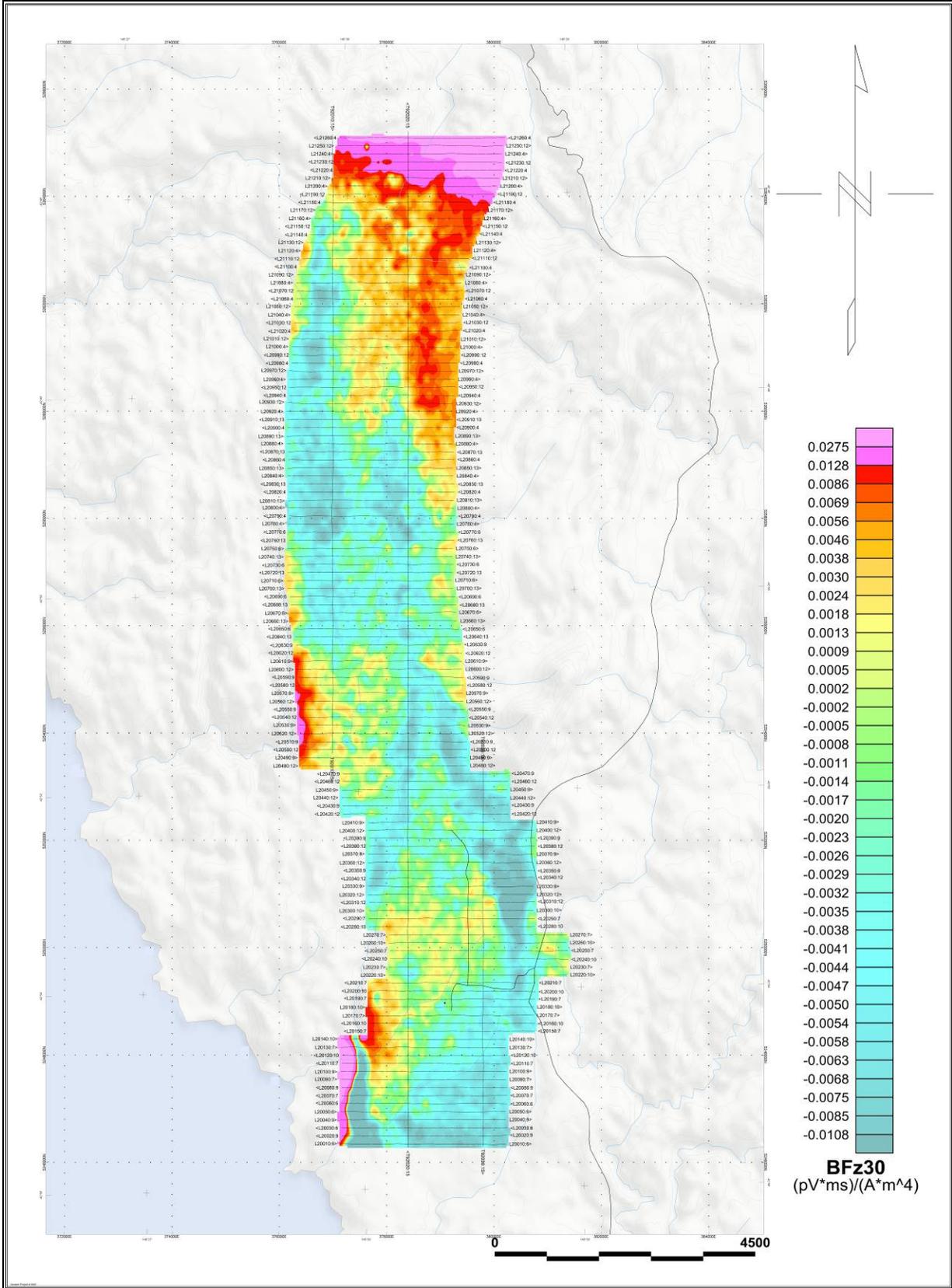
Daguiar Block – Analytic Signal (AS)

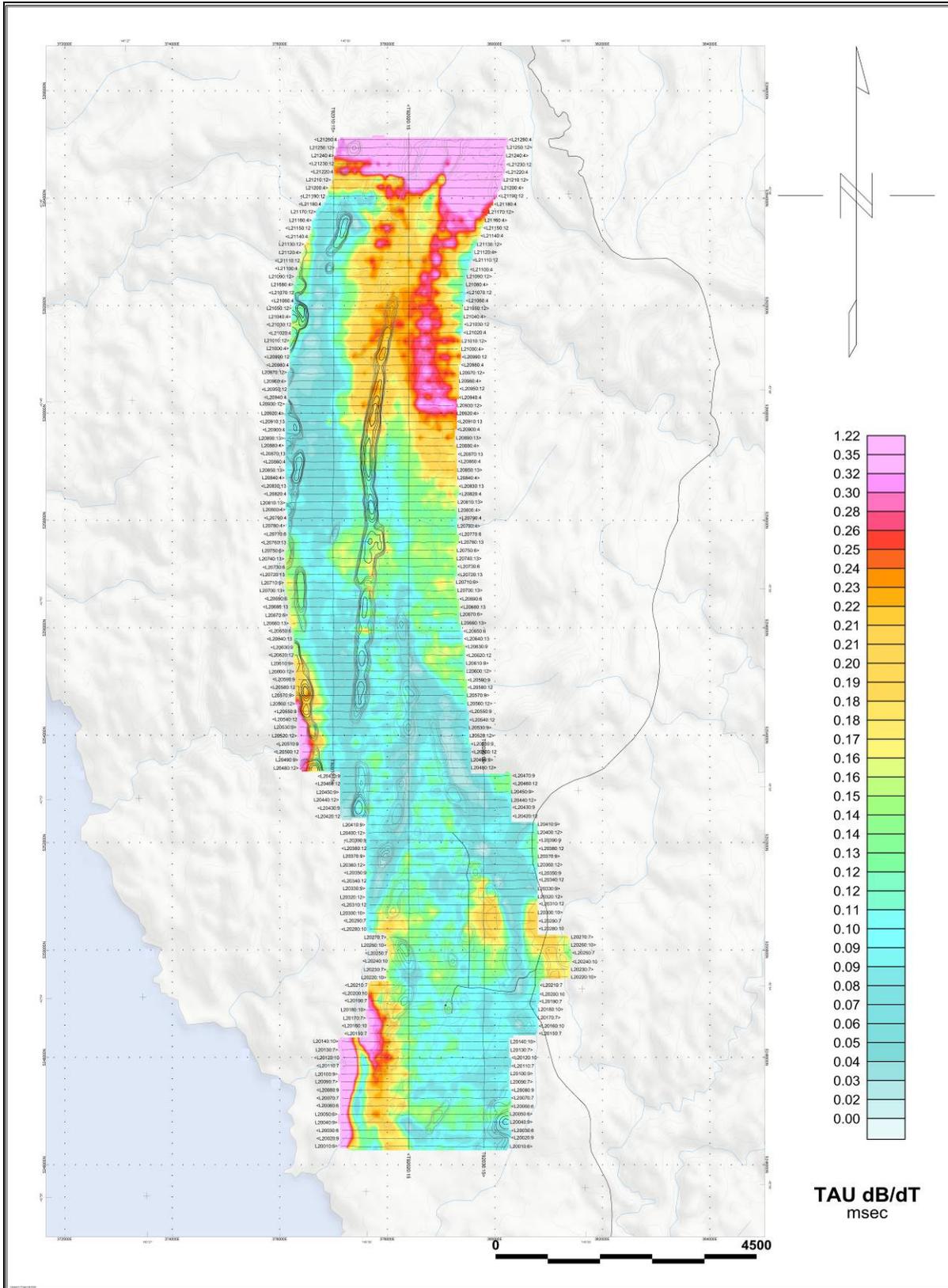


**Wart Hill Block - VTEM B-Field Z Component Profiles, Time Gates 0.220 to 7.036 ms**

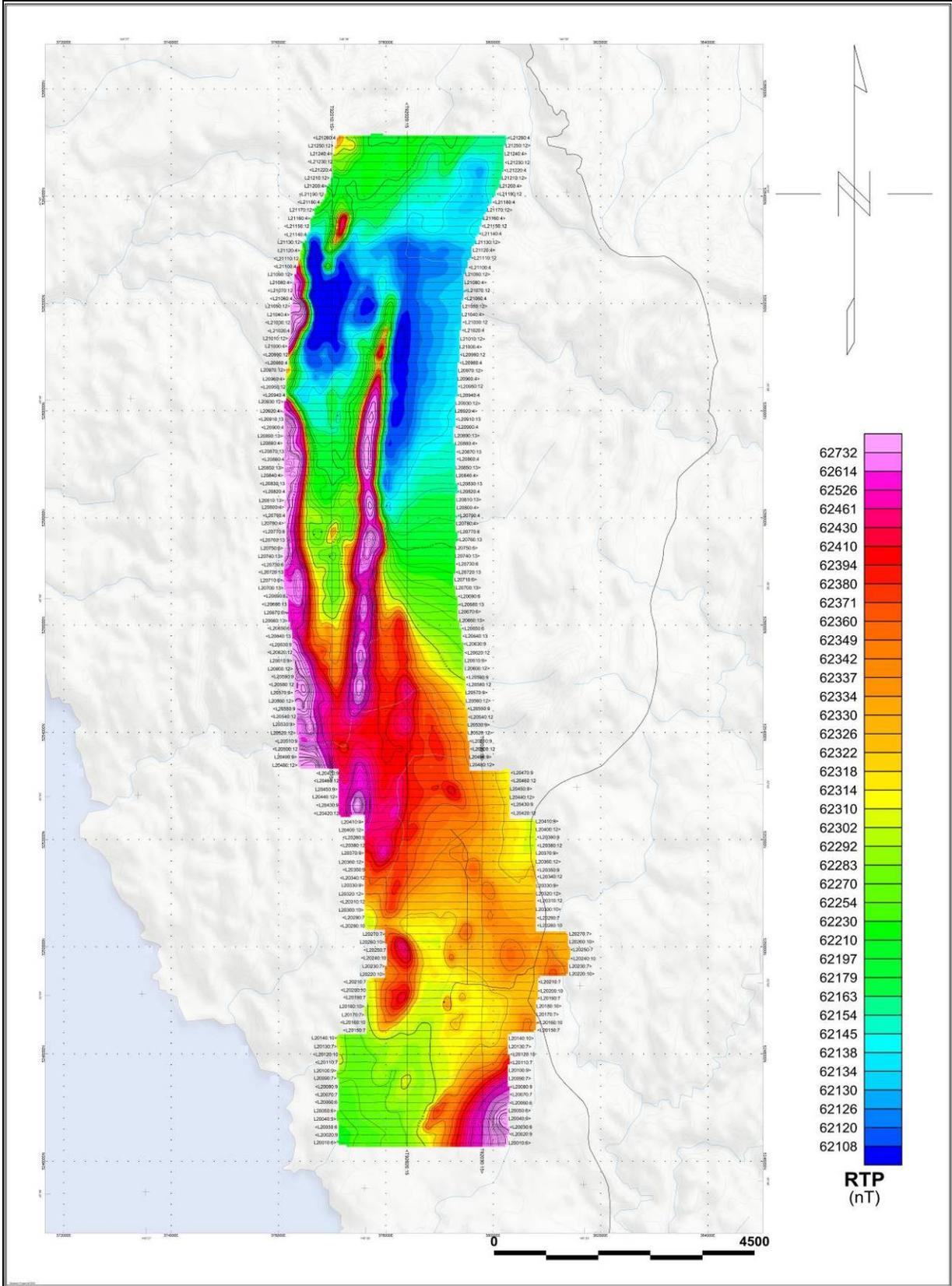


WartHill Block - VTEM dB/dt Z Component Profiles, Time Gates 0.220 to 7.036 ms

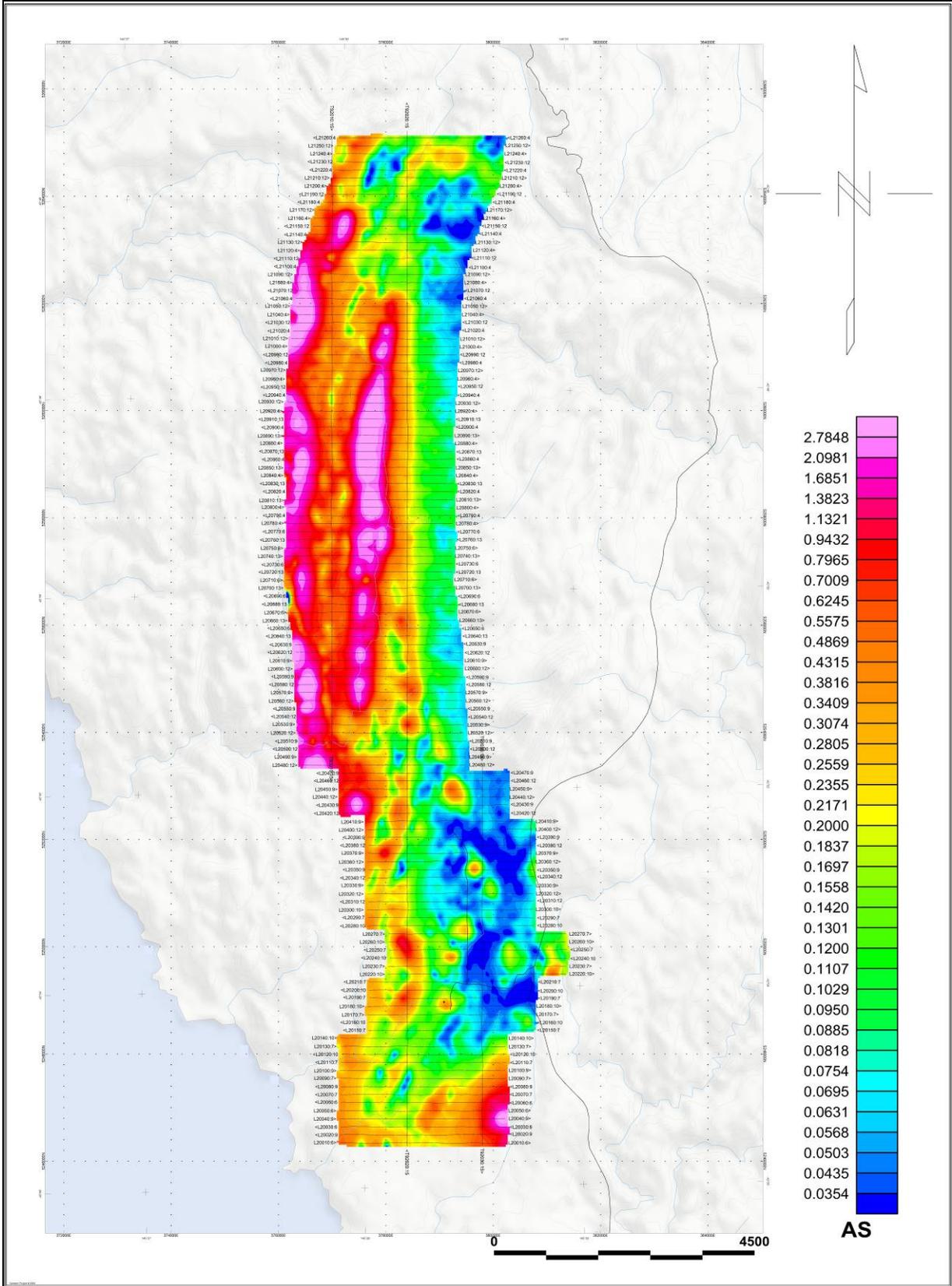




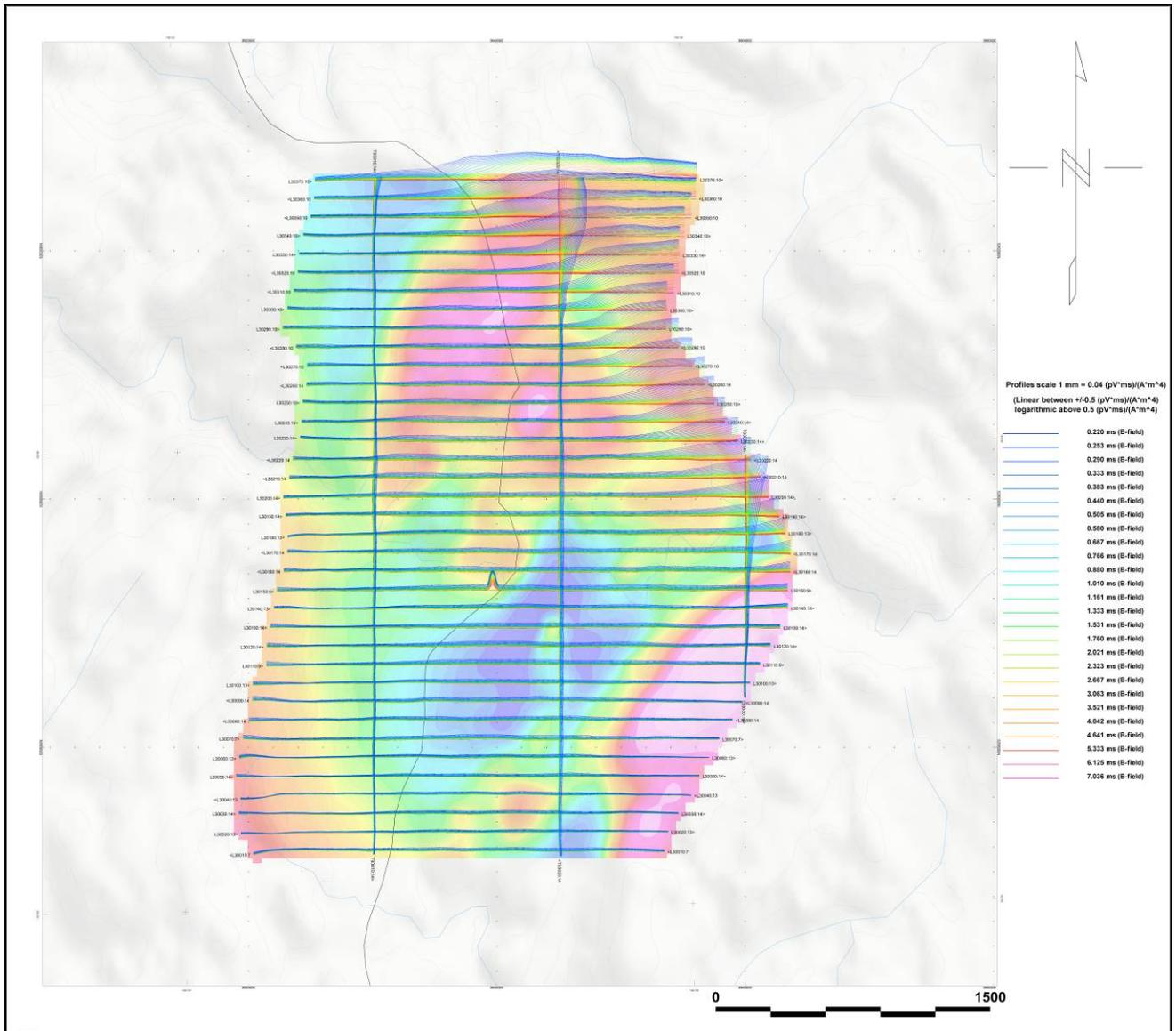
**Warthill Block - dB/dt Calculated Time Constant (Tau) with contours of anomaly areas of the Calculated Vertical Derivative of TMI**



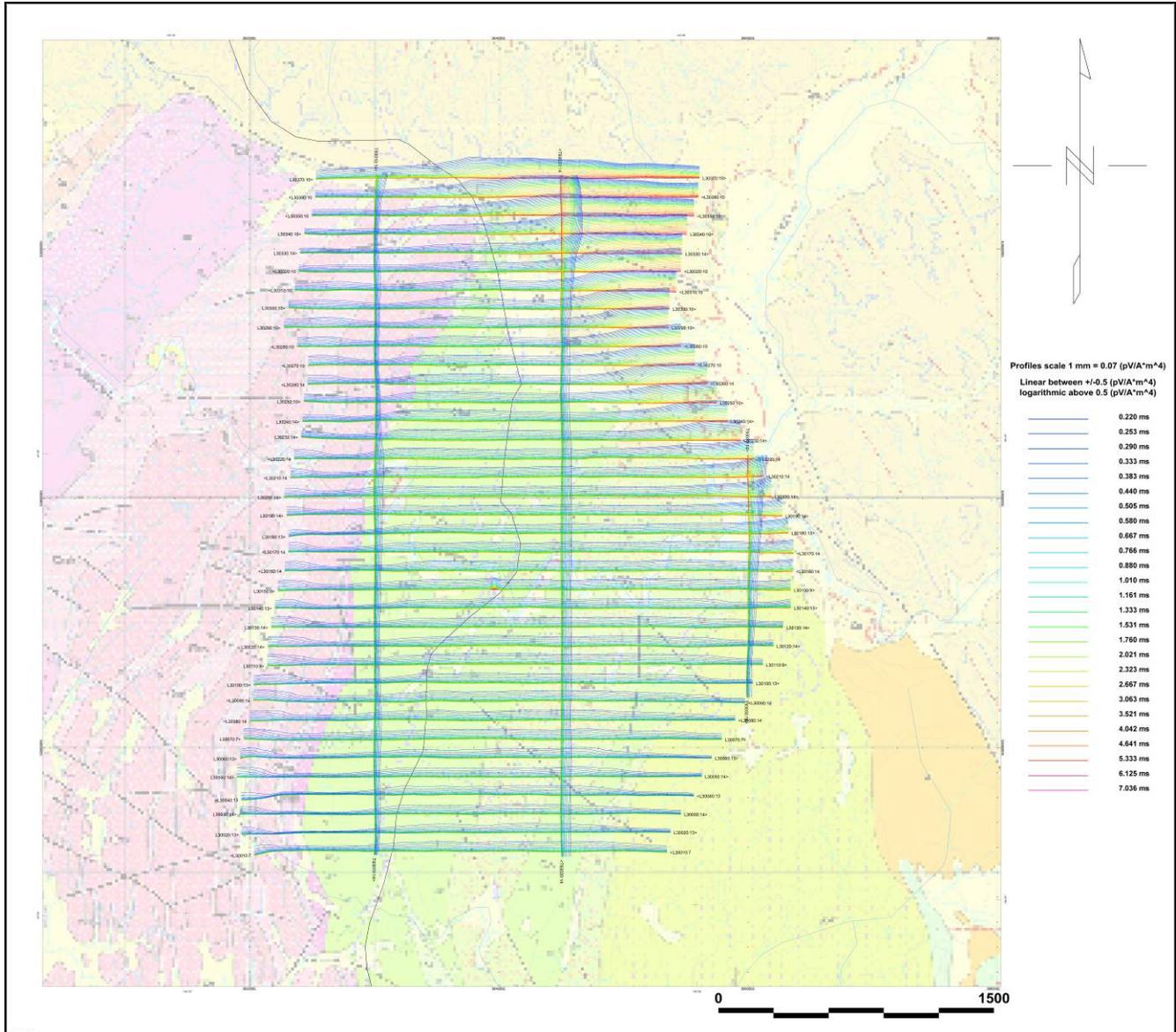
Wart Hill Block - Reduced to Pole of TMI (RTP)



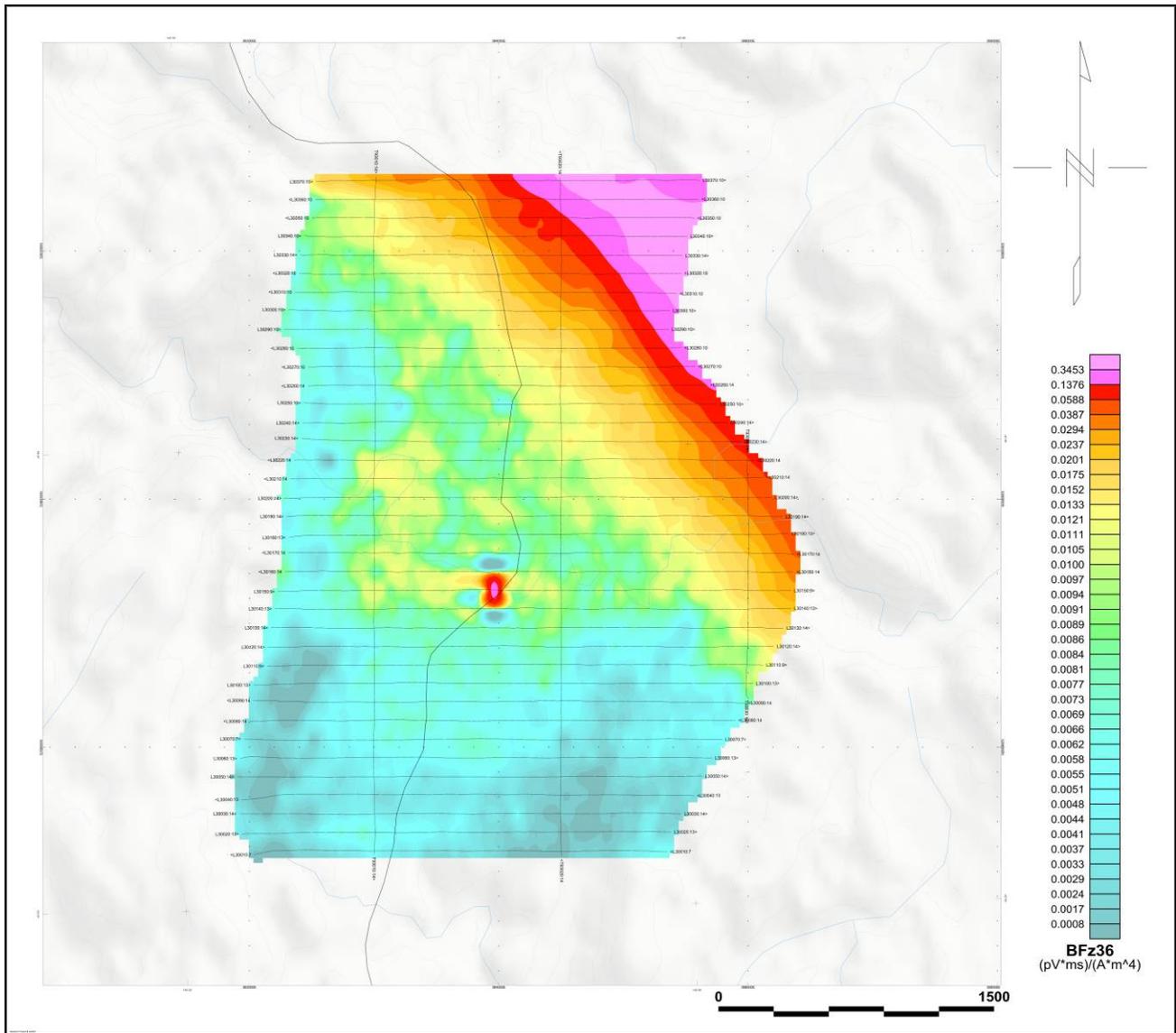
**Wart Hill Block – Analytic Signal (AS)**



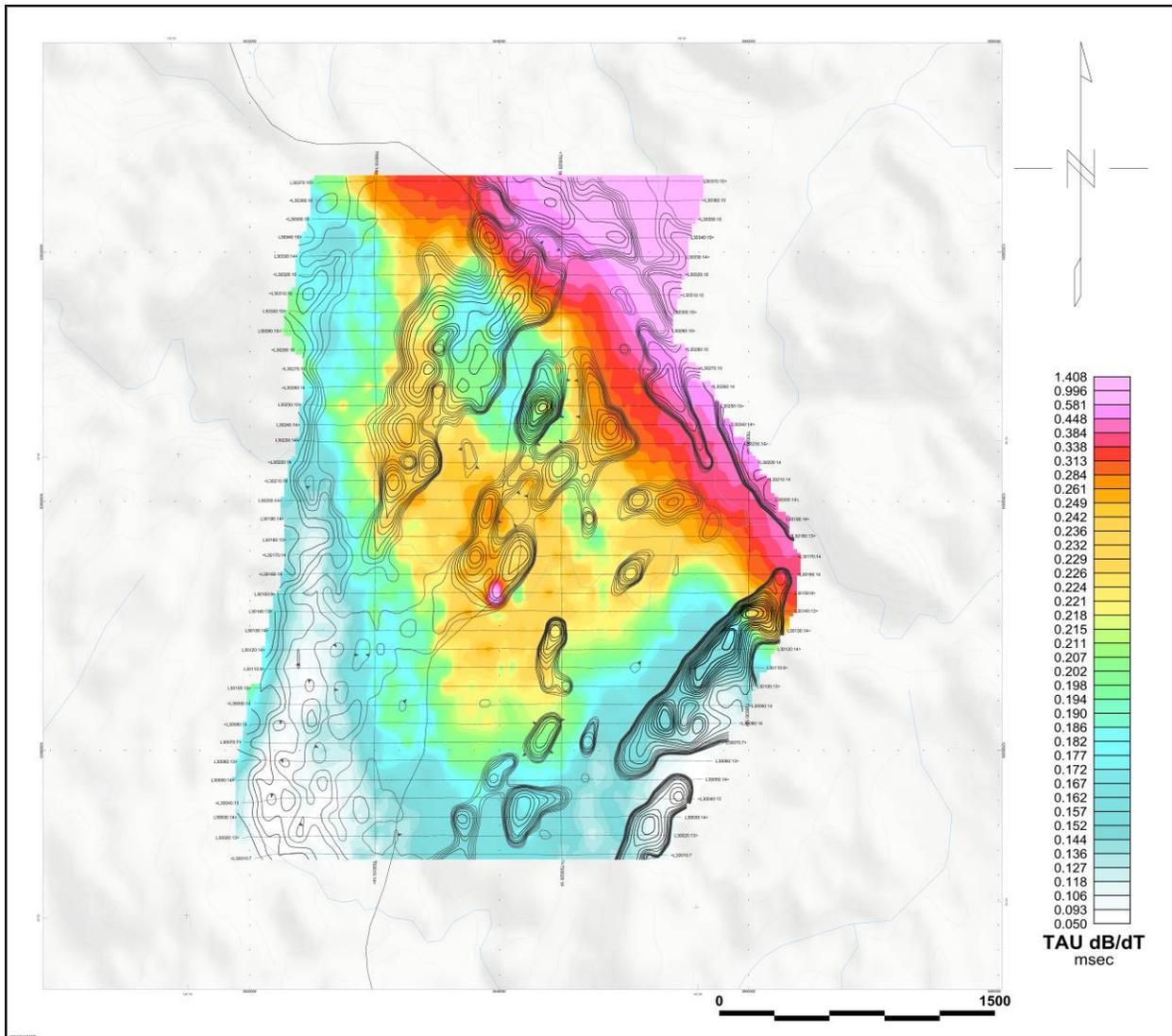
**Moores Block - VTEM B-Field Z Component Profiles, Time Gates 0.220 to 7.036 ms**



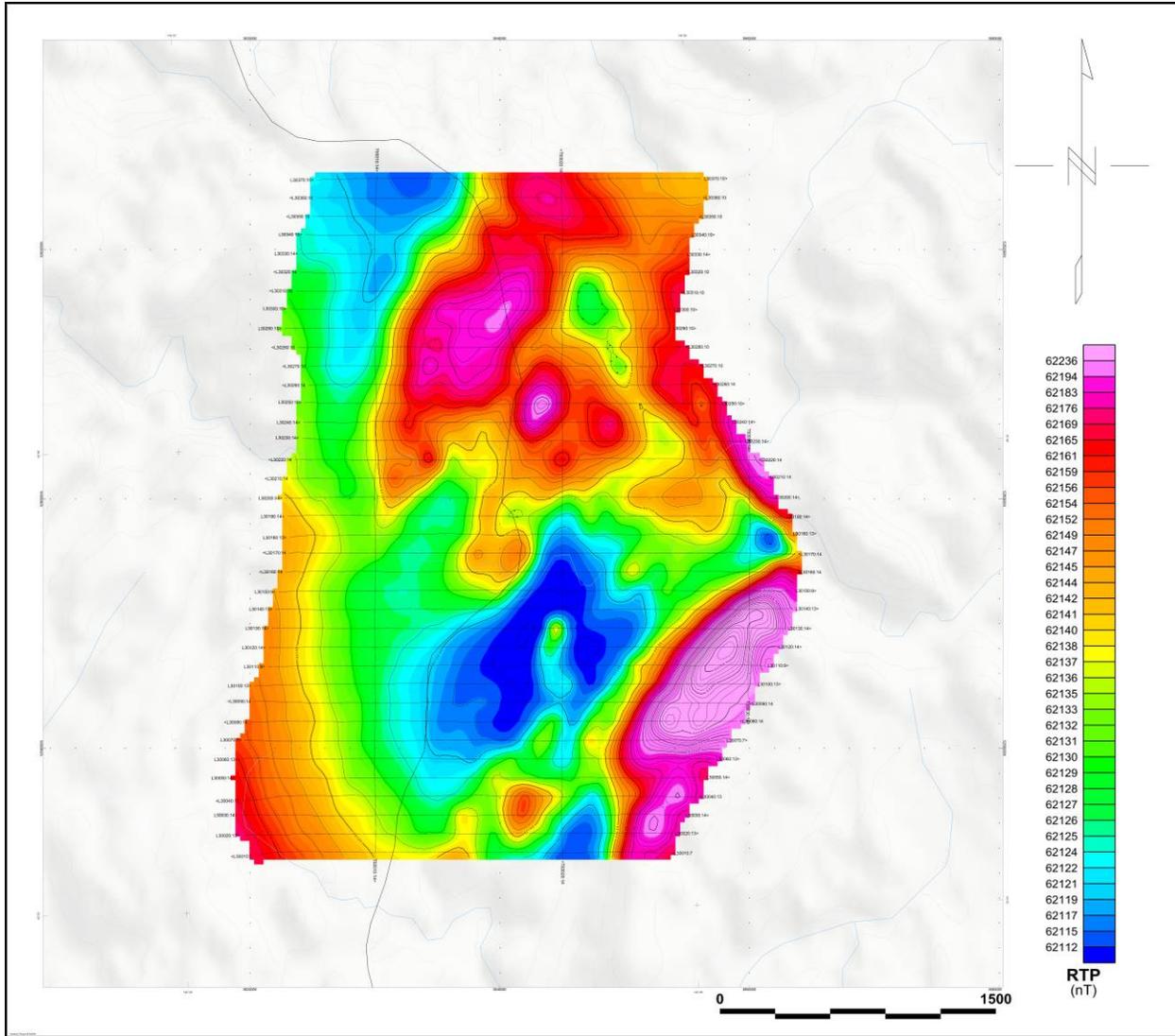
**Moores Block - VTEM dB/dt Z Component Profiles, Time Gates 0.220 to 7.036 ms**



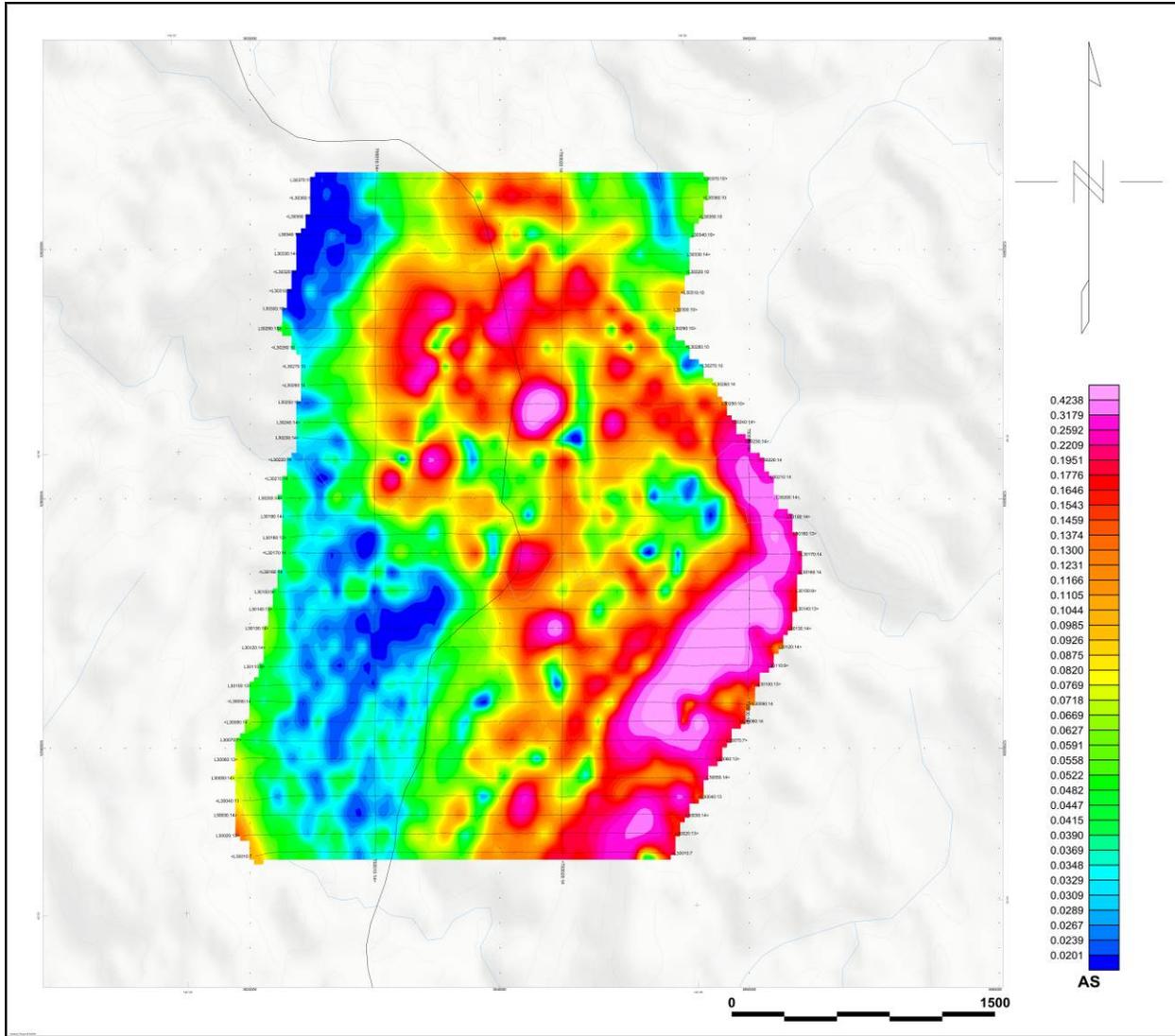
Moore's Block - VTEM B-Field Z Component Channel 36, Time Gate 2.021 ms



**Moores Block - dB/dT Calculated Time Constant (Tau) with contours of anomaly areas of the Calculated Vertical Derivative of TMI**



**Moores Block - Reduced to Pole of TMI (RTP)**

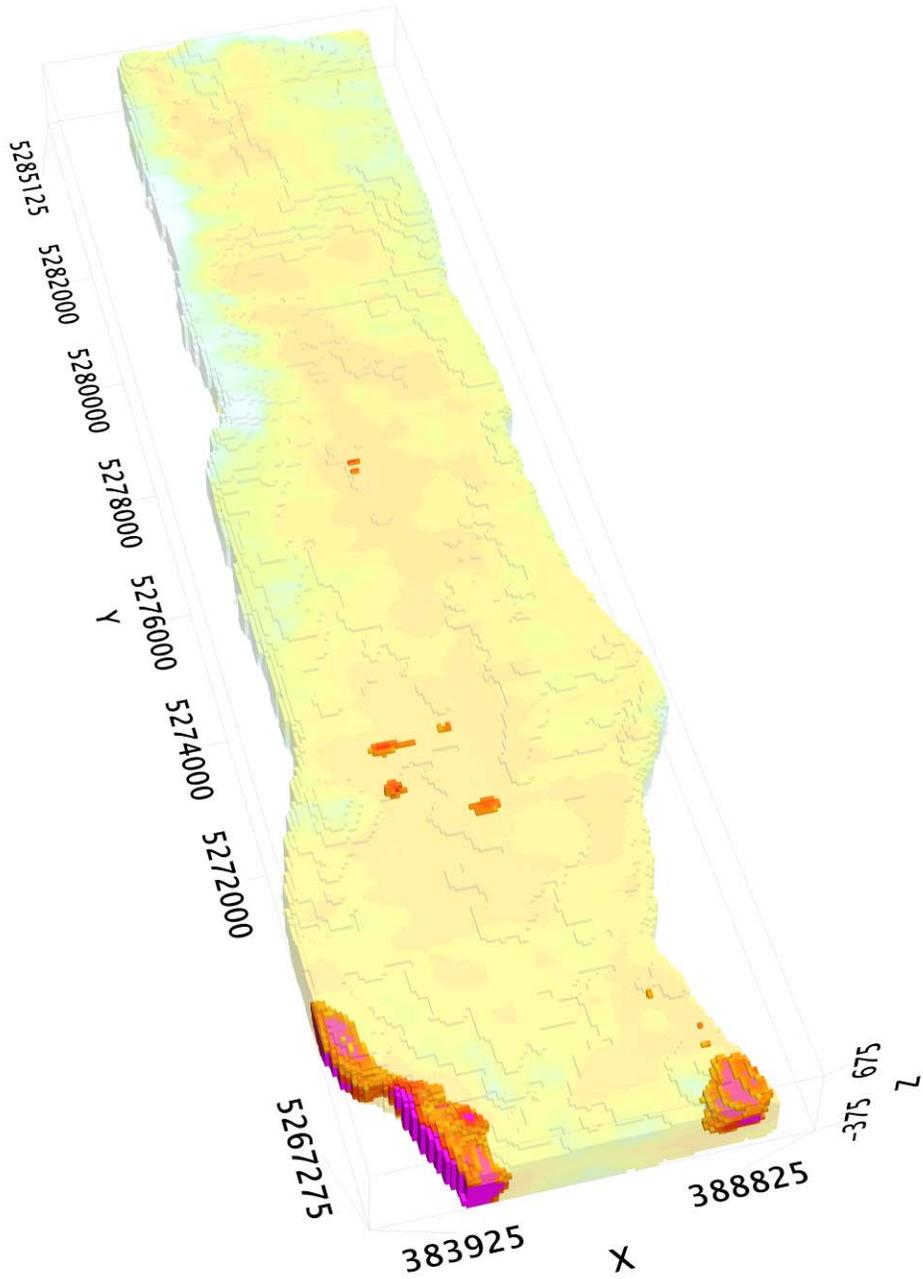


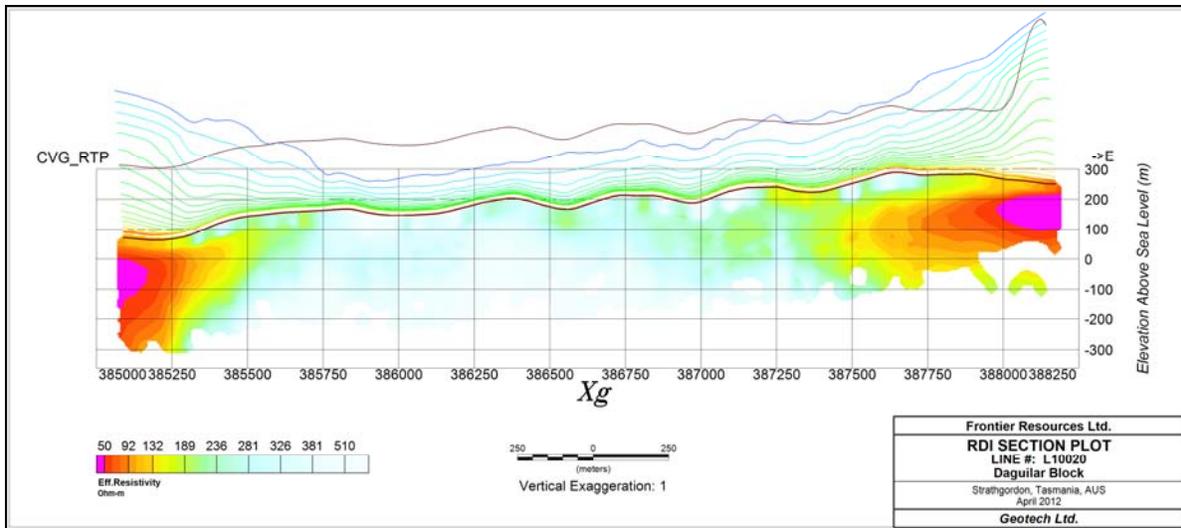
**Moores Block - Analytic Signal (AS)**

# RESISTIVITY DEPTH IMAGE (RDI) MAPS

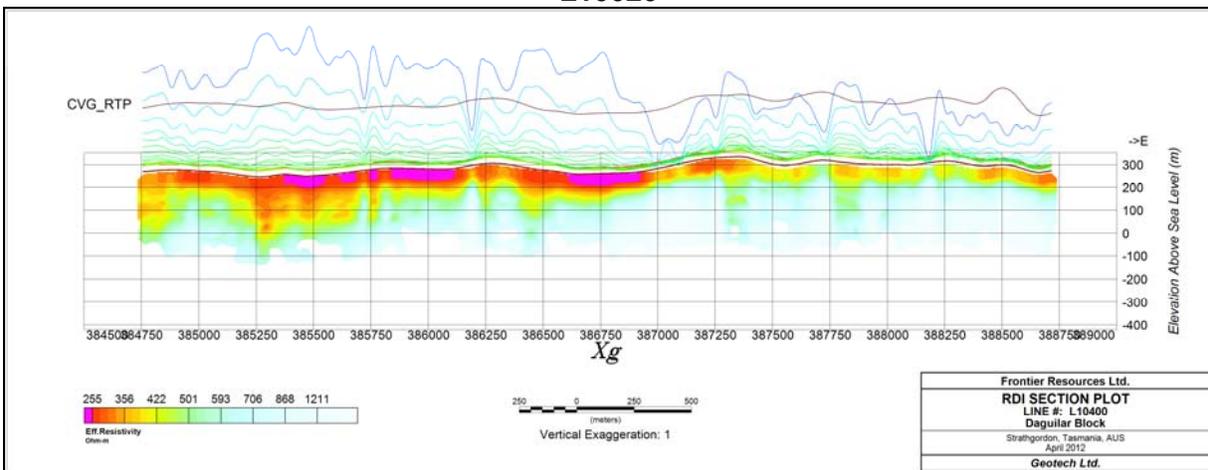
## 3D Resistivity Depth Images (RDI) (Daguilar)

### AA926\_Frontier\_Daguilar\_RDI\_Apparent\_Resistivity

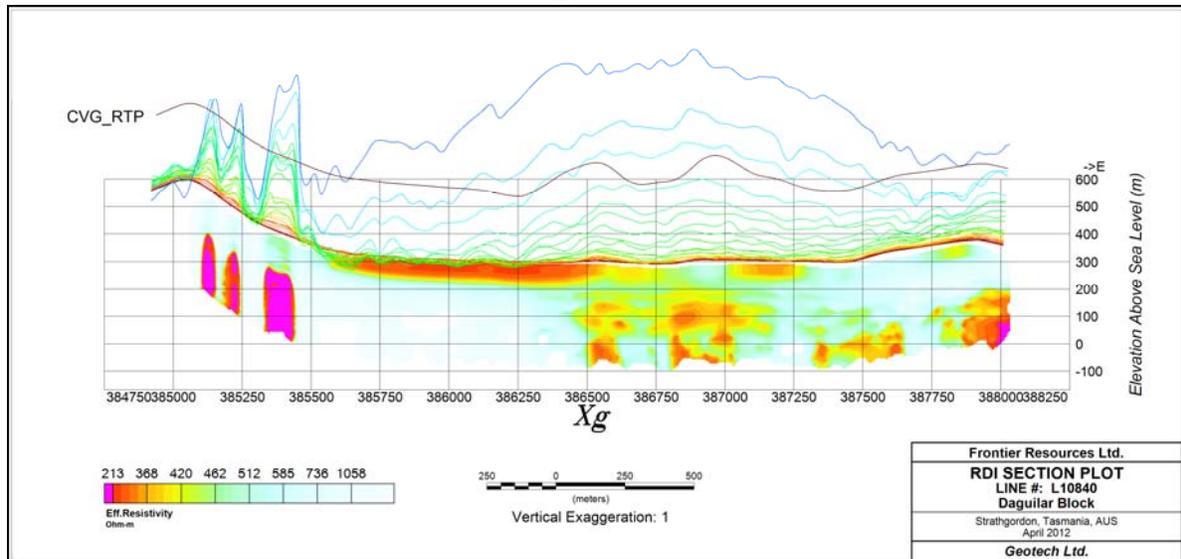




**L10020**



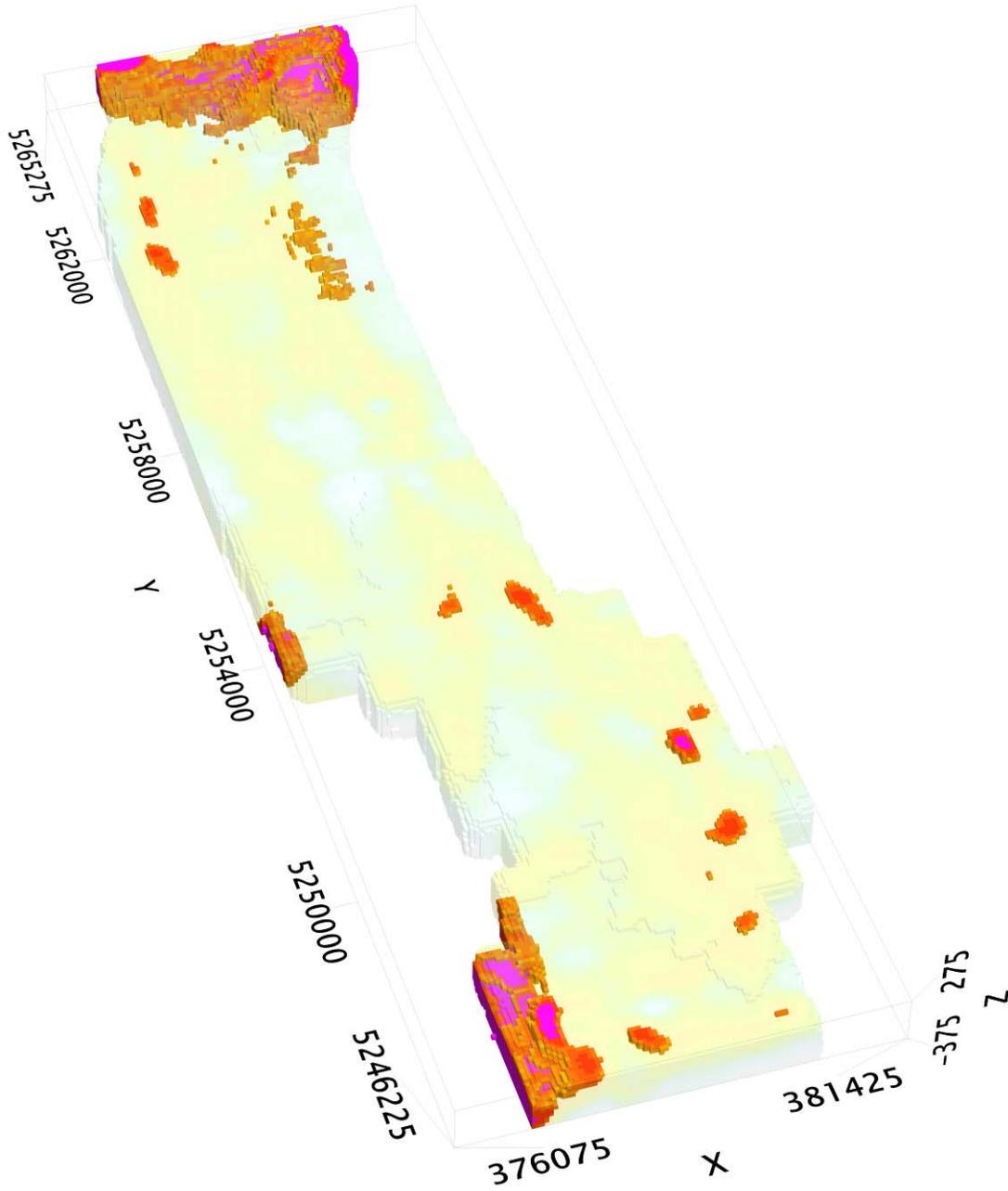
**L10400**

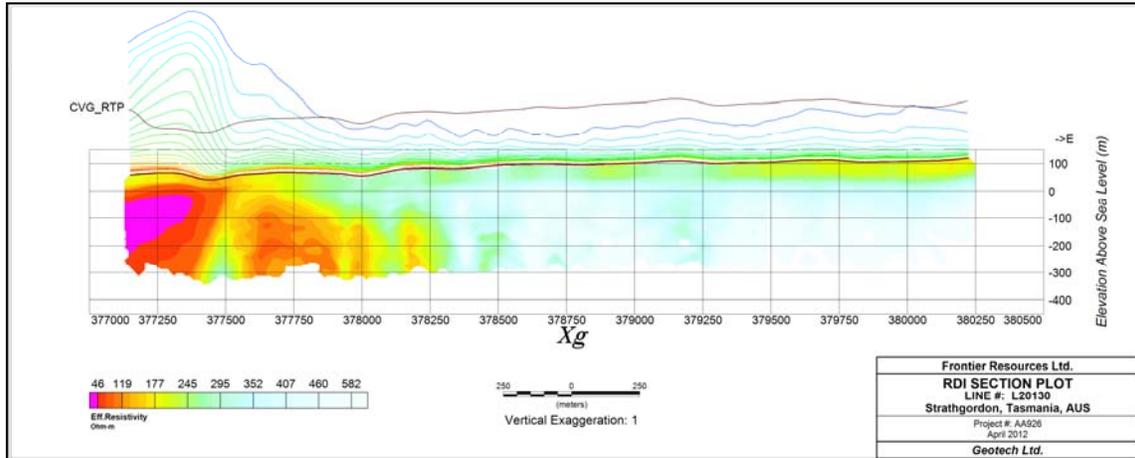


**L10840**

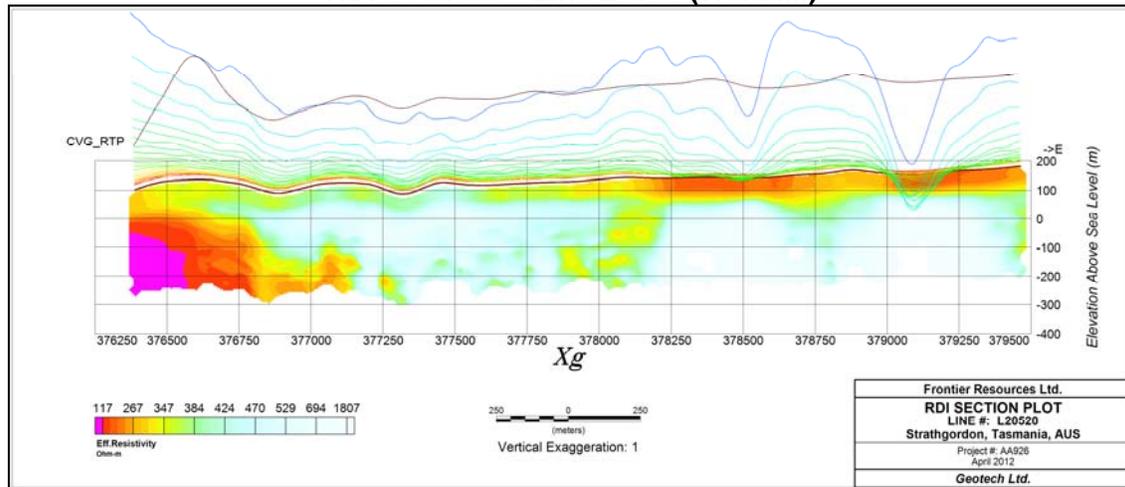
### 3D Resistivity Depth Images (RDI) (WartHill)

AA926\_Frontier\_WartHill\_RDI\_Apparent\_Resistivity

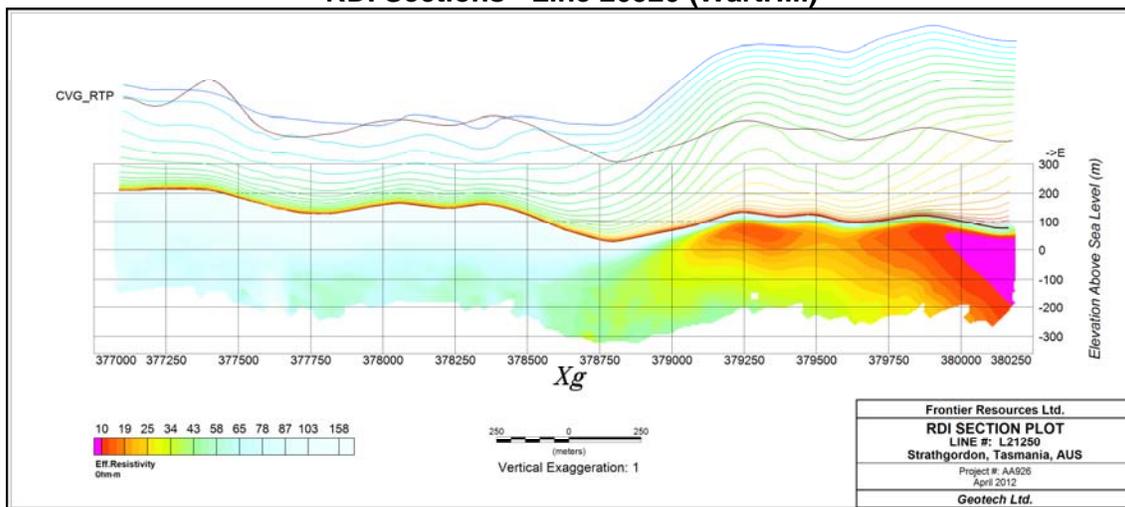




**RDI Sections - Line 20130 (WartHill)**



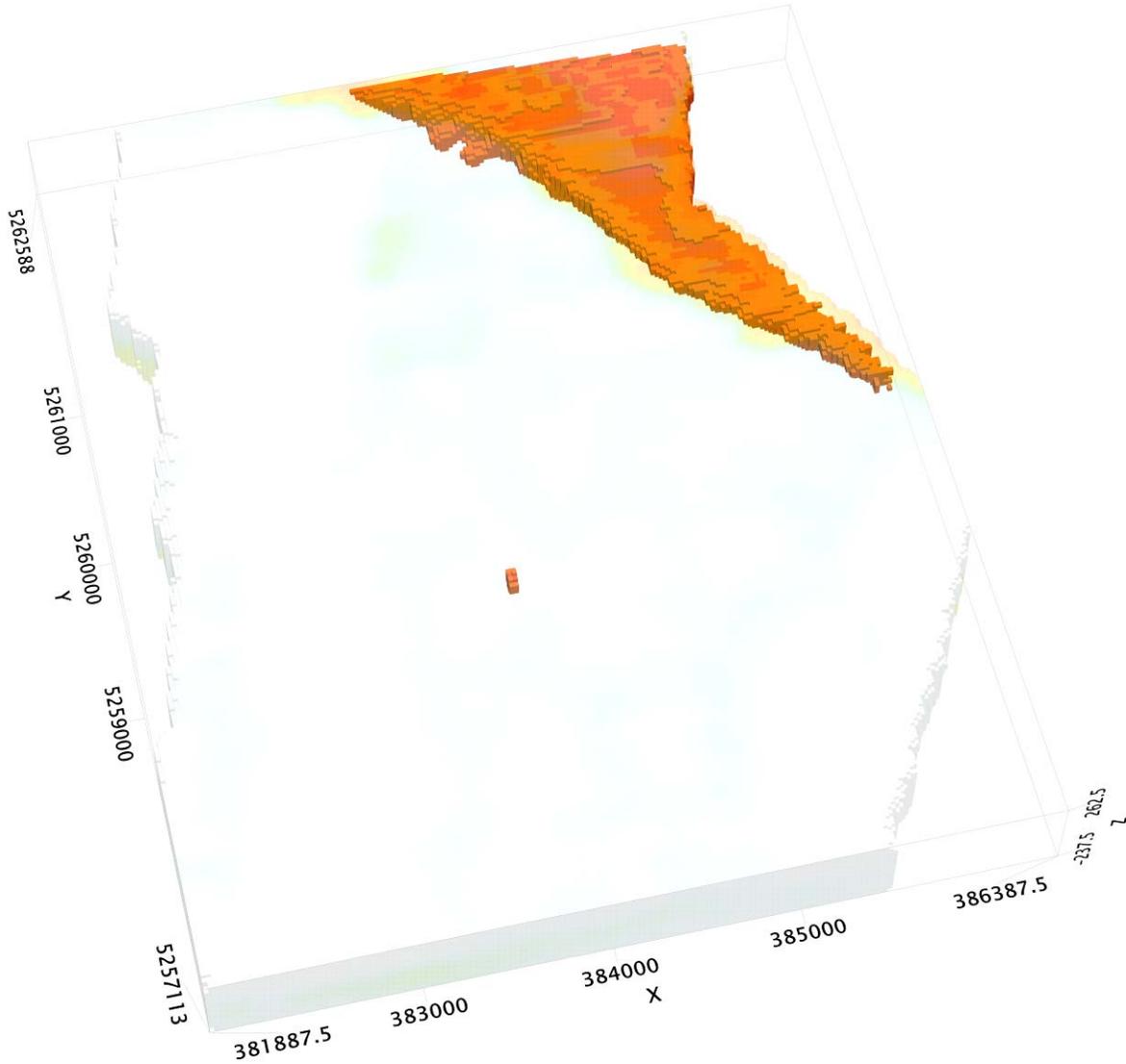
**RDI Sections - Line 20520 (WartHill)**

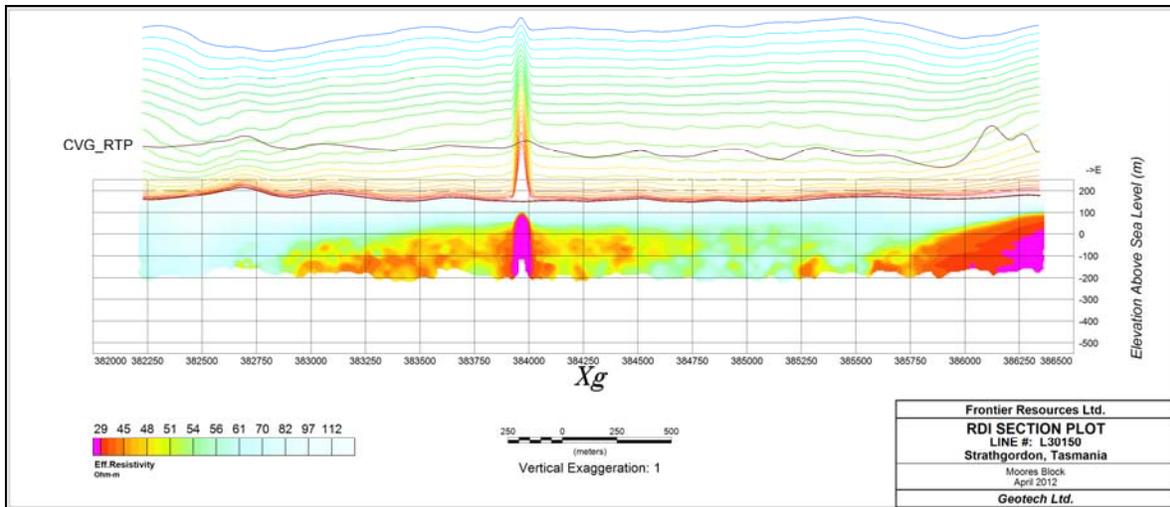


**RDI Sections - Line 21250 (WartHill)**

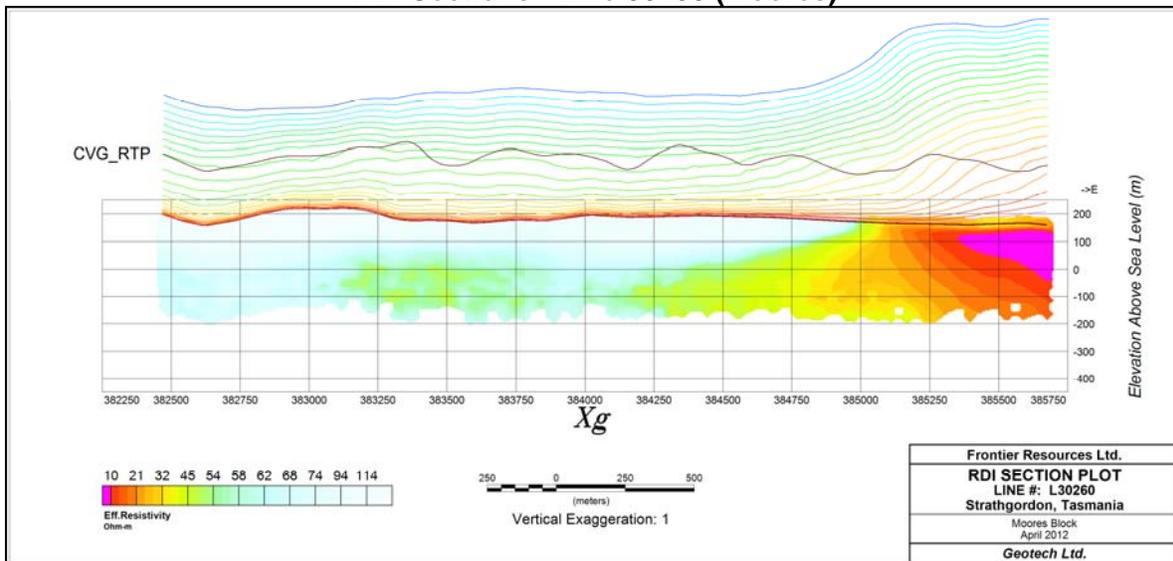
### 3D Resistivity Depth Images (RDI) (Moore's)

AA926\_Frontier\_Moore's\_RDI\_Apparent\_Resistivity

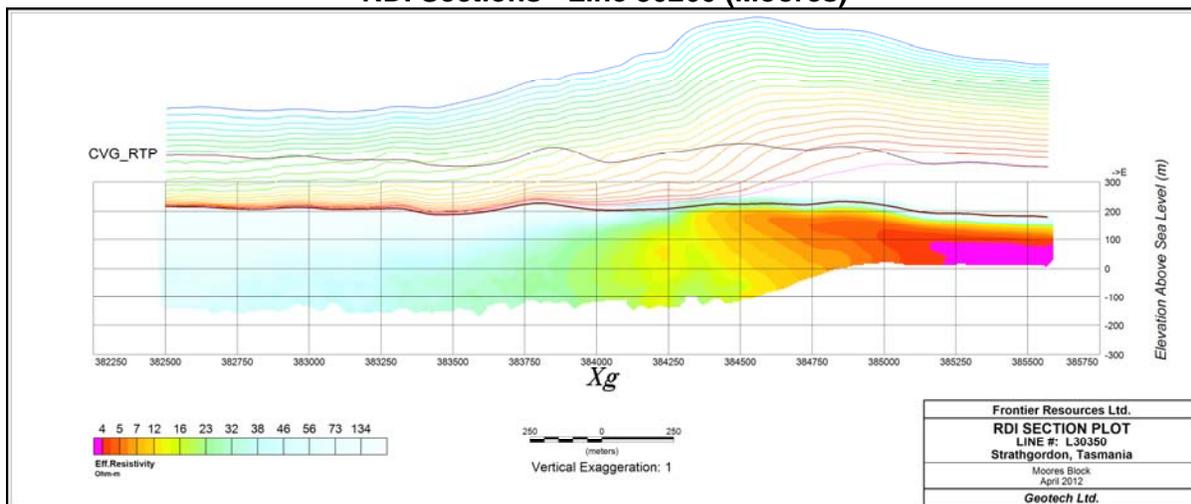




**RDI Sections - Line 30150 (Moores)**



**RDI Sections - Line 30260 (Moores)**



**RDI Sections - Line 30350 (Moores)**

## APPENDIX D

### GENERALIZED MODELING RESULTS OF THE VTEM SYSTEM

#### Introduction

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

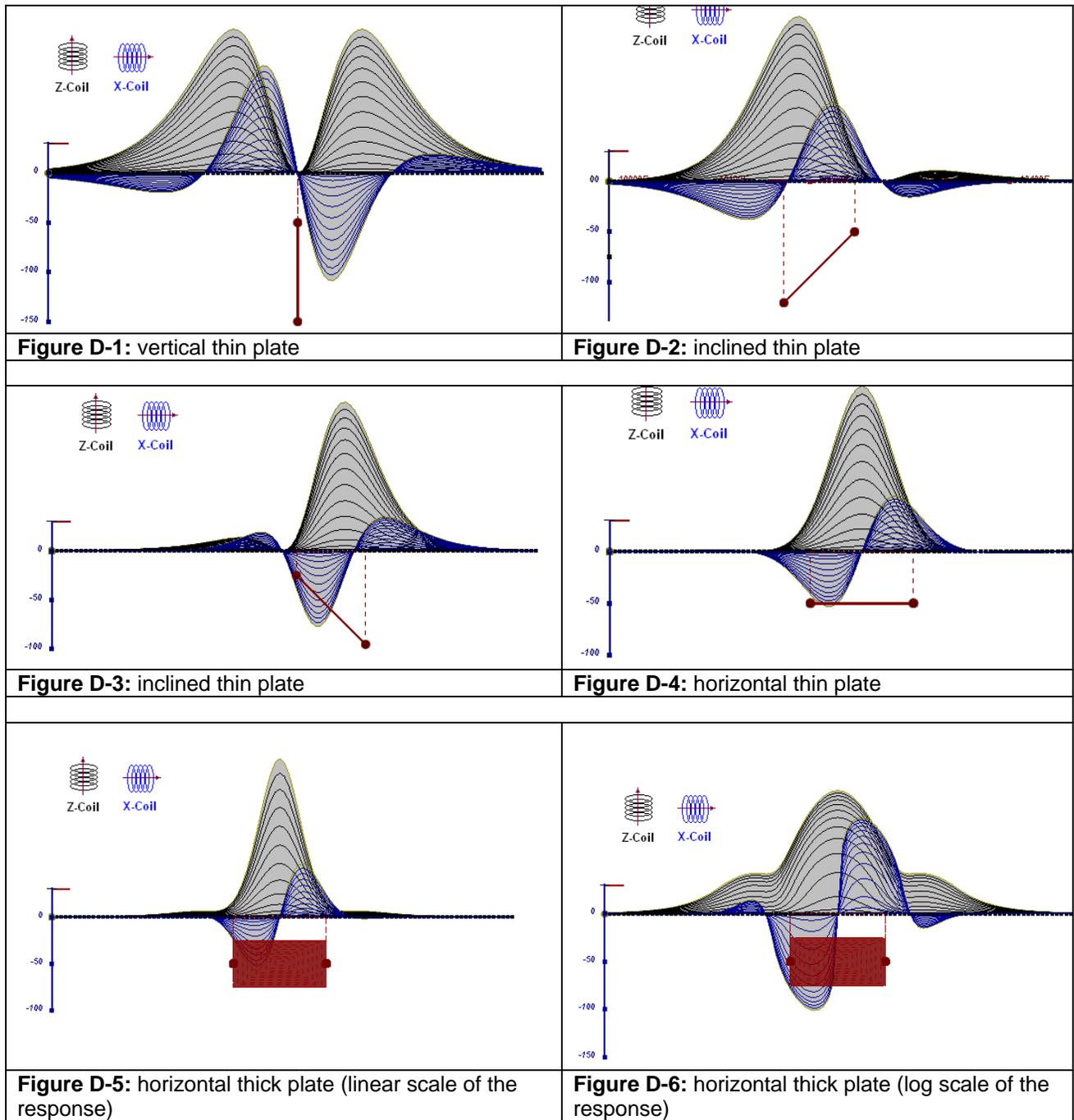
During turn-on and turn-off, a time varying field is produced ( $dB/dt$ ) and an electro-motive force (emf) is created as a finite impulse response. A current ring around the transmitter loop moves outward and downward as time progresses. When conductive rocks and mineralization are encountered, a secondary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

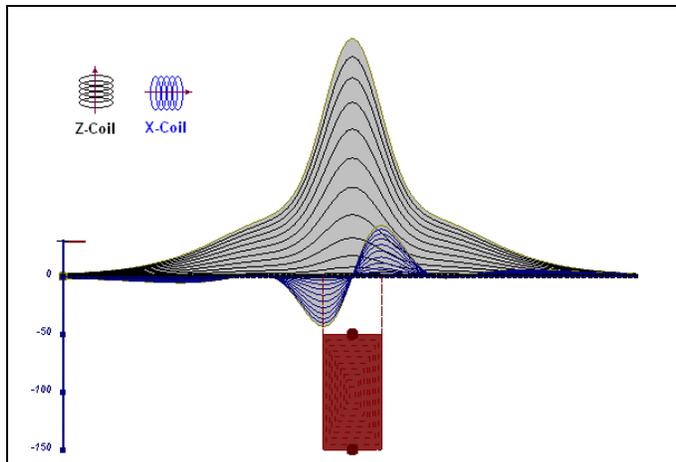
Efficient modeling of the results can be carried out on regularly shaped geometries, thus yielding close approximations to the parameters of the measured targets. The following is a description of a series of common models made for the purpose of promoting a general understanding of the measured results.

A set of models has been produced for the Geotech VTEM® system  $dB/dT$  Z and X components (see models D1 to D15). The Maxwell™ modeling program (EMIT Technology Pty. Ltd. Midland, WA, AU) used to generate the following responses assumes a resistive half-space. The reader is encouraged to review these models, so as to get a general understanding of the responses as they apply to survey results. While these models do not begin to cover all possibilities, they give a general perspective on the simple and most commonly encountered anomalies.

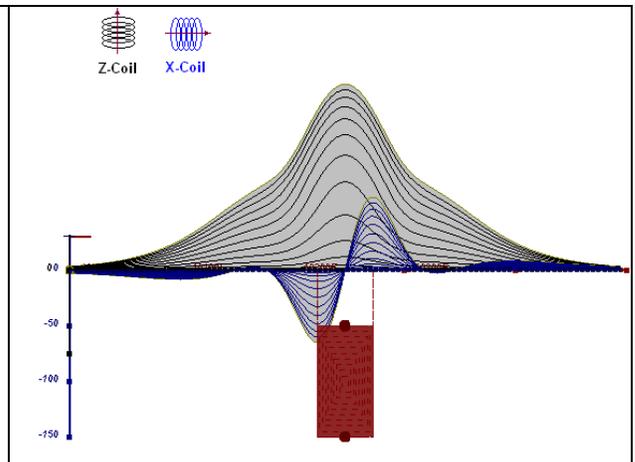
As the plate dips and departs from the vertical position, the peaks become asymmetrical.

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

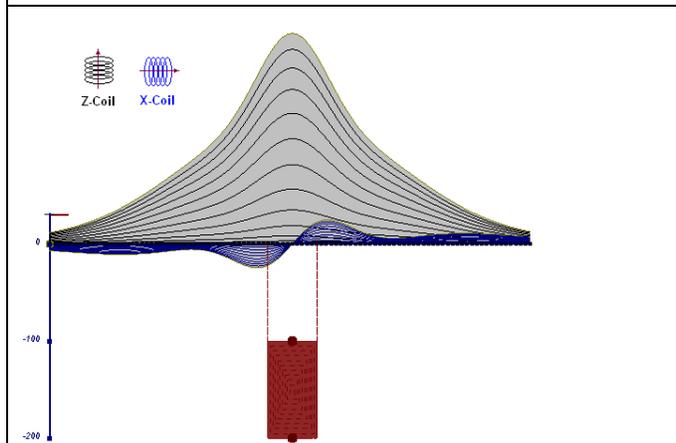




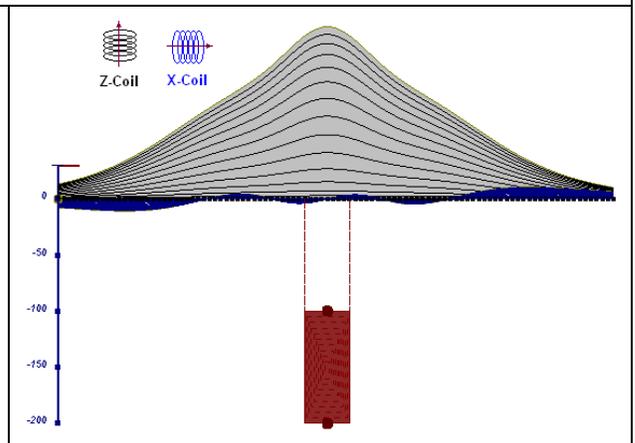
**Figure D-7:** vertical thick plate (linear scale of the response). 50 m depth



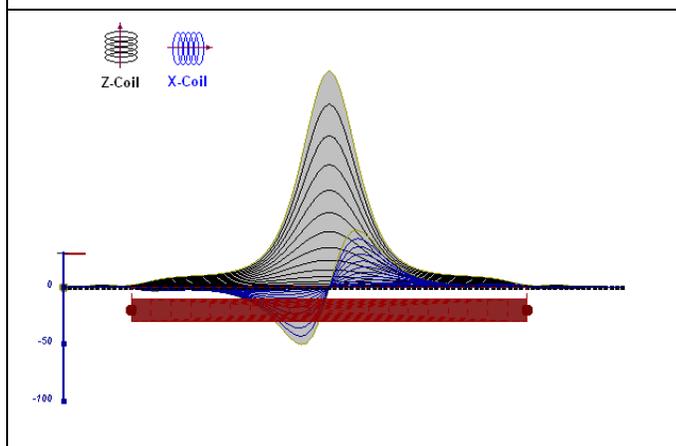
**Figure D-8:** vertical thick plate (log scale of the response). 50 m depth



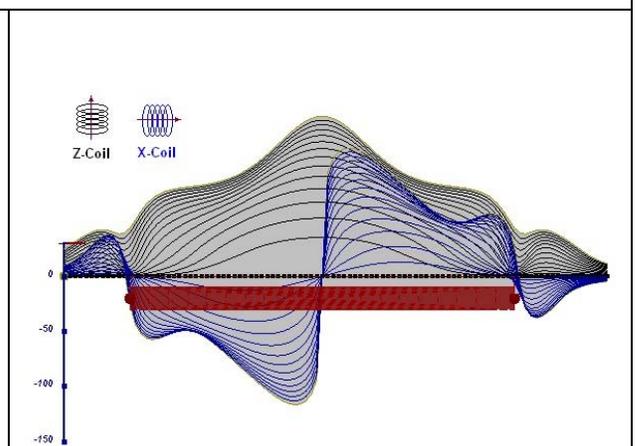
**Figure D-9:** vertical thick plate (linear scale of the response). 100 m depth



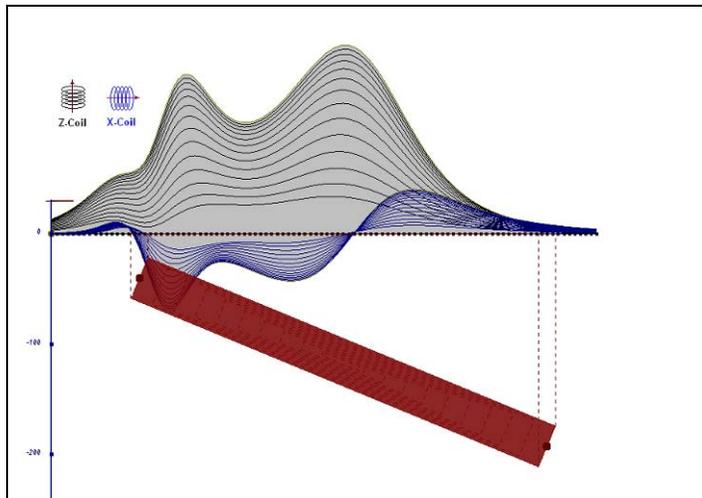
**Figure D-10:** vertical thick plate (linear scale of the response). Depth/hor.thickness=2.5



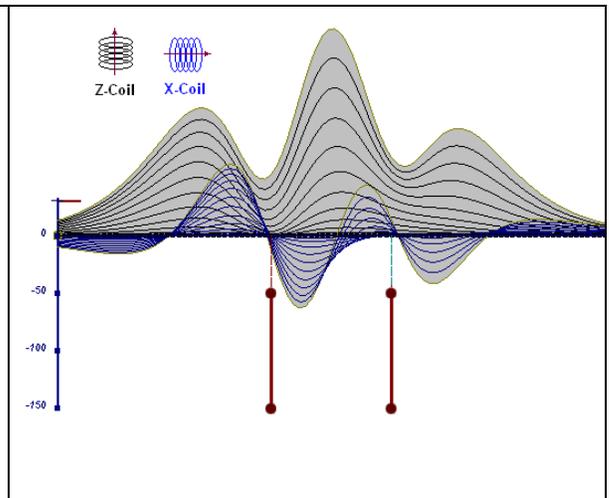
**Figure D-10:** horizontal thick plate (linear scale of the response)



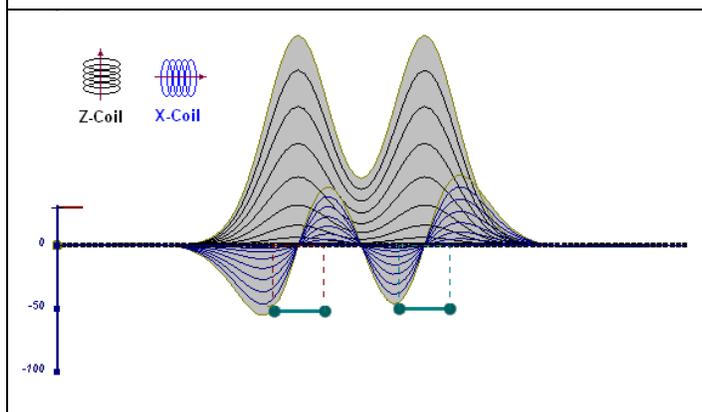
**Figure D-11:** horizontal thick plate (log scale of the response)



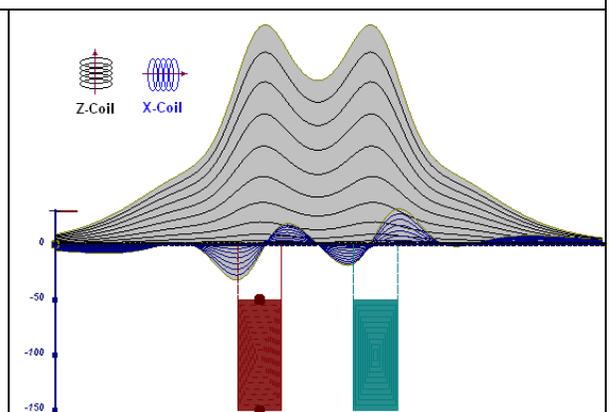
**Figure D-12:** inclined long thick plate



**Figure D-13:** two vertical thin plates

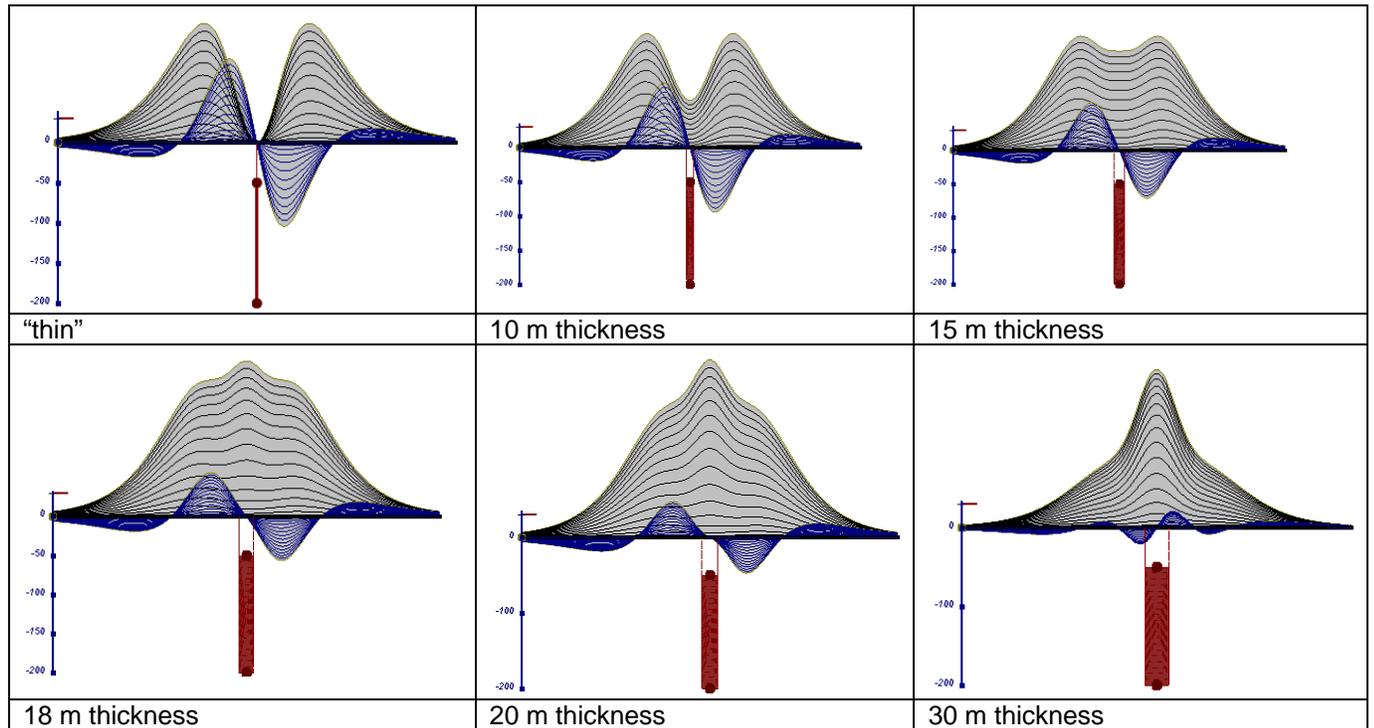


**Figure D-14:** two horizontal thin plates



**Figure D-15:** two vertical thick plates

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



**Figure D-16:** Conductive vertical plate, depth 50 m, strike length 200 m, depth extend 150 m.

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September 2010

# APPENDIX E

## EM TIME CONSTANT (TAU) ANALYSIS

Estimation of time constant parameter<sup>1</sup> in transient electromagnetic method is one of the steps toward the extraction of the information about conductances beneath the surface from TEM measurements.

The most reliable method to discriminate or rank conductors from overburden, background or one and other is by calculating the EM field decay time constant (TAU parameter), which directly depends on conductance despite their depth and accordingly amplitude of the response.

### Theory

As established in electromagnetic theory, the magnitude of the electro-motive force (emf) induced is proportional to the time rate of change of primary magnetic field at the conductor. This emf causes eddy currents to flow in the conductor with a characteristic transient decay, whose Time Constant (Tau) is a function of the conductance of the survey target or conductivity and geometry (including dimensions) of the target. The decaying currents generate a proportional secondary magnetic field, the time rate of change of which is measured by the receiver coil as induced voltage during the Off time.

The receiver coil output voltage ( $e_0$ ) is proportional to the time rate of change of the secondary magnetic field and has the form,

$$e_0 \propto (1 / \tau) e^{-(t / \tau)}$$

Where,

$\tau = L/R$  is the characteristic time constant of the target (TAU)

R = resistance

L = inductance

From the expression, conductive targets that have small value of resistance and hence large value of  $\tau$  yield signals with small initial amplitude that decays relatively slowly with progress of time. Conversely, signals from poorly conducting targets that have large resistance value and small  $\tau$ , have high initial amplitude but decay rapidly with time<sup>1</sup> (Figure E-1).

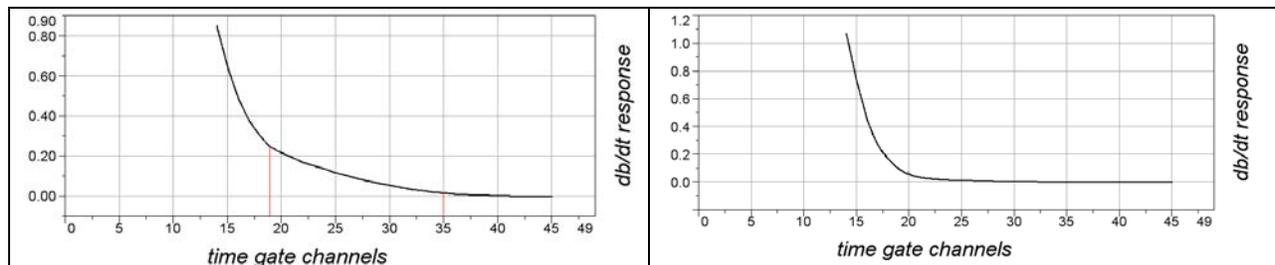


Figure E-1: Left – presence of good conductor, right – poor conductor.

<sup>1</sup> McNeill, JD, 1980, "Applications of Transient Electromagnetic Techniques", Technical Note TN-7 page 5, Geonics Limited, Mississauga, Ontario.

## EM Time Constant (Tau) Calculation

The EM Time-Constant (TAU) is a general measure of the speed of decay of the electromagnetic response and indicates the presence of eddy currents in conductive sources as well as reflecting the “conductance quality” of a source. Although TAU can be calculated using either the measured dB/dt decay or the calculated B-field decay, dB/dt is commonly preferred due to better stability (S/N) relating to signal noise. Generally, TAU calculated on base of early time response reflects both near surface overburden and poor conductors whereas, in the late ranges of time, deep and more conductive sources, respectively. For example early time TAU distribution in an area that indicates conductive overburden is shown in Figure 2.

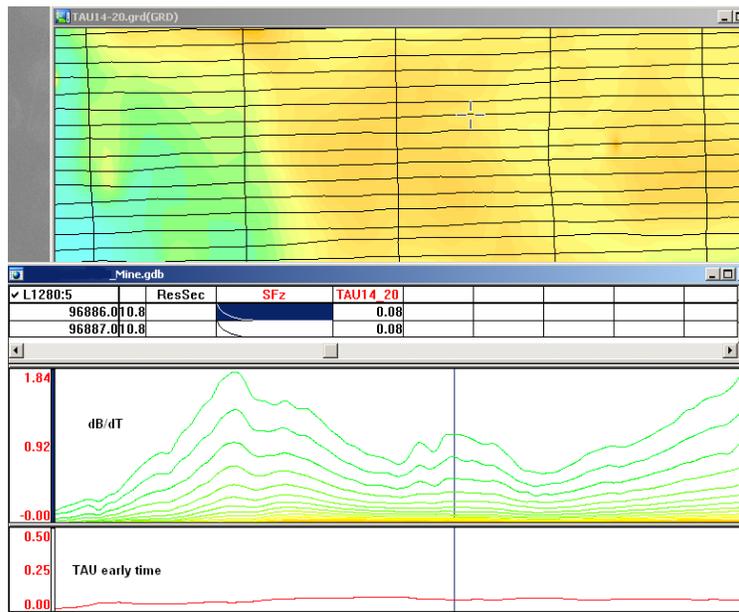
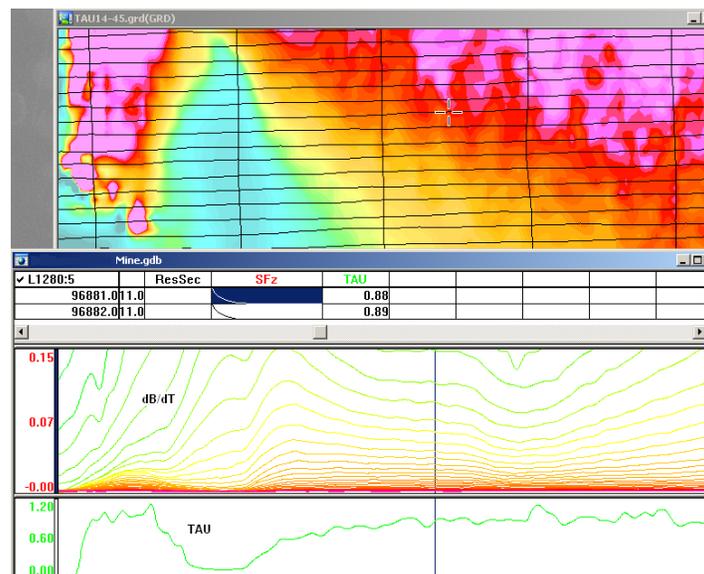


Figure E-2: Map of early time TAU. Area with overburden conductive layer and local sources.

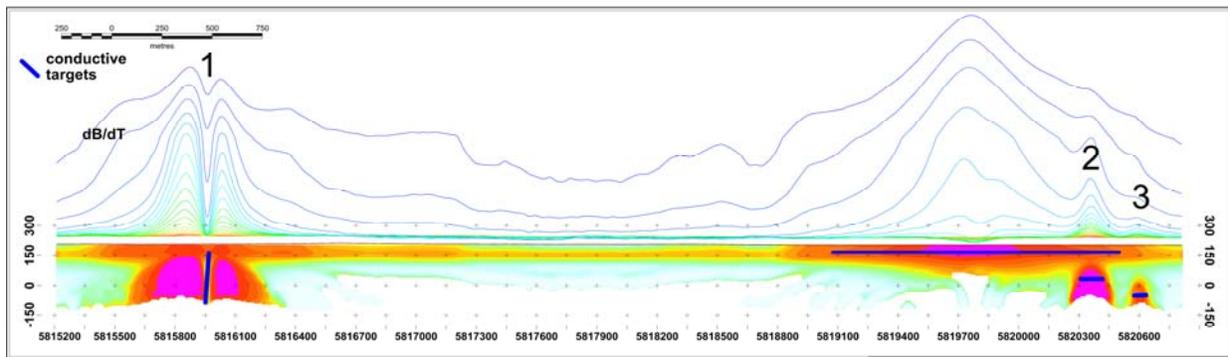


**Figure E-3:** Map of full time range TAU with EM anomaly due to deep highly conductive target.

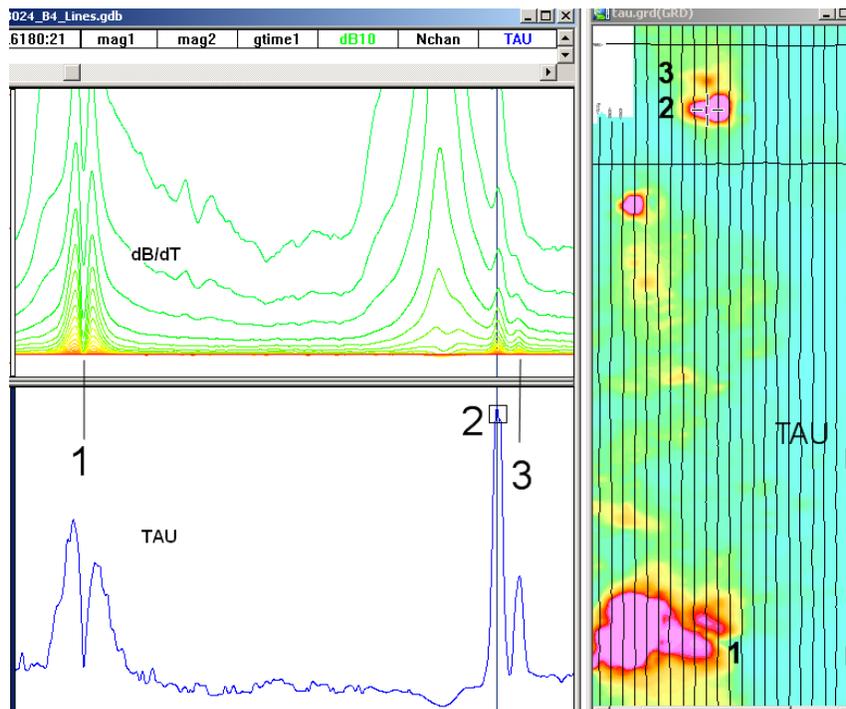
There are many advantages of TAU maps:

- TAU depends only on one parameter (conductance) in contrast to response magnitude;
- TAU is integral parameter, which covers time range and all conductive zones and targets are displayed independently of their depth and conductivity on a single map.
- Very good differential resolution in complex conductive places with many sources with different conductivity.
- Signs of the presence of good conductive targets are amplified and emphasized independently of their depth and level of response accordingly.

In the example shown in Figure 4 and 5, three local targets are defined, each of them with a different depth of burial, as indicated on the resistivity depth image (RDI). All are very good conductors but the deeper target (number 2) has a relatively weak dB/dt signal yet also features the strongest total TAU (Figure 4). This example highlights the benefit of TAU analysis in terms of an additional target discrimination tool.

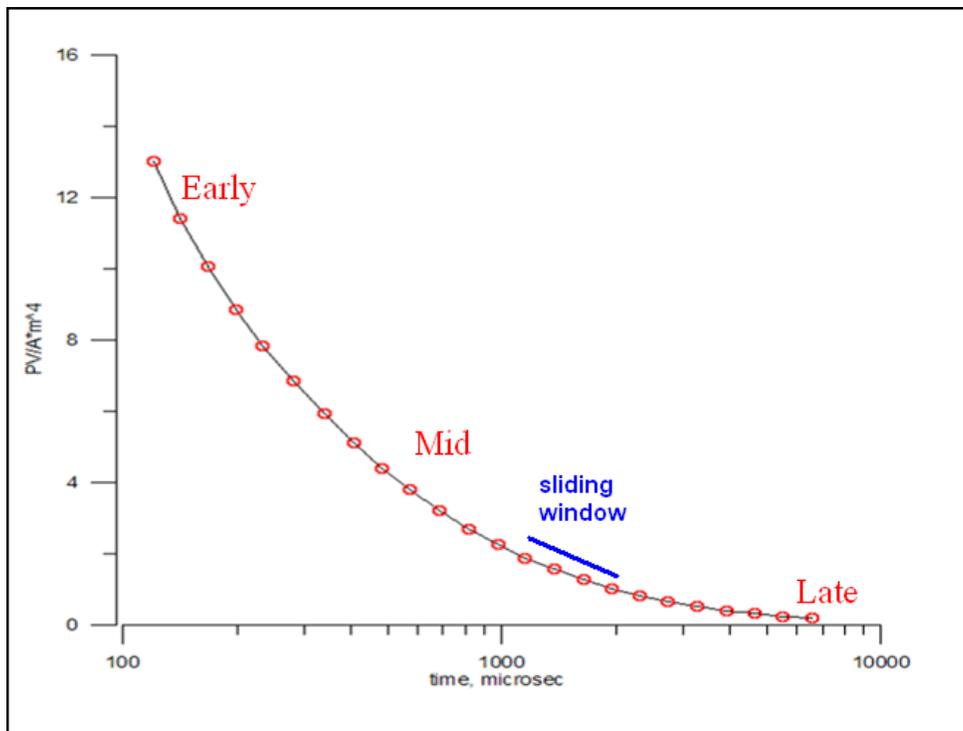


**Figure E-4:** dB/dt profile and RDI with different depths of targets.



**Figure E-5:** Map of total TAU and dB/dt profile.

The EM Time Constants for dB/dt and B-field were calculated using the “sliding Tau” in-house program developed at Geotech2. The principle of the calculation is based on using of time window (4 time channels) which is sliding along the curve decay and looking for latest time channels which have a response above the level of noise and decay. The EM decays are obtained from all available decay channels, starting at the latest channel. Time constants are taken from a least square fit of a straight-line (log/linear space) over the last 4 gates above a pre-set signal threshold level (Figure F6). Threshold settings are pointed in the “label” property of TAU database channels. The sliding Tau method determines that, as the amplitudes increase, the time-constant is taken at progressively later times in the EM decay. Conversely, as the amplitudes decrease, Tau is taken at progressively earlier times in the decay. If the maximum signal amplitude falls below the threshold, or becomes negative for any of the 4 time gates, then Tau is not calculated and is assigned a value of “dummy” by default.



**Figure E-6:** Typical dB/dt decays of Vtem data

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<sup>2</sup> by A.Prikhodko

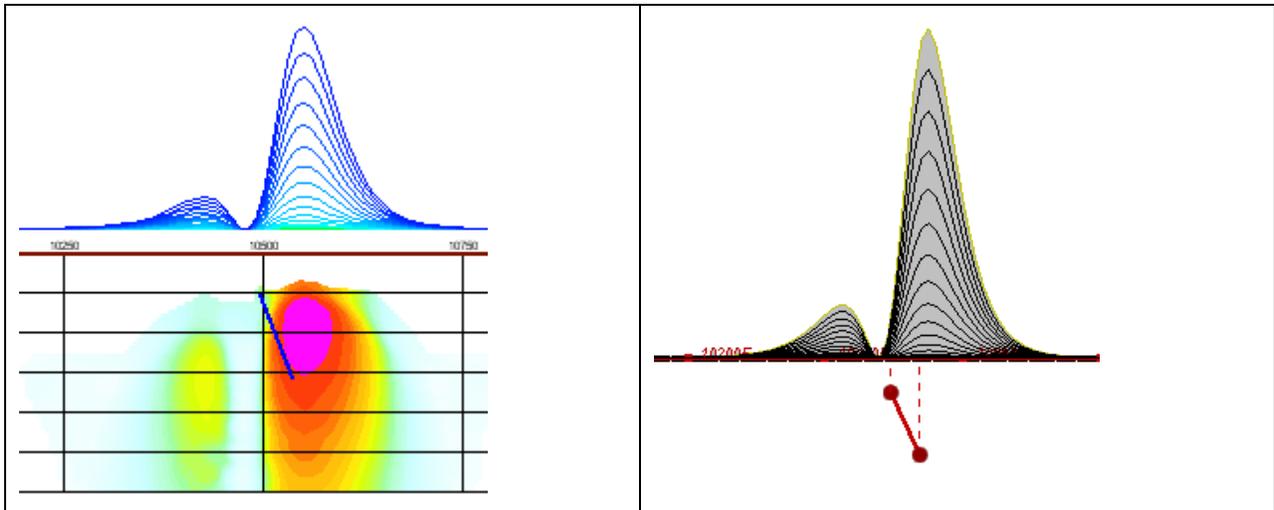
## APPENDIX F

### TEM RESISTIVITY DEPTH IMAGING (RDI)

Resistivity depth imaging (RDI) is a technique used to rapidly convert EM profile decay data into an equivalent resistivity versus depth cross-section, by deconvolving the measured TEM data. The used RDI algorithm of Resistivity-Depth transformation is based on the scheme of the apparent resistivity transform of Maxwell A. Meju (1998)<sup>1</sup> and TEM response from a conductive half-space. The program is developed by Alexander Prikhodko and is depth-calibrated based on forward plate modeling for VTEM system configuration (Fig. 1-10).

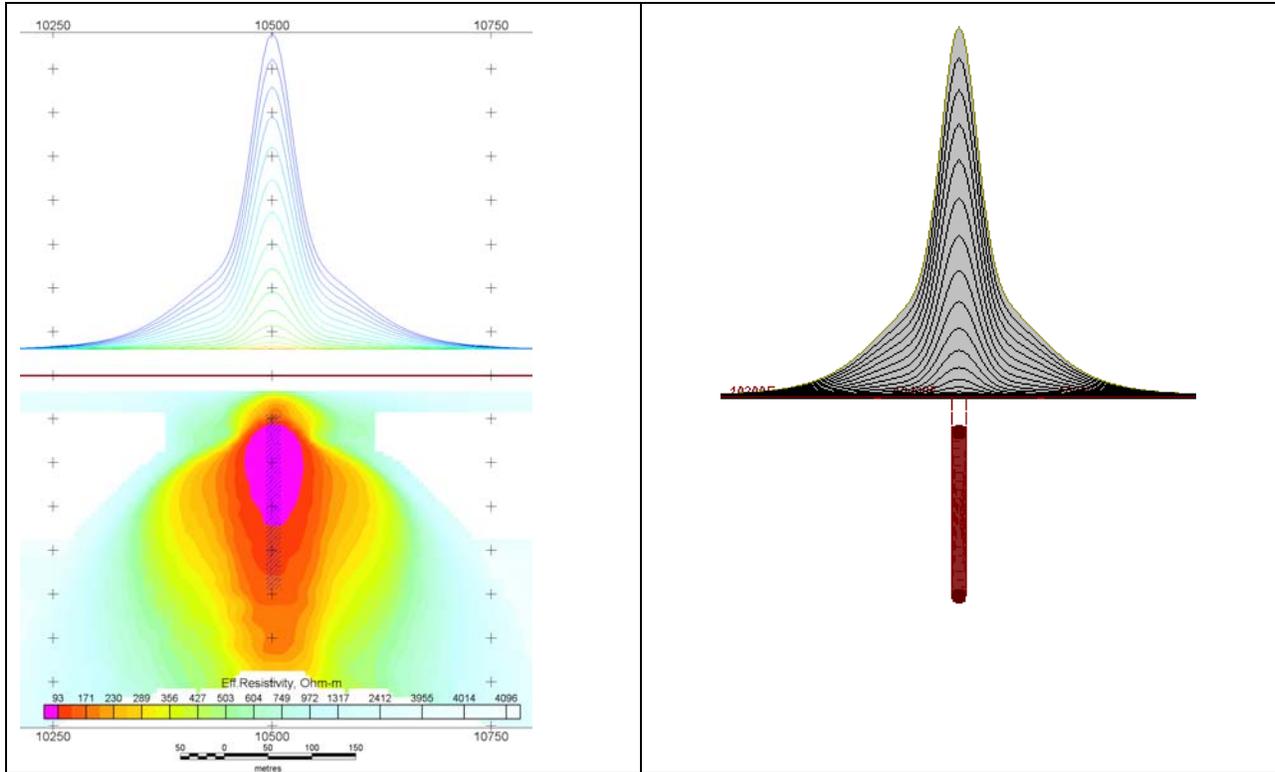
RDIs provide reasonable indications of conductor relative depth and vertical extent, as well as accurate 1D layered-earth apparent conductivity/resistivity structure across VTEM flight lines. Approximate depth of investigation of a TEM system, image of secondary field distribution in half-space, effective resistivity, initial geometry and position of conductive targets is the information obtained on the basis of the RDIs.

#### Maxwell forward modeling with RDI sections from the synthetic responses (VTEM system)

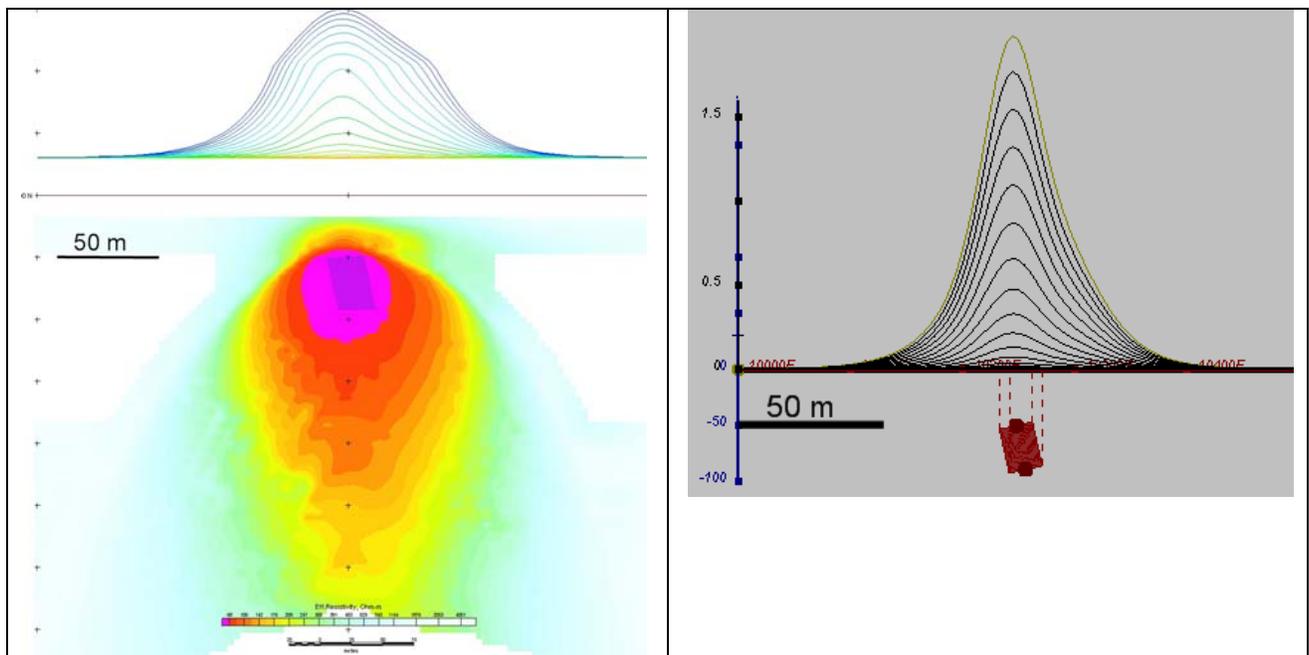


**Figure F-1:** Maxwell plate model and RDI from the calculated response for a conductive “thin” plate (depth 50 m, dip 65 degree, depth extend 100 m).

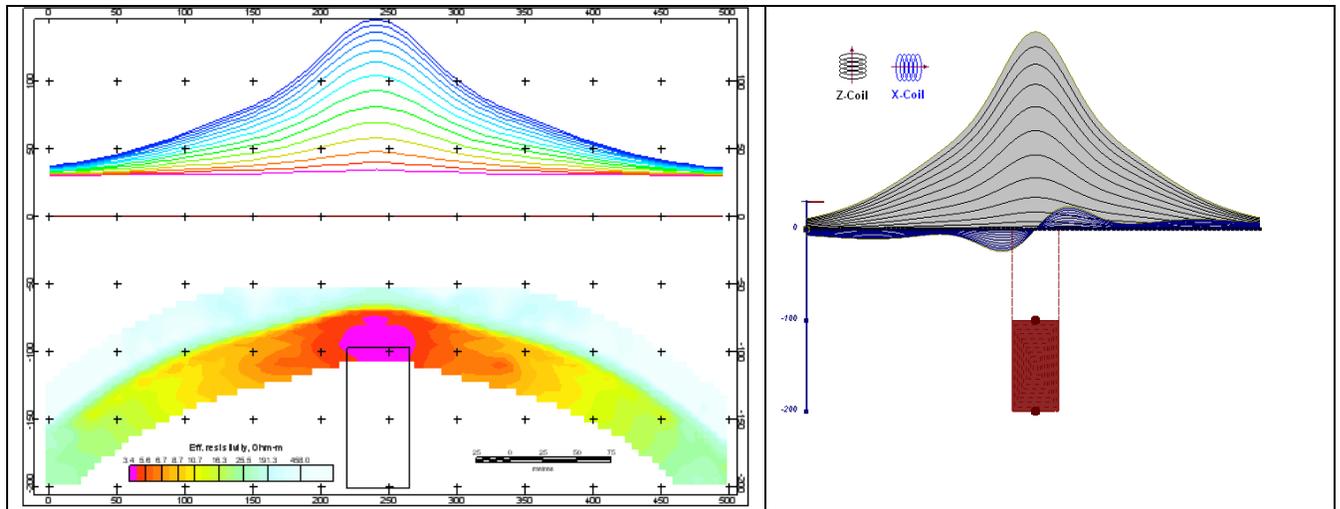
<sup>1</sup> Maxwell A. Meju, 1998, Short Note: A simple method of transient electromagnetic data analysis, *Geophysics*, **63**, 405–410.



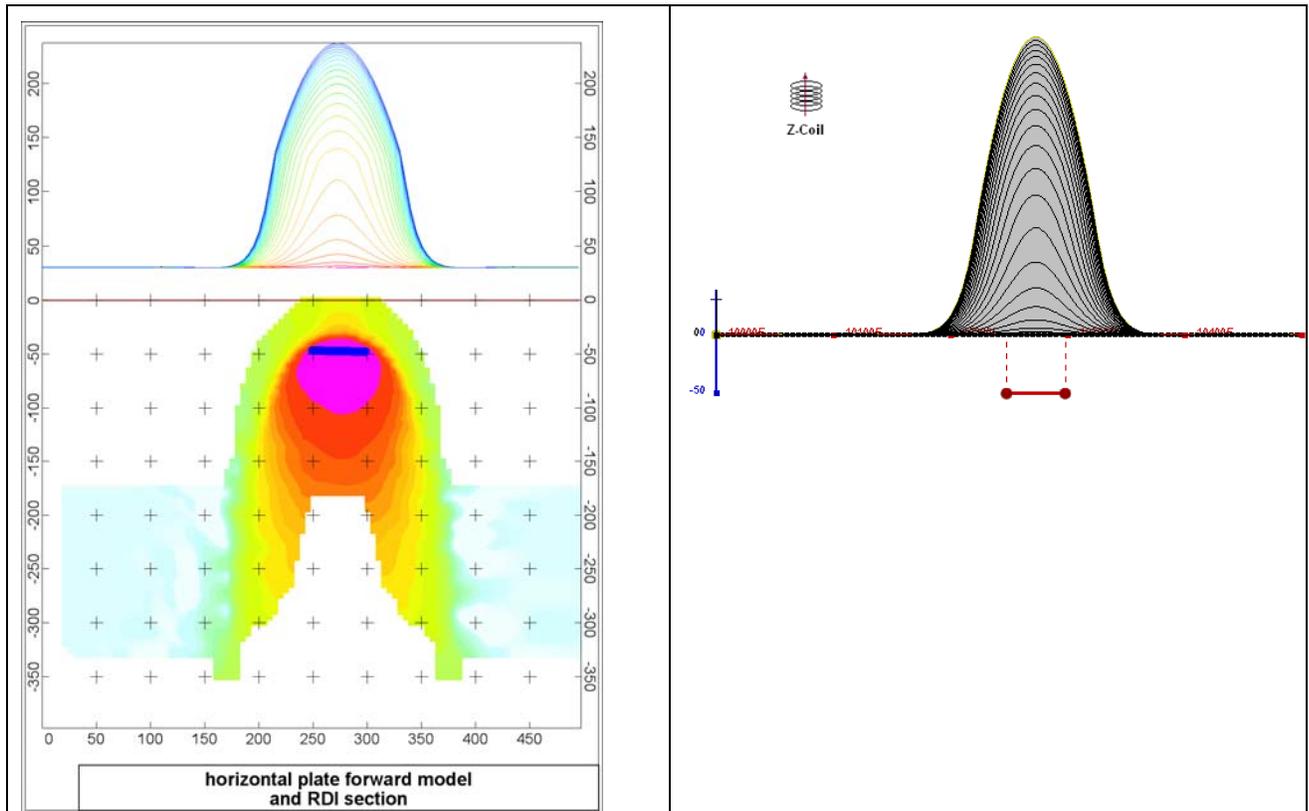
**Figure F-2:** Maxwell plate model and RDI from the calculated response for “thick” plate 18 m thickness, depth 50 m, depth extend 200 m).



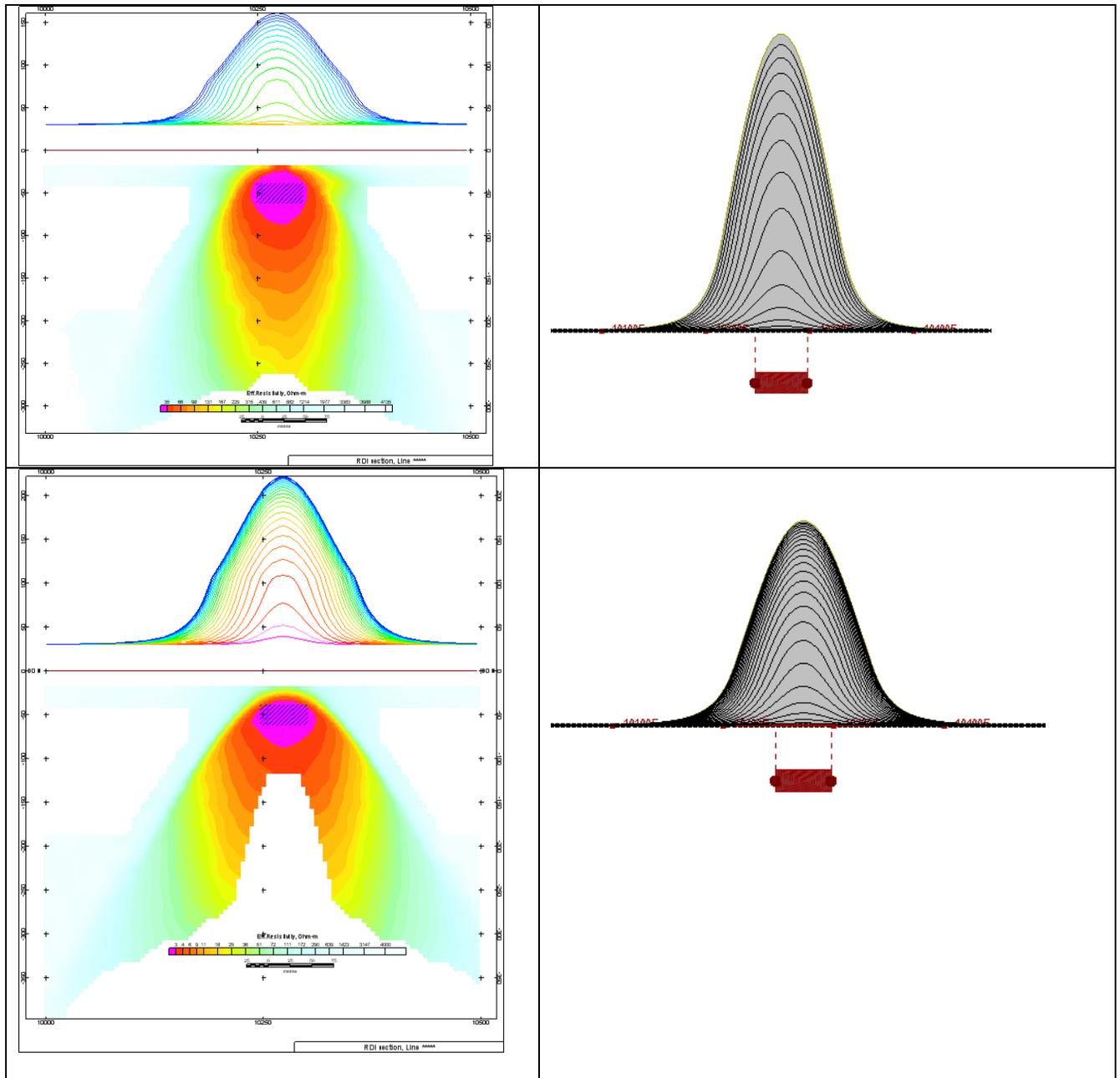
**Figure F-3:** Maxwell plate model and RDI from the calculated response for bulk (“thick”) 100 m length, 40 m depth extend, 30 m thickness



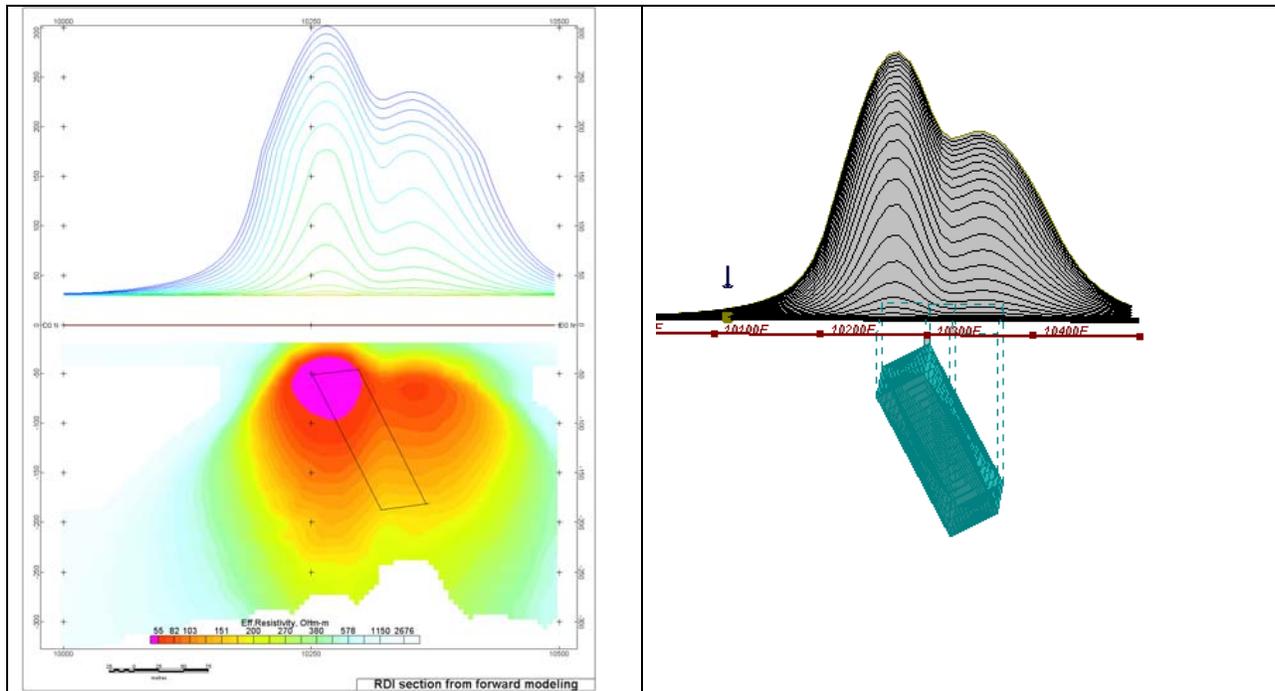
**Figure F-4:** Maxwell plate model and RDI from the calculated response for “thick” vertical target (depth 100 m, depth extend 100 m). 19-44 chan.



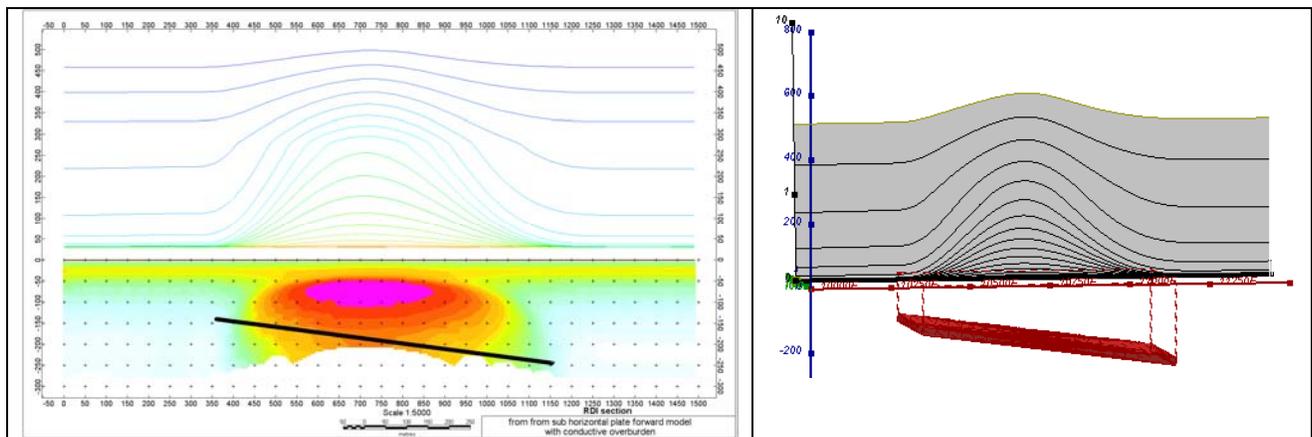
**Figure F-5:** Maxwell plate model and RDI from the calculated response for horizontal thin plate (depth 50 m, dim 50x100 m). 15-44 chan.



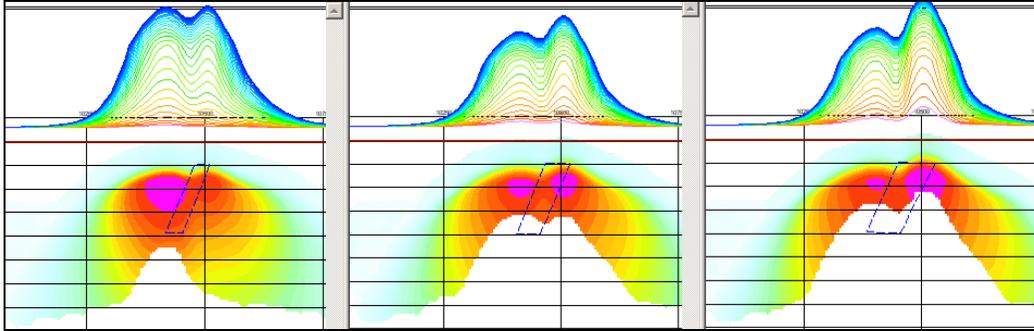
**Figure F-6:** Maxwell plate model and RDI from the calculated response for horizontal thick (20m) plate – less conductive (on the top), more conductive (below)



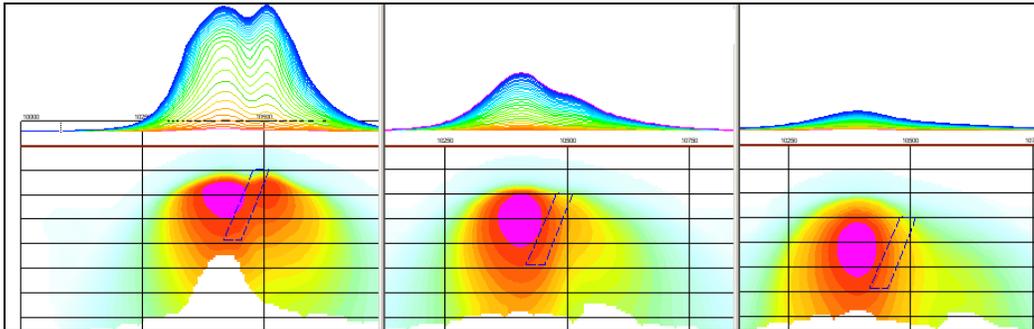
**Figure F-7:** Maxwell plate model and RDI from the calculated response for inclined thick (50m) plate. Depth extends 150 m, depth to the target 50 m.



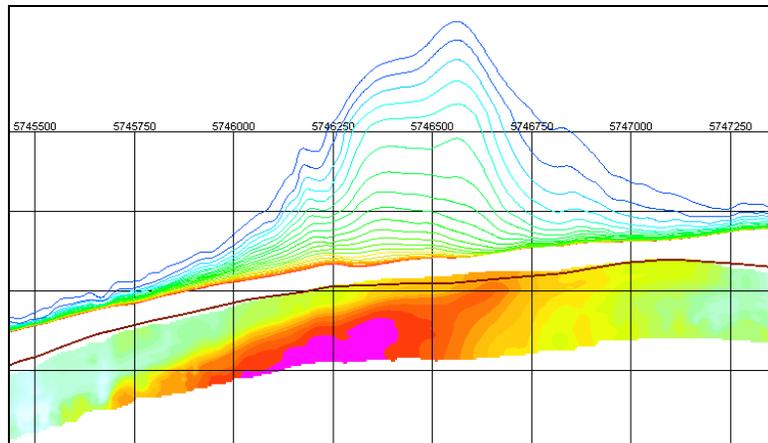
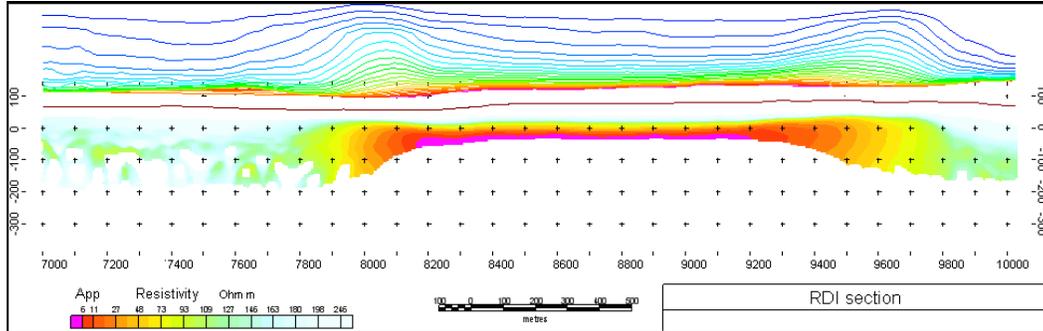
**Figure F-8:** Maxwell plate model and RDI from the calculated response for the long, wide and deep subhorizontal plate (depth 140 m, dim 25x500x800 m) with conductive overburden.



**Figure F-9:** Maxwell plate models and RDIs from the calculated response for “thick” dipping plates (35, 50, 75 m thickness), depth 50 m, conductivity 2.5 S/m.



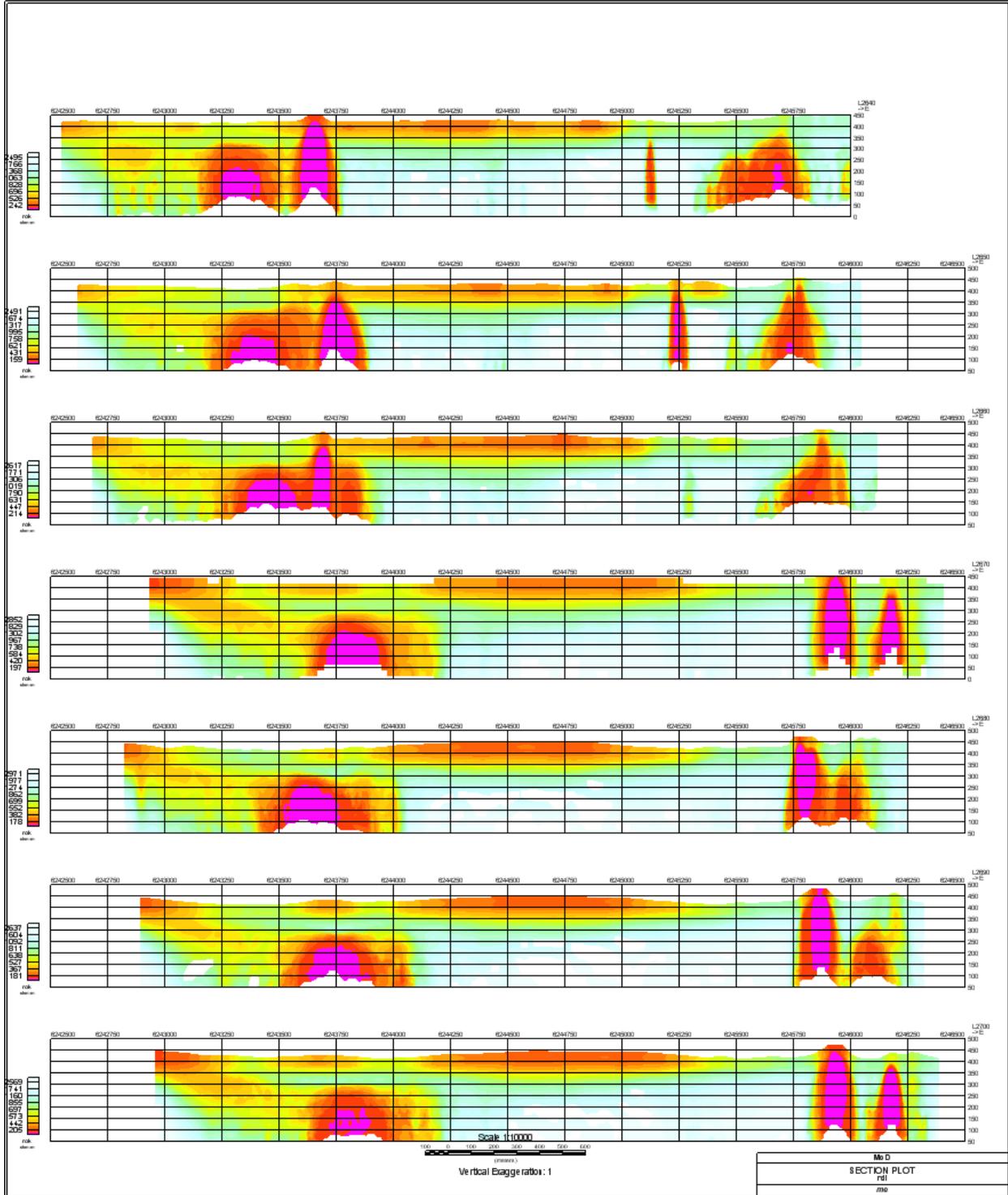
**Figure F-10:** Maxwell plate models and RDIs from the calculated response for “thick” (35 m thickness) dipping plate on different depth (50, 100, 150 m), conductivity 2.5 S/m.



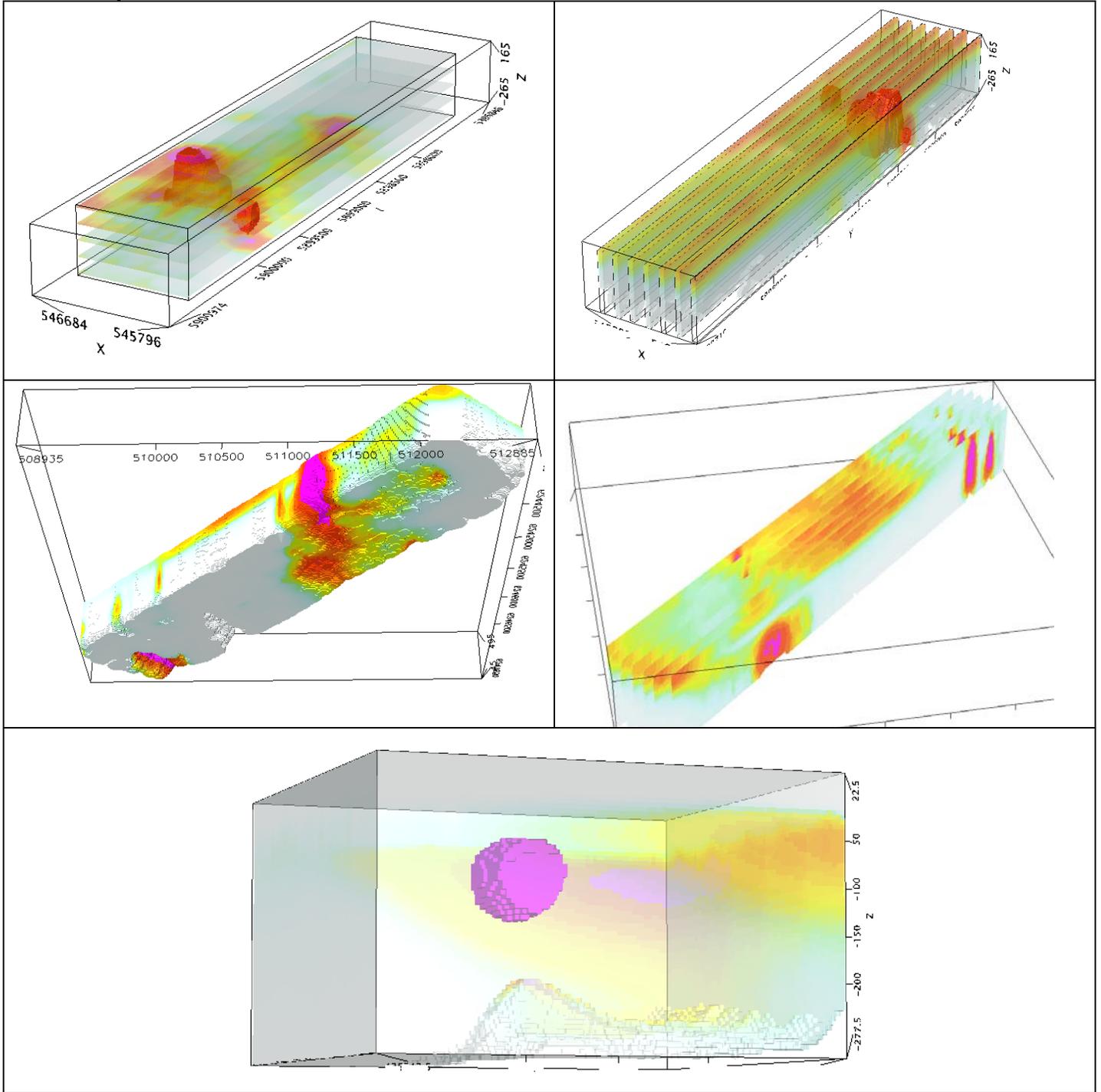
**Figure F-11:** RDI section for the real horizontal and slightly dipping conductive layers

# FORMS OF RDI PRESENTATION

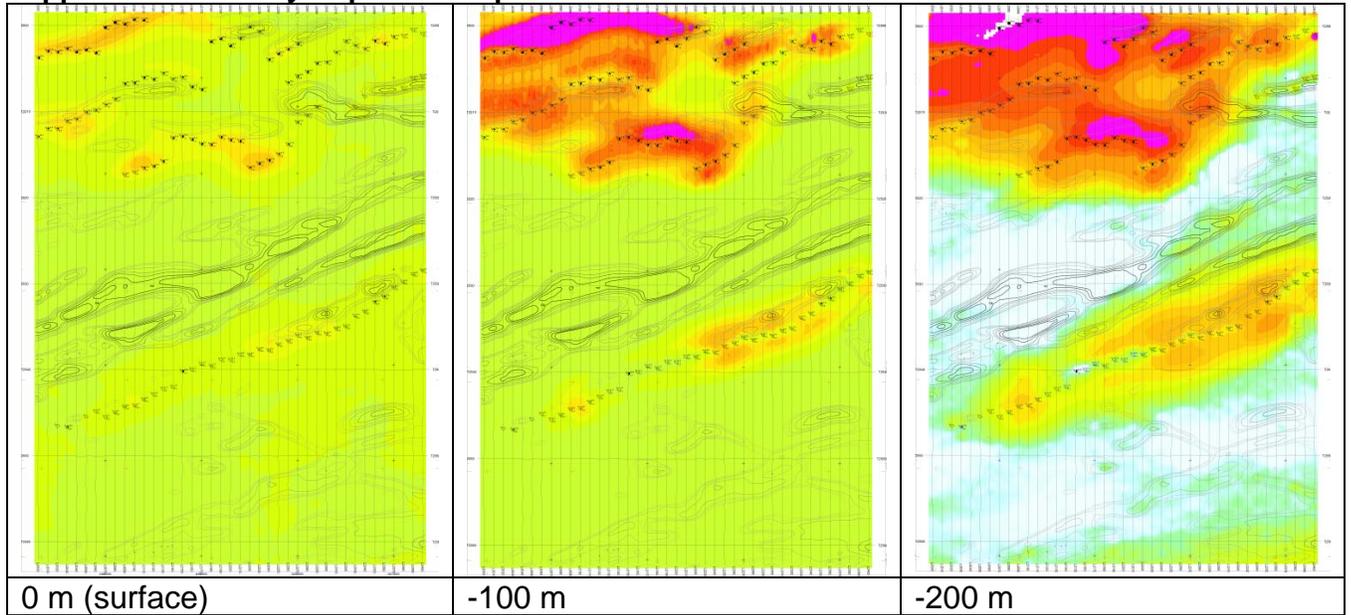
## Presentation of series of lines



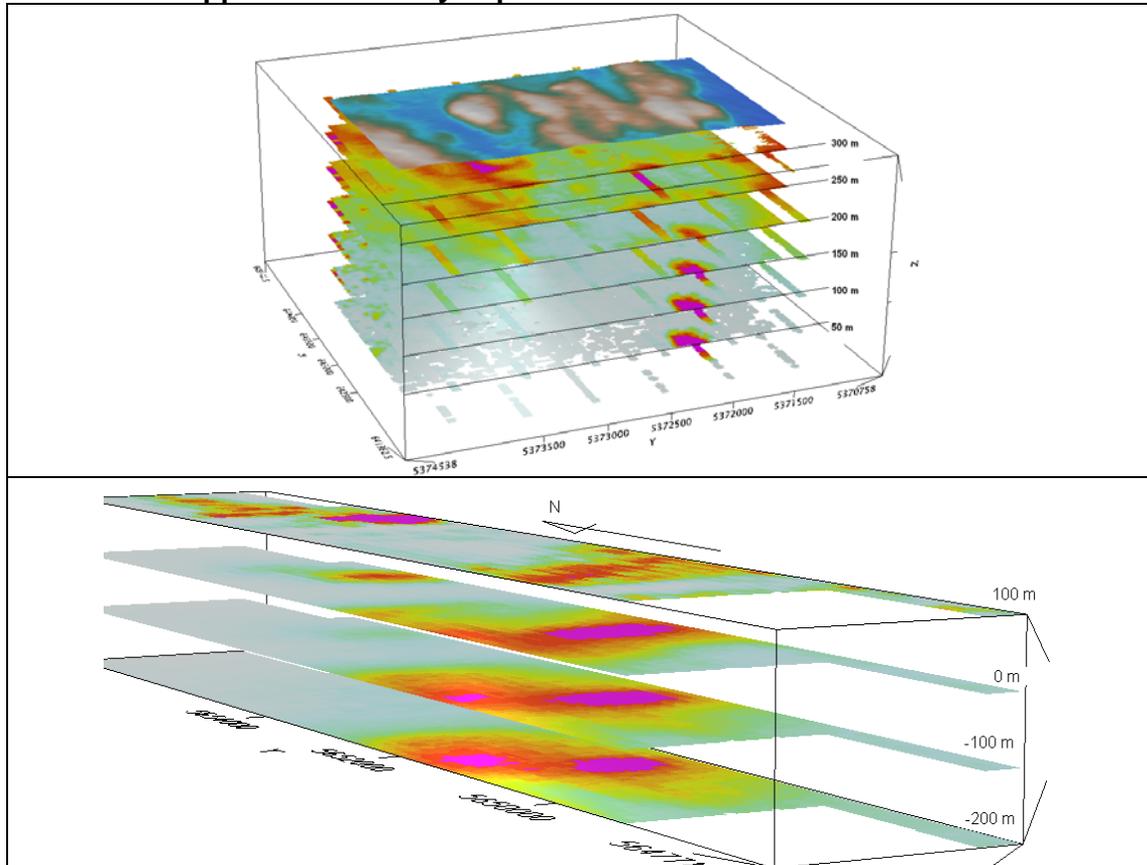
### 3d presentation of RDIs



**Apparent Resistivity Depth Slices plans:**

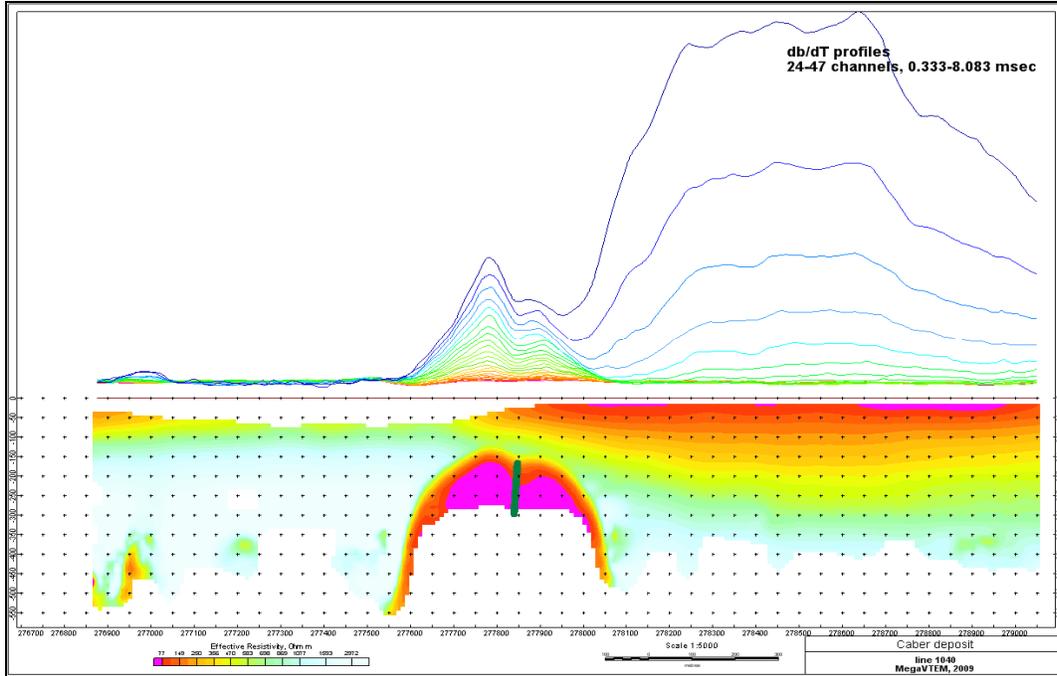


**3d views of apparent resistivity depth slices:**

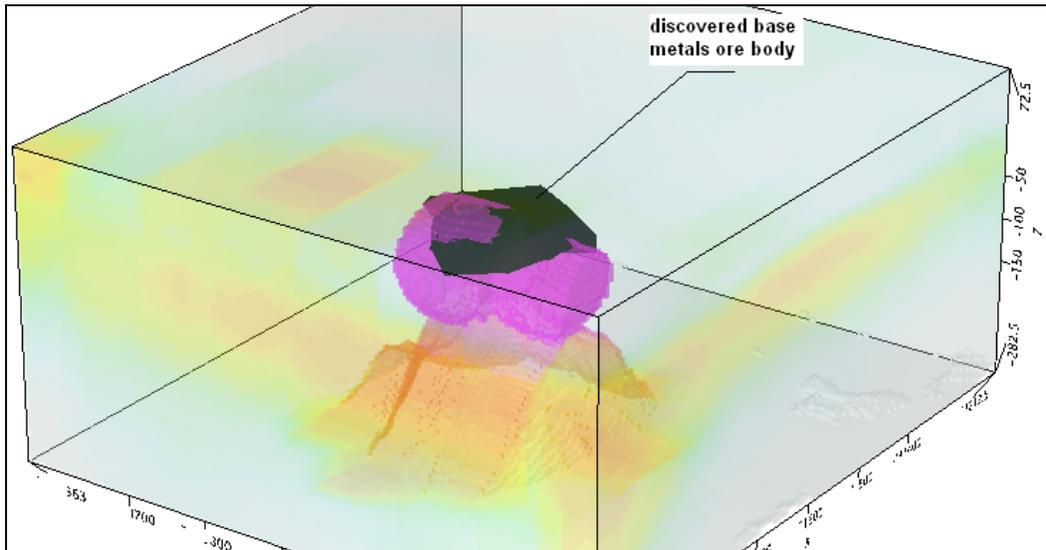


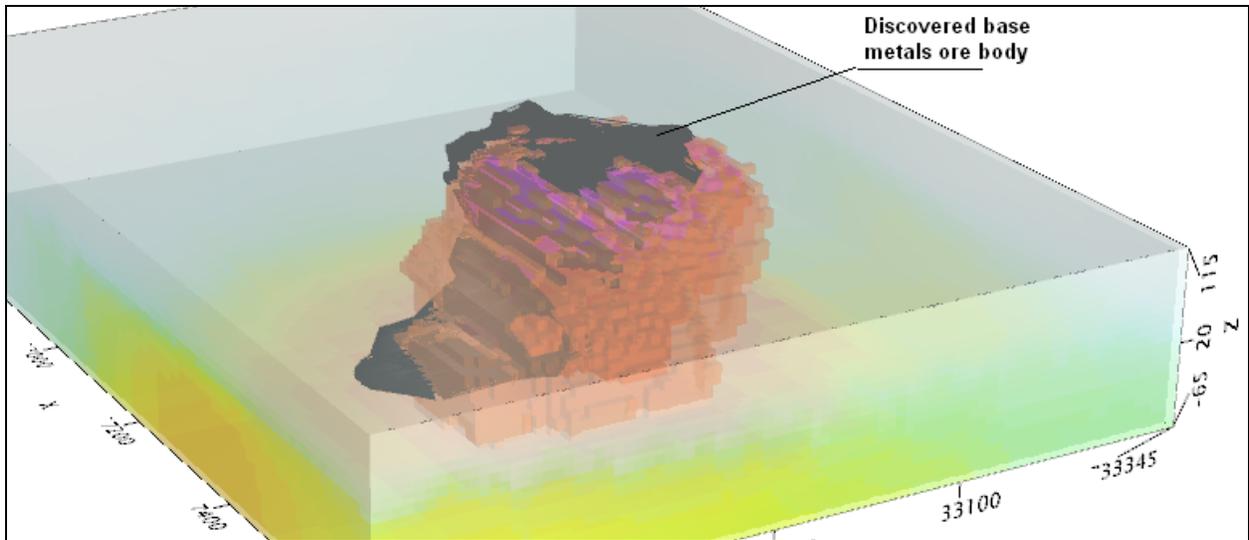
**Real base metal targets in comparison with RDIs:**

RDI section of the line over Caber deposit (“thin” subvertical plate target and conductive overburden).

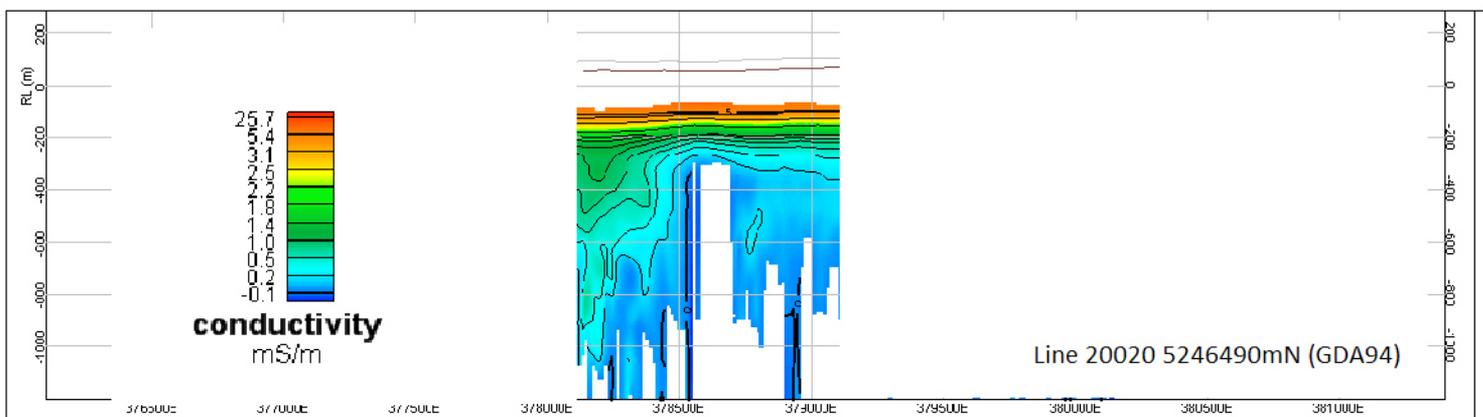
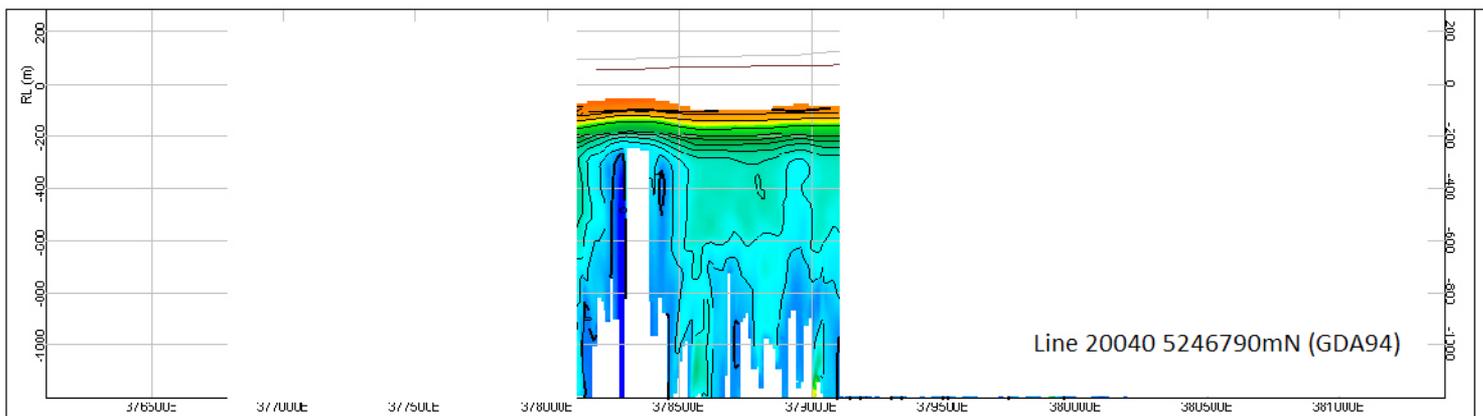
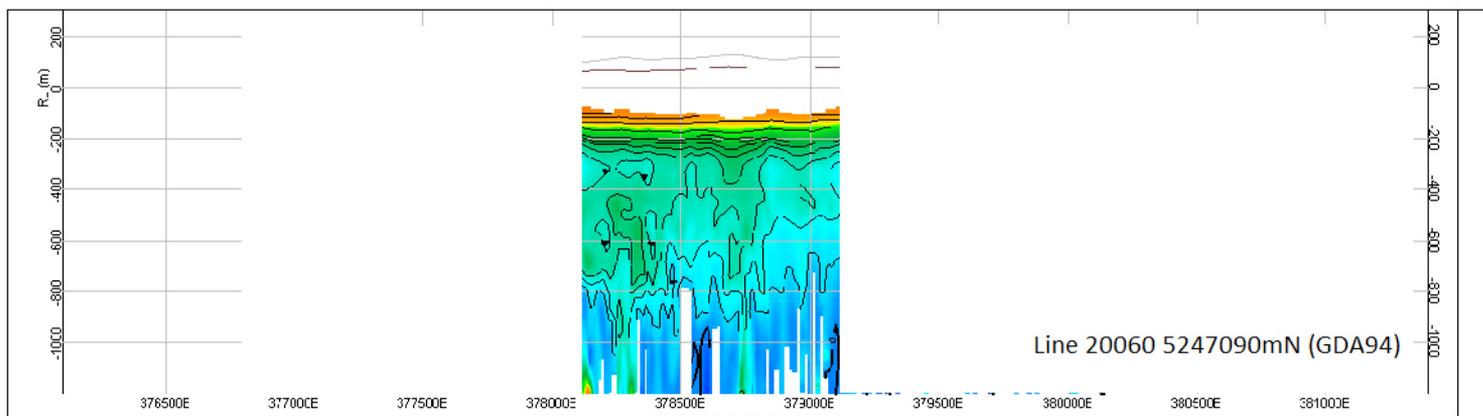
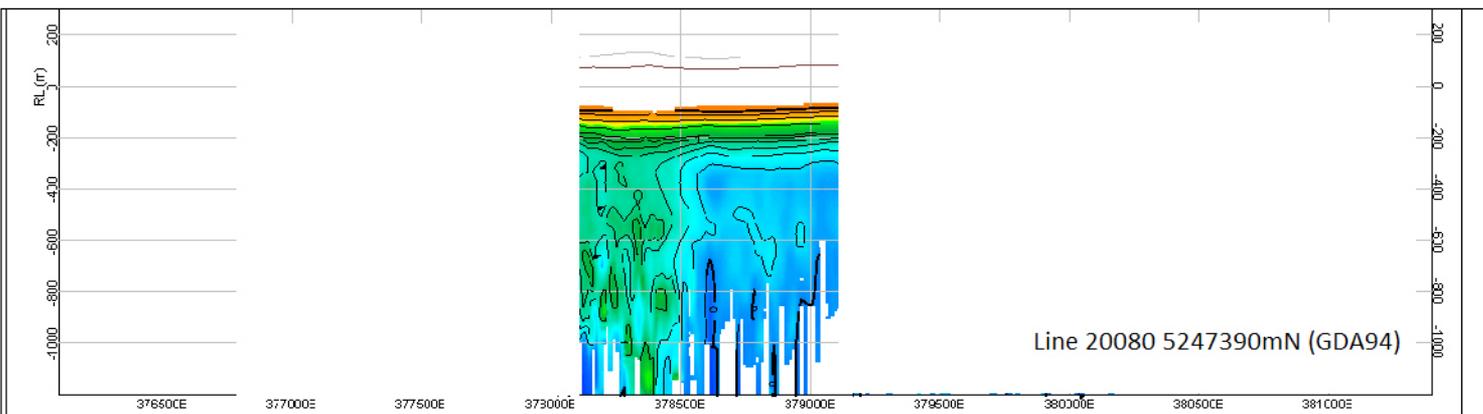
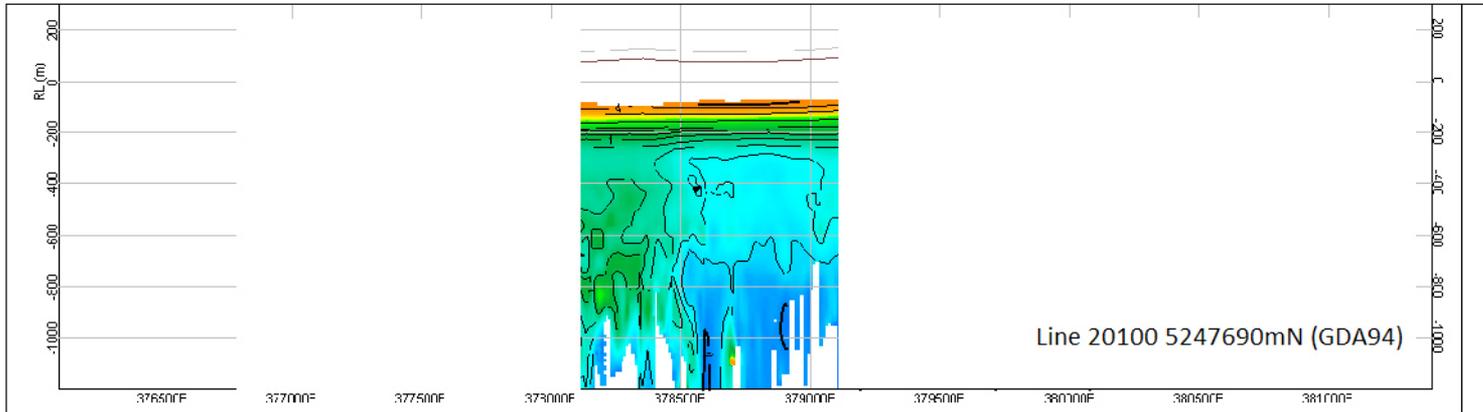


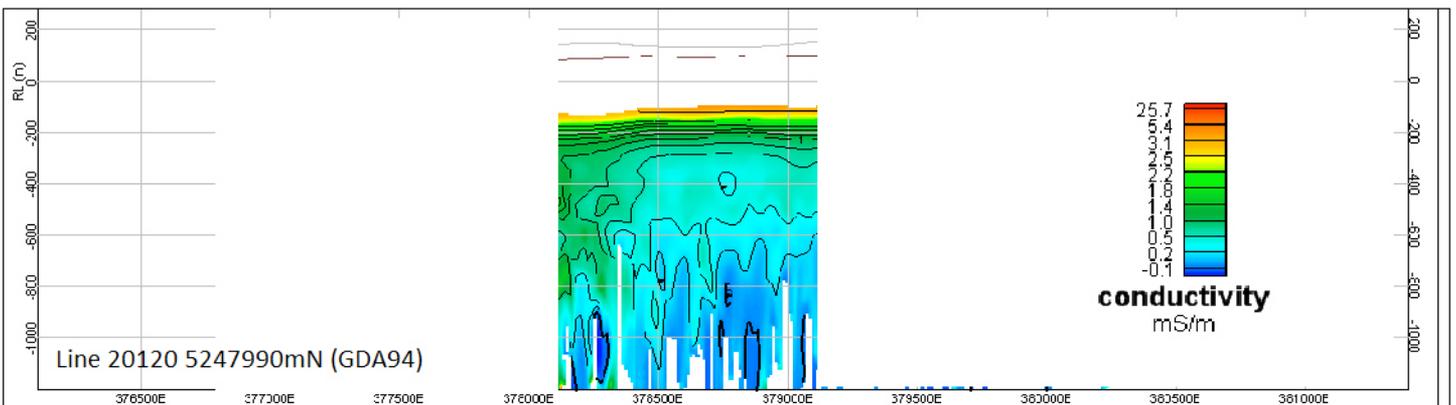
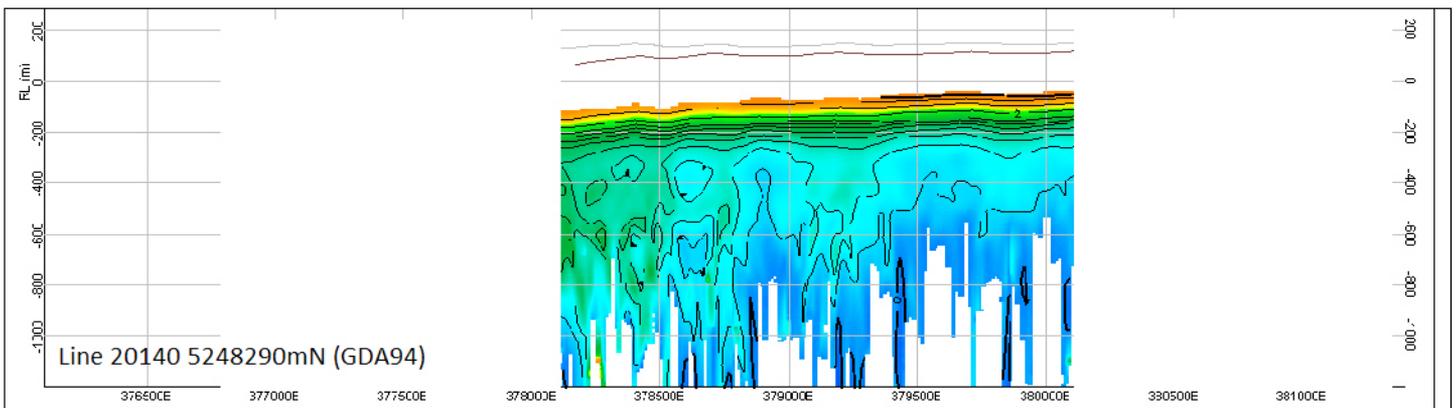
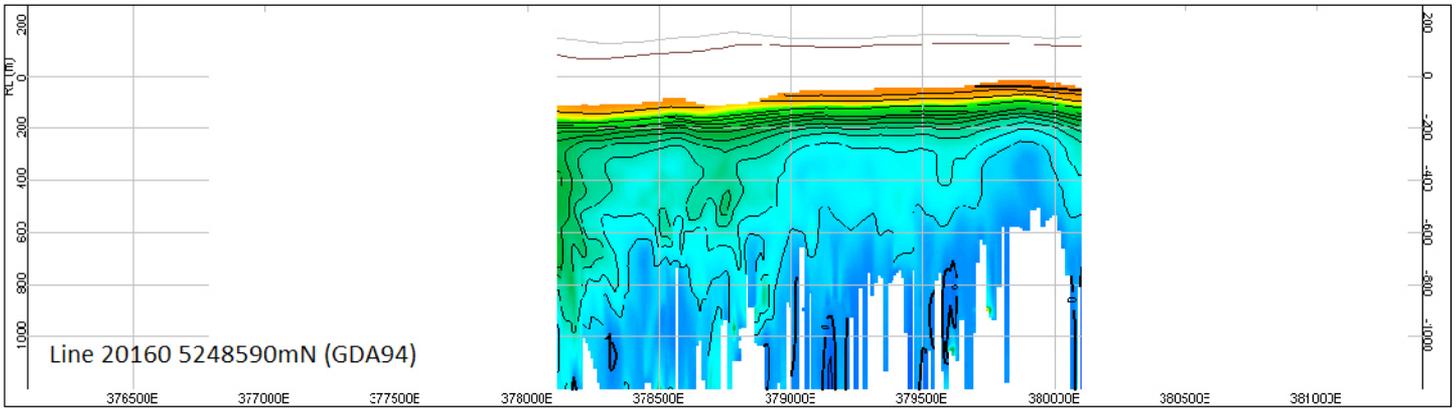
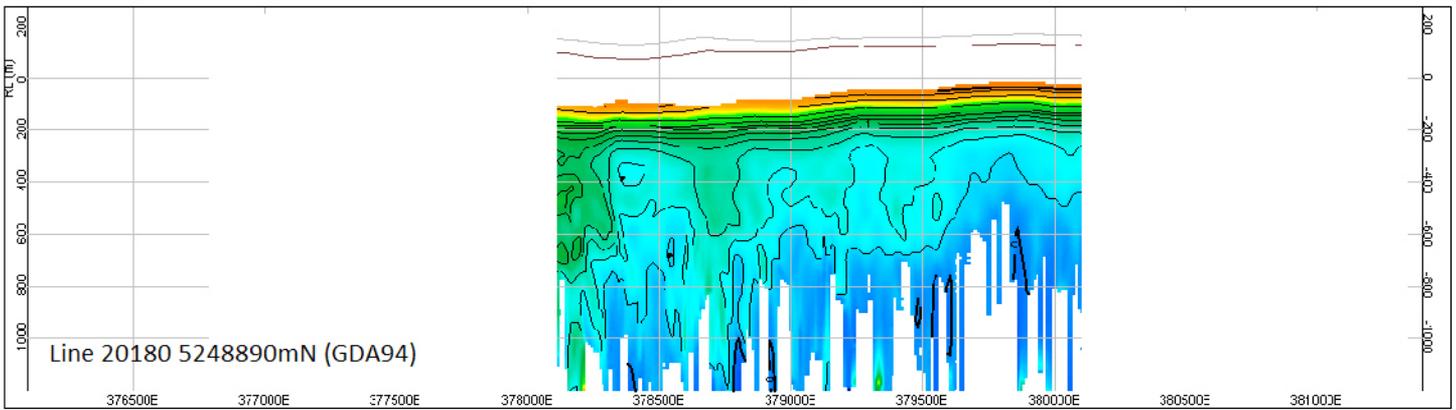
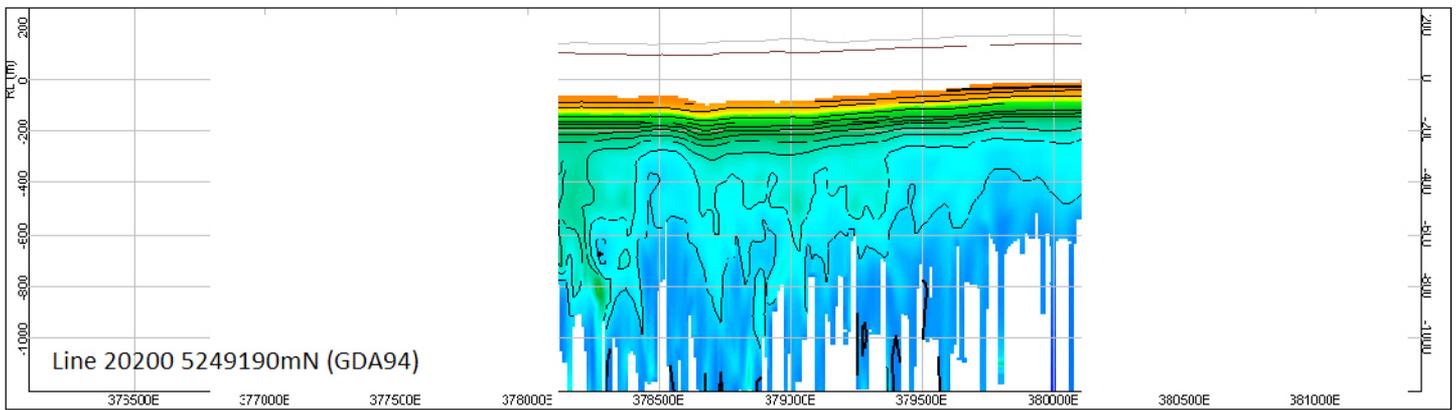
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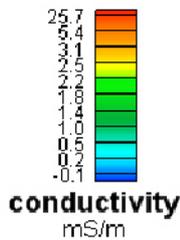
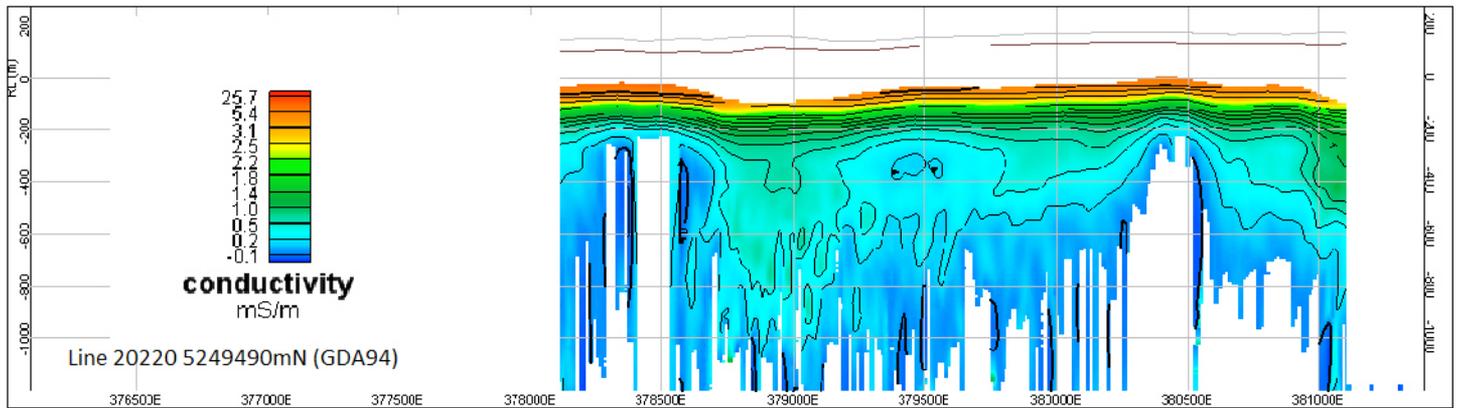
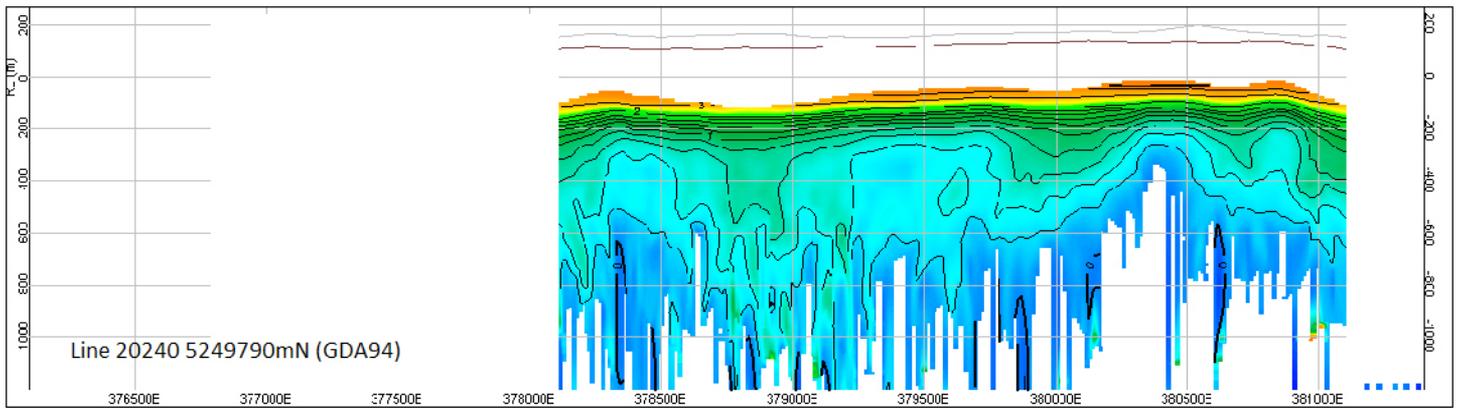
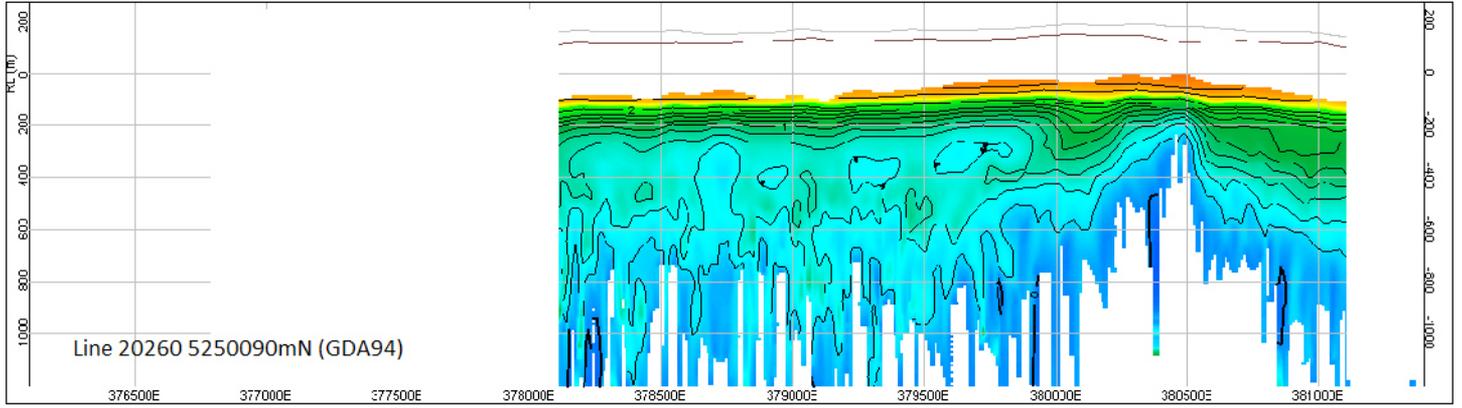
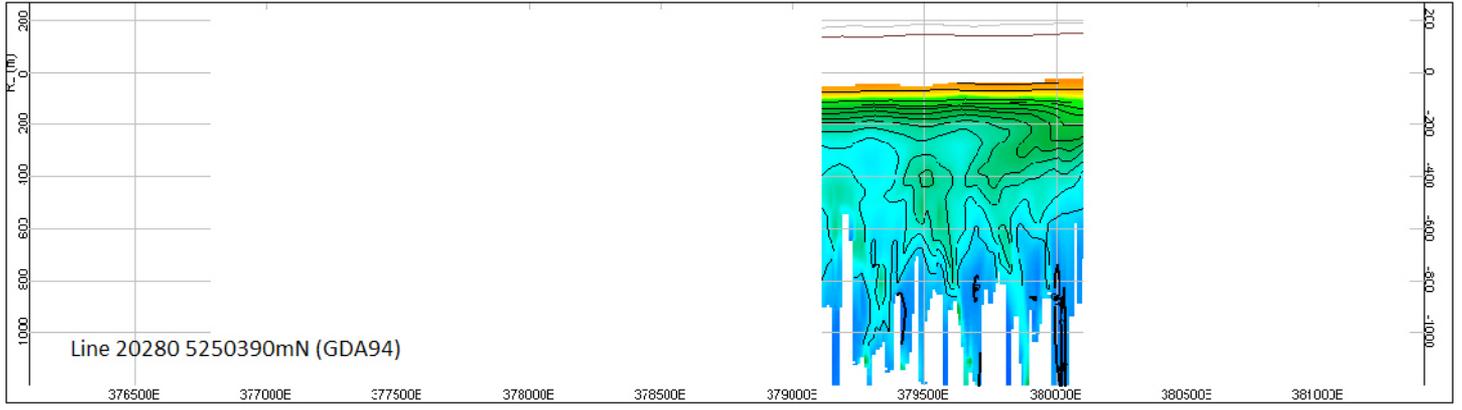
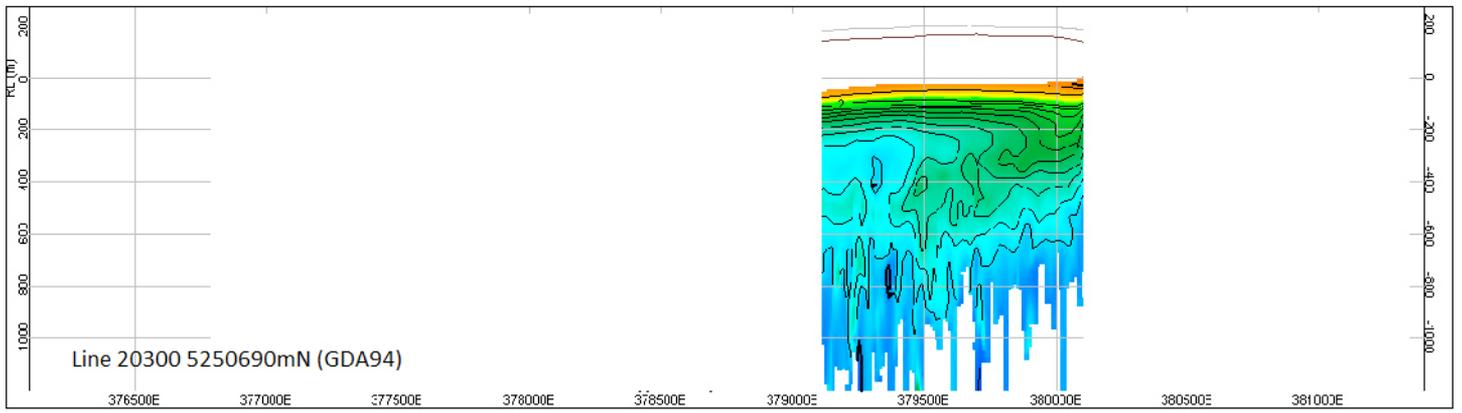


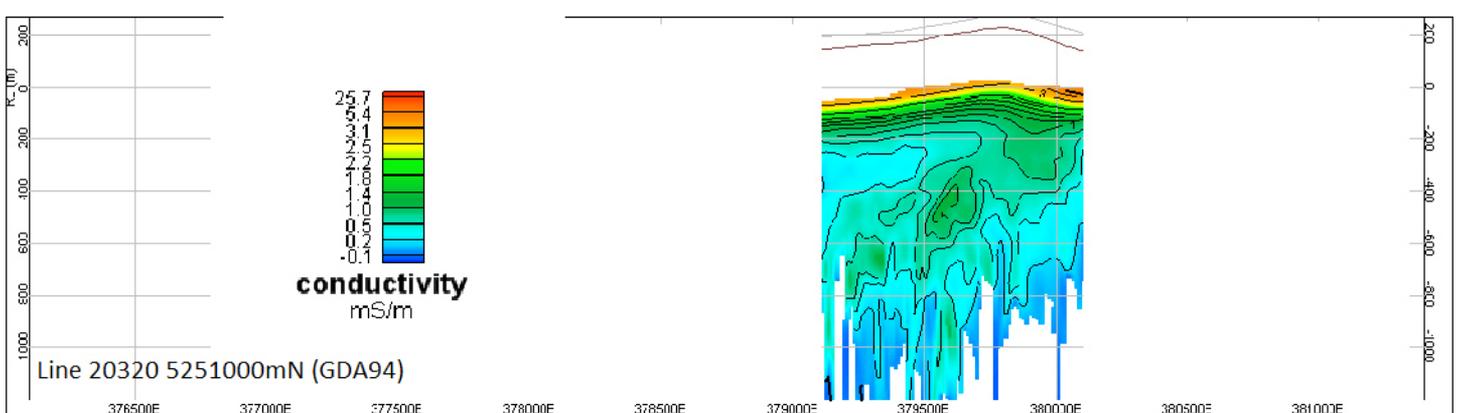
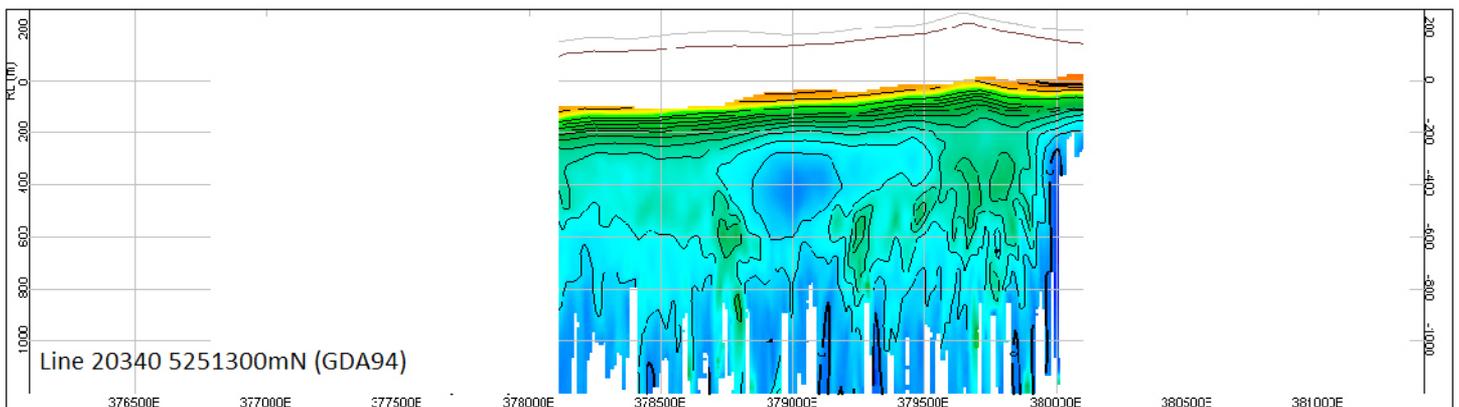
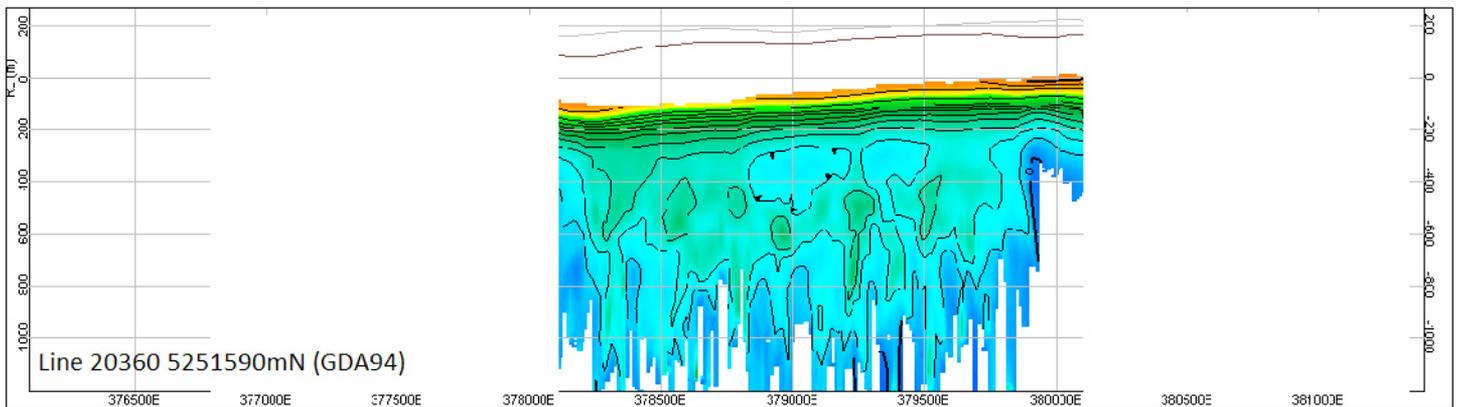
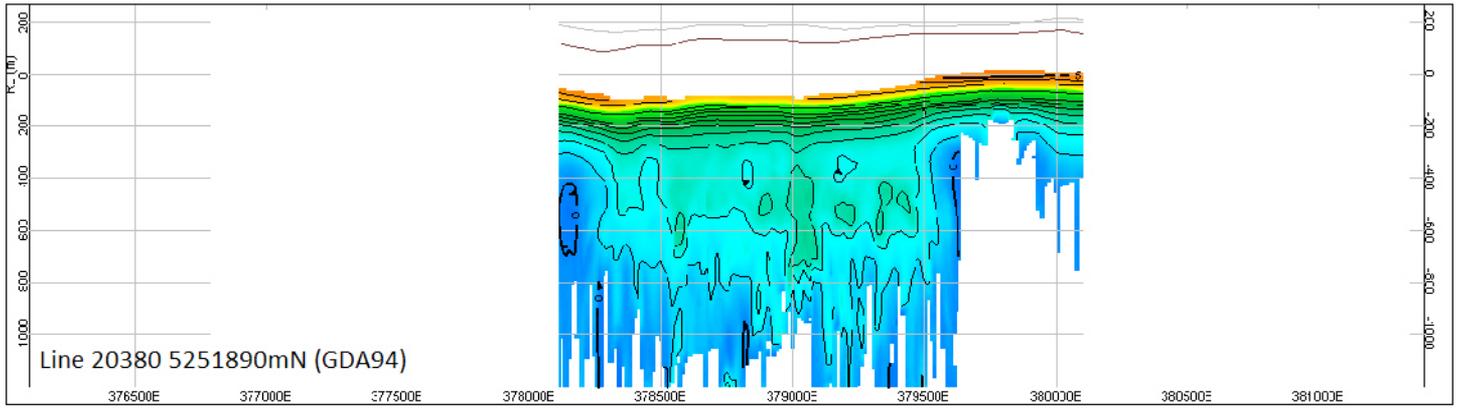
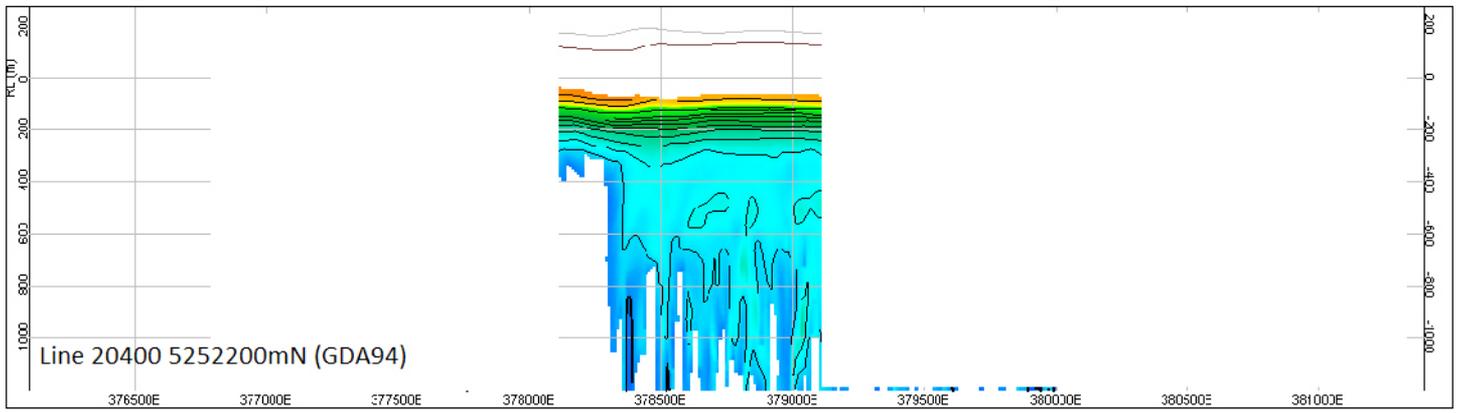


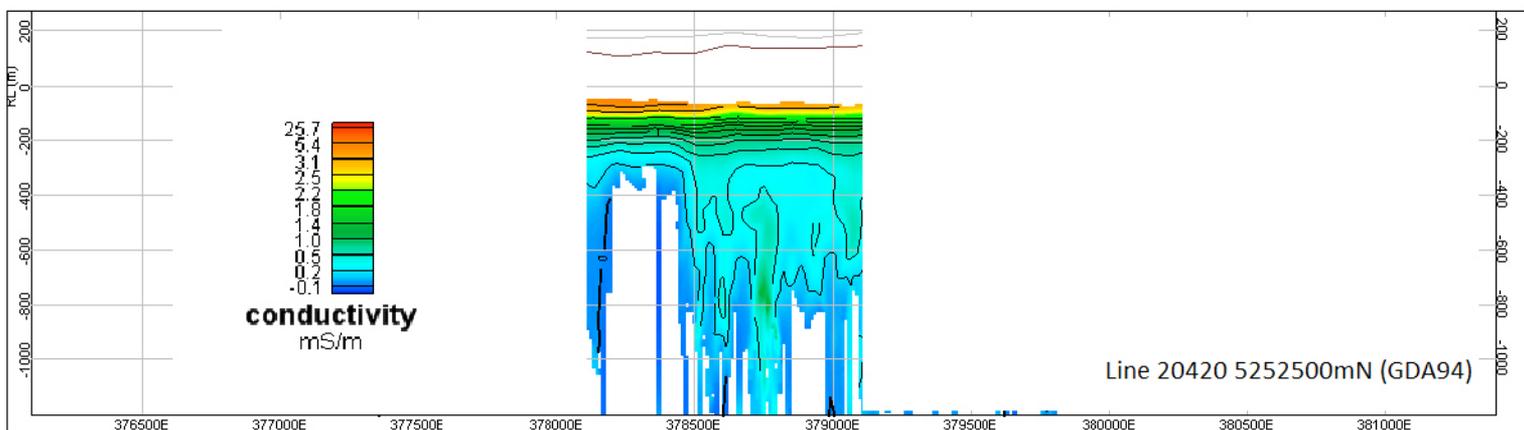
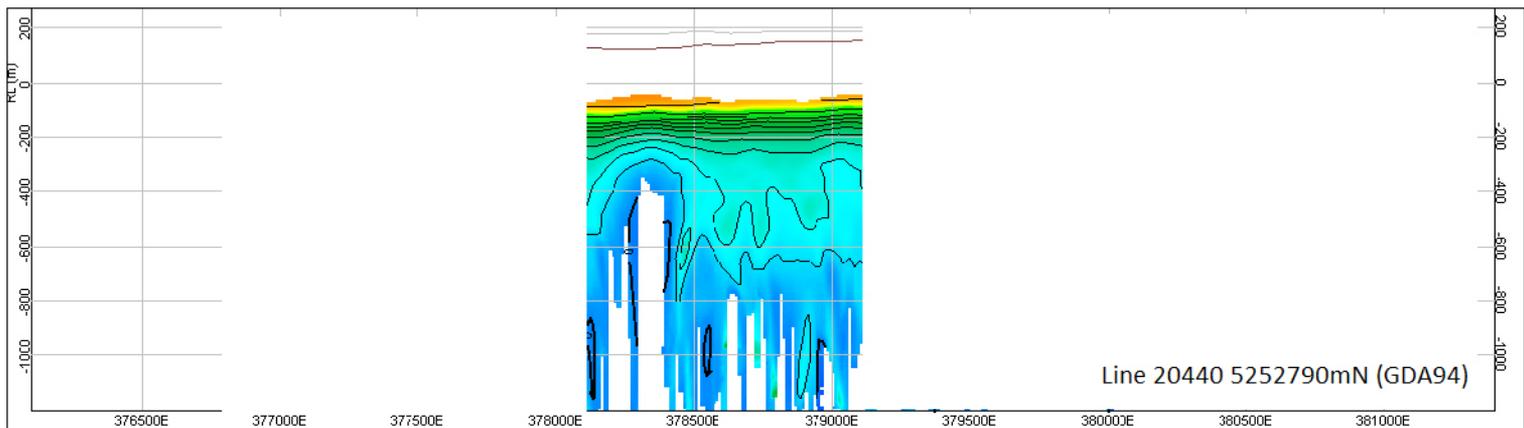
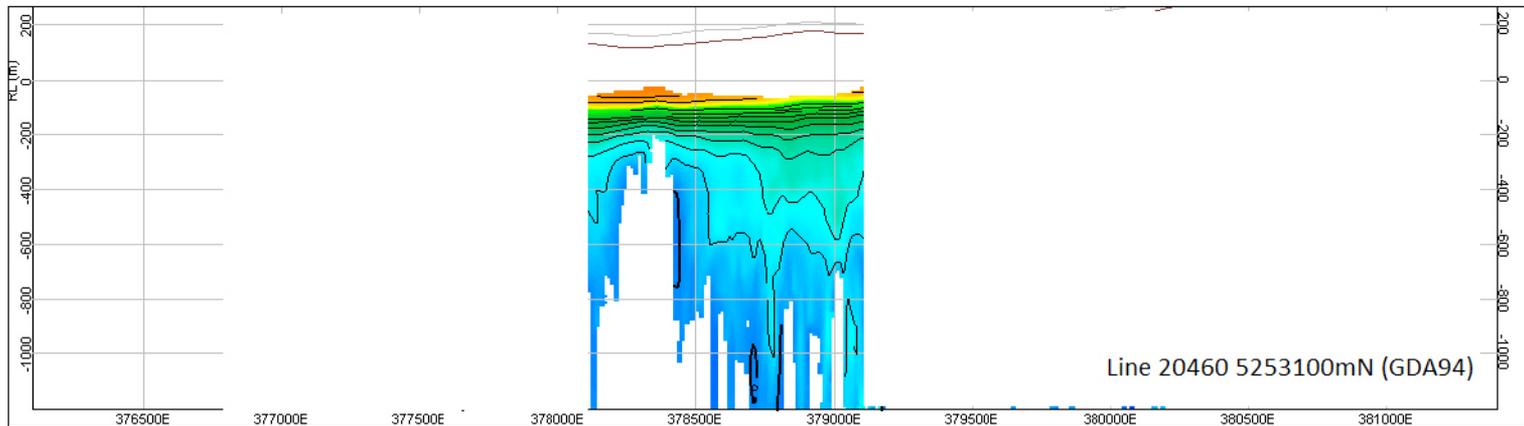
Alexander Prikhodko, PhD, P.Geol  
**Geotech Ltd.**  
April 2011

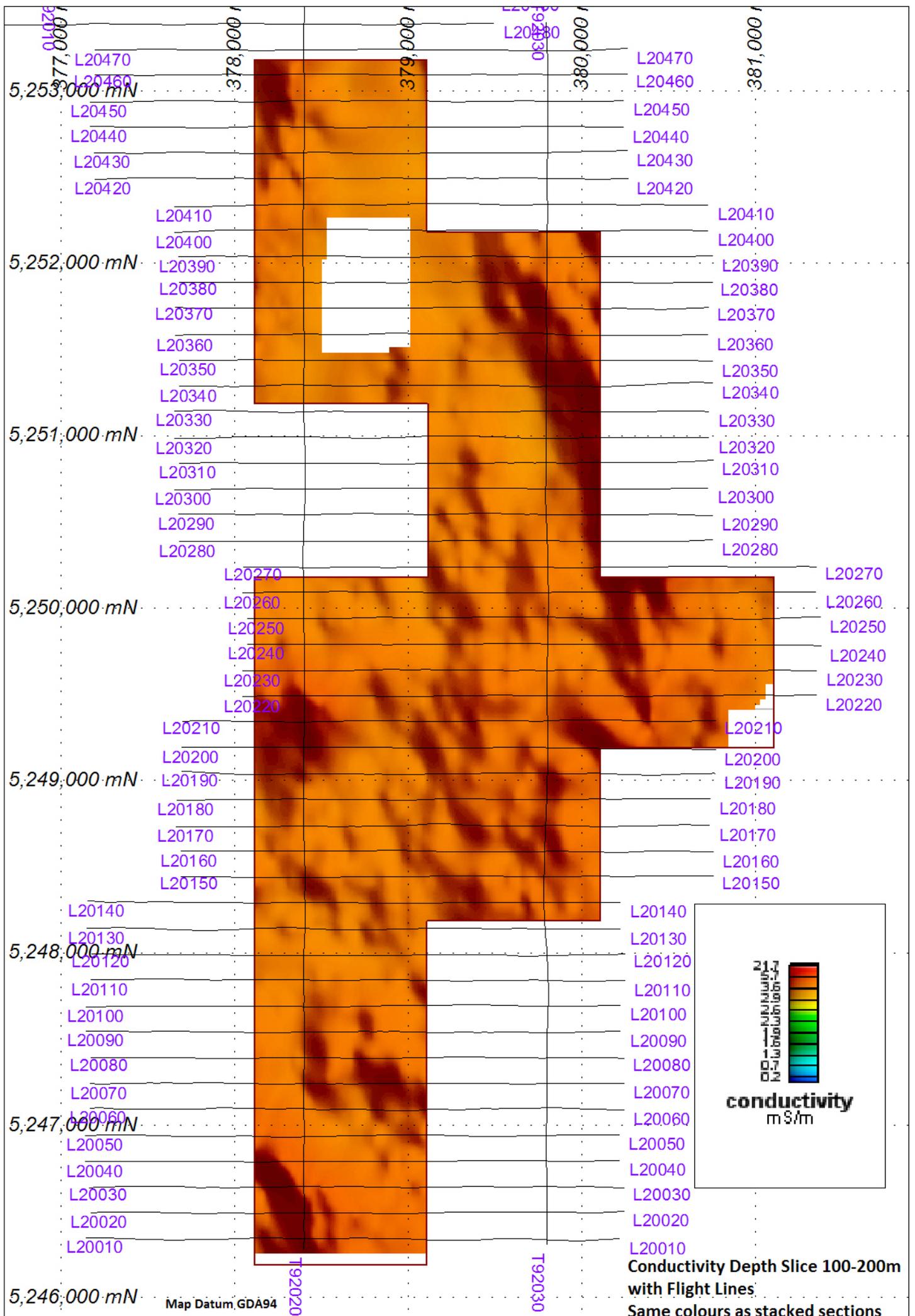


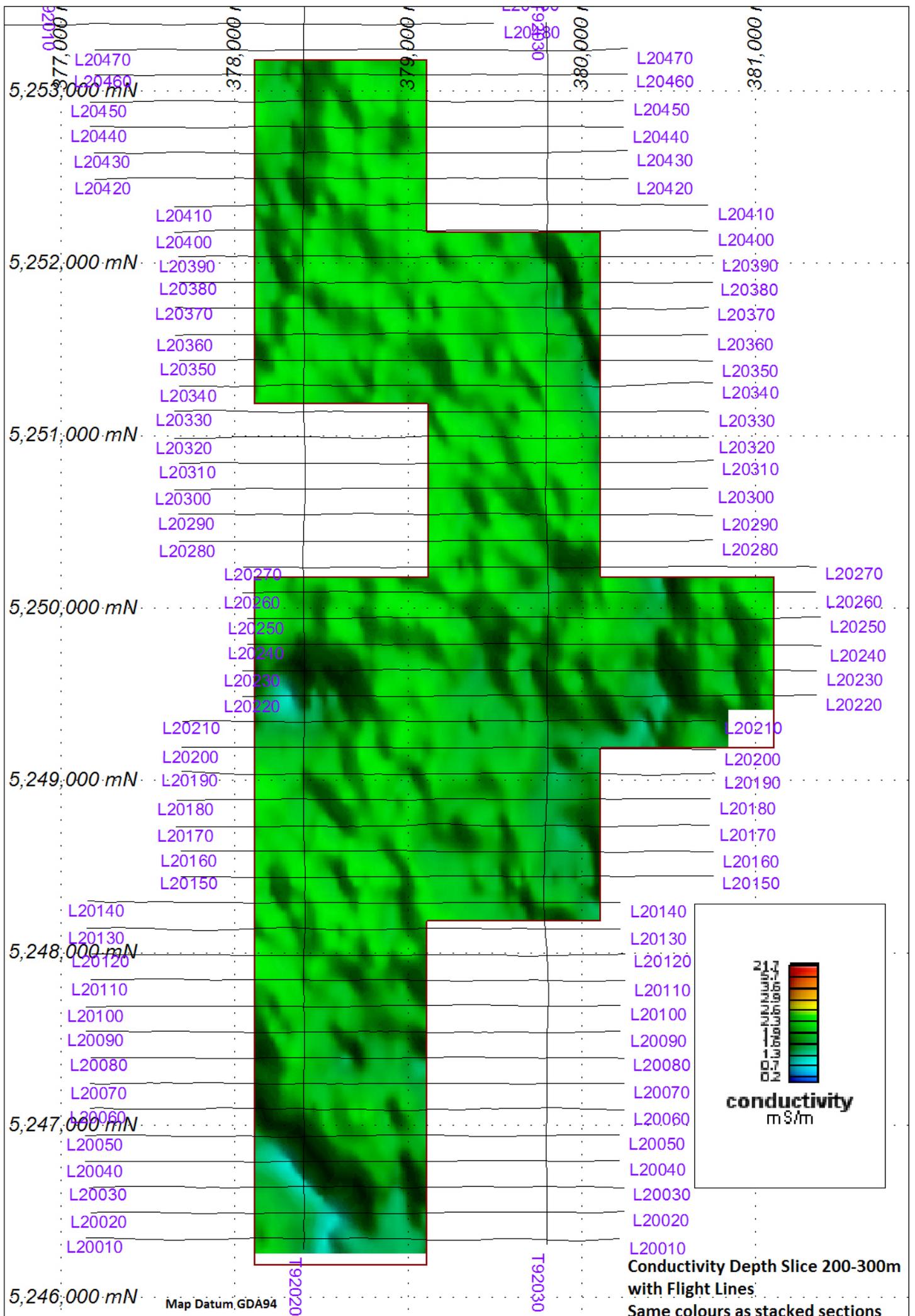




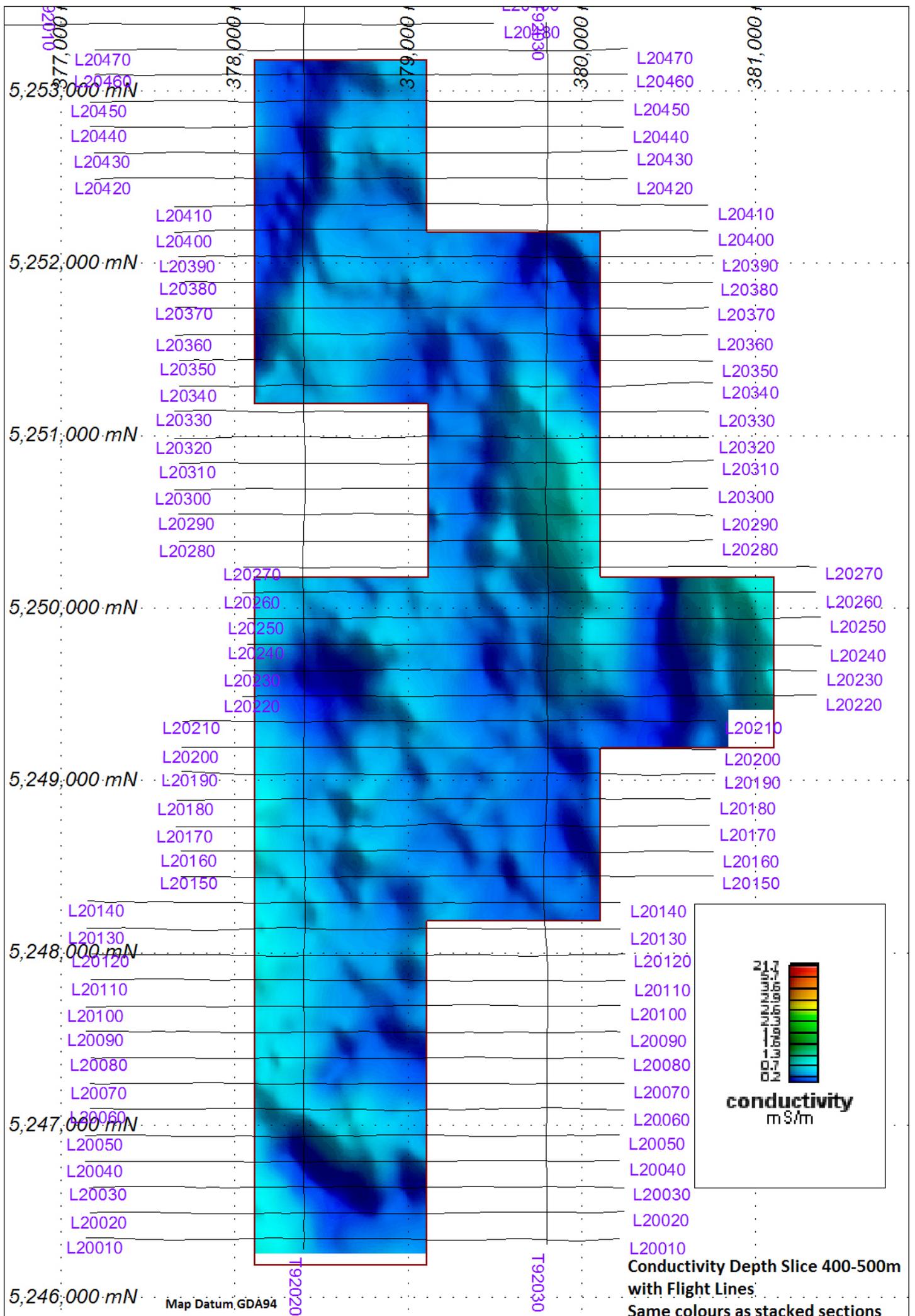






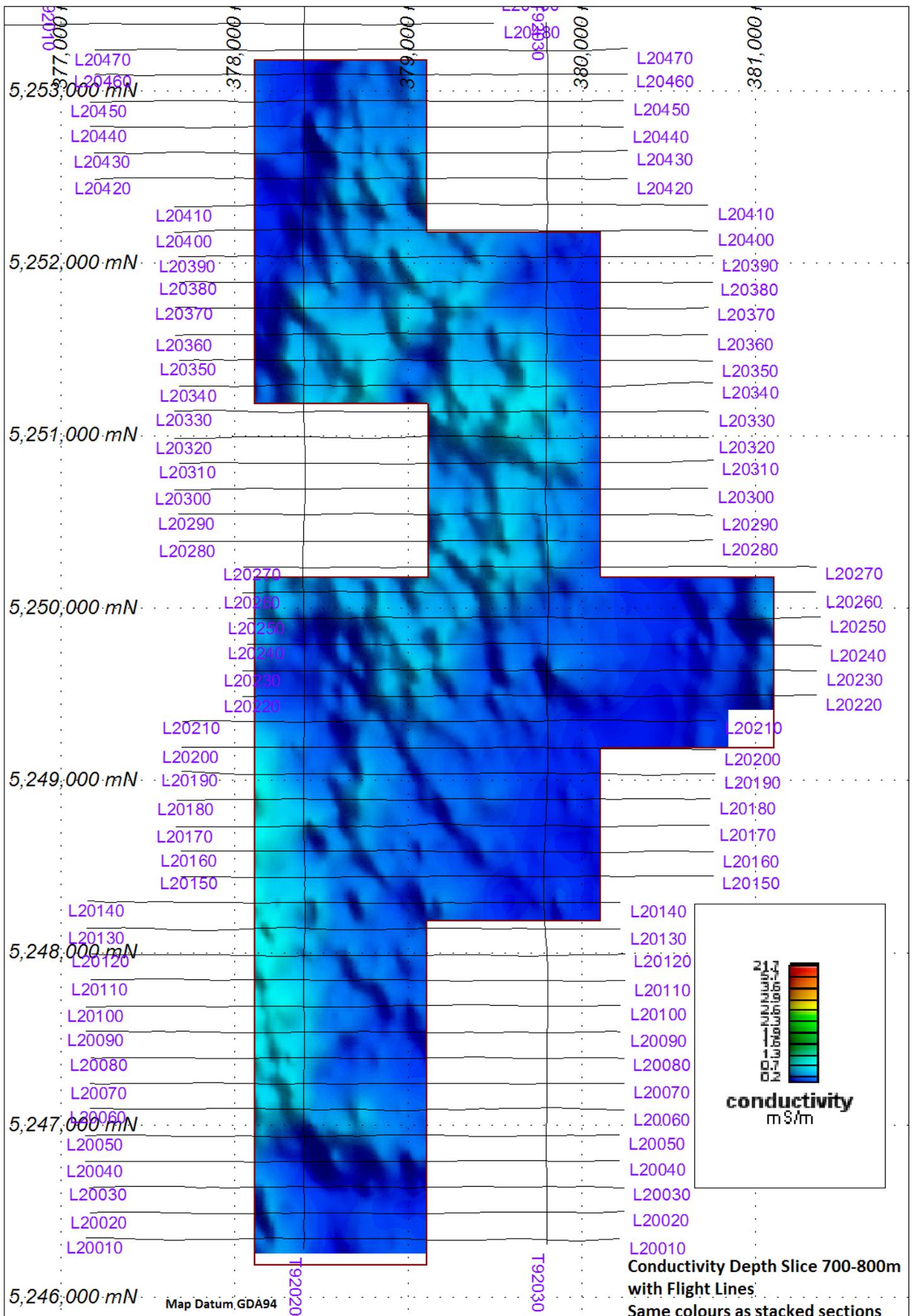


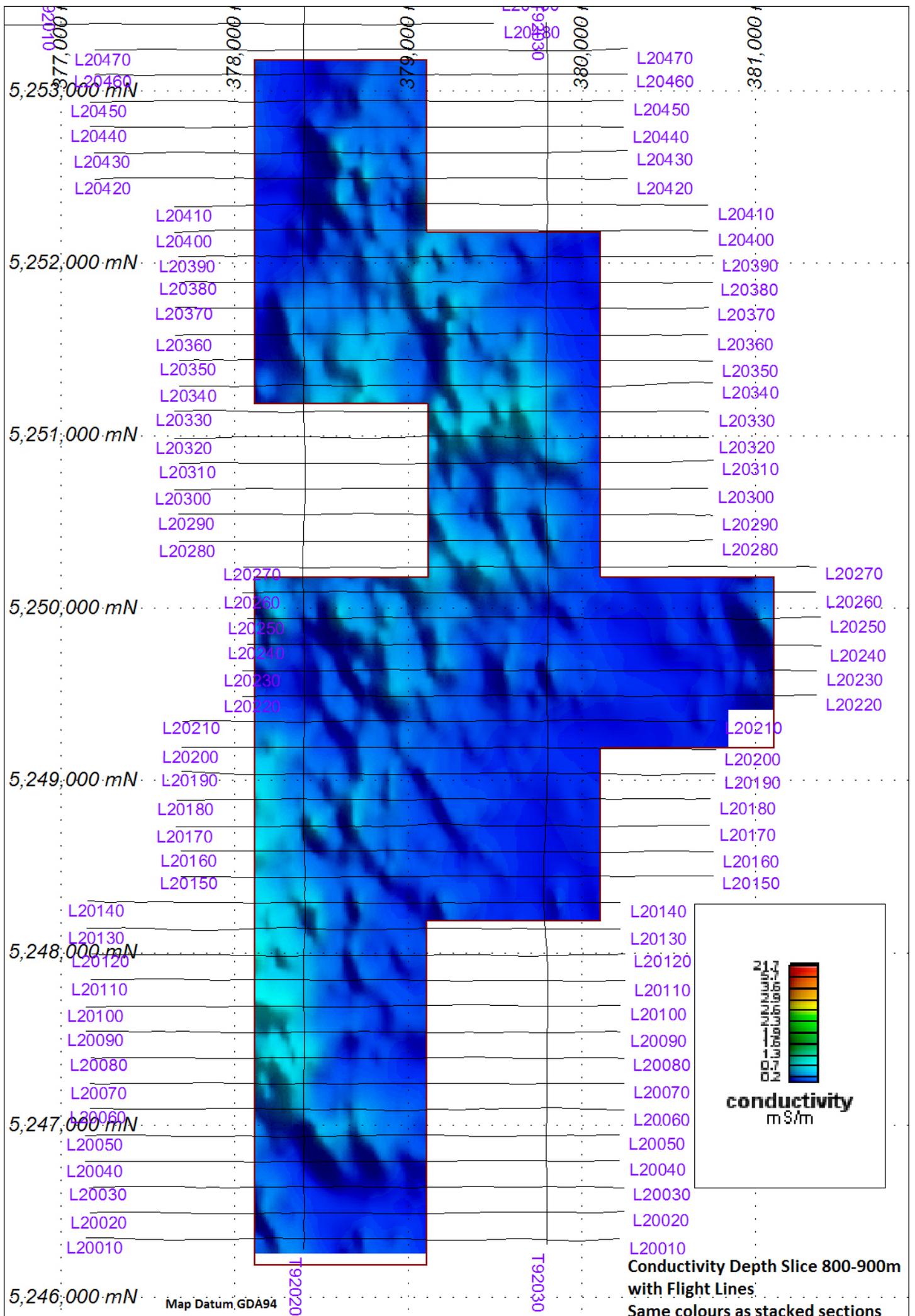


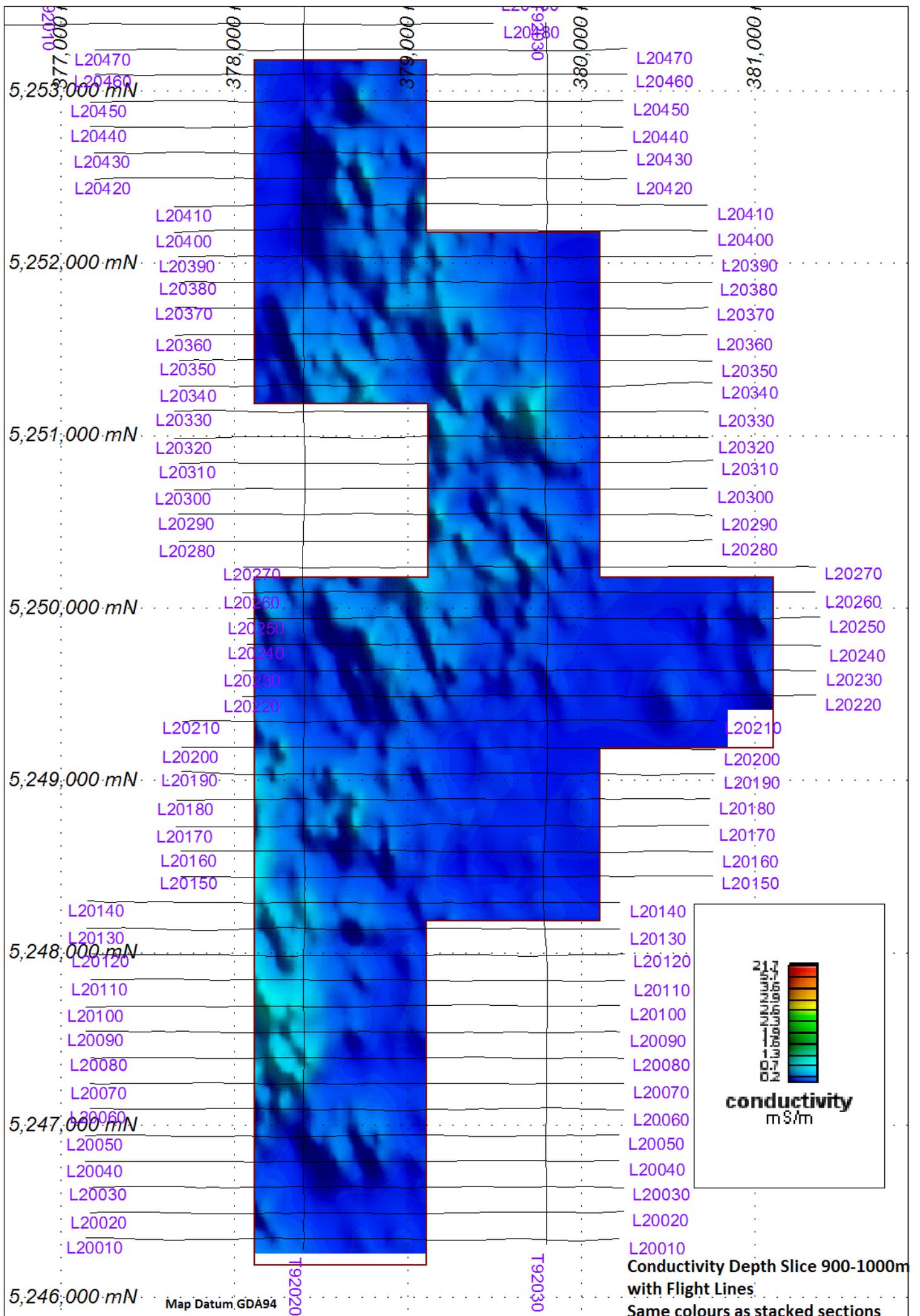


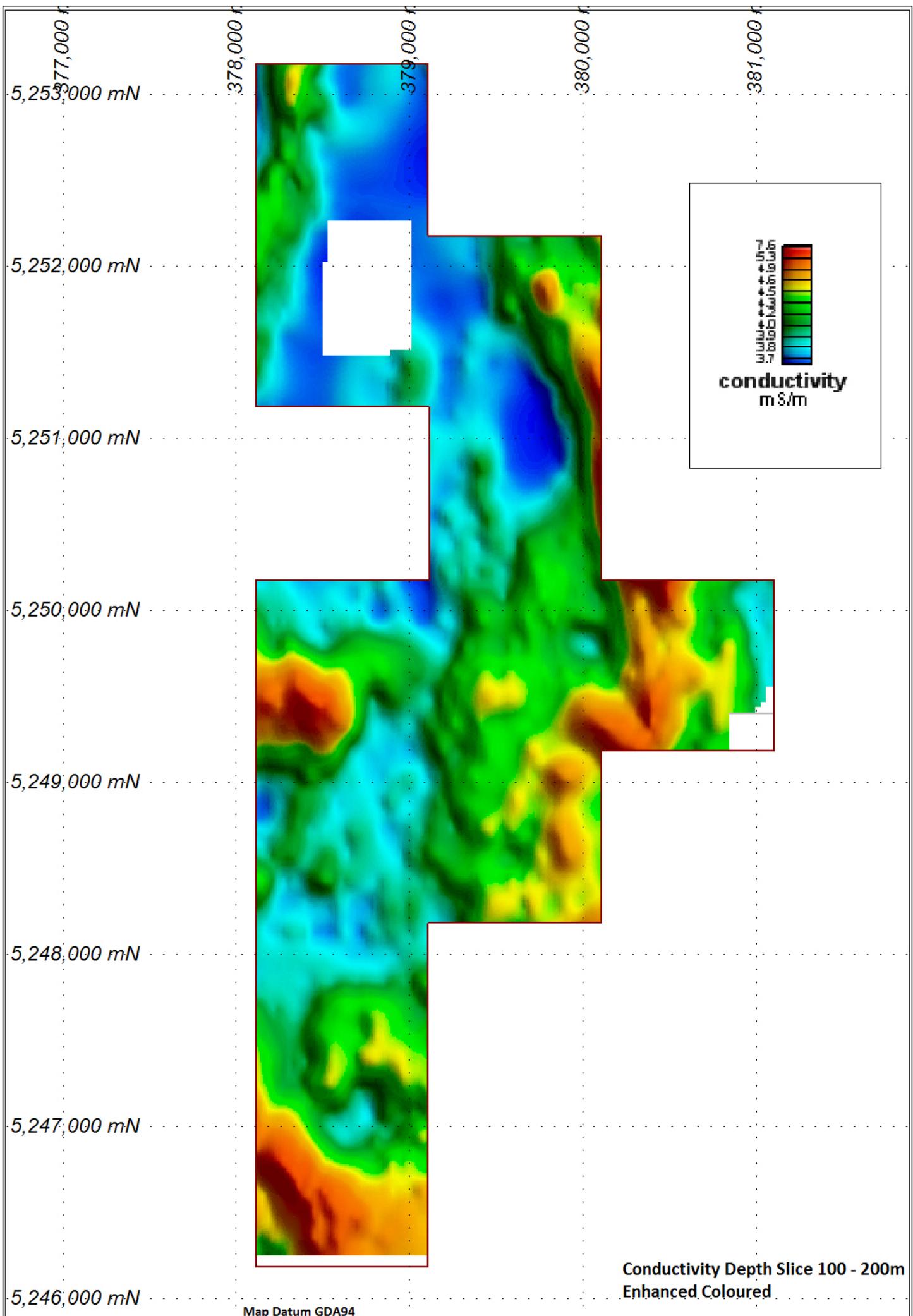






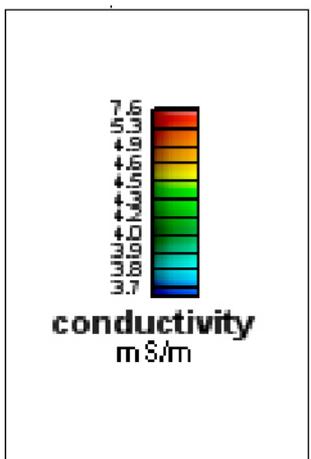






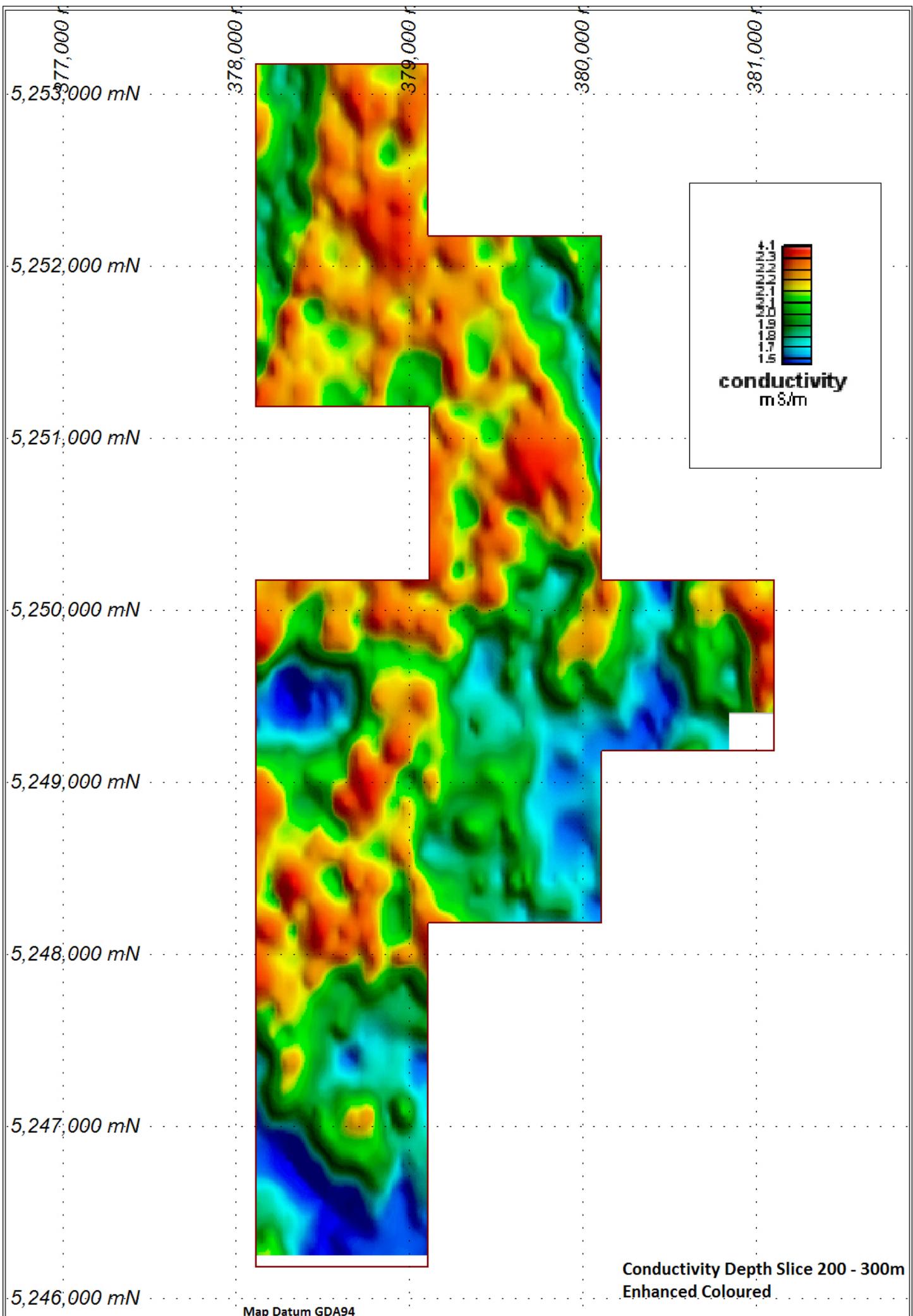
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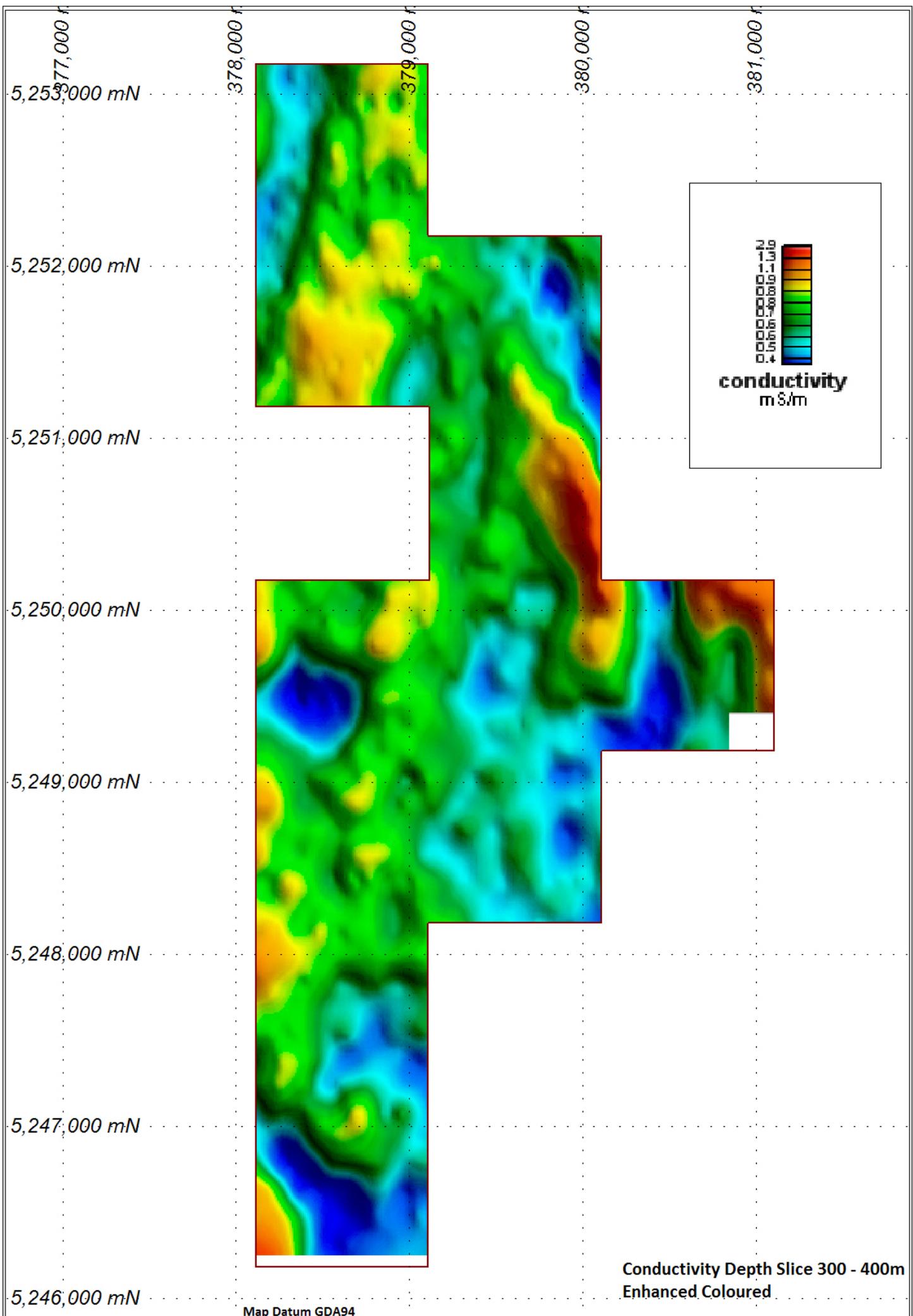
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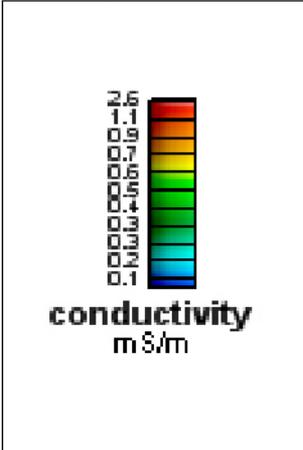
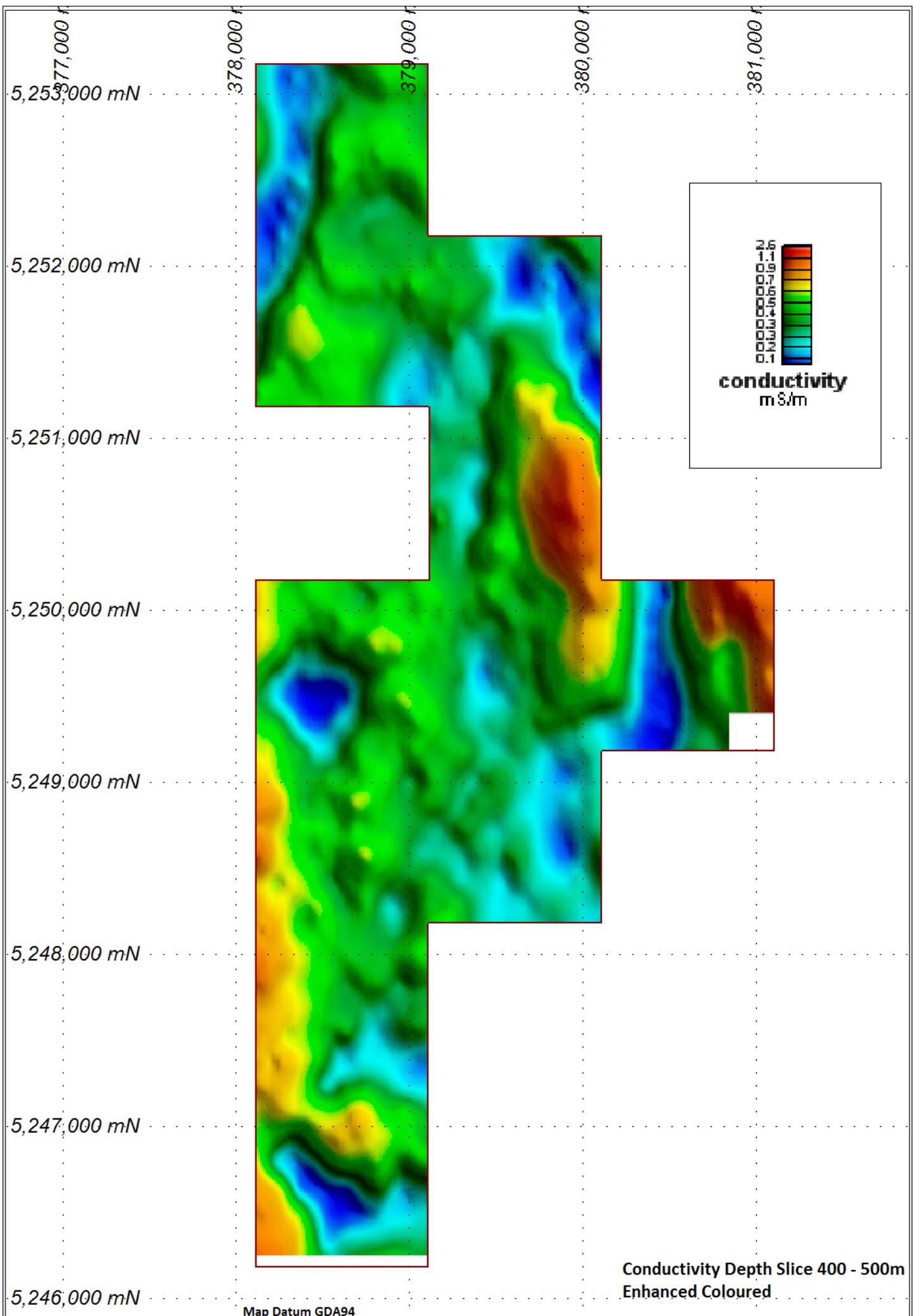


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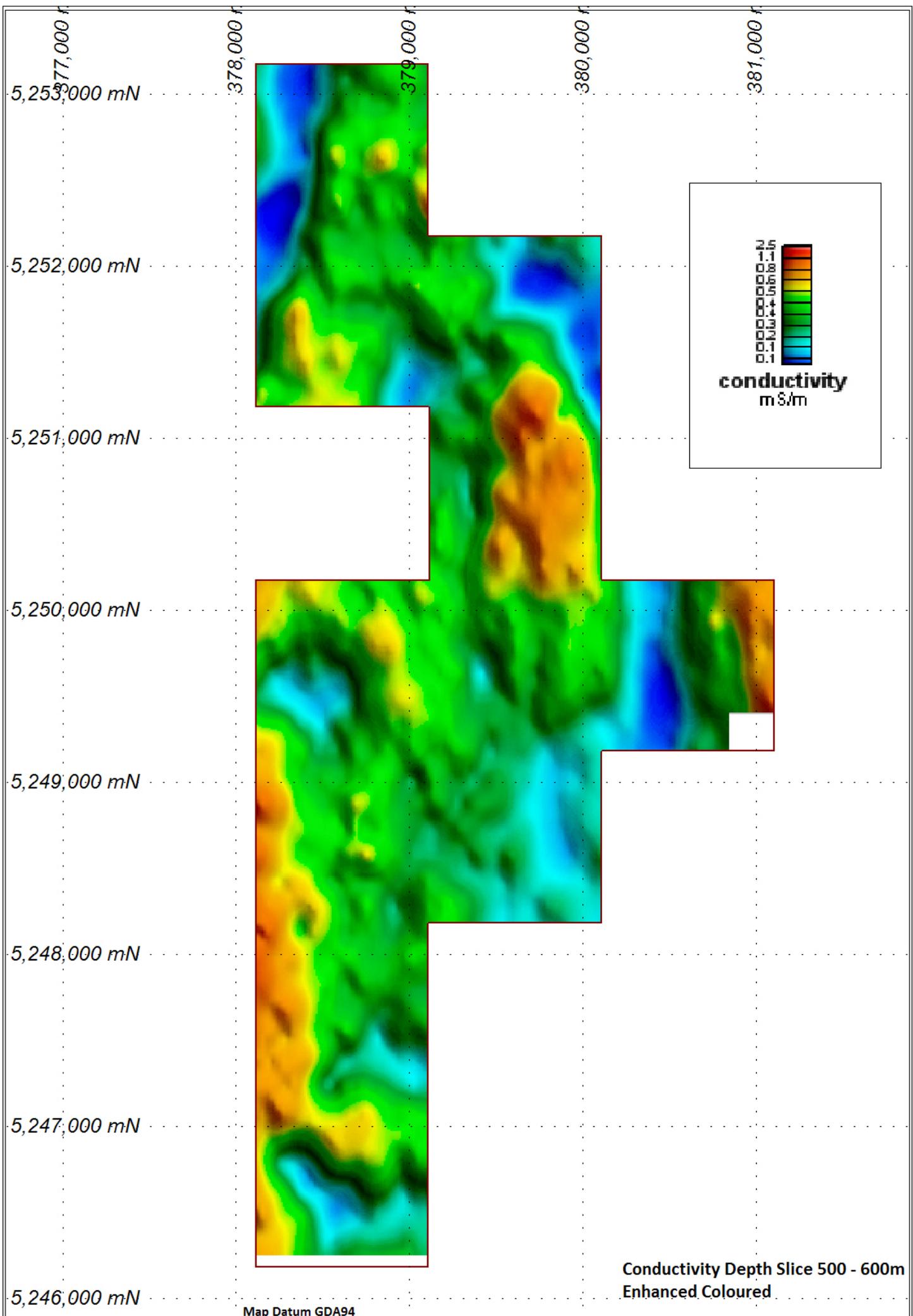


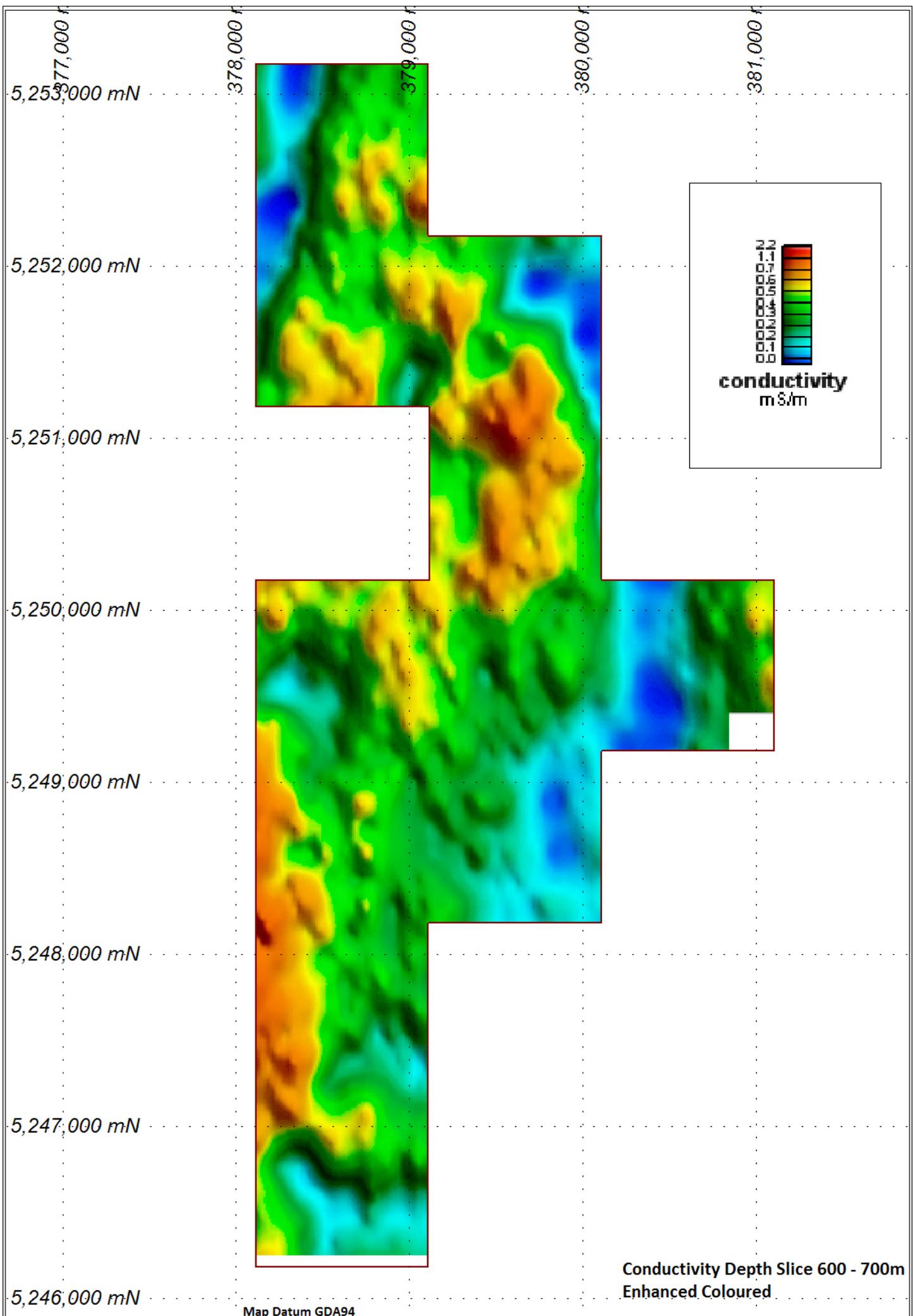


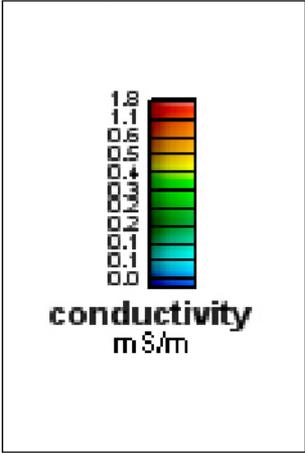
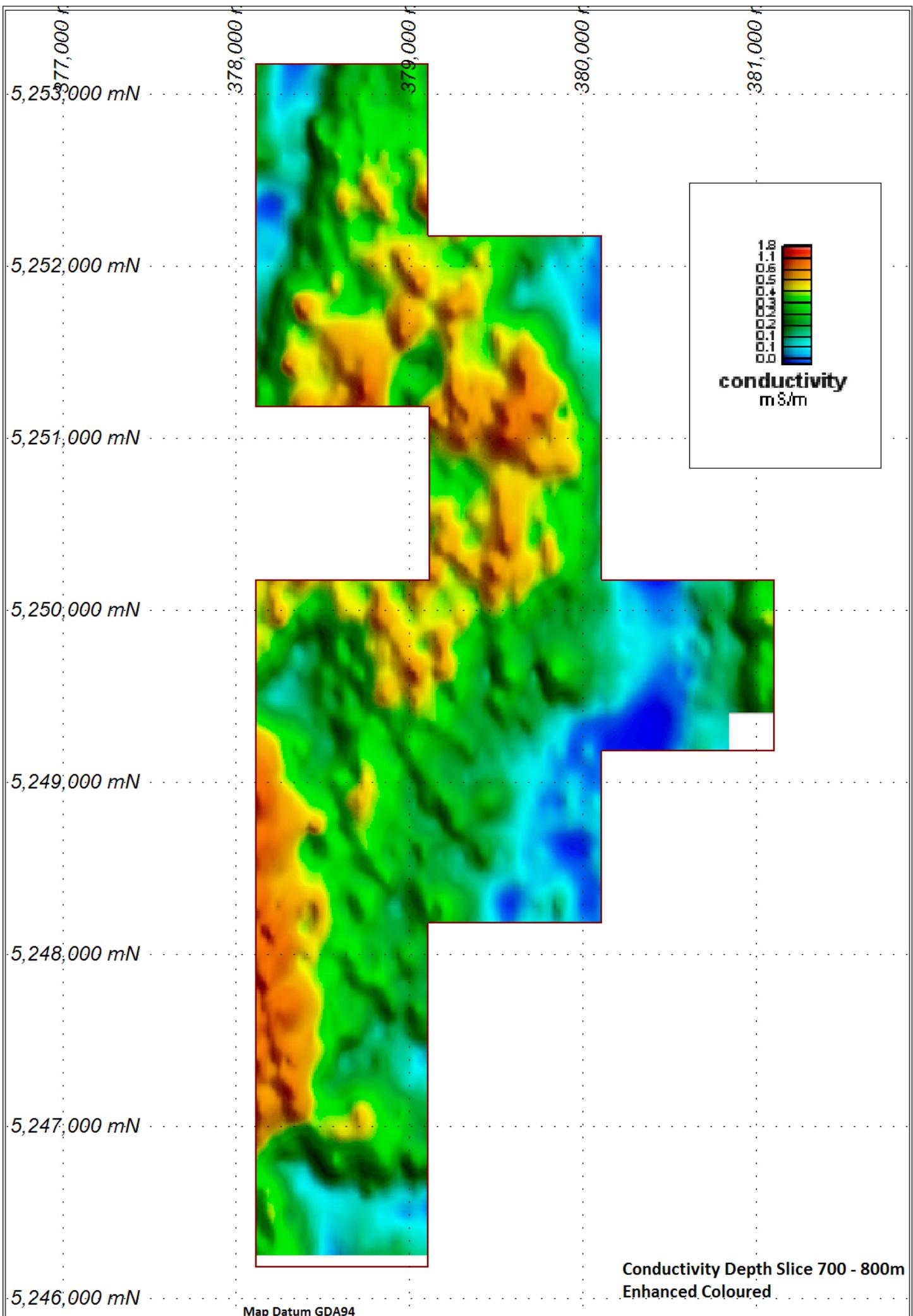


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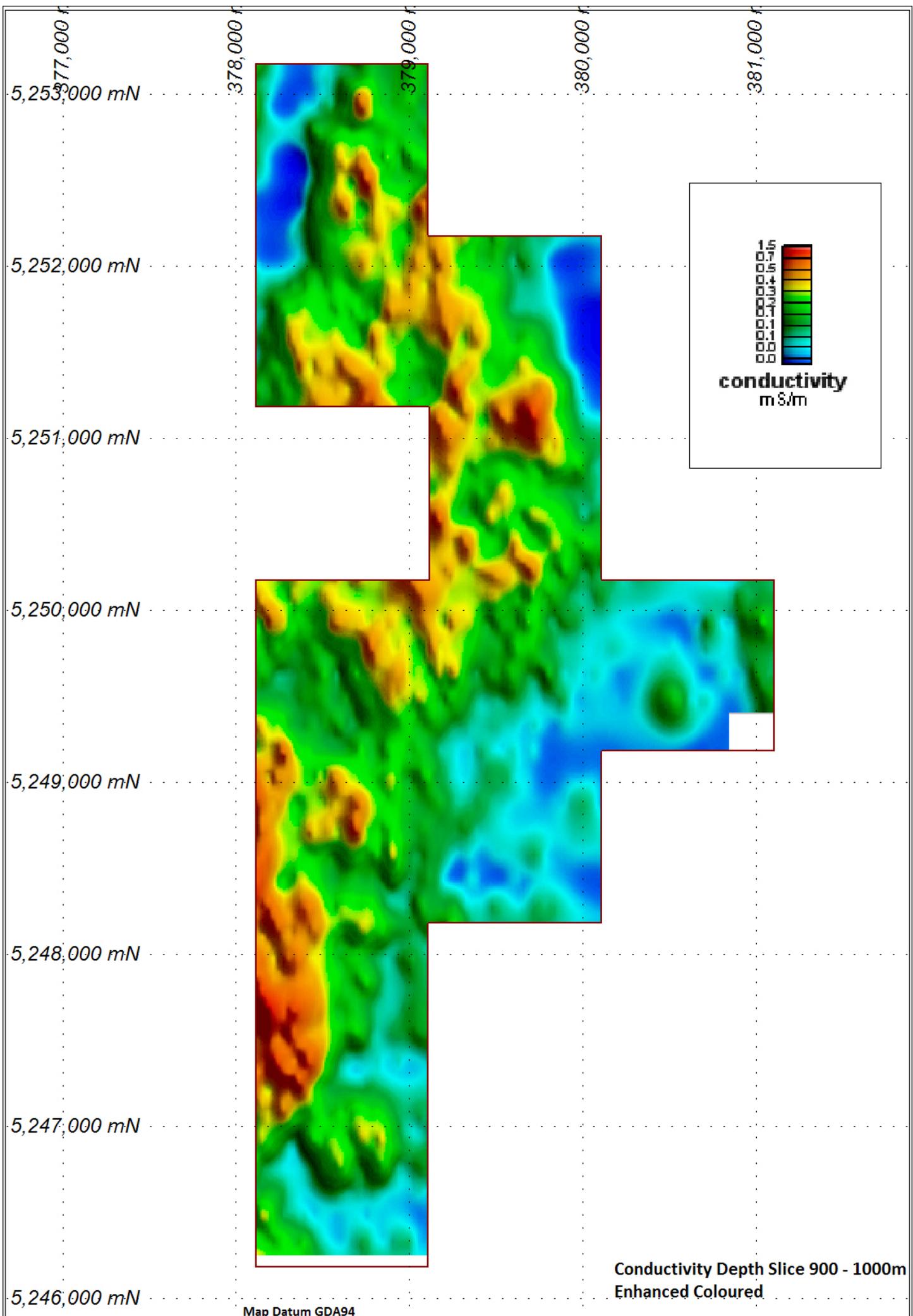


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Conductivity Depth Slice 700 - 800m  
Enhanced Coloured





**Frontier Resources Ltd**  
**Wart Hill Massive Sulphide Deposit**  
**Resource Estimate**  
**April, 2012**

**Grant MacDonald - B.Sc. (Hons)**  
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## Executive Summary

### Resource

The resource estimate for the Wart Hill massive sulphide deposit has been classified as Inferred Mineral Resources in accordance with the guidelines as set out in the Joint Ore Reserves Committee (JORC) Code (2004). The resource category is based on the robustness of the various data sources and particularly the level of geological knowledge and confidence in interpretation coupled with the overall drilling density.

At a 0g/t Au equivalent cut-off (i.e. including all material within wireframes) stands at:

**Central Zone 309,200t @ 0.12g/t Au, 25g/t Ag, 0.03% Cu, 1.03% Pb and 2.16% Zn (= 1.8g/t Au equivalent)**

**South Zone 356,200t @ 0.74g/t Au, 48g/t Ag, 0.14% Cu, 2.29% Pb and 4.44% Zn (= 4.33g/t Au equivalent)**

**Total Resource 665,400t @ 0.45g/t Au, 37g/t Ag, 0.09% Cu, 1.7% Pb and 3.38% Zn (= 3.15g/t Au equivalent)**

At a 5g/t Au equivalent cutoff the total resource is

**167,300t @ 1.14g/t Au, 74g/t Ag, 0.22% Cu, 3.9% Pb and 7.7% Zn (= 7.1g/t Au equivalent).**

The South Lens resource is wholly contained within the South Zone. The resource contained within the South Lens is presented in table 8.5. At a 0g/t Au equivalent cutoff the resource in the South Lens (wholly contained within South Zone) is;

**South Lens 46,500t @ 1.45g/t Au, 70g/t Ag, 0.27% Cu, 4.1% Pb and 8.03% Zn (= 3.15g/t Au equivalent)**

### Geological Model

Mineralisation at the Wart Hill massive sulphide deposit consists of disseminated sulphides, allochthonous clasts and in-situ pods of high grade massive sulphide of Volcanic Hosted Massive Sulphide (VHMS) style hosted within a largely volcanoclastic sequence.

The mineralised zone to consist of two separate zones offset at around 5,251,520mN with the southern end of the Central Zone between 30m-60m west of the northern end of the South Zone (the North Zone was not modelled and is uneconomic)..

The Central Zone outcrops over a short strike length and has dimensions of 170m vertically x 155m horizontally, dips -70 degrees to the west and ranges in thickness from a few metres to about 10m in thickness.

The South Zone also outcrops over a short strike. It has dimensions of 260m vertical x 165m horizontal and ranges in thickness from less than 0.5m up to 7m in thickness. It too dips at around -70 degrees to the west.

(Wholly) within the South Zone a discrete lens of massive sulphide can be recognised which is named the South Lens.. The South Lens is 90m x 90m and varies in thickness from less than 0.2m up to 5m.

### Block Model

Two block models were created with the larger model, *wart\_hill\_zones.mdl*, incorporating the Central and South Zones and a smaller separate model created for the South lens, *south\_lens.mdl*.

Both models used 5m x 5m x 5m blocks with sub-blocking to 0.625m in order to capture narrow zones.

Both models orientations are AMG north-south and east west which accords with the drill grid which is AMG east-west.

The estimation used Surpac's inverse distance squared methodology. A spherical search ellipse with radius of 100m, minimum samples 2 and maximum samples 20 was used.

Au, Ag, Cu, Pb and Zn were all estimated in this way. Au equivalent was calculated using the following metal prices as of 21<sup>st</sup> May 2012 i.e. Au equivalent (g/t) = [0.0178273 x Ag (ppm)] + [0.0001524 x Cu (ppm)] + [0.0000379 x Pb (ppm)] + [0.000372 x Zn (ppm)].

### **Recommendations**

Upgrading the resource category would require;

- thorough drillcore relogging and geological interpretation
- infill drilling in strategic positions to unequivocally demonstrate the strike continuity of the mineralised zones

The best potential to extend the current resource zones are at depth to the south of the South Zone and again at depth to the north of the Central Zone.

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## **1.0 Introduction**

### **1.1 Scope of Work**

The aim of the resource estimation work detailed herein was to model and estimate the resource of the Wart Hill massive sulphide deposit. Geological uncertainties and the need to include a number of styles of mineralisation (in-situ, clastic and disseminated sulphide) mean the estimation lies at the optimistic end of the spectrum. Two zones were recognised and modelled and named the Central Zone and the South Zone.

A secondary aim was to model the South Lens (arguably) in-situ massive sulphide lens which constitutes part of the South Zone.

### **1.2 Participants**

The resource estimation work was carried out by the author who has had over 10 years' experience in exploring and understanding volcanic hosted massive sulphide (V.H.M.S.) deposits as well as a number of years of experience in resource estimation. Geological data was collected by a number of geologists from Geopeko, Cyprus and Tasgold/Frontier with only limited review by the author.

### **1.3 Principal Sources of Information**

Whilst a small amount of data was generated by the author (i.e. that which relates to recent drillholes WD023, WD025 and WD026), the bulk of the data has come from Frontier's own database compiled by Rob Reid.

This compilation incorporated results from Geopeko's early 1980's drilling (V19/2 and V19/4) and trenching (herein named "TR81\_1" and "TR82\_2" to reflect the trench number of the particular year), Cyprus' later 1980's drilling (WH1, 2, 4, 6, 7, 8, 10, 11 and 12A) and trenching and Tasgold/Frontiers drilling (WD001 to 013, 017 to 019, 023, 025 and 026) over a number of programmes between 2005 and 2012.

### **1.4 Project Location, Access Land Usage**

The deposit lies a few km's inland from the southwest coast of Tasmania near Low Rocky Point. The project area is not accessible directly by road. It is ~45km from the nearest town and road-head Strathgordon to the east and ~85km from the nearest road-head along the coast at Strahan to the north.

The only track to the region, the Low Rocky Point track, leads from a riverbank landing at Birch's Inlet in Macquarie Harbour's south-eastern corner and requires vehicles to be boated across Macquarie Harbour from Strahan.

Alternatively vehicles (tracked and 4WD ATV's) have been barged down the coast and landed directly from the barge onto land in the mouth of the Lewis River, a few km's away from Wart Hill.

The deposit lies within the South West Conservation area. The area was intentionally excluded from the World Heritage Area and conversely included in the Sorell Peninsula Strategic Prospectivity zone.

The land is open heath country sloping gradually to the sea. Apart from Mt Osmund (elevation over 330m), Wart Hill is the highest point in the area at ~210m above sea level. The deposit is at an elevation of 160m above sea level.

### **1.5 Tenure**

The Wart Hill massive sulphide deposit lies in EL 20/1996 "Elliott Bay" which was granted to Exploration and Management Consultants, a private company managed by Peter McNeil, who retain a 10% ownership. The remaining 90% was held by Macmin N.L., then TasGold N.L. and now Frontier Resources Ltd., all manifestations of the same leadership group including Bob and Peter McNeil.

## 2.0 Project History

### 2.1 Exploration and mining history

The Wart Hill massive sulphide deposit is a virgin deposit yet to be touched by mining.

The deposit was discovered in the 1980/81 summer season by a Geopeko exploration team, led by (now) Professor Ross Large, which hand dug small trenches over highly anomalous soils samples taken over an area of (poorly) outcropping hydrothermal alteration and discovered an outcropping lens of high grade massive sulphide known as Lens A. Further trenching in 1981/82 discovered Lens B. Trenching and sampling through each lens defined their widths and grades.

Lens B lies in the South Zone and has been included in the South Zone resource.

**Lens A; 4.0m @ 10.2% Pb, 17.9% Zn, 138g/t Ag and 0.6g/t Au**

**Lens B; 3.0m @ 0.2% Cu, 13.9% Pb, 21.9% Zn, 680g/t Ag and 0.83g/t Au**

Whilst Lens A is from the same mineralised horizon, it lies north of and is offset from the Central and South Zones by a low angle fault, Cyprus Fault. Those drillholes which have tested Lens A downdip have not intersected anything of consequence and hence lens A has not been incorporated in any modelling. It remains incompletely tested and may yet be included into a resource.

To this end the name "North Zone" was consciously not used.

Geopeko drilled three holes in and around the lenses, i.e. V19/1, V19/2 and V19/4, but concluded the lenses were large rafts dislocated from their source (Large, 1981, Wilson *et. al.* 1981, Wilson *et. al.* 1982 and Herrmann, 1983).

Cyprus explored the prospect over two summer seasons in the late 1980's, drilling a number of holes (the WH series) into the zone, making a number of significant intersections and concluding that both in-situ and clastic sulphides are present (Torrey *et. al.* 1987, Torrey *et. al.* 1988 and Poltock, 1989).

Plutonic held the ground for a period in the mid 1990's but did not drill any holes (Herrmann, 1996).

Frontier's personnel became involved in the prospect in the late 1990's through Exploration and Management Consultants (10%) and Macmin (90%), the latter evolving into TasGold then into Frontier who collectively drilled the WD series holes into the zone (Reid, 2005, 2006a, 2006b, 2008 and 2009). A short lived JV with Fimiston Mining NL in the late 1990's saw the drilling of SD1 and SD2, neither used in resource estimate (Fehlberg and Coxhell, 1999).

### 2.2 Previous resource estimates

The only previous resource estimation was carried out by Rob Reid of Frontier Resources Ltd in 2009 using a sectional method and Mapinfo/Discover's estimation algorithm.

Rob states in the executive summary "an inferred resource for the V19 (*Wart Hill*) mineralisation has been calculated utilising a simple block model. Two inferred resource outcomes were generated; being a conservative **460,000tonnes @ 41.5g/t Ag, 0.72g/t Au, 1.81% and 3.41% Zn** and optimistic **600,000tonnes @ 40.5g/t Ag, 0.67g/t Au, 1.74% and 3.30% Zn.**" (Reid, 2006).

His work did not include clastic material, stating "continuity is now demonstrated between intersections with semi-massive to massive primary ore consistently identified in the same stratigraphic position, in part disproving the debris flow model model for occurrence of the primary mineralisation. Note that the debris flow model is still valid locally, but such mineralised intersections are not included in the resource calculation".

Rob defined the main mineralised zones by "geology and a ~25%Zn/\$50/tonne contained metal value". These zones do not include any trench assay data. He used an S.G. of 3.1g/cm<sup>3</sup> determined by assuming 20% (11.5% pyrite, 3% galena and 5.5% sphalerite) sulphide and a host rock S.G. of 2.6g/cm<sup>3</sup>. Gold equivalent was calculated using metal prices as of 4<sup>th</sup> May 2006. There was no top cutting.

### **3.0 Geology**

#### **3.1 Project geology**

The Wart Hill massive sulphide deposit is located within the southernmost outcropping of the Cambrian Mt. Read Volcanics, host to other V.H.M.S. and hybrid epithermal/V.H.M.S. and/or porphyry/V.H.M.S. deposits such as Rosebery, Hellyer, Mt. Lyell and Henty to the north.

The Mt. Read Volcanics are less well understood in the Elliott Bay area due to relatively limited drilling (away from Wart Hill itself) than elsewhere in the belt, although outcrop in the open heathy country is reasonable and drill density in the Wart Hill area is good.

The Mt. Read Volcanics in the Wart Hill area (shown in figure 3.1) are predominantly quartz+feldspar+/-biotite phyric lavas, lava breccias, pumiceous mass flows, finer sandy and cherty sediments, limestone and shale, minor basaltic dykes, polymict "epiclastics" containing clasts including massive sulphides and in-situ massive sulphides.

The sequence is overturned, dipping around 70° to the west but facing east and stratigraphically overlies a body to the west mapped as quartz+feldspar+biotite porphyry. This facing has been debated by previous geologists with ambiguous grading in part responsible, but Frontier's geologists have had the benefit of seeing the greatest volume of drillcore and their conclusions of an east facing is supported by Cyprus geologists and accepted here.

The presence of an in-situ mineralised horizon has also been the subject of debate with clearly clastic sulphide present. Cyprus considered that bedded chert, pyritic chert and limestone represent facies variations of the massive sulphide horizon. These are commonly but not invariably found within a polymictic "epiclastic" unit.

Drilling subsequent to Cyprus has shown the mineralised zone to consist of two separate zones offset at around 5,251,520mN with the southern end of the Central Zone between 30m-60m west of the northern end of the South Zone. It is not clear as to the reason for this offset. There does not appear to be any obvious structural offset of the porphyry contact to the west. An explanation might be found in the high energy, topographically constructive/destructive nature of the largely mass flow derived pumice breccias. In a number of drillholes exhalative-like sulphide (pyrite and/or base metals), chert and sulphidic chert lies within these mass flows and there is a strong sense of ongoing exhaling hydrothermal fluids being repeatedly buried by these mass flows. Structurally the offset could be explained by a northeast trending sinistral shear.

This interpretation of an in-situ mineralised horizon has been supported by Frontier's subsequent drilling. In particular this drilling has shown the presence of an in-situ lens of massive sulphide, named the South Lens, in the deeper part of the South Zone. Furthermore, shallower drilling in the upper Central Zone has intersected spatially combined clastic, disseminated and in-situ massive sulphide in what collectively constitute coherent mineralised intersections.

It is not unusual for massive sulphide deposits to include in their resources clastic, stringer and/or disseminated styles though these are commonly lower grade, lesser components of the resource. The presence of a range of styles, particularly clastic, should not be surprising given the active volcanic/hydrothermal nature of the depositional environments common to such deposits.

#### **3.2 Resource geology**

The mineralised zone consists of a combination of massive in-situ, disseminated footwall alteration style sulphide and sulphide clasts in polymict breccias. Frontier's previous resource estimation attempted to include only in-situ material; however, this is not easily achieved given the ambiguity of some intersections. The close spatial relationship between in-situ, clastic and disseminated sulphide in most drillholes suggests that there is a discrete mineralised zone or horizon which can be traced along strike between drillholes.

A typical Wart Hill intersection consists of disseminated and clastic sulphides in a polymict volcanoclastic unit with included and occasionally stratigraphically overlying bands of massive sulphide.

In a number of instances drillholes intersected the expected position of the mineralised horizon with no suggestion of mineralisation or polymict host horizon. Here mass flows may have removed mineralisation or acted to bury the hydrothermal system.

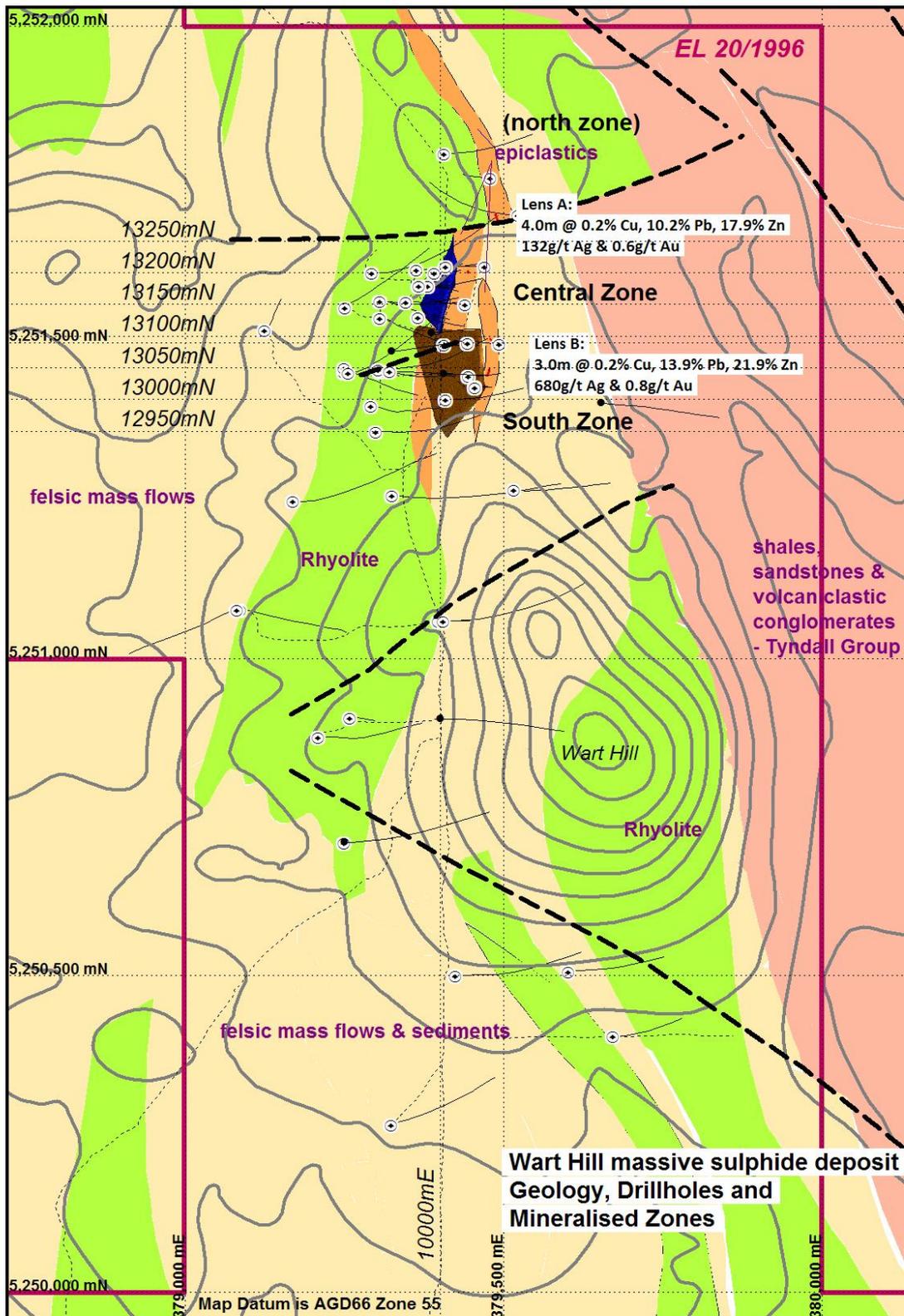


Figure 3.1: Geology of the Wart Hill massive sulphide deposit showing resource DTM/3DM's projected to surface and drillholes.

## 4.0 Data

### 4.1 Introduction

Data for the generation of the 3 resources comes from 8 overall programmes of drilling and 2 of trenching conducted by Geopeko, Cyprus and Tasgold/Frontier between 1981 and 2012.

Both the South Zone and Central Zone are defined by 15 intersections made up of 14 drillhole intersections and 1 trench intersection each. Intersections and hole/collar details are summarised in table 4.1. These fifteen (each) intersections also include the waste intersections around the margins of the resource.

All but 2 holes (V19/2 and V19/4) have been assayed for each of Au, Ag, Cu, Pb and Zn. V19/2 and V19/4 have not been assayed for gold. This is a deficiency in the dataset.

It is important to note that in a number of instances relevant drillhole sections had not been assayed due to the lack of visible mineralisation. In these instances 1m samples with 0 values for Au, Ag, Cu, Pb and Zn have been added into the database. This has been generally done to define "waste" bounds but has also been done to some internal holes or parts of.

**Table 4.1: All intersections used in modelling the Central Zone, South Zone resources**

Zone	Hole_ID	From (m)	To (m)	Length (m)	Au g/t	Ag g/t	Cu %	Pb %	Zn %	Au equivalent g/t
Central	TR81_3	4	9	5	0	34.5	0	2.01	5.83	3.55
	WD001	42	62	20	0.21	37.39	0.029	1.92	3.21	2.84
	inc. WD001	56	57.6	1.6	0.761	238	0.003	11.04	18.46	16.06
	and WD001	58.5	58.9	0.4	0.5	55	0.068	4.32	8.44	6.36
	WD002	57.5	71.5	14	0.33	52.95	0.069	2.57	4.74	4.12
	inc. WD002	62.8	63	0.2	0.096	23	0.014	0.98	2.4	1.79
	and WD002	65.7	67.55	1.85	0.31	166	0.253	5.72	12.48	10.47
	WD003	75	81	6	0.023	2.67	0.015	0.186	0.31	0.279
	WD004	84	89	5	0.14	43.2	0.042	0.39	0.8	1.42
	WD005	75	78.2	3.2	0.17	35.9	0.027	0.43	0.9	1.35
	WD006	73	82	9	0.1	14.3	0.021	0.74	1.33	1.16
	WD007	133	144.3	11.3	0.14	24	0.009	0.68	1.12	1.26
	WD008	47.5	51.3	3.8	0.037	11.1	0.028	0.28	0.58	0.599
	WD017	163.65	168.84	5.19	0.038	17.2	0.02	0.18	0.43	0.603
	WH1	16	25	9	0.003	2.33	0.001	0.041	0.09	0.095
	WH2	32	51	19	0.1	16.1	0.057	0.7	1.9	1.45
	WH4	46.4	54.7	8.3	0.041	22.9	0.019	0.95	1.95	1.56
	WH7	107	116	9	0.027	1.61	0.011	0.05	0.1	0.129
	WH8	180	185.95	5.95	0.19	24	0.006	1.98	4.73	3.13
South	TR82_2	3	9	6	0.48	368.5	0.106	7.8	11.7	14.5
	inc. TR82_2	5	8	3	0.843	679	0.202	13.9	3.131	19.69
	V19/2	55	57	2	0	15	0.031	7	1.7	3.6
	V19/4	28	29	1	0	0	0.003	0.027	0.095	0.05
	WD009	197	204	7	1.81	55.6	0.216	3.33	6.16	6.68
	inc. WD009	198	199	1	5.63	117	0.875	8.9	19	19.49
	and WD009	202	204	2	1.71	85.5	0.118	4.81	7.56	8.05
	WD010	16	26	10	0.1	41.63	0.033	1.24	2.4	2.25
	WD010	24.5	25	0.5	0.95	306	0.044	1.59	2.79	8.11
	WD011	16	25	9	0.039	14.1	0.033	0.44	0.8	0.805
	WD012	193	196	3	0.67	35.3	0.168	2.6	5.15	4.46
	WD012	194	195	1	1.36	75	0.377	5.43	10.6	9.27
	WD013	218	219	1	0	6	0.019	0.41	1.28	0.767
	WD018	80.86	83.25	2.39	0.024	2.19	0.003	0.05	0.13	0.135
	WD019	159.7	160.08	0.38	0.43	120	0.047	2.24	4.79	5.27
	WD023	101	105	4	0	0	0	0	0	0
	WD025	157.1	171	13.9	1.11	59.4	0.31	4.47	8.97	7.67

	inc.	WD025	157.1	157.85	0.75	1.04	48	0.871	14.6	28.6	19.4
	and	WD025	159.85	160.6	0.75	4.9	75	1.39	12.8	27.4	23.4
	and	WD025	163.2	170.25	7.05	1.08	53	0.71	7.15	13.4	10.8
		WD026	78	79	1	0	0	0	0	0	0
		WH10	185	190	5	1.35	31.5	0.254	2.968	6.04	5.67
	inc.	WH10	187	189	2	2.33	59	0.54	6.03	11.7	10.8
		WH11	180.8	182.8	2	0	0	0	0	0	0
		WH12A	270	279	9	0.01	1.44	0.002	0.027	0.07	0.075
		WH6	46	51	5	0.28	31.2	0.081	0.95	1.66	1.94

The South Lens is defined by five drillhole intersections. It does not outcrop.

**Table 4.2: All intersections used in modelling the South Lens resource**

Hole_ID	From (m)	To (m)	Length (m)	Interval (m)	Au g/t	Ag g/t	Cu %	Pb %	Zn %	Au equivalent g/t
WD009	197.7	203.7	6	6	1.77	53	0.213	3.32	6.21	11.2
WD012	193.35	194.9	1.55	1.55	1.03	51.5	0.26	3.93	7.86	10.2
WD019	159.8	160	0.2	0.2	0.43	120	0.047	2.24	4.79	21.8
WD025	163.9	171	7.1	7.1	1.48	102	0.349	5.58	11.2	19.7
WH10	185.6	189.65	4.05	4.05	1.62	35.6	0.303	3.31	6.8	7.97

## 4.2 Drilling

All drillholes were diamond cored with most holes collared in HQ and the mineralised intersection in NQ core. Core recoveries are in general very good.

**Table 4.3: Drillhole and channel survey details**

Zone	Hole_ID	Easting (AGD66 zone55)	Northing (AGD66 zone55)	RL (m.a.s.l.)	Azimuth (TN)	Dip	Depth (m)	
Central	tr81_3	379417.5	5251610	149.6	90	0	19	
	tr82_2	379460	5251455	157.35	90	0	16	
	WD001	379381.03	5251589.48	157.138	90	-45	119.8	
	WD002	379367.57	5251589.74	157.804	91	-42	83.7	
	WD003	379367.5	5251590	154	91	-55	96	
	WD004	379367.5	5251590	154	91	-66.5	118.7	
	WD005	379364.15	5251615.86	156.605	92	-45	99	
	WD006	379346.75	5251564.95	156.952	93	-45	113.9	
	WD007	379306.49	5251565.64	156.5	96	-46.5	157.5	
	WD008	379365.56	5251540.18	157.75	90	-45	100.7	
	WD017	379306.51	5251565.78	156.5	98	-65	288	
	WH1	379410	5251620	153.93	90	-50	78.5	
	WH2	379391.02	5251610.38	155.458	90	-50	64	
	WH4	379440	5251560	158.37	270	-50	95.1	
	WH7	379470	5251620	152.88	270	-60	120	
	South	V19/2	379410	5251410	162.9	90	-45	164.2
		V19/4	379445	5251447	158	90	-45	70.6
WD009		379306.51	5251539.19	157.7	96	-60	249.4	
WD010		379454.87	5251431.06	161.721	90	-44.5	29.7	
WD011		379455	5251430	161.5	90	-57.5	50.7	
WD012		379306.56	5251454.68	157.56	94	-63.5	241.4	
WD013		379291.92	5251400.47	158.279	96	-69.5	252.5	
WD018		379407.4	5251496.27	157.65	92	-60	109.4	
WD019		379321.56	5251454.68	158.1	94	-50	233.5	
WD023		379386	5251515	140	90	-65	148.5	
WD025	379324	5251486	149.3	86	-60	200		

	WD026	379405	5251450	156	92	-60	120
	WH10	379304	5251457	157.32	90	-50	244.5
	WH11	379300	5251360	164.56	92	-51	264.7
	WH12A	379256.5	5251452	154.84	90	-70	359
	WH6	379493.55	5251498.12	157.66	270	-50	68.8
	WH8	379293.51	5251610.64	151.419	90	-50	283.4

Almost all historical collars were surveyed by Frontier by digital G.P.S. with an accuracy of 20cm, the exception being recent drillholes (WD023, WD025 and WD026) which were surveyed by hand held G.P.S. with +/-3m accuracy.

Downhole surveying at nominally 30m spacings is typical of all drillholes. The rocks are essentially non-magnetic and surveys are reliable. Any drill survey error is unlikely to have any impact on the estimate in any significant way.

In most instances the original drill logs have been used in interpreting the geology. As noted earlier the author has logged and seen a number of the holes around which the resource is based but has had to rely on others logging for some significant intersections, particularly the Central Zone.

Drillcore was cut by diamond saw and one half assayed.

#### 4.3 Trenching

Trenches were apparently dug by small excavator and sampled by chipping along trench walls.

Trench locations were surveyed by digital G.P.S. Directions were measured by tape and suunto compass.

Samples were collected by chipping along one wall of the trench. Samples were assayed in the same way as drillcore samples.

#### 4.4 Sample preparation and analyses

All samples were assayed by reputable laboratories using fire assay for gold with AAS for most silver and base metal assays, with Frontier's 2012 samples done by ICP.

**Table 4.4: Assay methods and detection limits**

Sampling programme	Laboratory	Au Method	Detection Limit (ppm)	Ag, Cu, Pb, Zn Method	Detection Limit (ppm)
1. 1981/82 Geopeko trenches and drillholes	Analabs	fire assay	0.008	AAS	0.5 (Ag), 5 (Cu,Pb,Zn)
	Analabs	fire assay			
2. 1988/89 Cyprus drilling	Analabs	fire assay	0.005	AAS	0.5 (Ag), 5 (Cu, Pb, Zn)
	Analabs				
	Comlabs (chk)	fire assay	?	AAS	?
3. 2005/2008 Frontier drilling	SGS	fire assay	0.01	AAS	5 (Ag), 10 (Cu, Zn), 20 (Pb)
4. 2010/2011 Frontier drilling	Amdel	fire assay	0.01	ICP	1 (Ag), 2 (Cu, Zn), 5 (Pb)

#### 4.5 Quality control procedures

No geostatistical assessment of the QA/QC of the data was considered in this estimate

#### 4.6 Bulk Density

65 samples from both ore zones (46 from the Central Zone, 19 from the South Zone) were measured for density using the water immersion method. Results are summarised in table 4.5. In estimation the value 2.8 was utilised in all instances.

**Table 4.5: Bulk Density data summary**

Zone	No. Samples	Range	Mean	Std. Dvn.
Central	46	2.49-3.86	2.8	0.26

South	19	2.48-3.49	2.82	0.4
Total	65	2.48-3.86	2.805	0.265

#### **4.7 Data quality summary**

The drilling, surveying, sampling and assaying work is of essentially industry standard for exploration purposes and is unlikely to impact on the estimated tons and grade materially at the Inferred status level. There are some deficiencies with the consistency of logging leading to a lowered confidence in the overall geological interpretation.

## 5.0 Geological interpretation and modelling

Geological interpretation was based largely on existing drill logs and geological mapping. The exceptions were WD023, WD025 and WD026 which were logged by the author. The author has also seen holes WD009, WD018, WH8, WH10 and WH12A, has worked at Wart Hill and has seen both lens A and lens B in outcrop.

Mineralisation at the Wart Hill massive sulphide deposit consists of disseminated sulphides, allochthonous clasts and in-situ pods of high grade massive sulphide hosted within a largely volcanoclastic sequence. Previous interpretations have stressed the clastic aspect of the deposit (i.e. Geopeko and Plutonic) or the in-situ aspect (Cyprus and Frontier).

Whilst a number of intersections, particularly WD025, WD009, WH10 and WD012, appear to define an in-situ "classic" V.H.M.S. lens which has been modelled separately as the South Lens resource, the main intent of this resource estimate was to determine the total metal including disseminated, clastic and in-situ sulphides held in the Wart Hill deposit.

The major concern was establishing and justifying geological continuity. Problems were encountered due to the apparent inconsistency of logging, exacerbated by the varied nature of the mineralisation and the high energy nature of the host rocks.

The Central and South 3DM's were modelled based to a large degree on a 0.5g/t gold equivalent grade cut-off but with some significant control by lithology. The modelling considered combined and contiguous, in-situ massive, disseminated and clastic sulphide mineralisation as part of a single ore zone which drilling has shown has apparent continuity.

Drillhole intersections where the interpreted mineralised horizon was expected but no indication of any massive sulphide or exhalative activity encountered were included where internal or used to define bounds where external.

The Central Zone outcrops over a short strike length and has dimensions of 170m vertically x 155m horizontally, dips -70 degrees to the west and ranges in thickness from a few metres to about 10m in thickness.

The South Zone also outcrops over a short strike. It has dimensions of 260m vertical x 165m horizontal and ranges in thickness from less than 0.5m up to 7m in thickness. It too dips at around -70 degrees to the west.

The South Lens was modelled on logged lithology wholly. The edges of the lens were projected  $\sim 1/3$  of the distance to surrounding holes without evidence of the South Lens.

The South Lens is wholly contained within the South Zone. The South Lens is 90m x 90m and varies in thickness from less than 0.2m up to 5m.

The DTM/3DM's constructed to model the Central and South Zones are shown in figures 5.1 to 5.3 and the South Lens in figure 5.4.

50m spaced drill sections showing drill assay and ore zone intercepts, sections through the DTM/3DM's and coloured sections through the block model are shown in figures 5.6 to 5.12 with legend in 5.5.

In a number of instances intersections of probable discrete clasts, e.g. WH8, were effectively "diluted" by considering the host clastic unit to be the mineralised unit.

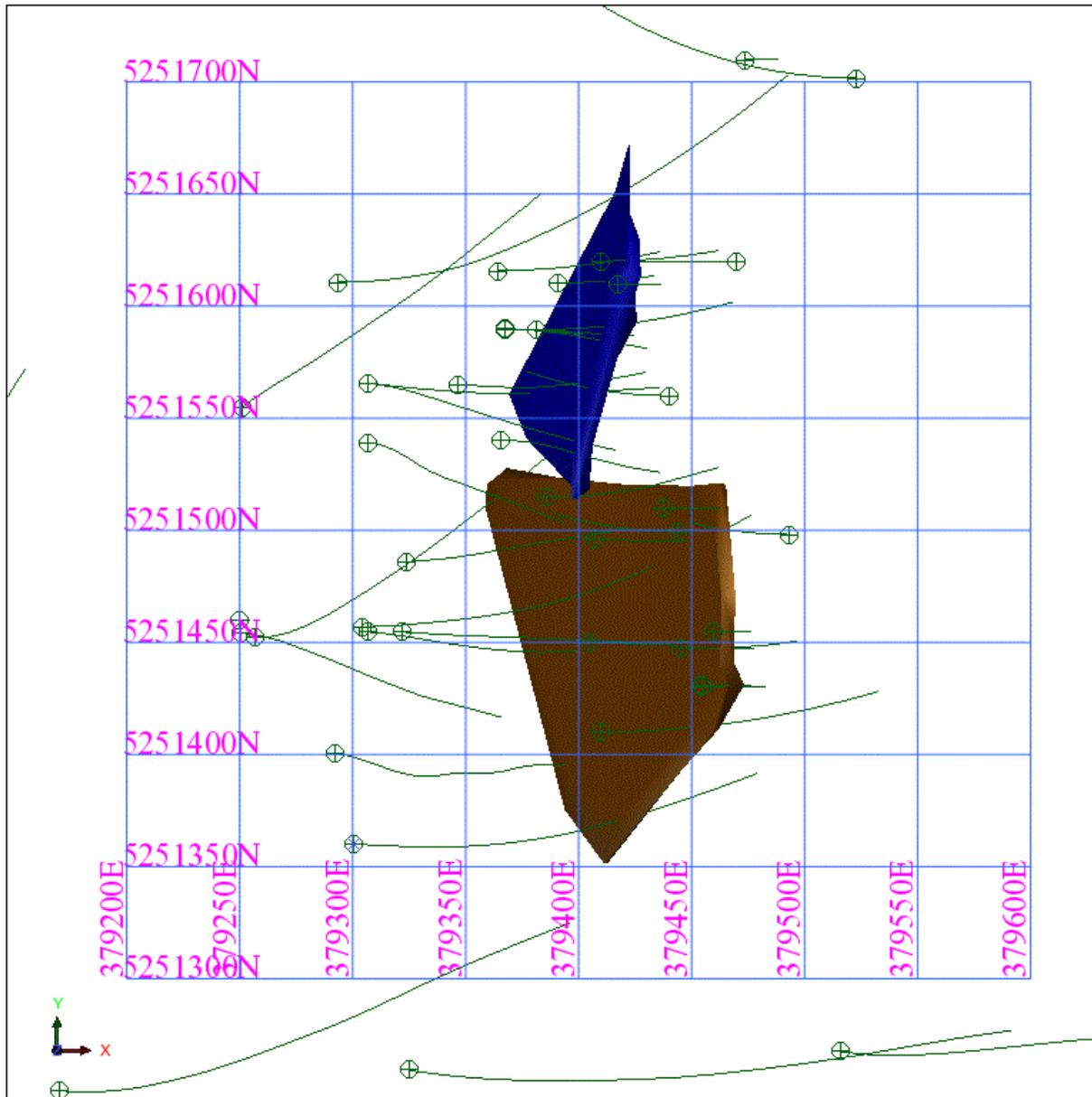


Figure 5.1: Plan view of wireframe DTM/3DM models of the Central (blue) and South (brown) Zones. Drill hole traces shown. Grid datum AGD66.

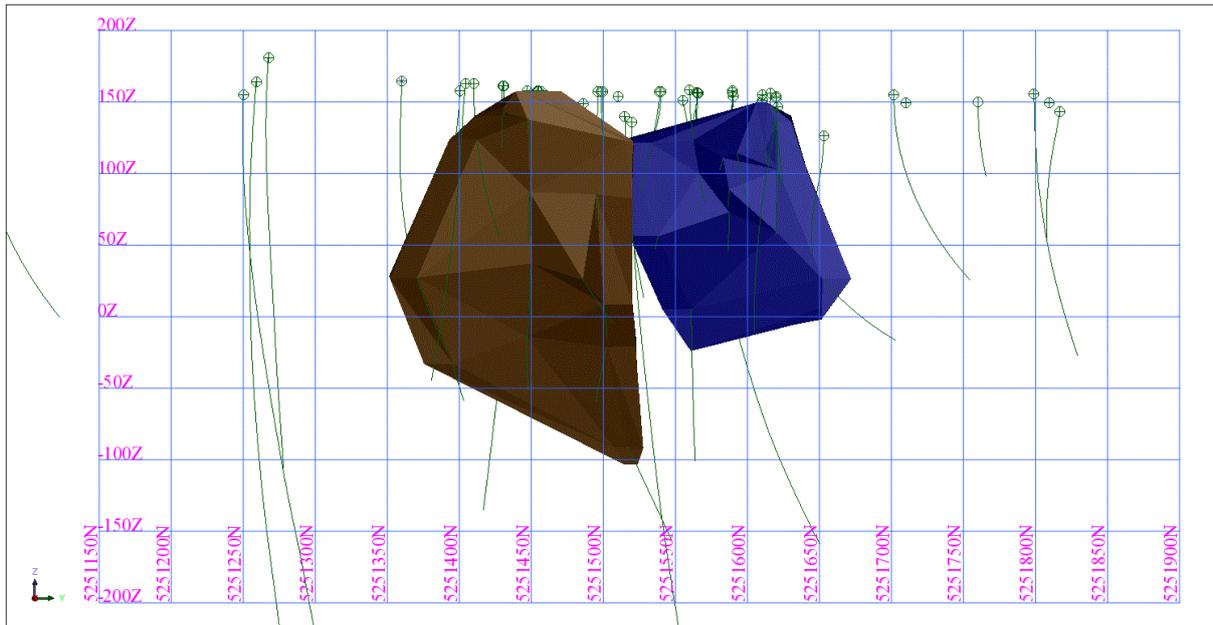


Figure 5.2: Long section view of wireframe DTM/3DM models of the Central (blue) and South (brown) Zones. Drill hole traces shown. Grid datum AGD66.

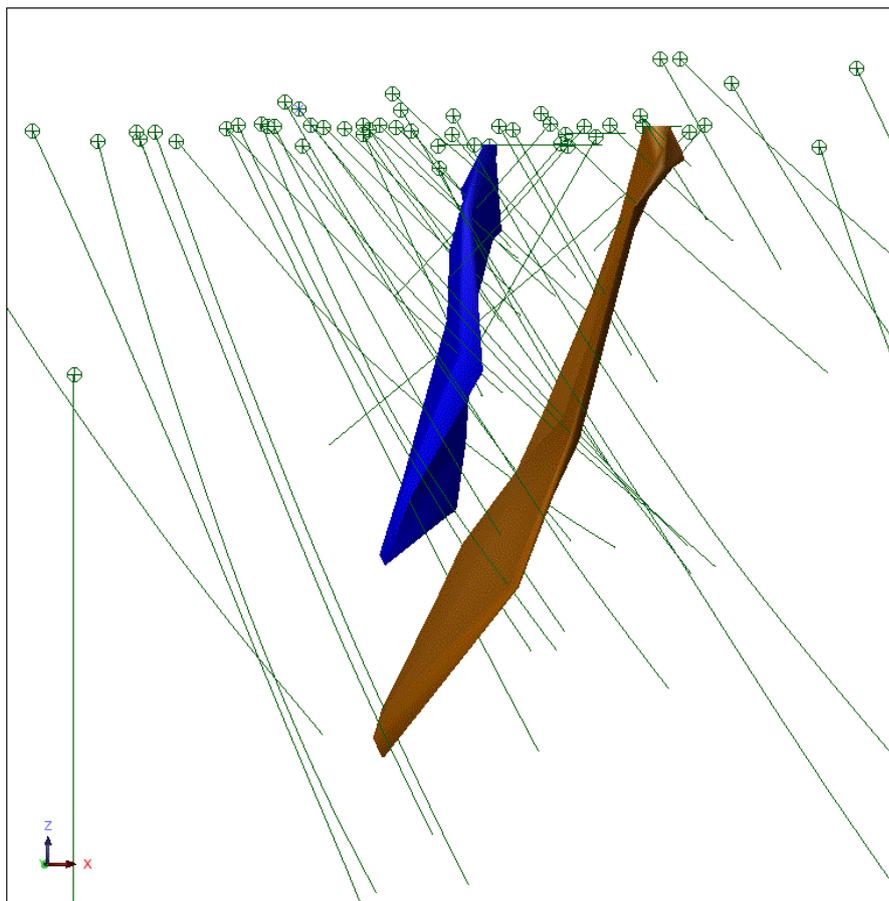


Figure 5.3: Cross section view of wireframe DTM/3DM models of the Central (blue) and South (brown) Zones, looking due north. Drill hole traces shown.

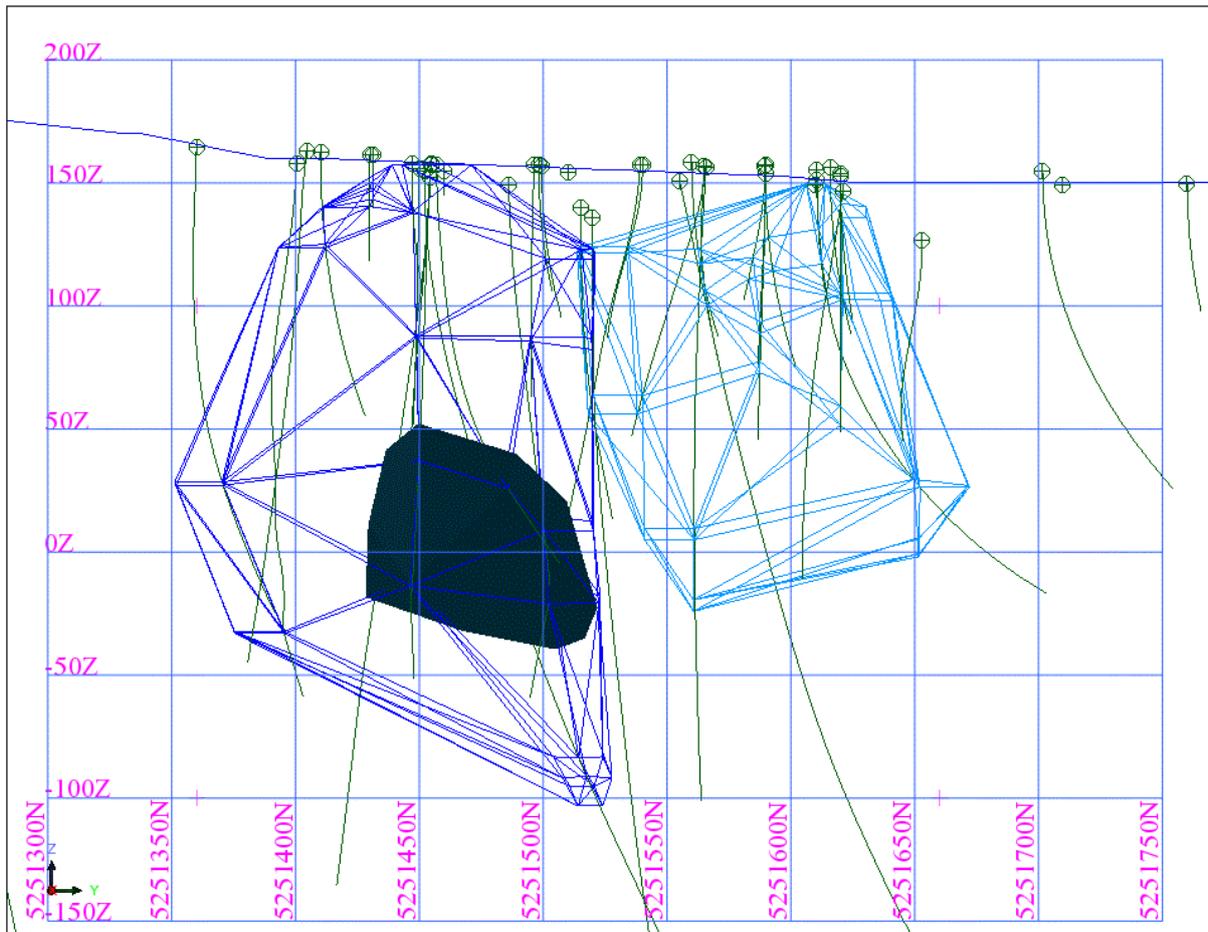


Figure 5.4: Long section view of wireframe DTM/3DM model of the South Lens and framework of Central (aqua) and South (blue) Zones. Drill hole traces shown. Grid datum AGD66.

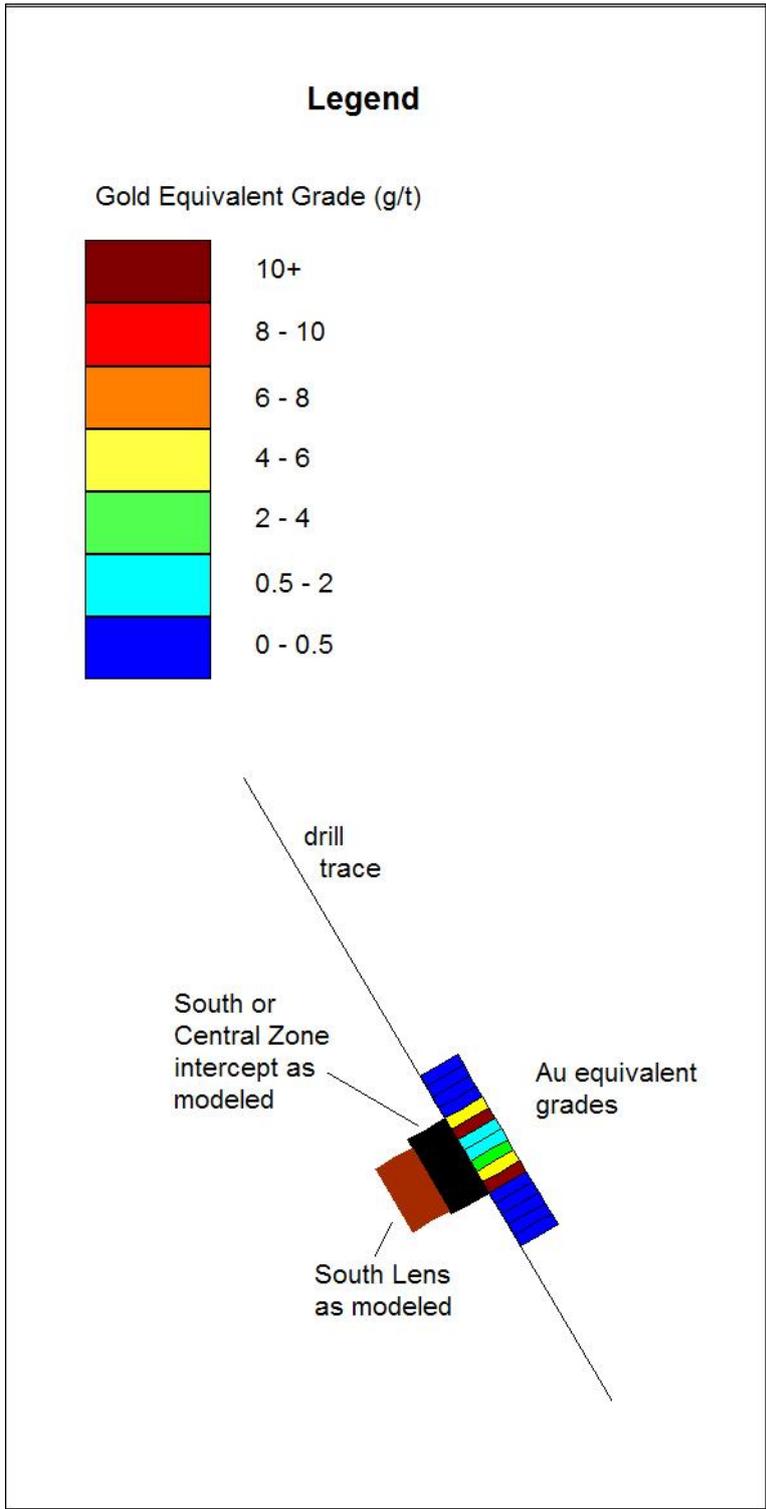


Figure 5.5: Legend for following sections.

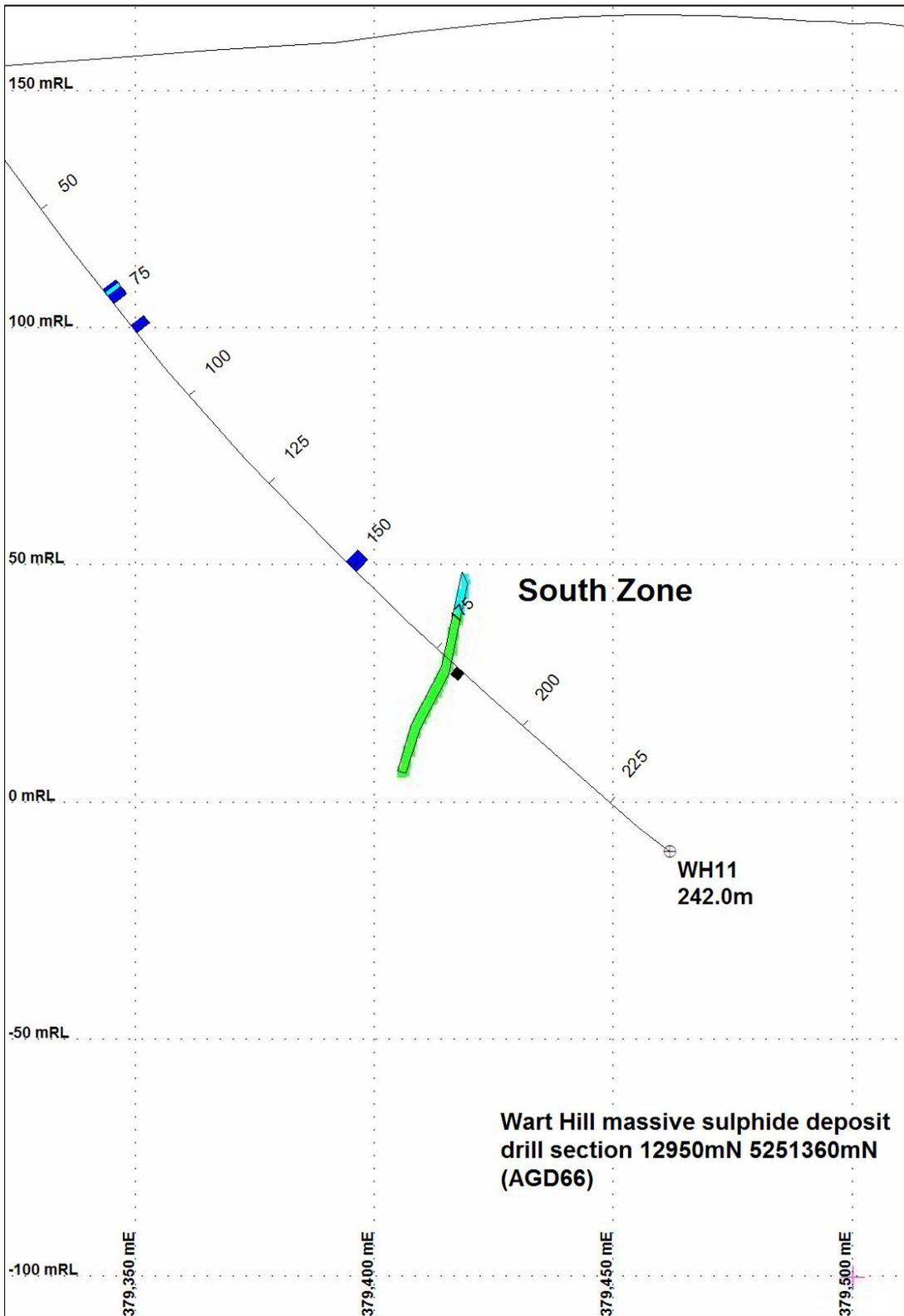


Figure 5.6: Section 12950mN 5251360mN (AGD66).

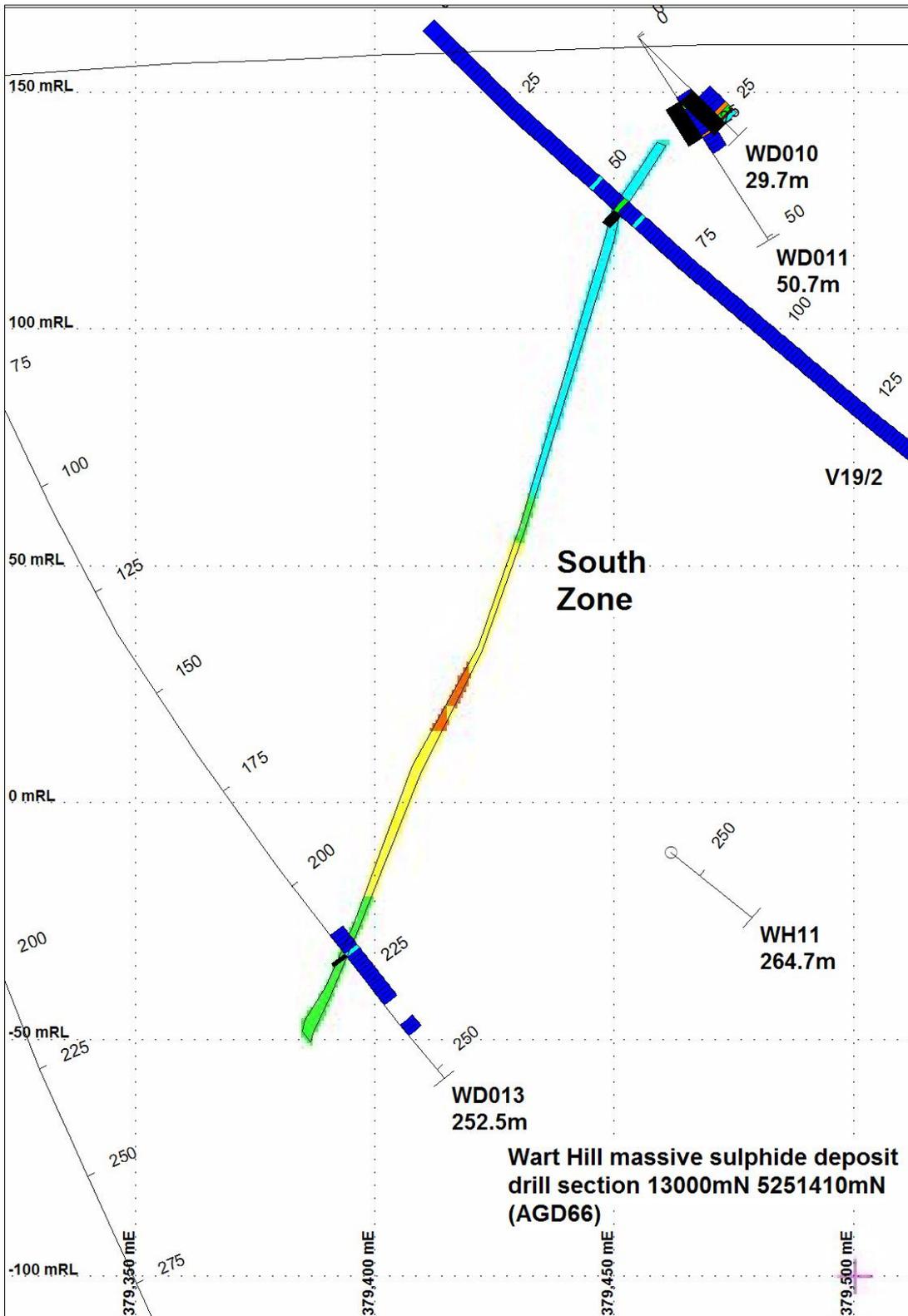


Figure 5.7: Section 13000mN 5251410mN (AGD66)

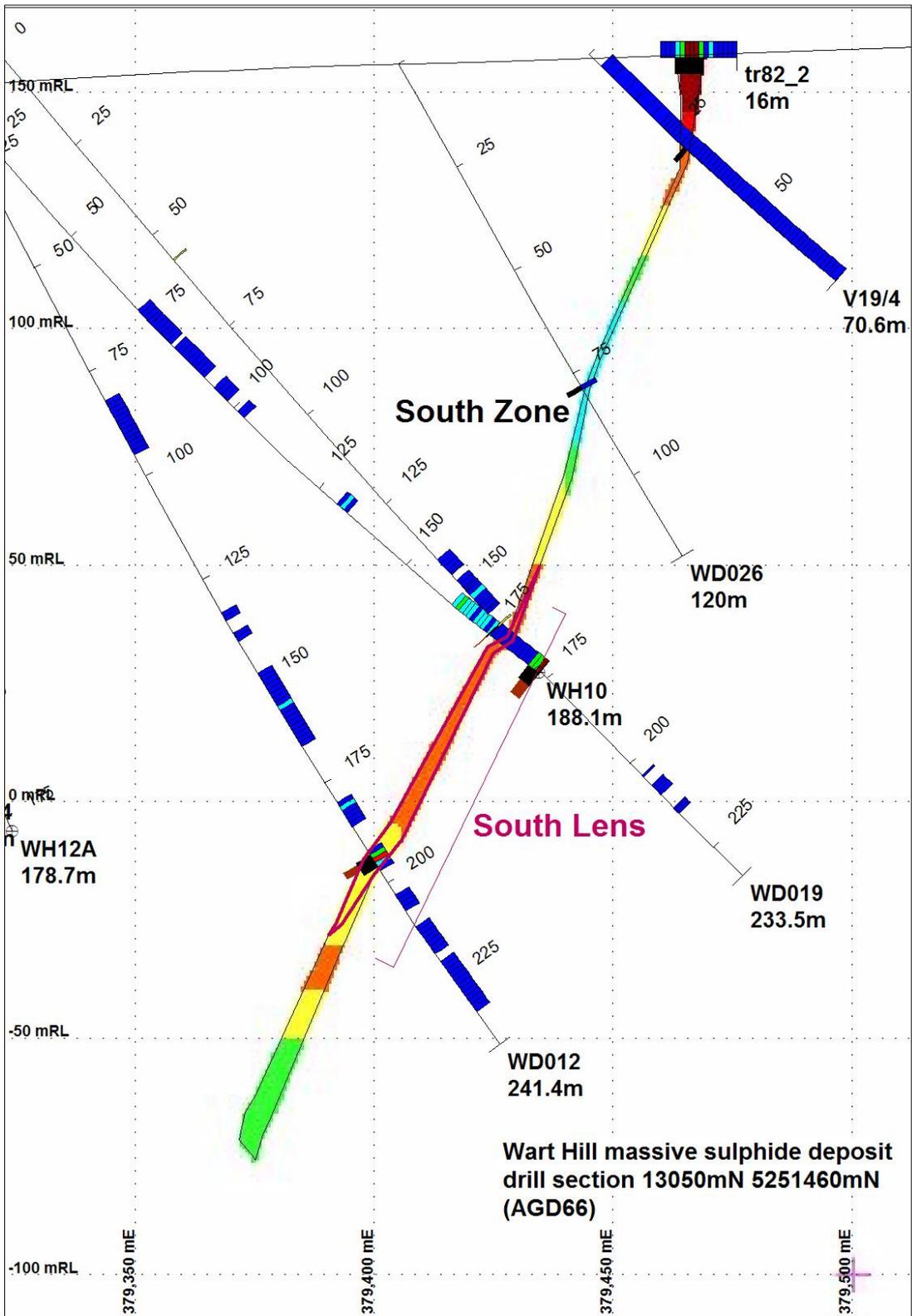


Figure 5.8: Section 13050mN 5251460mN (AGD66)

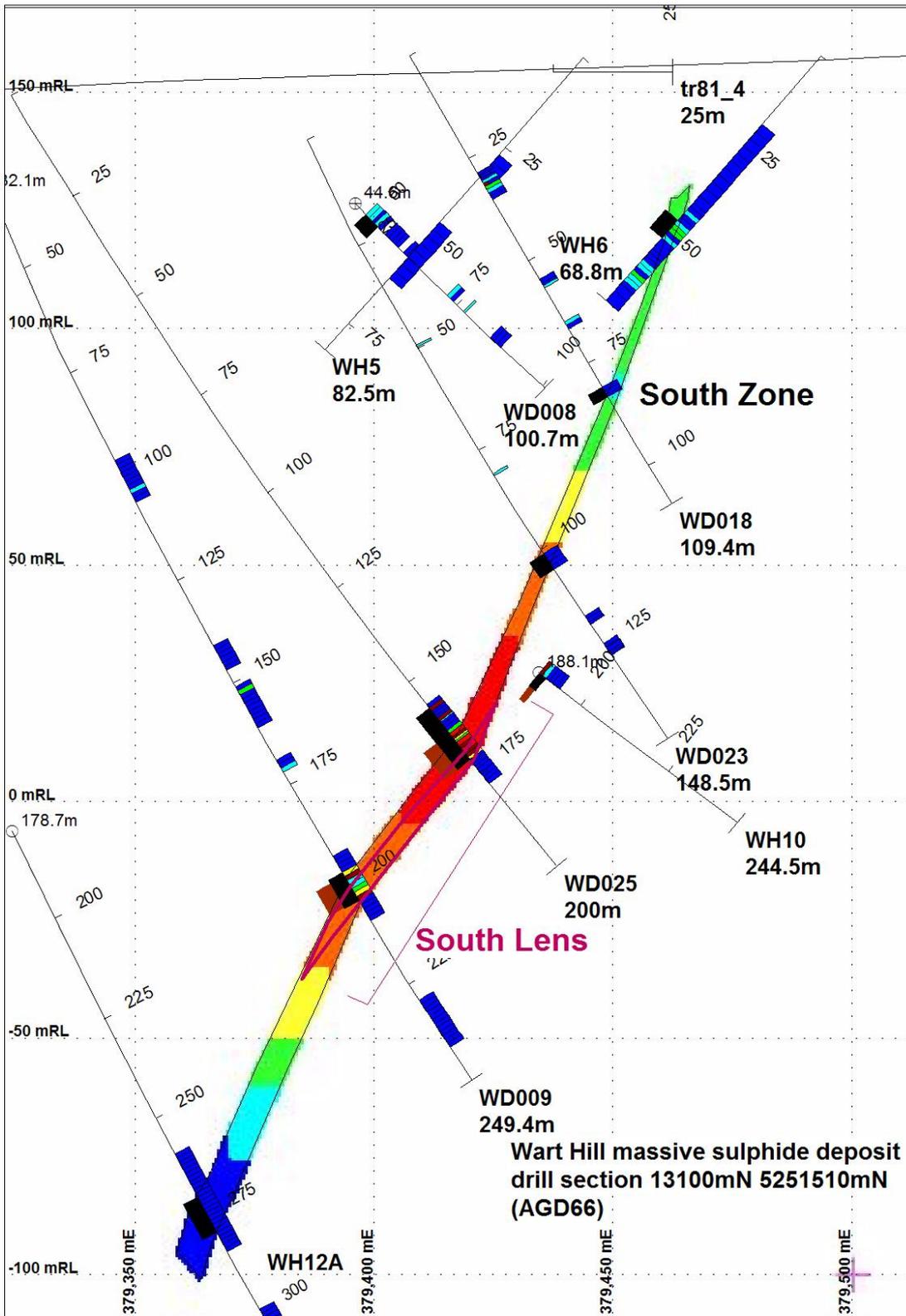


Figure 5.9: Section 13100mN 5251510mN (AGD66)

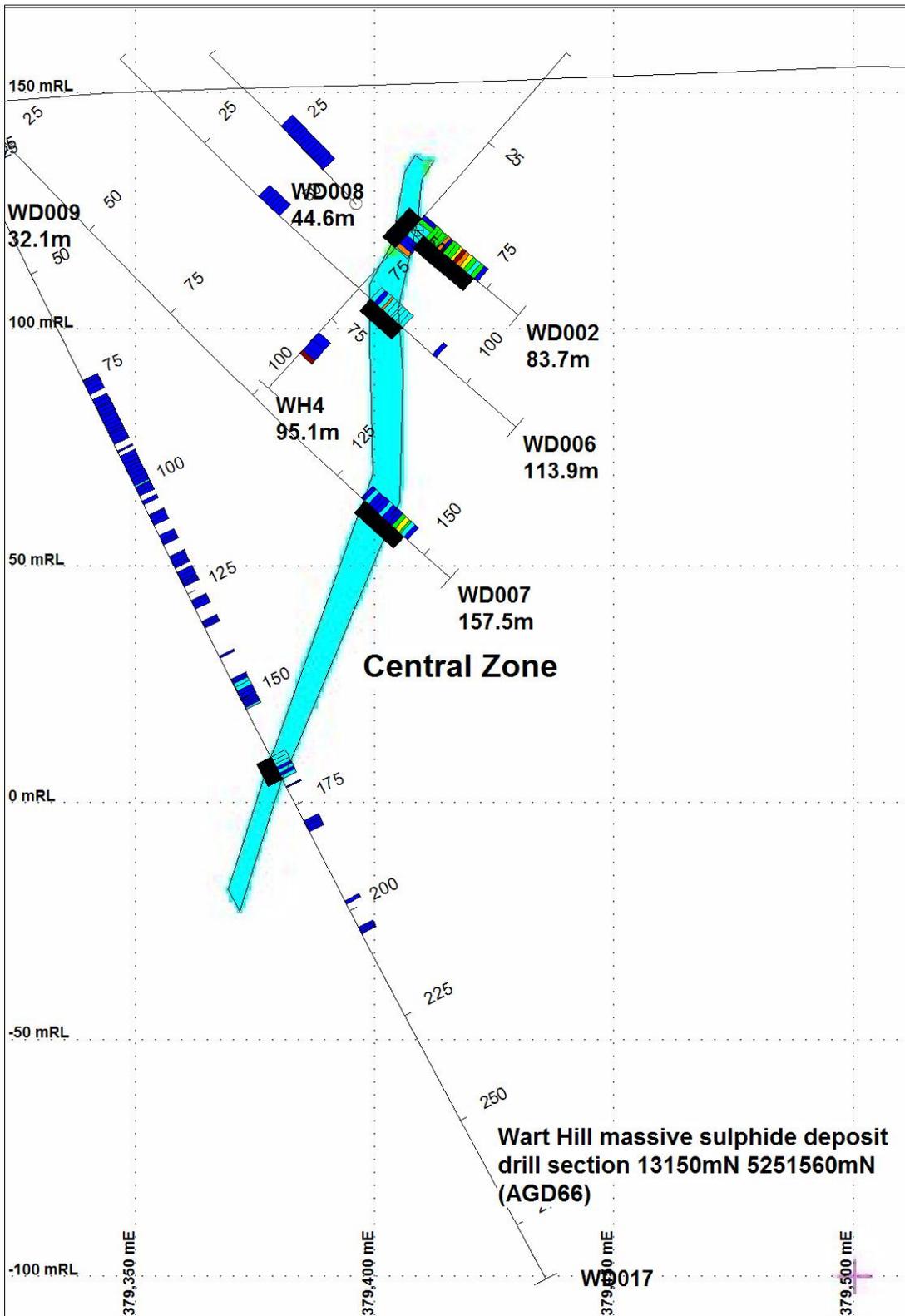


Figure 5.10: Section 13150mN 5251560mN (AGD66)

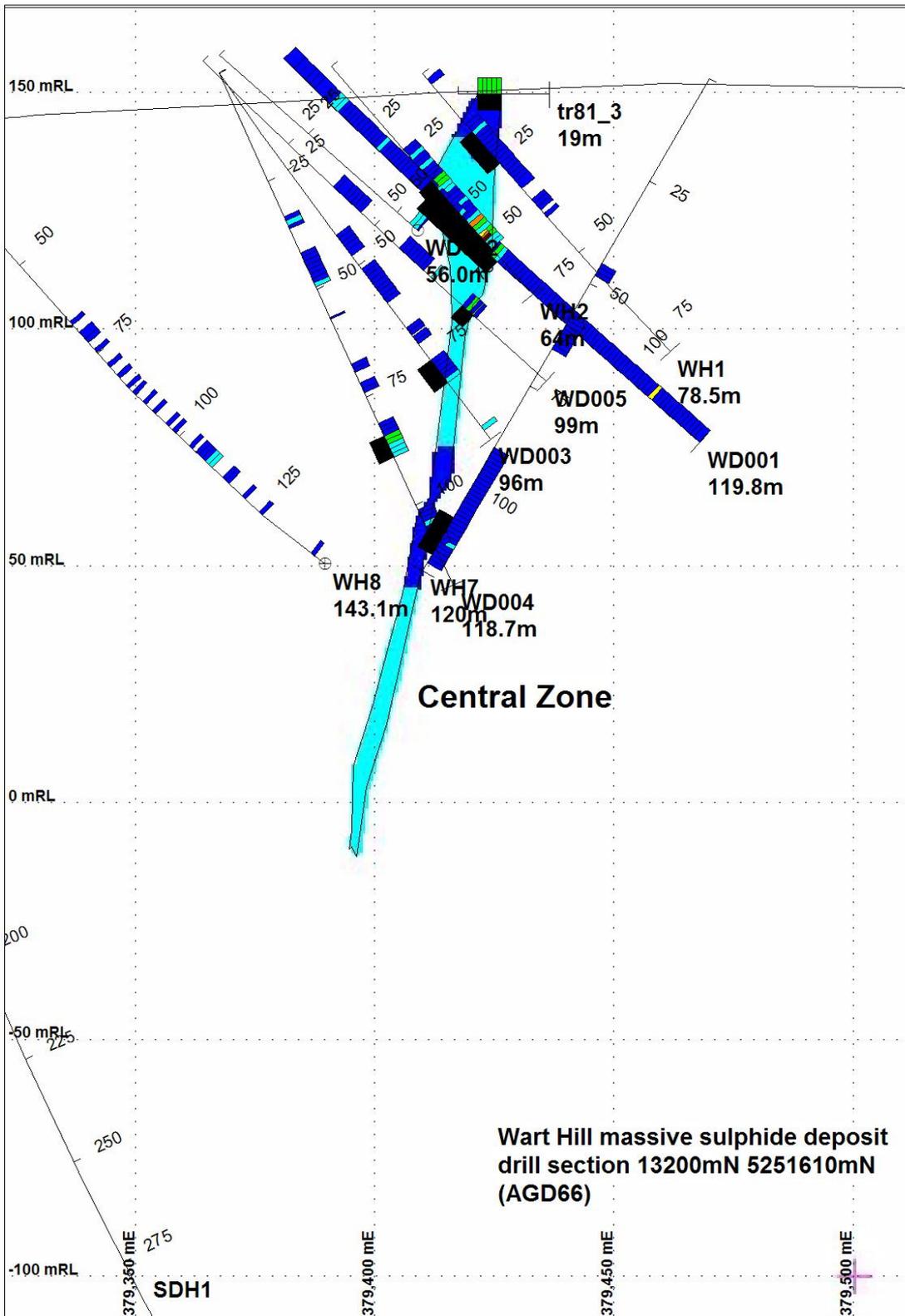


Figure 5.11: Section 13200mN 5251610mN (AGD66)

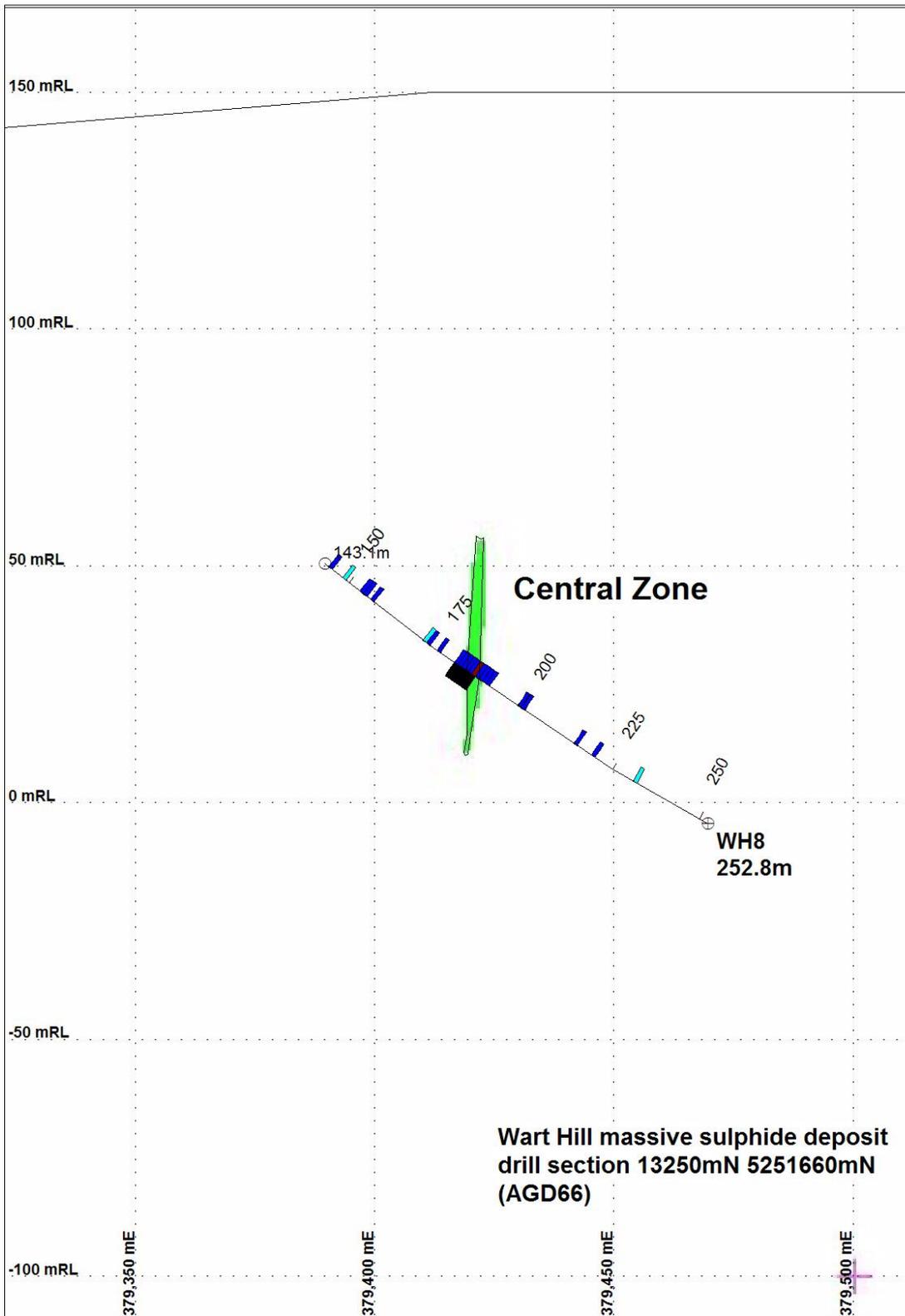


Figure 5.12: Section 13250mN 5251660mN (AGD66)

## 6.0 Statistical Analysis of Data

Limited statistical analysis of the data was performed due to the relatively low number of samples and the ultimately Inferred classification of the resource.

### 6.1 Compositing

Samples were composited downhole. Separate composite files were created for each of the South Zone, Central Zone and South Lens.

Most samples are 1m downhole or 1m trench samples and so 1m composites were chosen. In the case of each of the Central and South Zones as well as the South Lens significant narrow intersections would have been excluded from the estimation and so these composites were included in the estimation. This is expressed in the following figures 6.1 to 6.5.

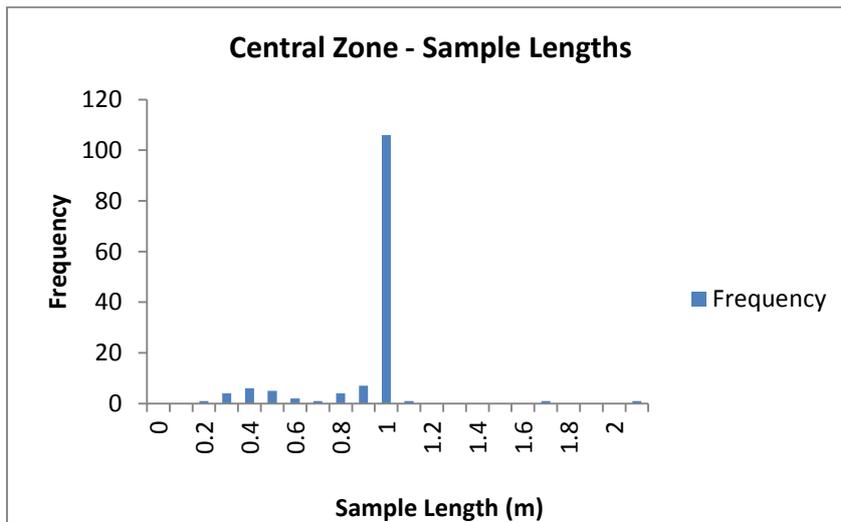


Figure 6.1: Sample Length Histogram – Central Zone

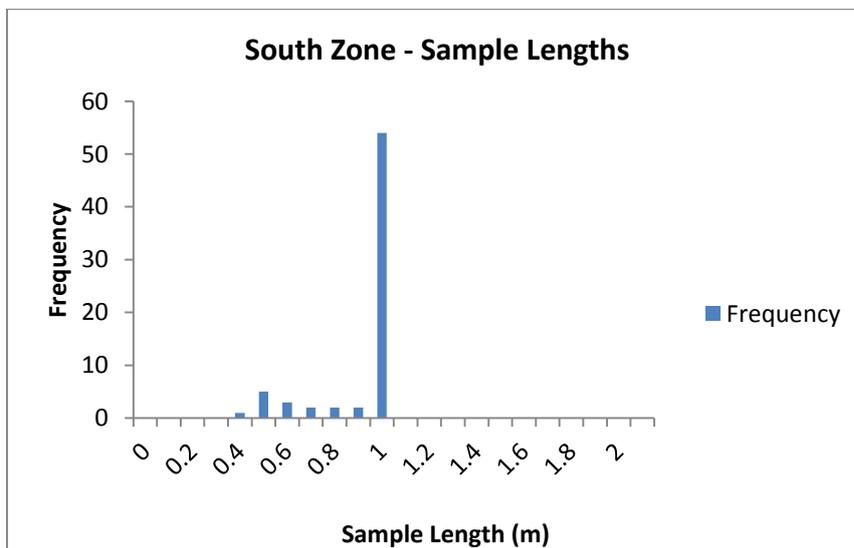


Figure 6.2: Sample Length Histogram – South Zone

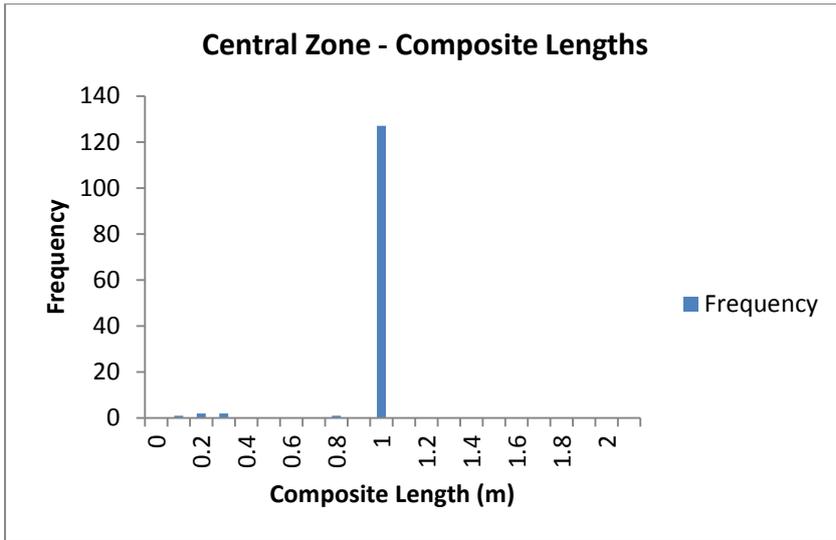


Figure 6.3: Composite Length Histogram – Central Zone

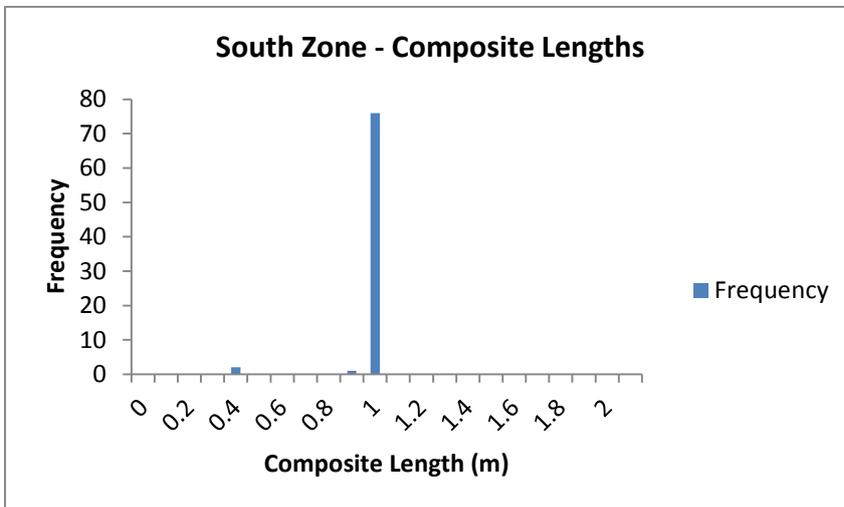


Figure 6.4: Composite Length Histogram – Central Zone

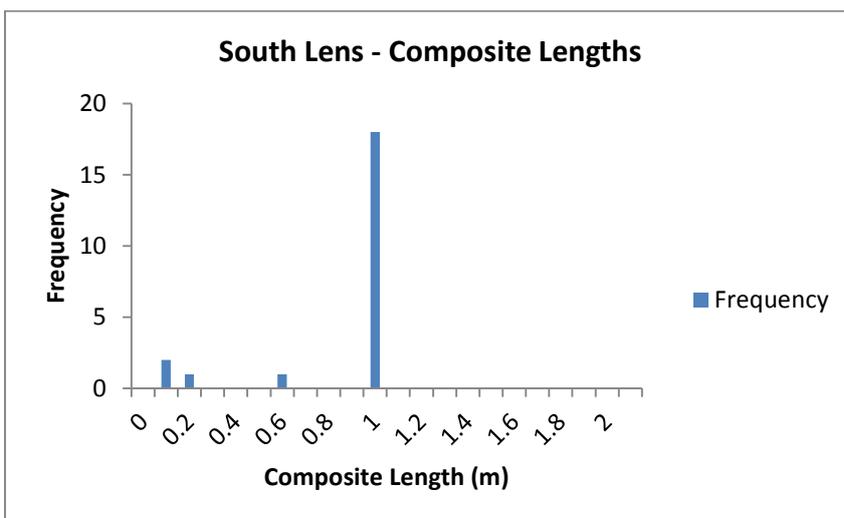


Figure 6.5: Composite Length Histogram – South Lens

**Table 6.1: Summary composite statistics**

Mineralised Domain		Au (ppm)	Ag (ppm)	Cu (ppm)	Pb (ppm)	Zn (ppm)
Central zone	Count	133	133	133	133	133
	Minimum	0* (0.005)	0* (0.5)	0* (10)	0* (35)	0* (80)
	Maximum	0.966	294.8	3725	132080	246600
	Mean	0.13	25.46	329	11273	22889
	Median	0.04	14	130	3400	7100
	Standard Deviation	0.18	39.85	596	20256	41279
	Coefficient of Variation	1.40	1.57	1.81	1.80	1.80
South zone	Count	76	79	79	79	79
	Minimum	0* (0.009)	0* (0.5)	0* (10)	0* (50)	0* (140)
	Maximum	5.63	990	8750	173000	254000
	Mean	0.57	57.95	1196	22886	42329
	Median	0.07	17	260	4770	10700
	Standard Deviation	1.03	144.04	1915	35310	61759
	Coefficient of Variation	1.82	2.49	1.60	1.54	1.46
South Lens	Count	22	22	22	22	22
	Minimum	0.156	5.5	288	5665	8031
	Maximum	6.032	135.9	6881	75129	146950
	Mean	1.41	68.72	2163	39662	78168
	Median	0.89	65.7	2711	37560	73046
	Standard Deviation	1.43	40.75	1898	21289	42090
	Coefficient of Variation	1.01	0.59	0.73	0.54	0.54

## 6.2 Correlation analysis

Correlation analysis (see table 6.2) shows a strong correlation between Pb and Zn and clear associations between Zn and Ag, Pb and Ag, and Cu and Au.

**Table 6.2: Correlation Analysis**

	Au	Ag	Cu	Pb	Zn
Au		0.10	0.60	0.27	0.29
Ag			0.15	0.68	0.58
Cu				0.33	0.40
Pb					0.95
Zn					

## 7.0 Block modelling

Two block models were created with the larger model, *wart\_hill\_zones.mdl*, incorporating the Central and South Zones and a smaller separate model created for the South lens, *south\_lens.mdl*.

Both models used 5m x 5m x 5m blocks with sub-blocking to 0.625m in order to capture narrow zones.

Both models orientations are AMG north-south and east west which accords with the drill grid which is AMG east-west.

Attributes included are listed in table 7.1

**Table 7.1: Block Model Attributes**

Attribute	Description	How Determined
zone	mineralised zone	constrained by DTM/3DM
au	gold grade (g/t)	estimated by inverse distance squared
ag	silver grade (g/t)	estimated by inverse distance squared
cu	copper grade (ppm)	estimated by inverse distance squared
pb	lead grade (ppm)	estimated by inverse distance squared
zn	zinc grade (ppm)	estimated by inverse distance squared
au_equivalent	gold equivalent grade (g/t)	calculated from estimated values
sg	density (g/cm3)	assigned value

The "zone" attribute was generated by constraining all blocks inside the DTM/3DM *central\_zone\_v2.dtm* (coded as "cent") for the Central Zone, *south\_zone\_v2.dtm* (coded as "sth") for the South Zone, and inside the DTM/3DM *south\_lens.dtm* for the South Lens (coded as "south\_lens")

Validation was carried out by visual inspection of grade and blocks in Surpac.

## 8.0 Grade estimation

### 8.1 Methodology

The estimation used Surpac's inverse distance squared methodology. A spherical search ellipse with radius of 100m was used. The following parameters are copied directly from the Surpac .not file generated following the estimation.

```
SEARCH PARAMETERS
ROTATION CONVENTION - Surpac ZXY LRL
ANGLES OF ROTATION
First Axis      0.00
Second Axis    0.00
Third Axis     0.00
ANISOTROPY FACTORS
Semi_major axis 1.00
Minor axis     1.00
OTHER INTERPOLATION PARAMETERS
Max search distance of major axis 100.000
Max vertical search distance      100.000
Maximum number of informing samples 20
Minimum number of informing samples 2
```

Au, Ag, Cu, Pb and Zn were all estimated in this way. Au equivalent was calculated using the following metal prices as of 21<sup>st</sup> May 2012

- Au = US\$1592.5/ounce,
- Ag = US\$28.39/ounce,
- Cu = US\$3.54/lb,
- Pb = US\$0.881/lb and
- Zn = US\$0.863/lb;

leading to a gold equivalent formula of

Au equivalent (g/t) = [0.0178273 x Ag (ppm)] + [0.0001524 x Cu (ppm)] + [0.0000379 x Pb (ppm)] + [0.000372 x Zn (ppm)]

### 8.2 Resource reporting

The resource estimate for the Wart Hill massive sulphide deposit has been classified as Inferred Mineral Resources in accordance with the guidelines as set out in the Joint Ore Reserves Committee (JORC) Code (2004). The resource category is based on the robustness of the various data sources and particularly the level of geological knowledge and confidence in interpretation coupled with the overall drilling density. The key criteria considered during resource classification are listed in table 8.1.

**Table 8.1: Key Confidence Criteria**

Item	Discussion	Confidence
Drilling/channelling techniques	Industry standard diamond drilling and channels	high
Logging	Capable geologists with generally consistent approach.	moderate
Drill sample recovery	Generally good	moderate/high
Sub-sampling techniques and sample prep.	Industry standard	high
Quality of assay data	Industry standard exploration	moderate/high
Verification of sampling and assaying	Negligible verification conducted	moderate/low?
Location of sampling points	~25m spaced drill sections with similar separation up/down dip	moderate
Data density and distribution	Reasonable for resource category	moderate
Database integrity	Reasonable for resource category	moderate
Geological interpretation	Interpretation optimistic	moderate/low?
Estimation and modelling techniques	Inverse distance squared	moderate
Tonnage factors	Limited density data points	moderate

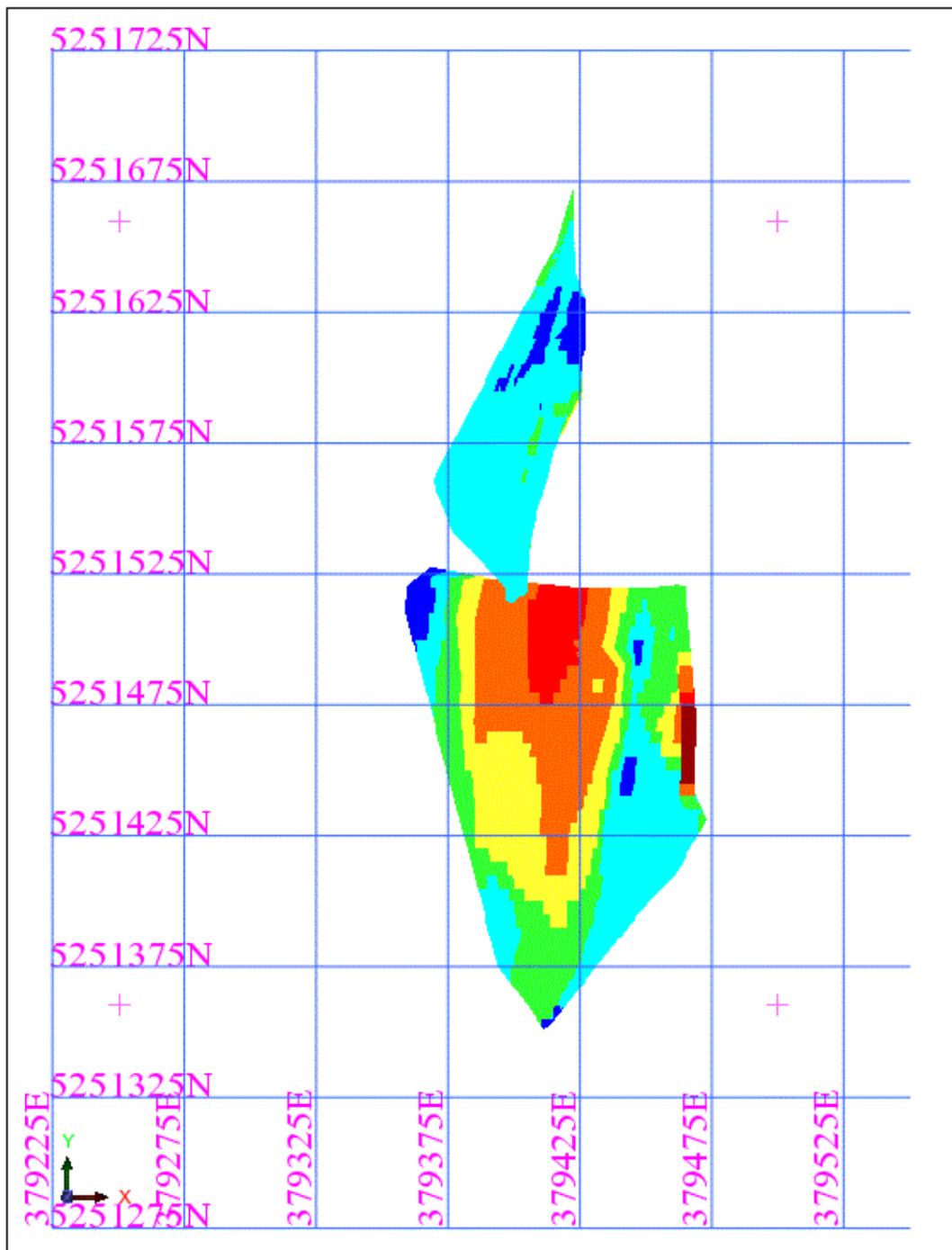


Figure 8.1: Plan view Central and South Zones resources colour coded by gold equivalent grade (legend in figure 5.5). Grid datum is AGD66.

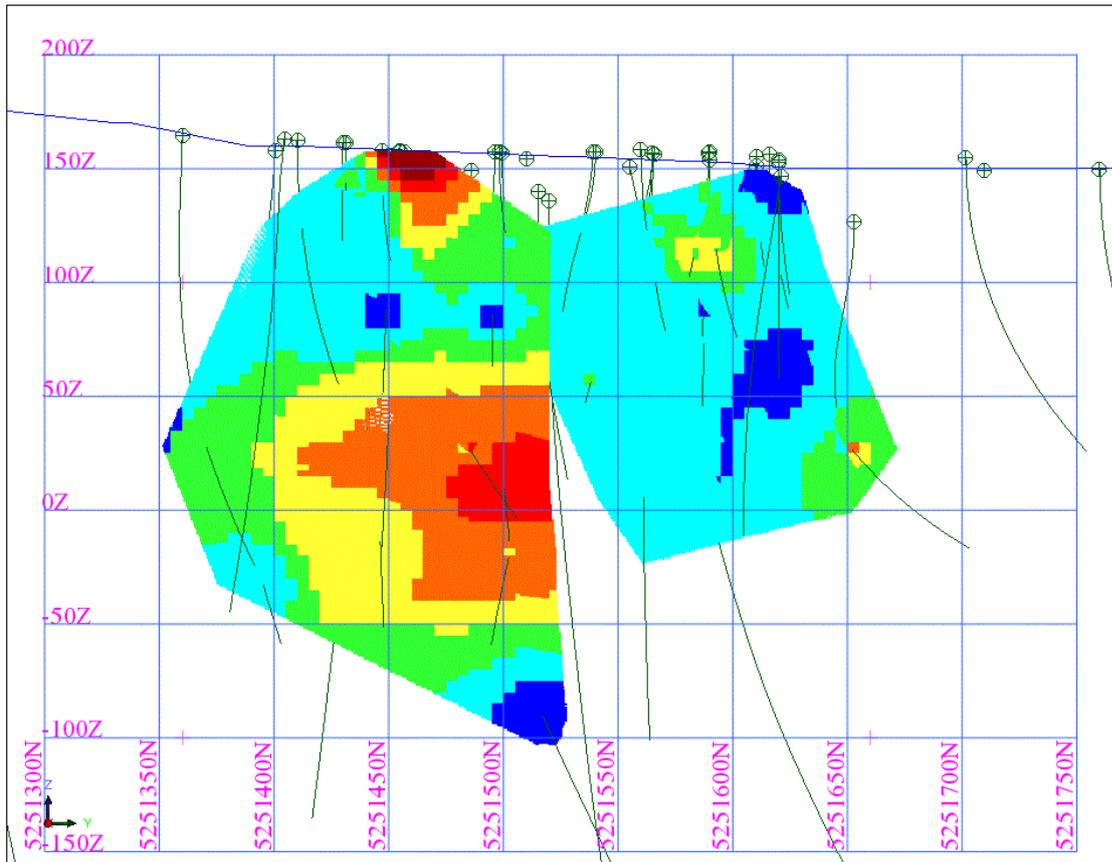


Figure 8.2: South Zone and Central Zone resources colour coded for gold equivalent (legend in figure 5.5). Grid datum is AGD66. Drill hole traces shown. The Z values are metres above/below sea level,

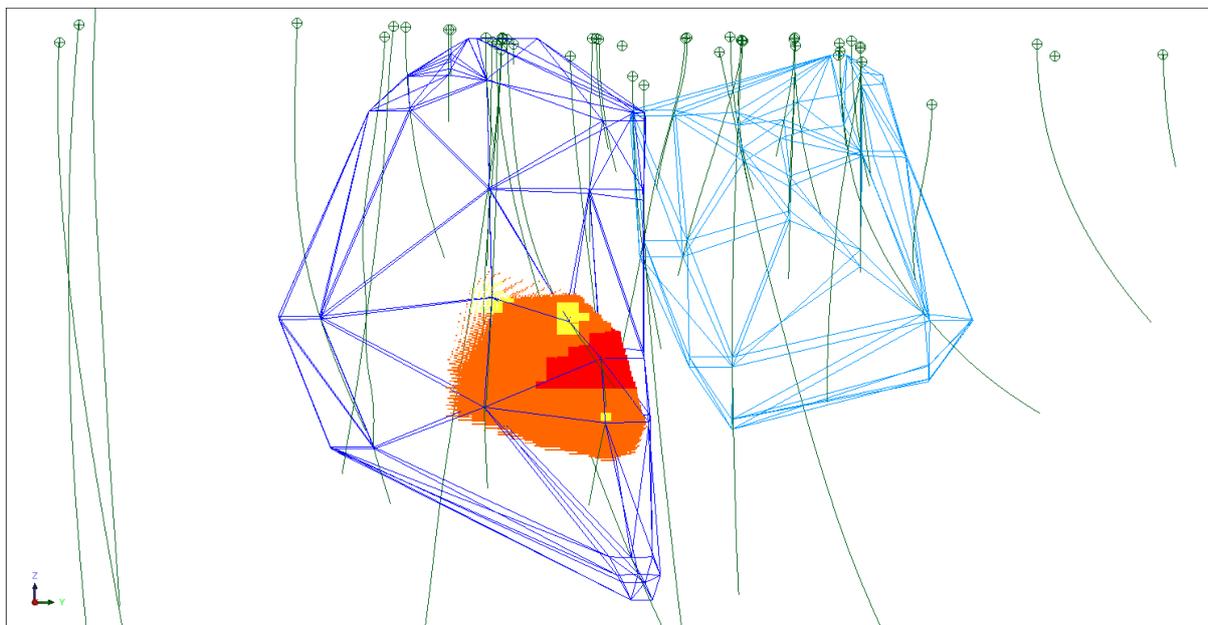


Figure 8.3: South Lens resource colour coded by gold equivalent (see legend in figure 5.5) within framework of the Central (aqua) and South (blue) Zones.

### 8.3 Grade tonnage report

The Mineral Resource is presented as a series of tons and grade tables and a graph based on a range of gold equivalent cut-offs. The individual resources contained in each of the Central and South Zones are presented separately in tables 8.2 and 8.3 respectively and combined into the **overall total resource in table 8.4 and figure 8.4.**

At a 0g/t Au equivalent cut-off (i.e. including all material within wireframes) stands at:

**Central Zone 309,200t @ 0.12g/t Au, 25g/t Ag, 0.03% Cu, 1.03% Pb and 2.16% Zn (= 1.8g/t Au equivalent)**

**South Zone 356,200t @ 0.74g/t Au, 48g/t Ag, 0.14% Cu, 2.29% Pb and 4.44% Zn (= 4.33g/t Au equivalent)**

**Total Resource 665,400t @ 0.45g/t Au, 37g/t Ag, 0.09% Cu, 1.7% Pb and 3.38% Zn (= 3.15g/t Au equivalent)**

**At a 5g/t Au equivalent cutoff the total resource is 167,300t @ 1.14g/t Au, 74g/t Ag, 0.22% Cu, 3.9% Pb and 7.7% Zn (= 7.1g/t Au equivalent).**

The South Lens resource is wholly contained within the South Zone. The resource contained within the South Lens is presented in table 8.5. At a 0g/t Au equivalent cutoff the resource in the South Lens (wholly contained within South Zone) is;

**South Lens 46,500t @ 1.45g/t Au, 70g/t Ag, 0.27% Cu, 4.1% Pb and 8.03% Zn (= 3.15g/t Au equivalent)**

**Table 8.2: Central Zones Tons and Grades based on Au Equivalent Cut-off**

Au_equ_cutoff	Volume (m3)	Mass (t)	Au g/t	Ag g/t	Cu %	Pb %	Zn %	Au equivalent g/t
0	110425	309191	0.12	24.53	0.032	1.03	2.16	1.8
1	78455	219675	0.15	28.31	0.038	1.33	2.79	2.25
2	21987	61564	0.24	46.28	0.076	2.96	6.48	4.71
3	13738	38466	0.3	56.9	0.098	3.85	8.5	6.09
4	9130	25565	0.34	65.46	0.121	4.71	10.6	7.43
5	5225	14629	0.39	76.08	0.16	6.11	14.4	9.67
6	4324	12107	0.42	81.74	0.174	6.66	15.8	10.54
7	3842	10756	0.44	85.32	0.182	6.98	16.5	11.04
8	3174	8886	0.46	90.61	0.194	7.45	17.7	11.77
9	2751	7703	0.48	94.23	0.201	7.78	18.4	12.28
10	2329	6521	0.5	97.58	0.209	8.08	19.2	12.75

**Table 8.3 South Zone Tons and Grades based on Au Equivalent Cut-off**

Au_equ_cutoff	Volume (m3)	Mass (t)	Au g/t	Ag g/t	Cu %	Pb %	Zn %	Au equivalent g/t
0	127218	356210	0.74	48	0.136	2.29	4.44	4.33
1	116549	326338	0.8	52	0.147	2.49	4.8	4.68
2	94762	265335	0.95	59	0.172	2.87	5.54	5.41
3	80588	225645	1.04	64	0.189	3.16	6.09	5.93
4	72123	201943	1.1	67	0.2	3.33	6.41	6.24
5	54548	152735	1.21	74	0.22	3.67	7.06	6.88
6	37138	103986	1.32	83	0.237	4.01	7.65	7.52
7	20251	56703	1.28	101	0.252	4.5	8.52	8.34
8	11058	30961	1.18	124	0.252	4.95	9.24	9.09
9	3576	10012	0.83	197	0.191	5.62	9.62	10.3
10	1484	4155	0.41	298	0.092	6.38	9.65	11.9

**Table 8.4: Combined Central and South Zones Tons and Grades based on Au Equivalent Cut-off**

Au_equ_cutoff	Volume (m3)	Mass (t)	Au g/t	Ag g/t	Cu %	Pb %	Zn %	Au equivalent g/t
0	237643	665401	0.45	37	0.088	1.7	3.38	3.15
1	195005	546013	0.54	42	0.103	2.02	3.99	3.7
2	116750	326899	0.82	57	0.154	2.89	5.72	5.28
3	94325	264111	0.93	63	0.176	3.26	6.44	5.95
4	81253	227508	1.01	67	0.191	3.49	6.88	6.37
5	59773	167364	1.14	74	0.215	3.88	7.7	7.12
6	41461	116093	1.23	83	0.23	4.29	8.5	7.83
7	24092	67459	1.15	98.5	0.241	4.9	9.79	8.77
8	14231	39847	1.02	117	0.239	5.51	11.1	9.69
9	6327	17715	0.68	152	0.195	6.56	13.4	11.1
10	3813	10676	0.46	176	0.163	7.42	15.5	12.4

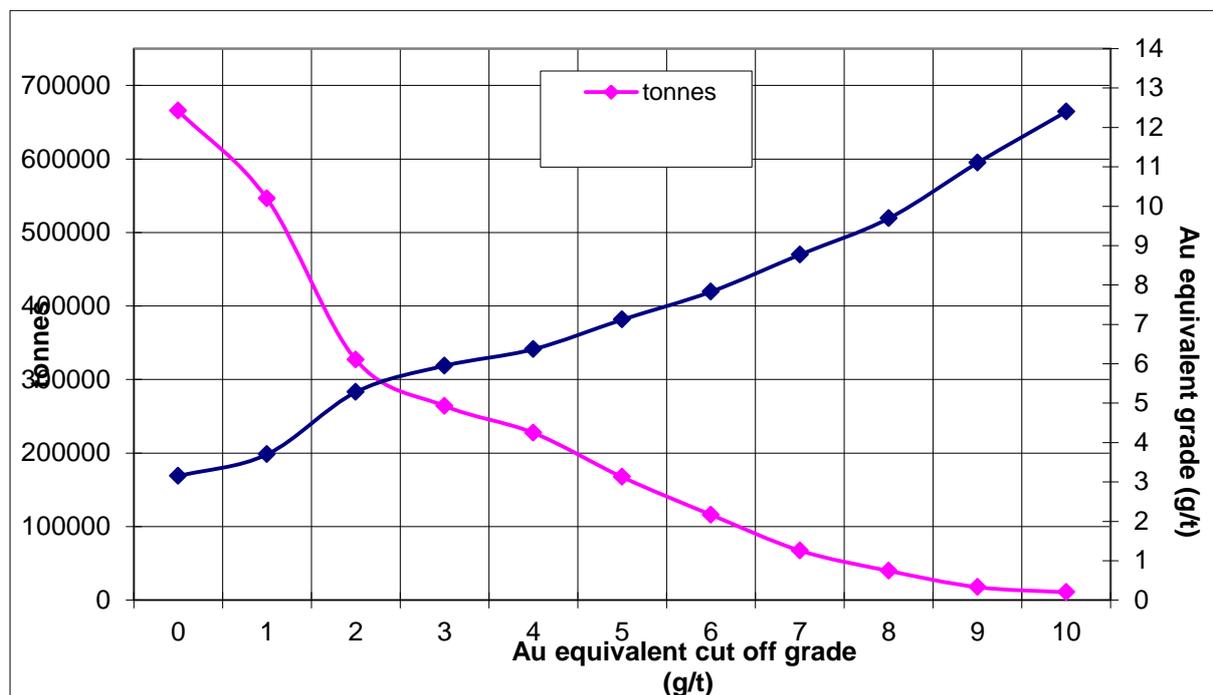


Figure 8.4: Tons and grade graph for combined South and Central Zone resource.

Table 8.5: South Lens Tons and Grades based on Au Equivalent Cut-off

Au_equ_cutoff	Volume (m3)	Mass (t)	Au g/t	Ag g/t	Cu %	Pb %	Zn %	Au equivalent g/t
0	16596	46469	1.45	70	0.27	4.09	8.03	7.64
5	16596	46469	1.45	70	0.27	4.09	8.03	7.64
6	16035	44897	1.45	71	0.27	4.12	8.1	7.7
7	12517	35049	1.43	75	0.28	4.33	8.53	8.01
8	5310	14867	1.4	87	0.3	4.76	9.42	8.71
9	1306	3656	1.41	96	0.32	5.19	10.3	9.43
10	259	724	1.63	97	0.35	5.51	11	10.08

## **9.0 Conclusions and Recommendations**

The Wart Hill massive sulphide deposit has been modelled based on combining clastic, disseminated and massive sulphide mineralisation and considering the mineralised zone to have along strike continuity.

Modelling based on this approach indicates the presence of two spatially separate zones, the South Zone and the Central Zone (the "North Zone" name remains unused as future drilling around Lens A, not included in modelling or estimation herein, may yet grow this currently uneconomic zone) which might be the same horizon structurally offset, but also may be separate manifestations of the same ongoing hydrothermal system in an active depositional environment.

Within the South Zone a discrete in-situ massive sulphide lens may be interpreted in the deeper part of the zone.

Upgrading the resource category would require more thorough drillcore relogging and geological interpretation. It would also require infill drilling in strategic positions to unequivocally demonstrate the strike continuity of the mineralised zones and the overall interpretation that spatially associated clastic, disseminated and massive sulphide styles may be grouped as a single mineralised zone.

Whilst drilling to the south and, particularly, to the north along strike appears to close off mineralisation, the drilling density is not sufficient for such a conclusion to be made confidently. The best potential to extend the current resource zones are at depth to the south of the South Zone and again at depth to the north of the Central Zone.

## 10.0 References

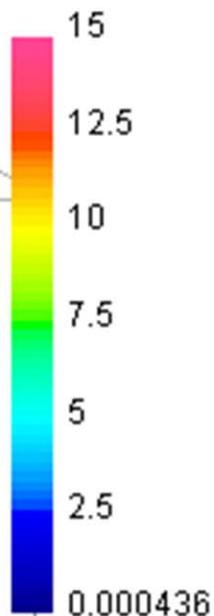
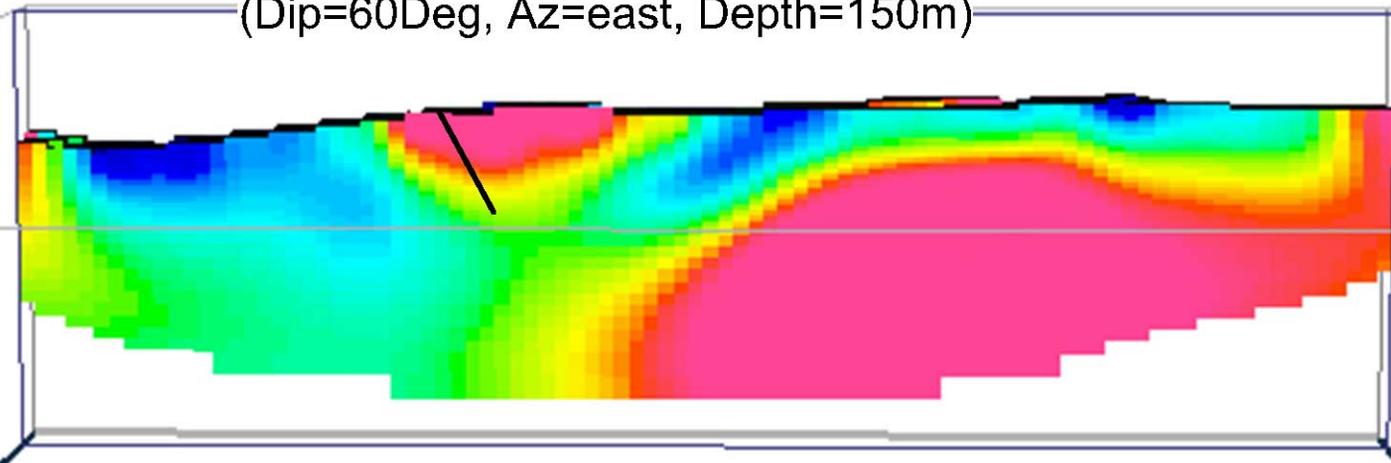
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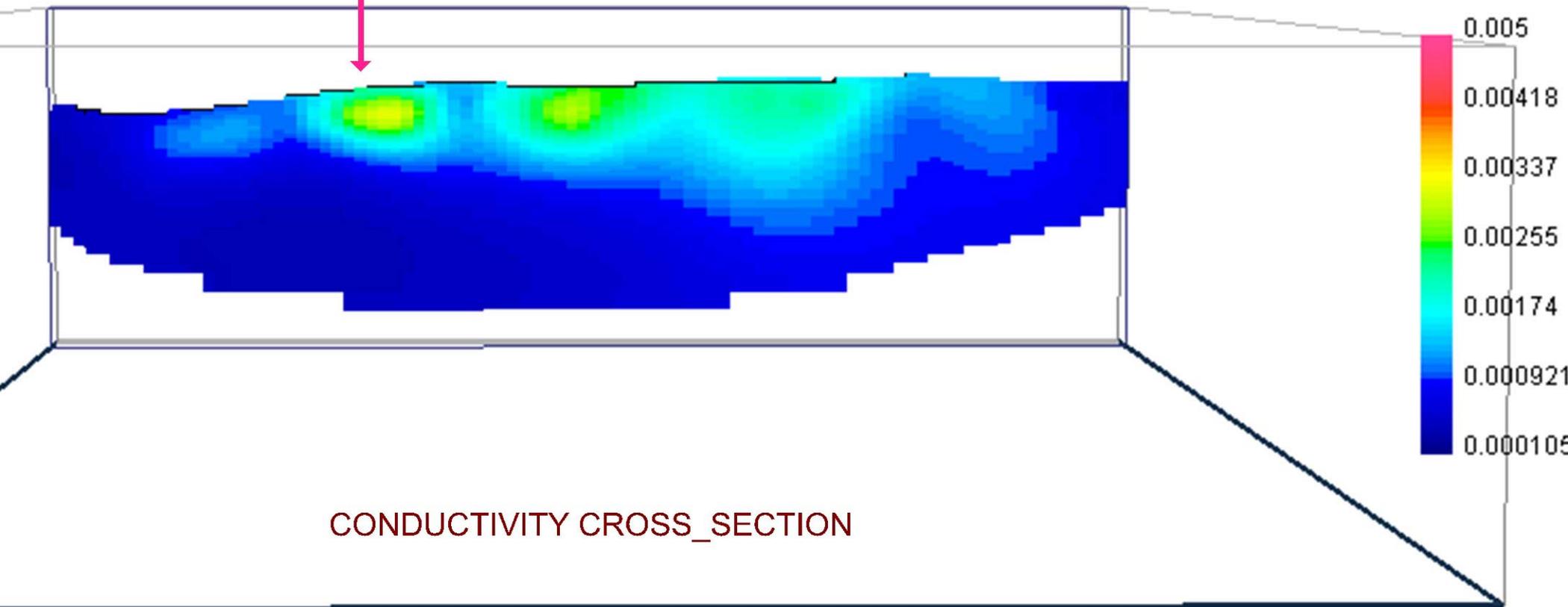
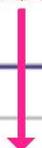
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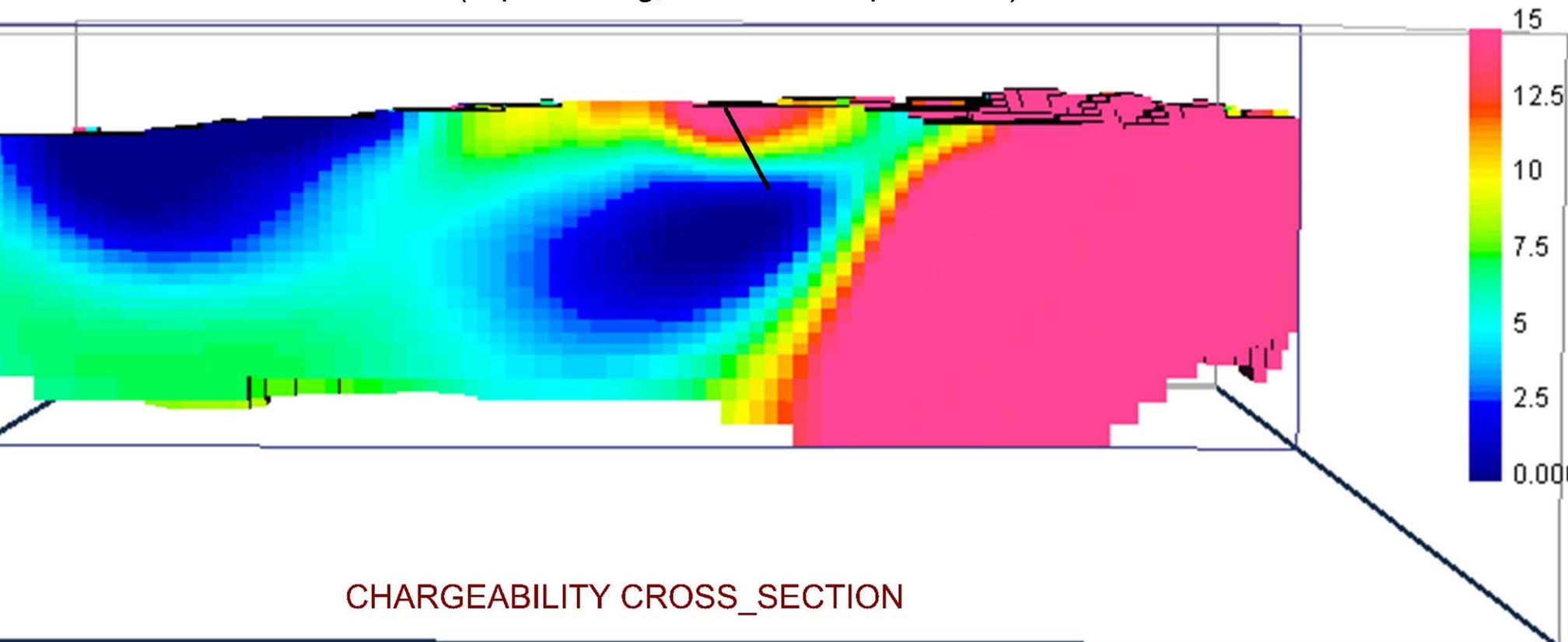
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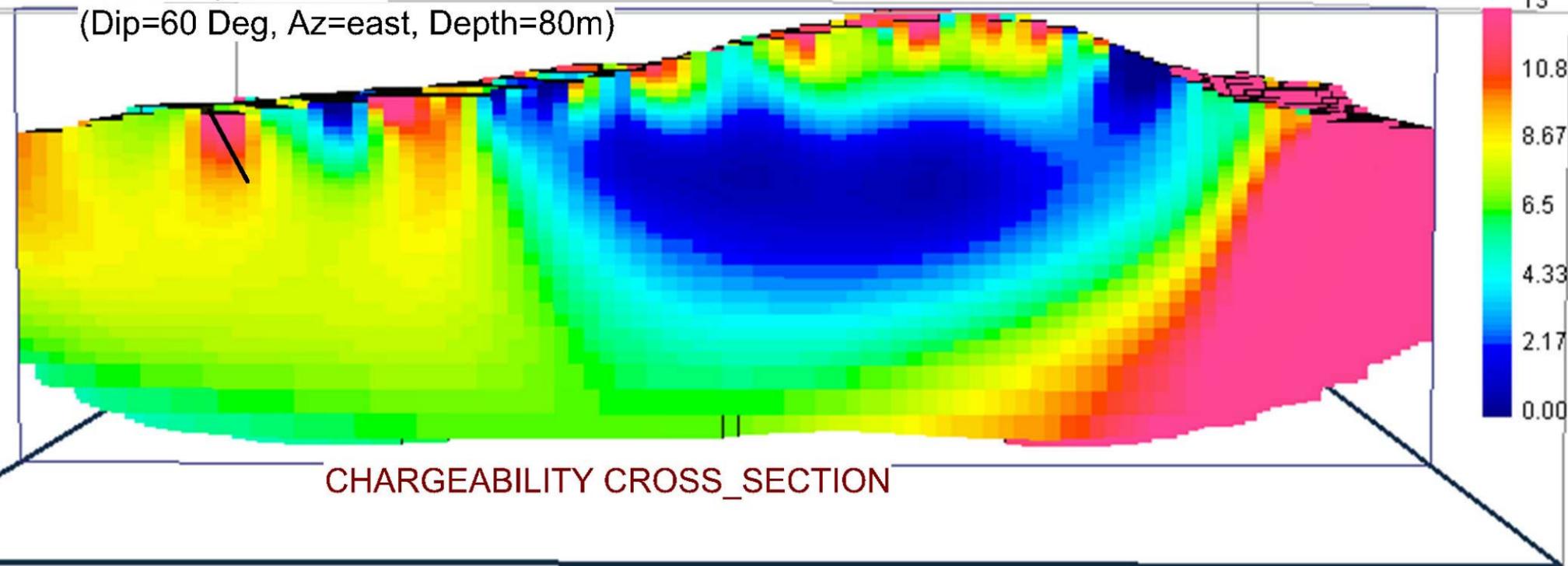
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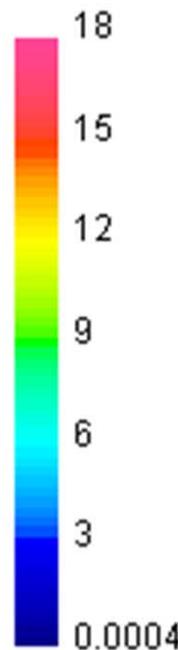
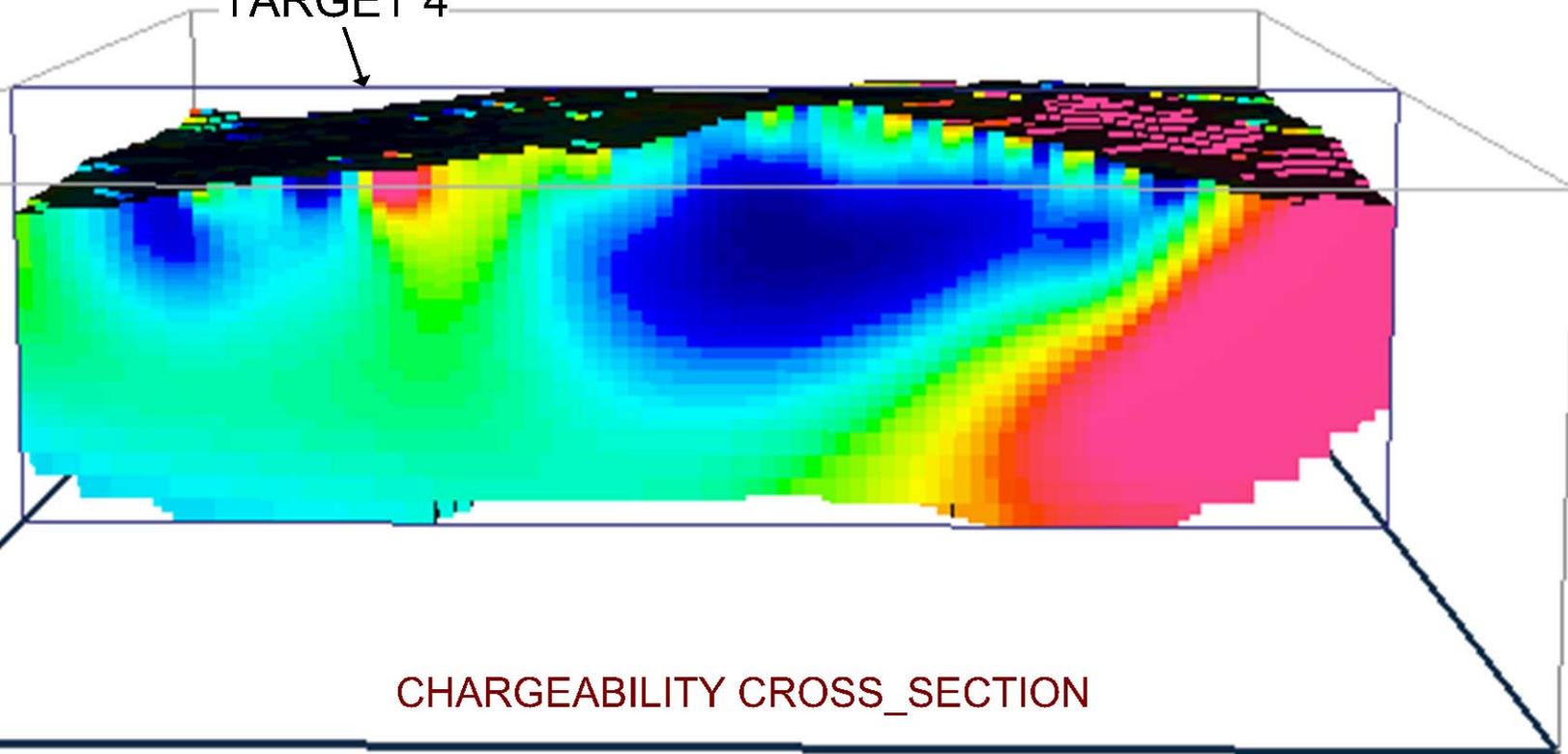
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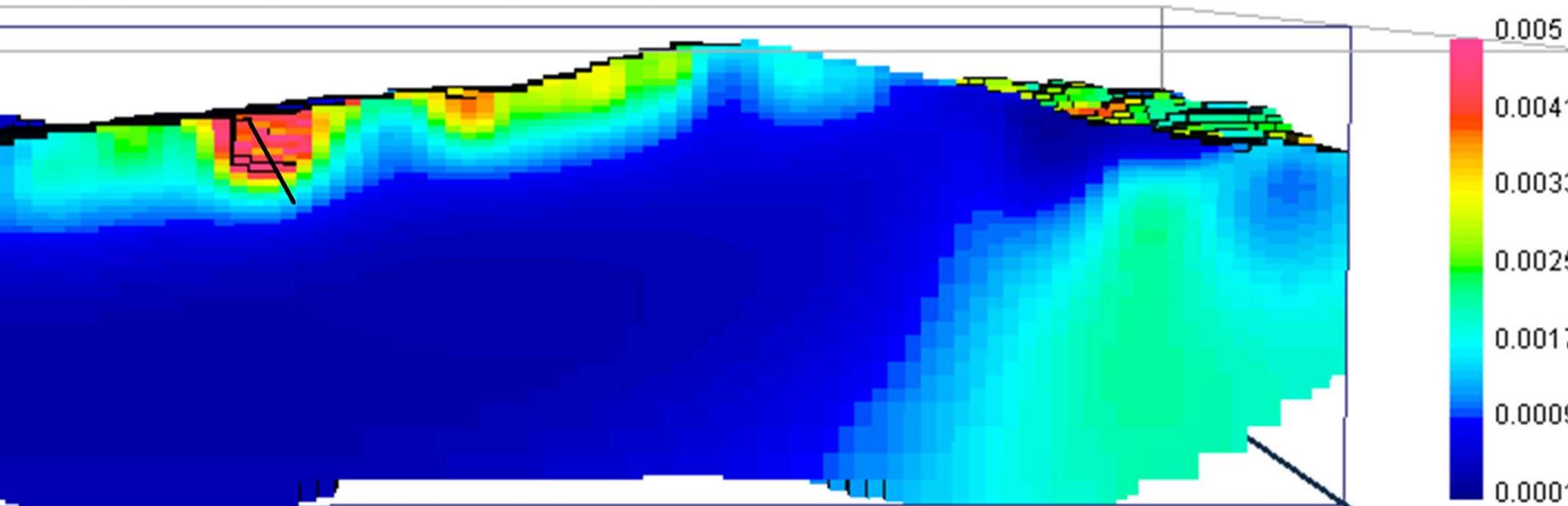


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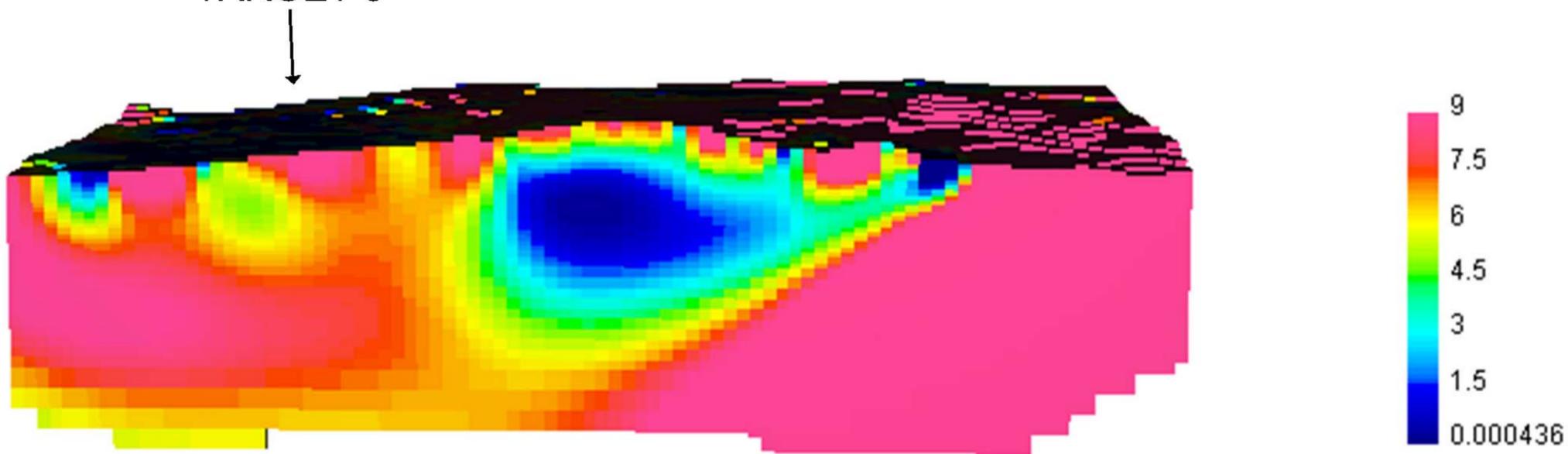
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TARGET 5

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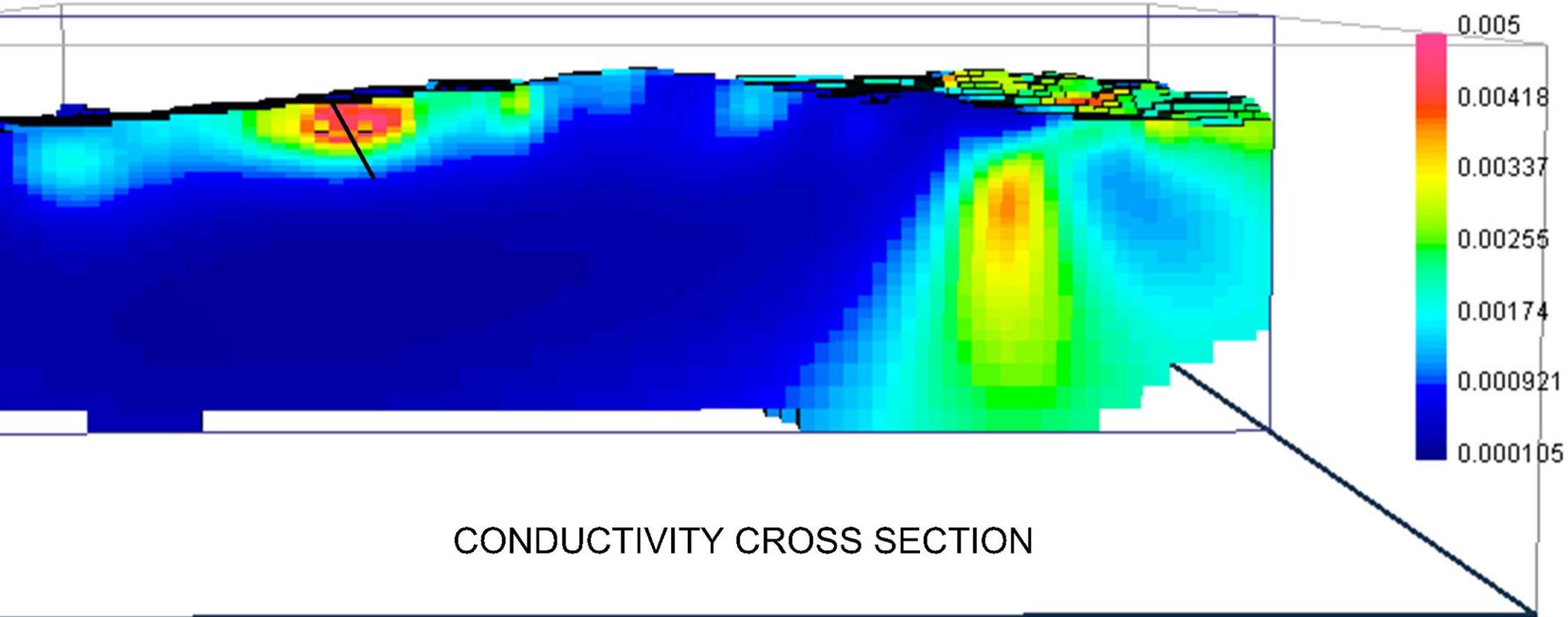
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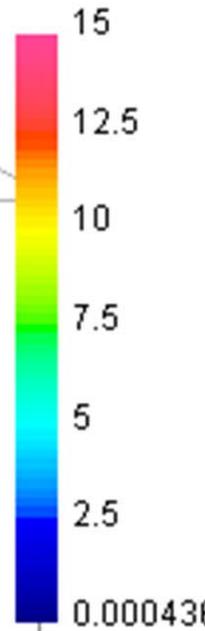
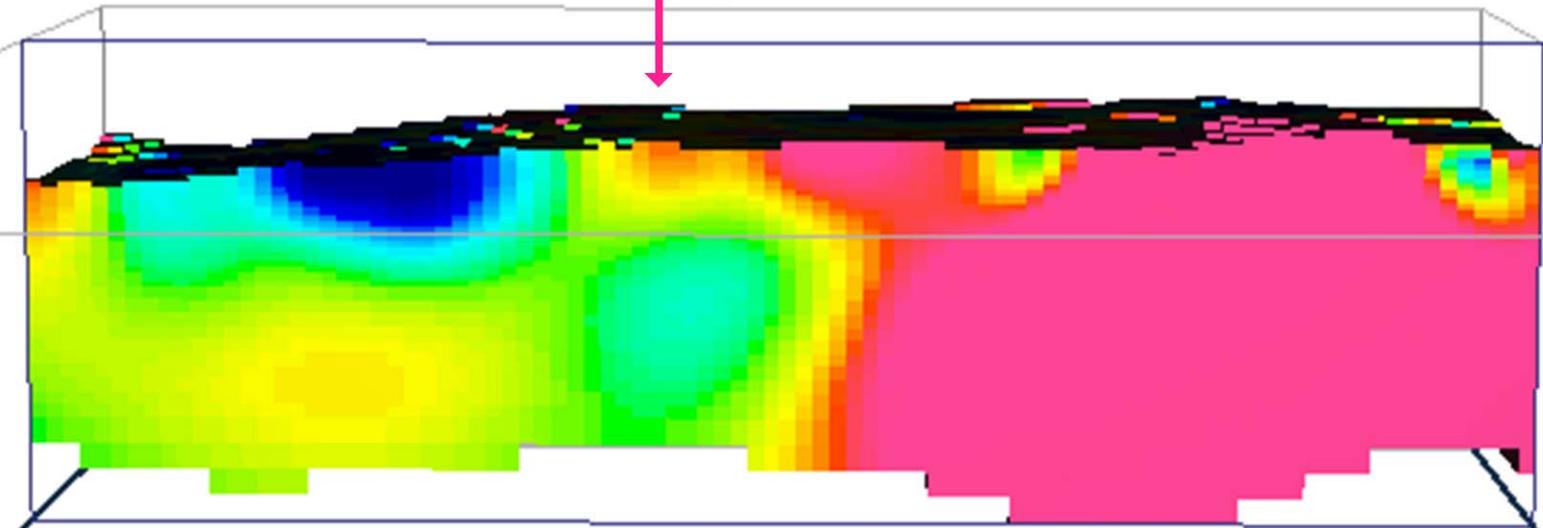
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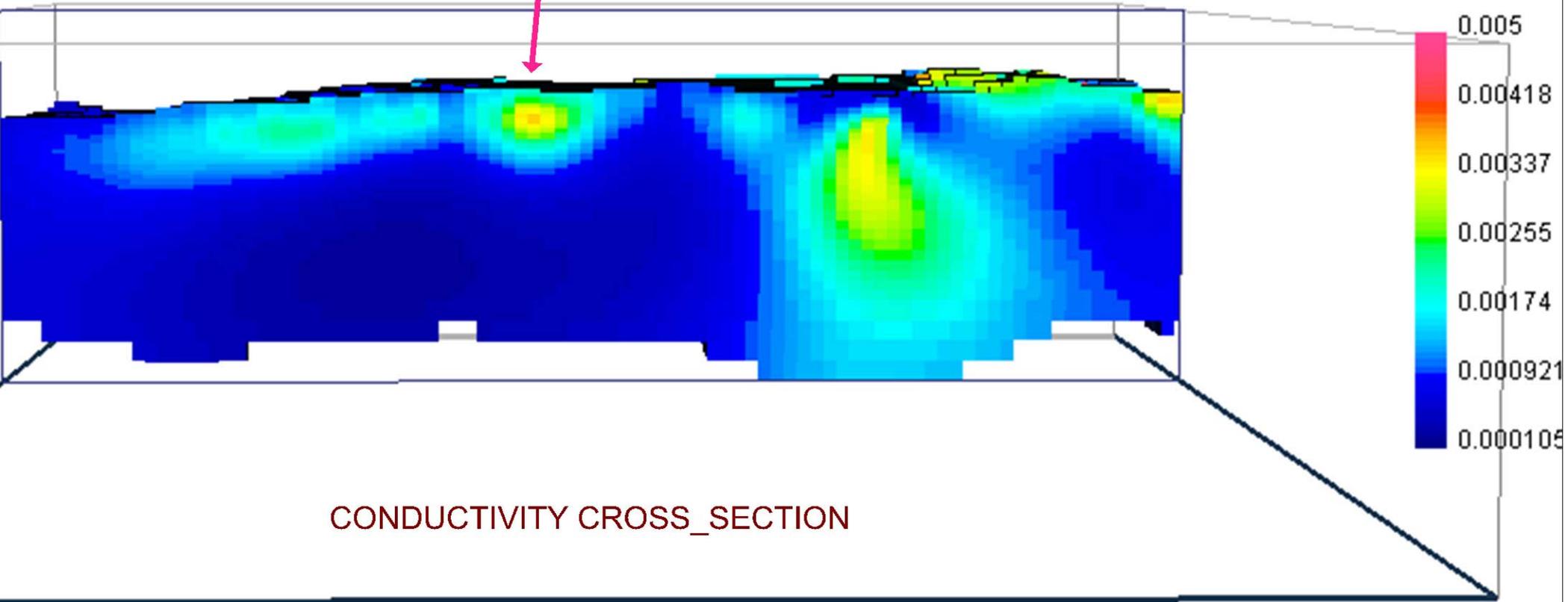
WART HILL  
Massive sulphide



CHARGEABILITY CROSS\_SECTION

Northing = 5251500.5

WART HILL  
massive sulphide



Northing = 5251500.5

**Wart Hill  
massive  
sulphide**

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*pumice breccia*  
*sandstone*

shales and siltstone

sandstone

lava

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0.00337

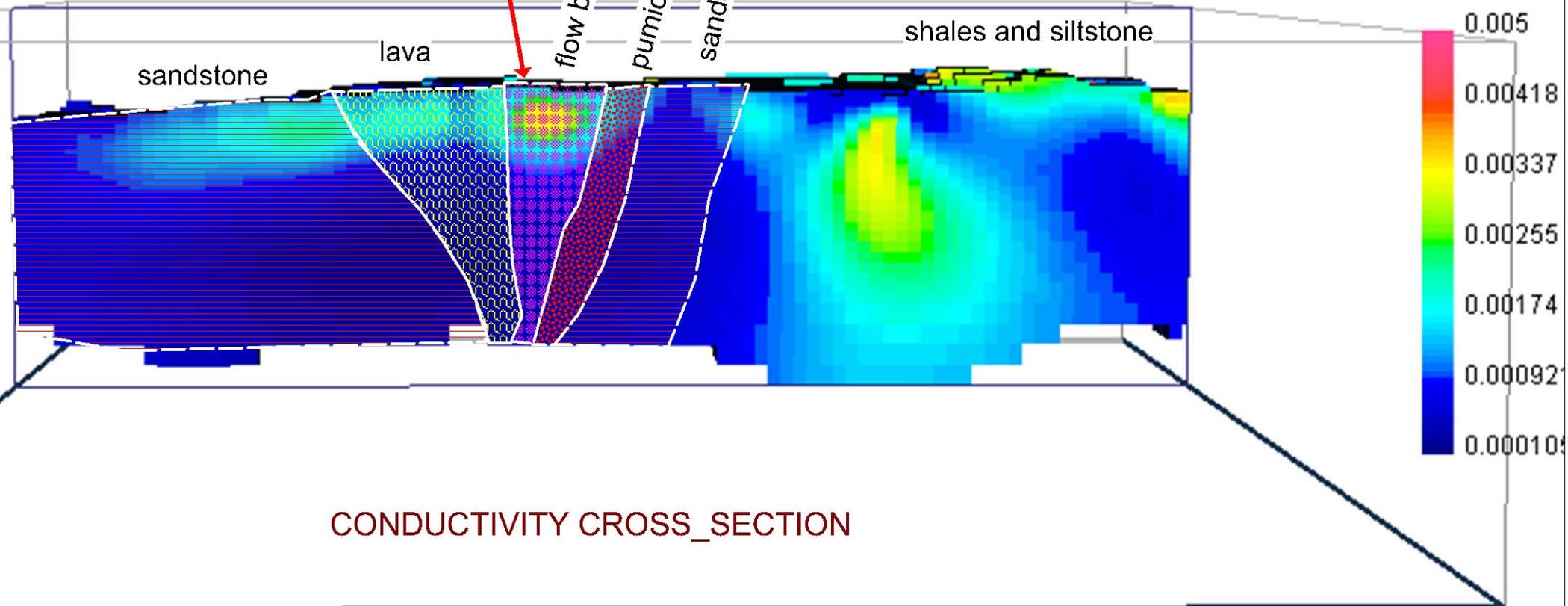
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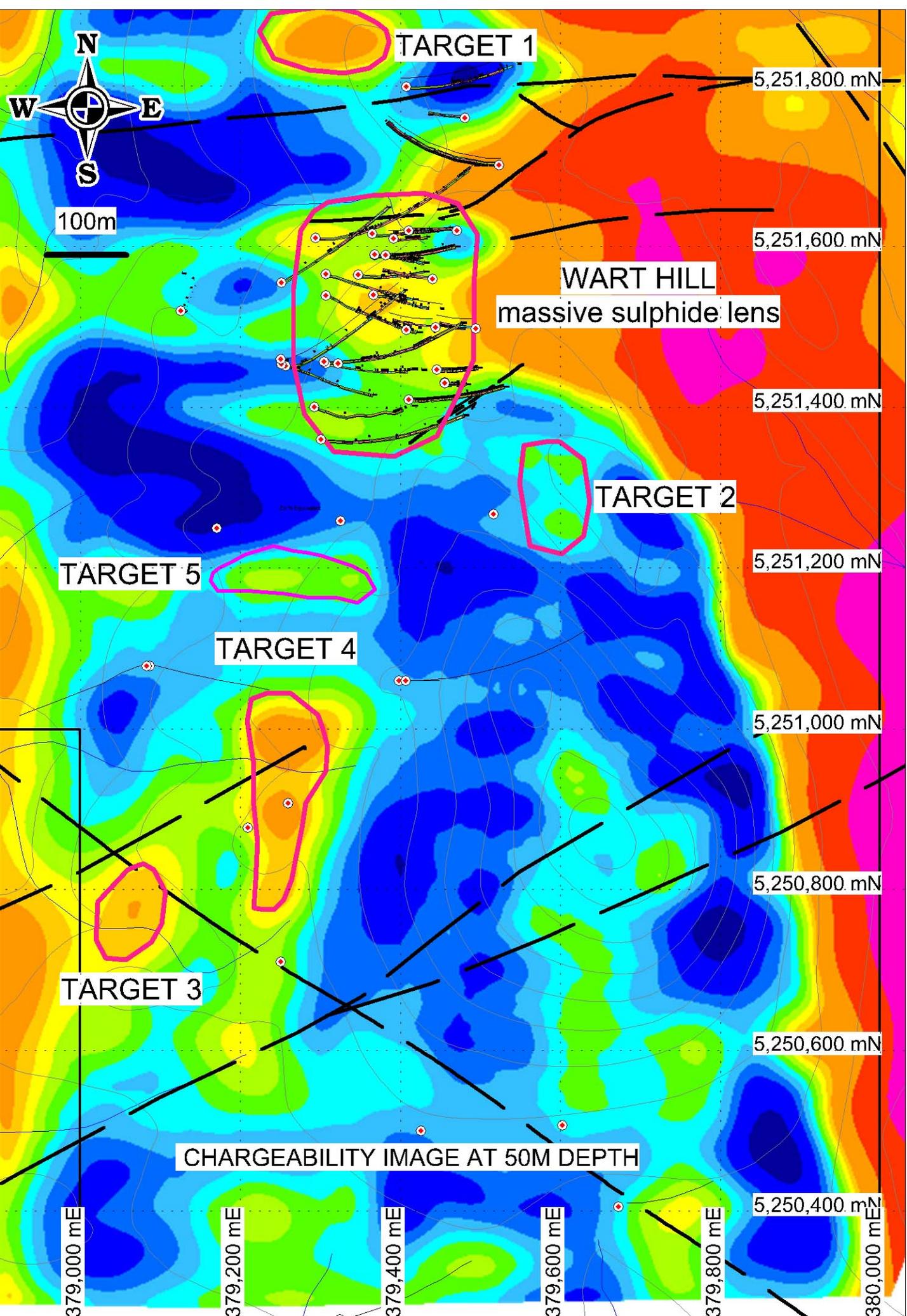
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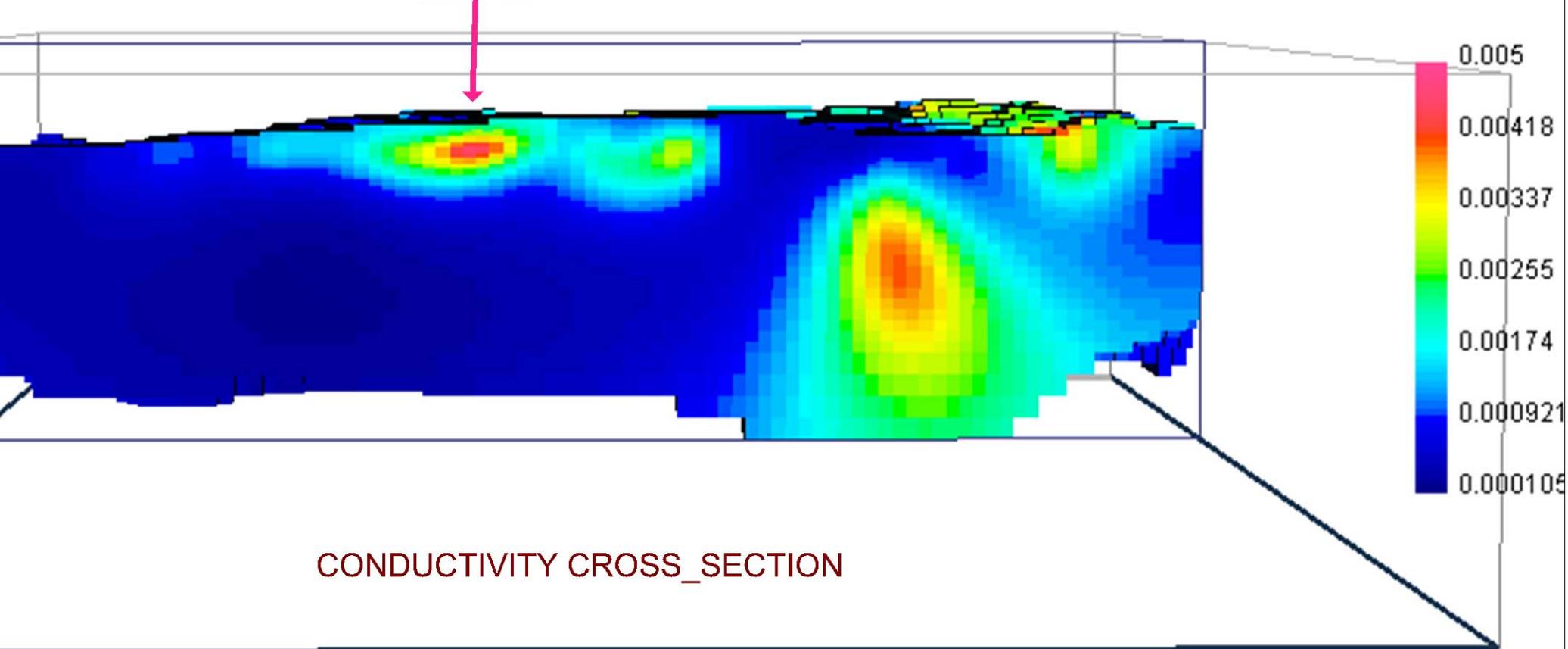
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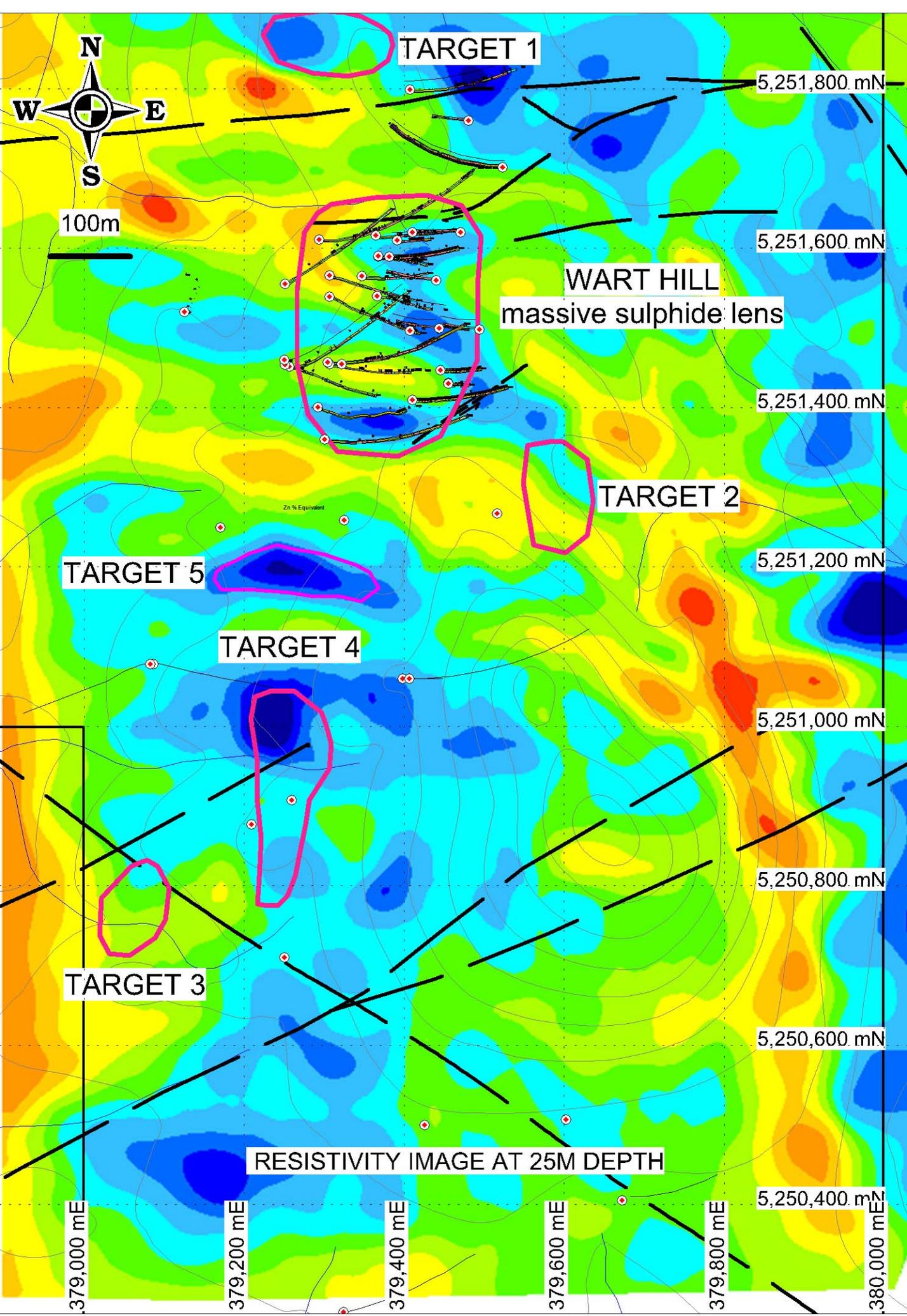




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WART HILL  
SOUTH





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5,251,800 mN

100m

5,251,600 mN

WART HILL  
massive sulphide lens

5,251,400 mN

TARGET 2

TARGET 5

5,251,200 mN

TARGET 4

5,251,000 mN

TARGET 3

5,250,800 mN

RESISTIVITY IMAGE AT 25M DEPTH

5,250,600 mN

379,000 mE

379,200 mE

379,400 mE

379,600 mE

379,800 mE

5,250,400 mN

380,000 mE