M36
Airborne TEM Study
GeoTEM – 2007
ProTEM - 2008

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August 2008

Preamble

The reported success of Quaterra (April, 2008) in finding a hidden breccia pipe through the use of airborne EM prompted Uranium One USA to ask us to re-evaluate the airborne GeoTEM data flown over the Arizona strip in February and March, 2007.

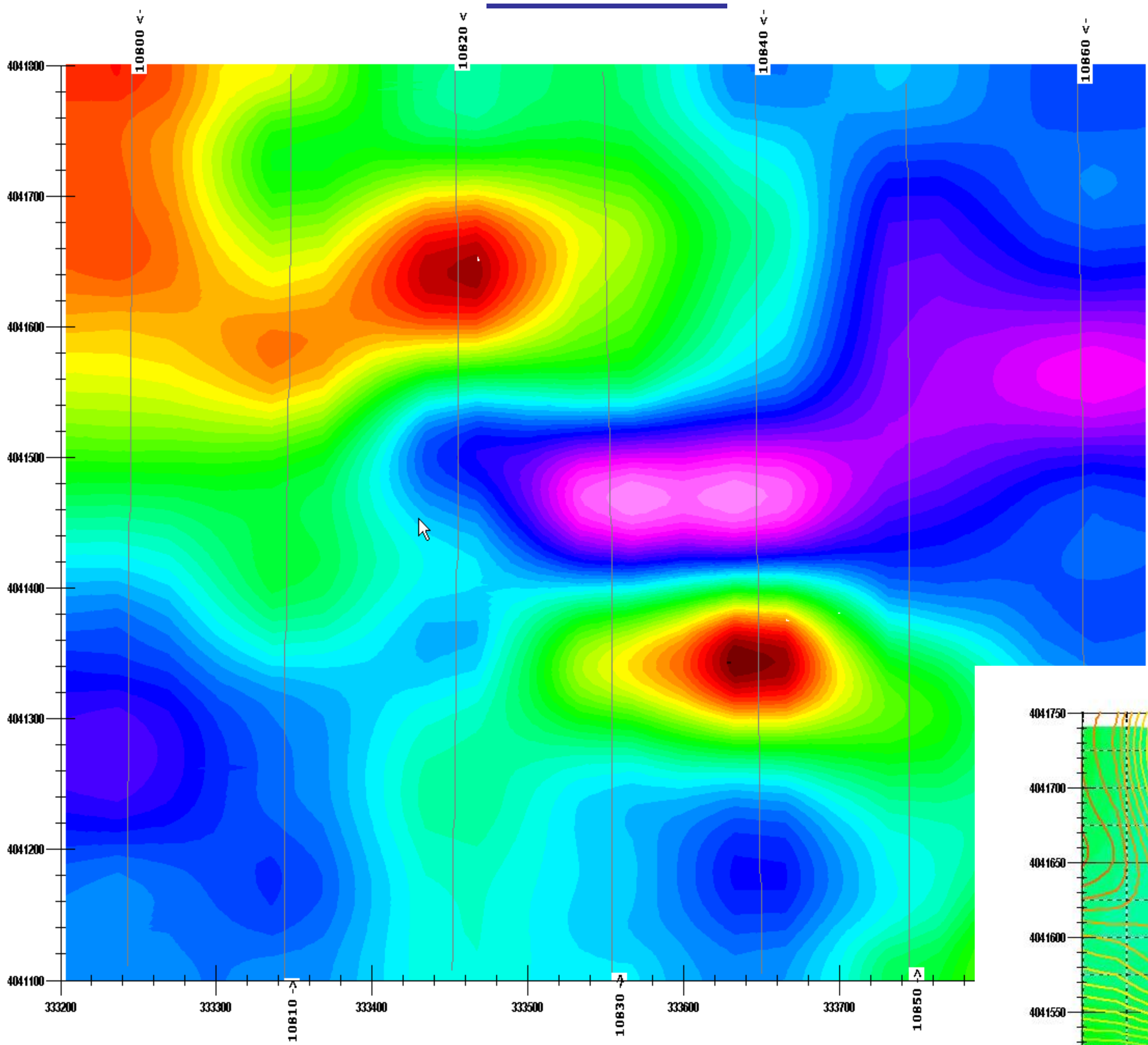
Quality control of this data was performed by Kenco Minerals of Denver who subsequently performed inversions on this data in March/April 2008.

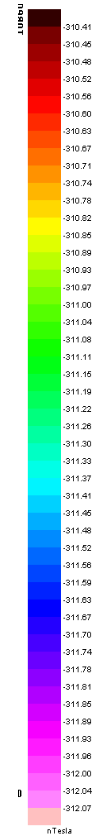
Over the last year, we have generally found the GeoTEM data to be of little value in the exploration activities of U1. However, in May of 2008, several sets of ground TEM data were collected which along with the previous EM data (VLFR, MaxMin) allowed us to better evaluate how to use the GeoTEM data. Of principal consideration are two ground surveys at FT. The first of these surveys being a large survey with a fixed loop north of the FT drilling areas but still under the test airborne EM data flown in 2007 (GeoTEM, MegaTEM, VTEM).

These studies helped us determine how to better utilize the data for the inversion process. As an example, we were able to confirm that there was an amplitude problem with all of the GeoTEM data, that there was a critical system setting which had to be adjusted and which data could be used in the inversions and how this data should be weighted.

More details of these aspects, will be presented in a Findlay Tank area report concentrating on comparisons of the models derived from the various airborne datasets and those models derived from the two ground TEM surveys as well as the models from the other EM data.

Magnetics – Total field gradient removed



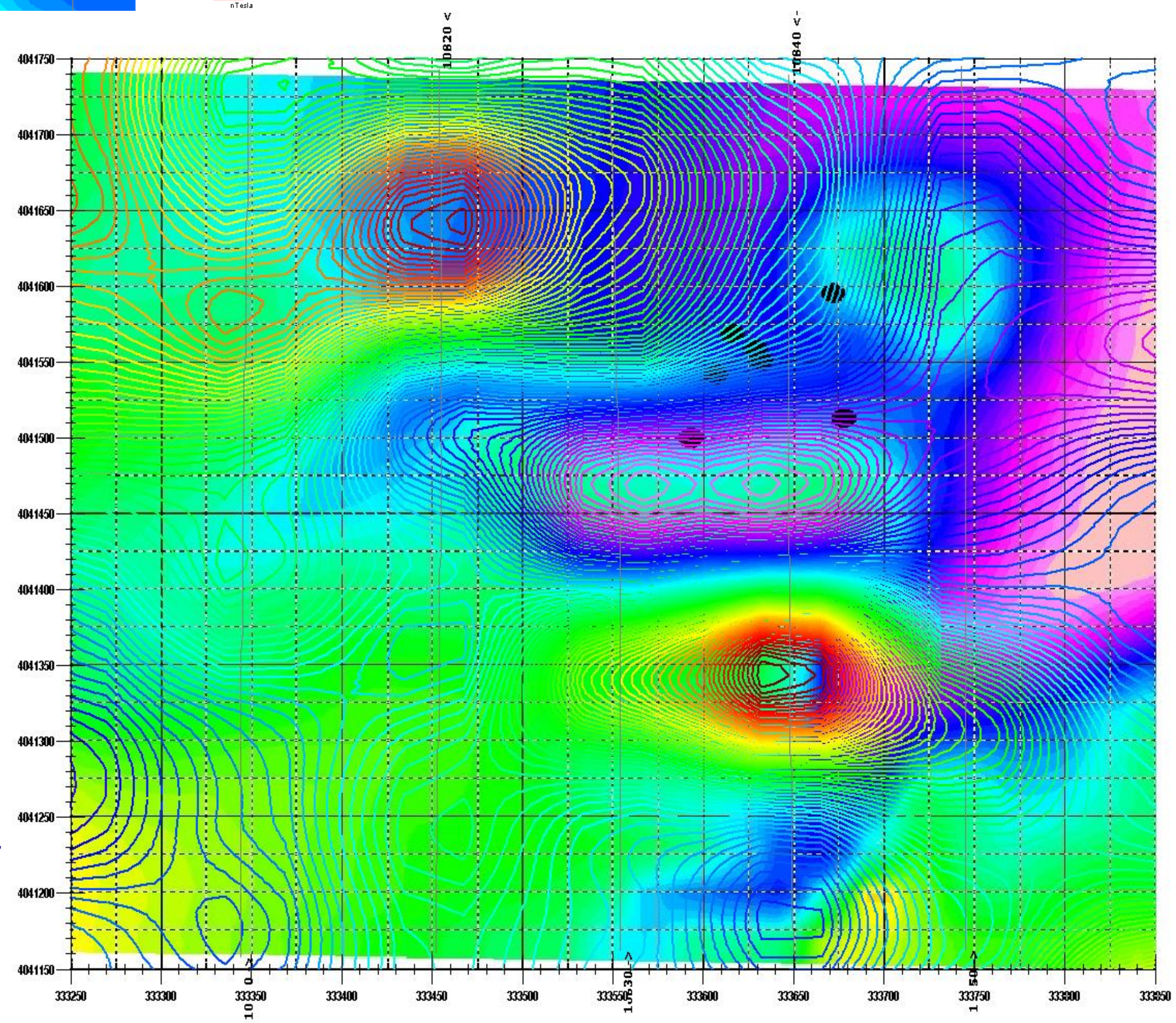


On the left is the total field measurement (contoured). However, the regional gradient has been removed. Below, is the same display but with contour lines and the DEM underlayed. The locations of previous drilling are in black dots (not all BHs are displayed).

The magnetics displays indicates little correlation with the DEM. There are 2 highs and 3 lows with a long NE magnetic low structure trending NE from the SW. The strong low in the centre is just North of the drill holes on the hill slope.

While the mag high is on top of the hill, it must be remembered that the flight lines are 100m apart. The strongest part of this high comes from about 50m of high along 1 line but the EW extent shown into the yells covers 2 lines and stretches to a third. This high may be a dipole response of which the central low is a part.

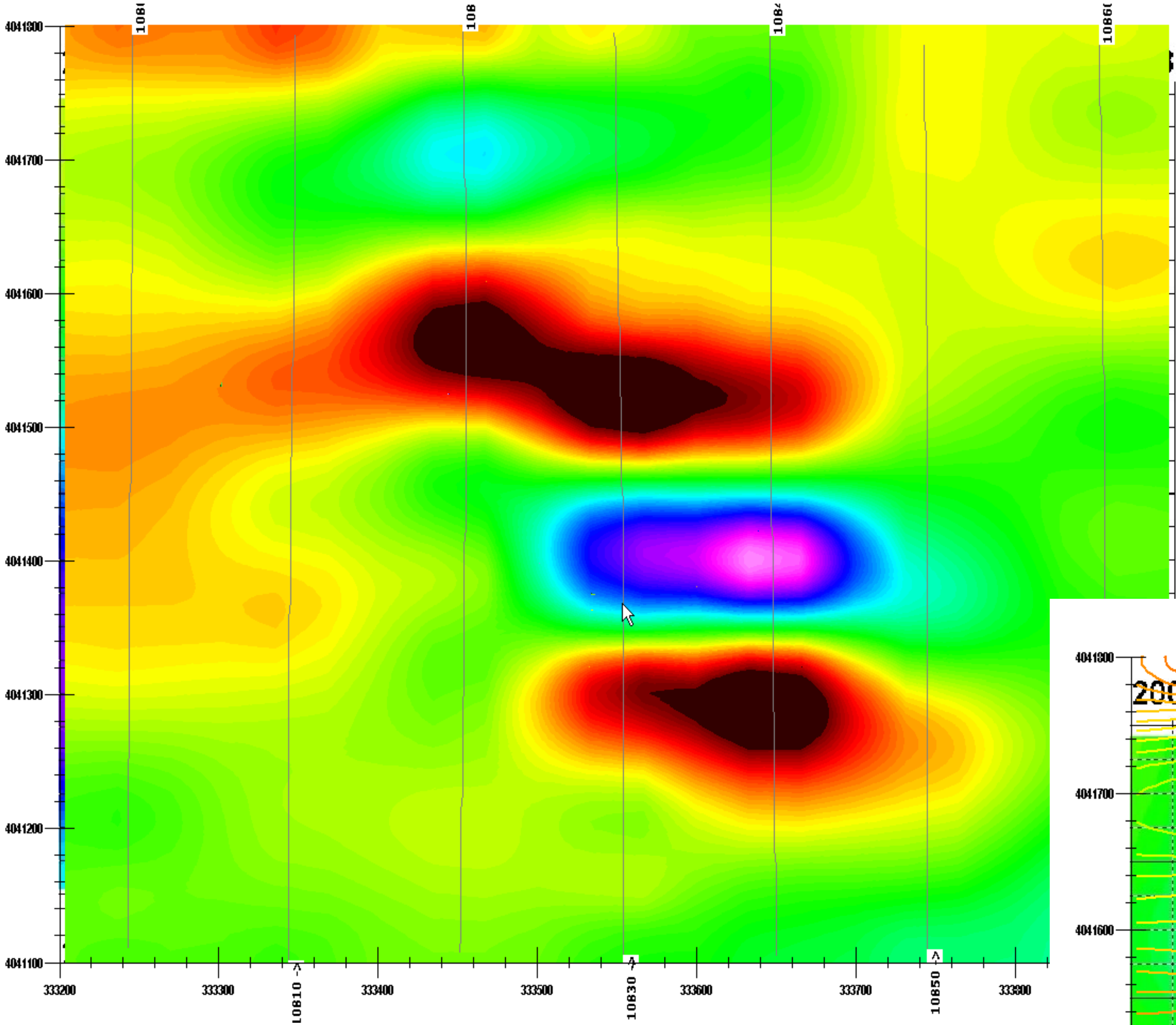
Total field magnetics with regional gradient removed.

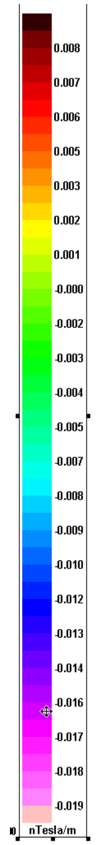


Contours of total field magnetics with DEM underlayed.

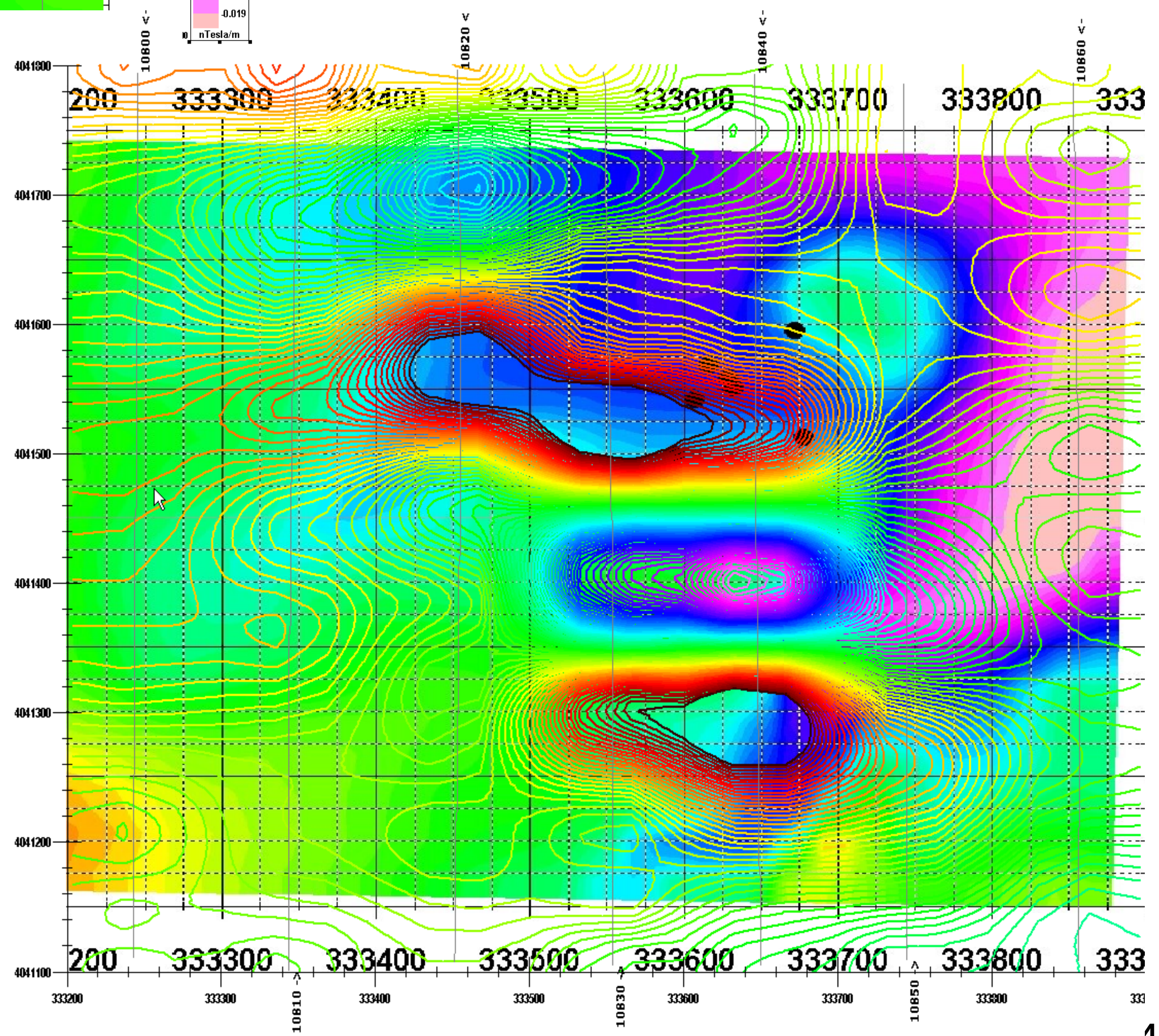
Magnetics – Derivatives of Total field

The inline derivative (direction of flight) indicates 3 strong anomalies. The most northern has some correlation with the topography and is consistent with alluvial wash but trends eastwards towards the location of pipe. The other 2 anomalies are on top of the hill with the centre point of these 2 anomalies at the centre of the total field high (previous page). These 2 anomalies indicate strongly that this anomaly on the hill is not limited to a single flight line.





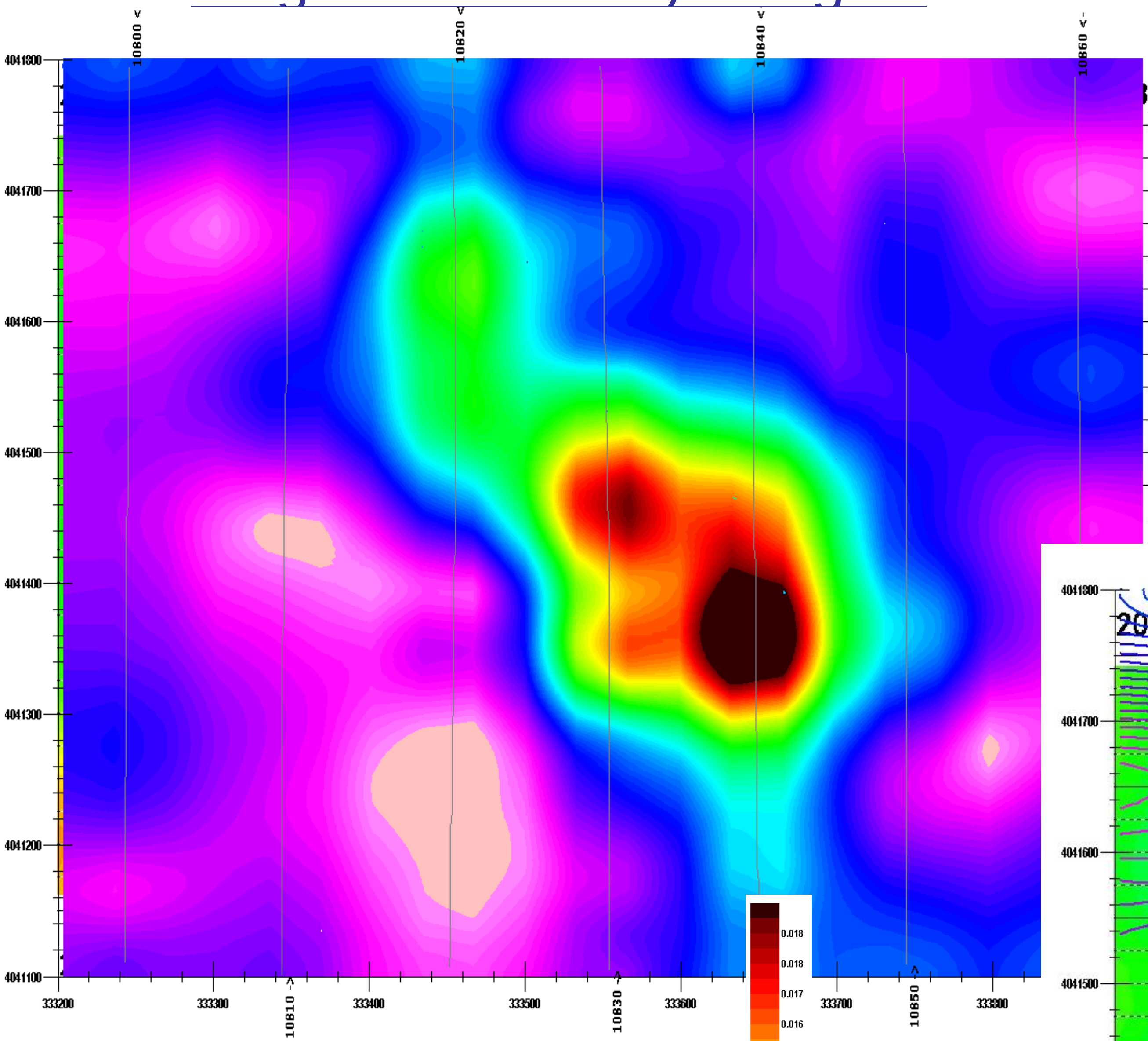
Total field inline derivative.

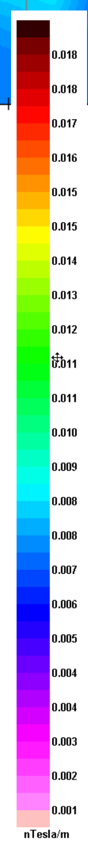


Contours of inline derivative with DEM underlayed.

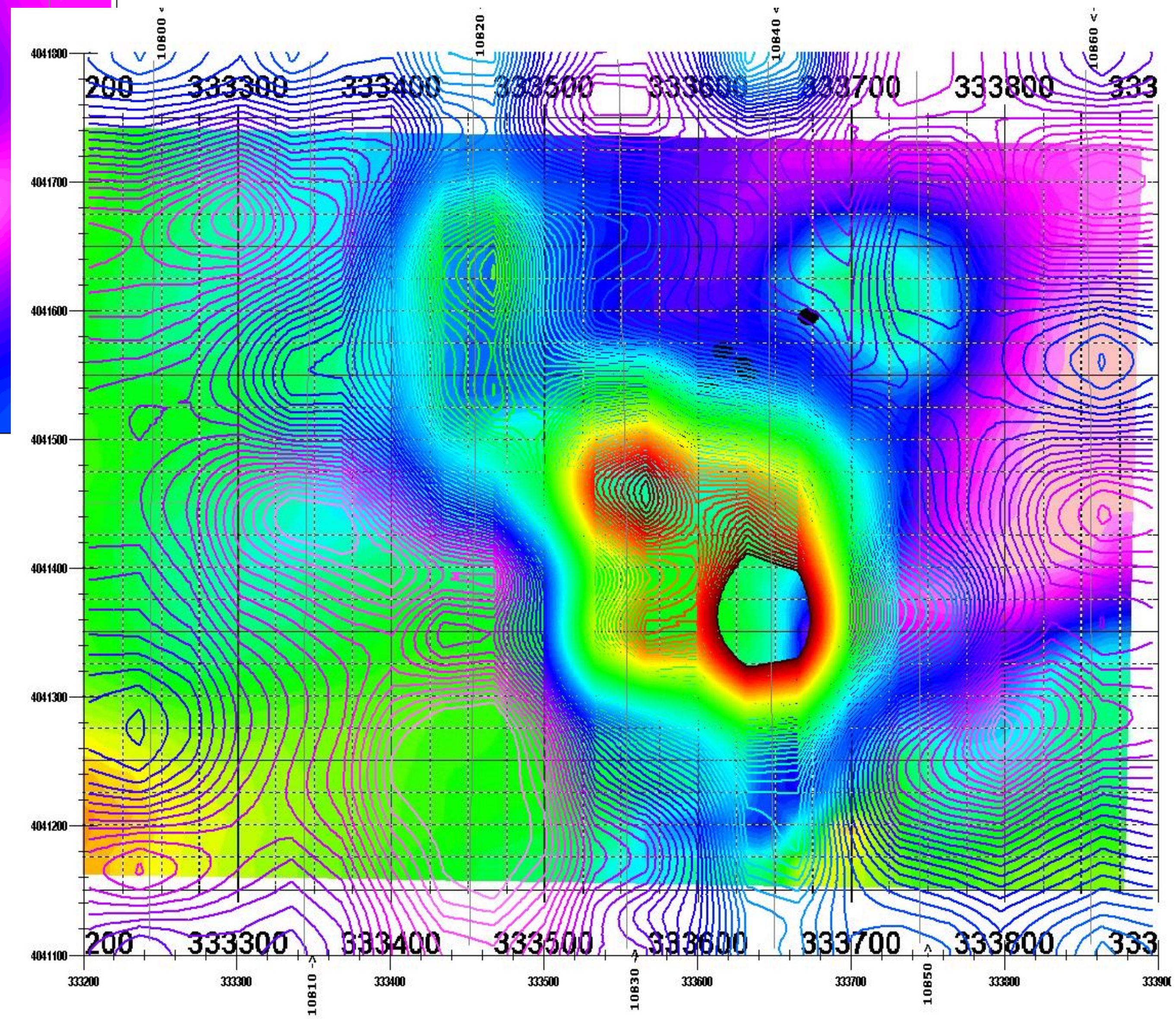
Magnetics – Analytic signal

The analytic signal is a combination of all 3 derivatives of the magnetic field (inline, crossline and vertical). It has been shown that this process will centre the image over the structural anomaly. This image appears to show clearly that the magnetic anomaly is centred over the hill with the drillholes on the edge of the anomaly. The anomaly is approximately 200m in radius.





Analytic signal (combination of derivatives).

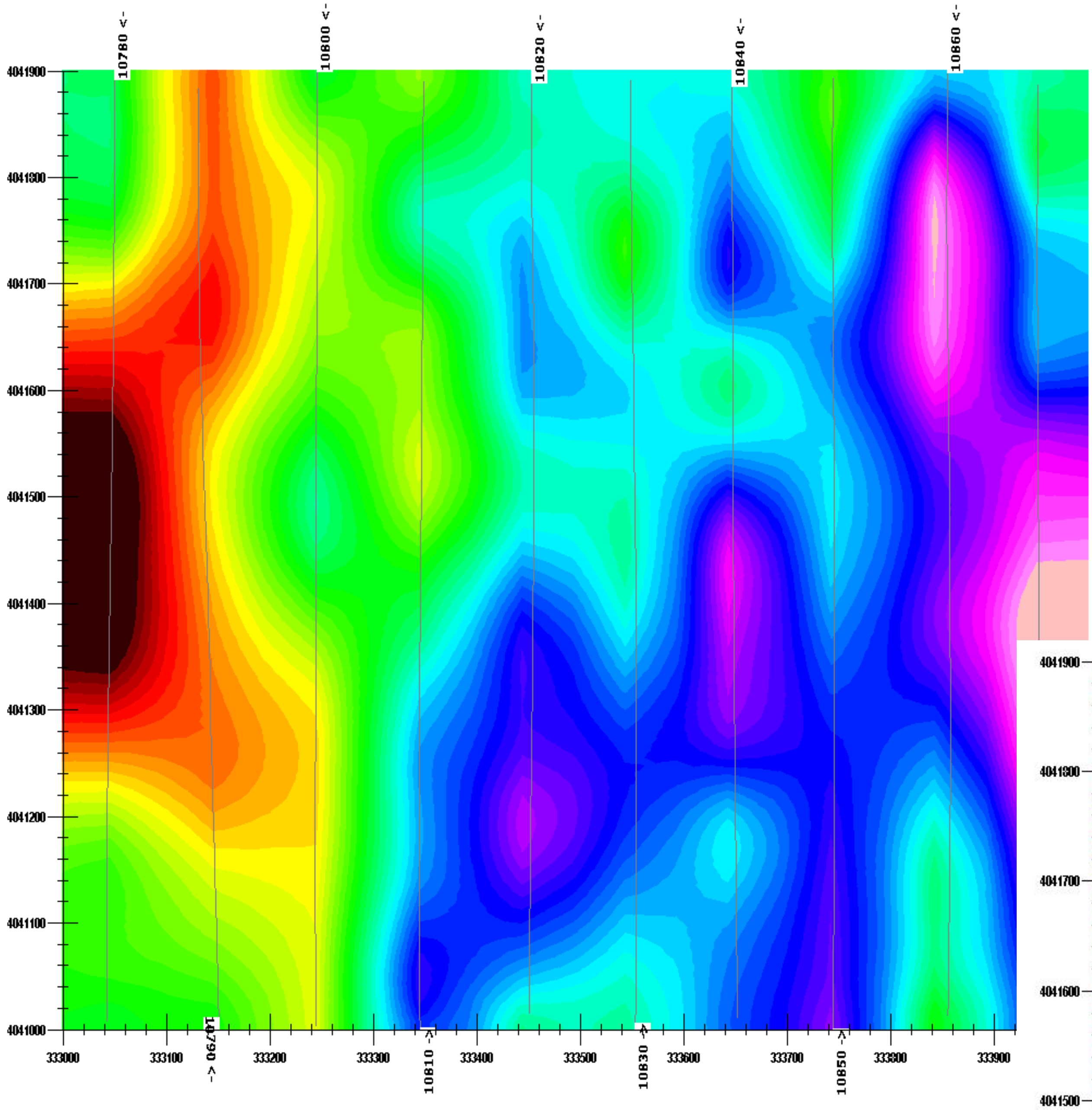


Analytic signal with DEM underlayed.

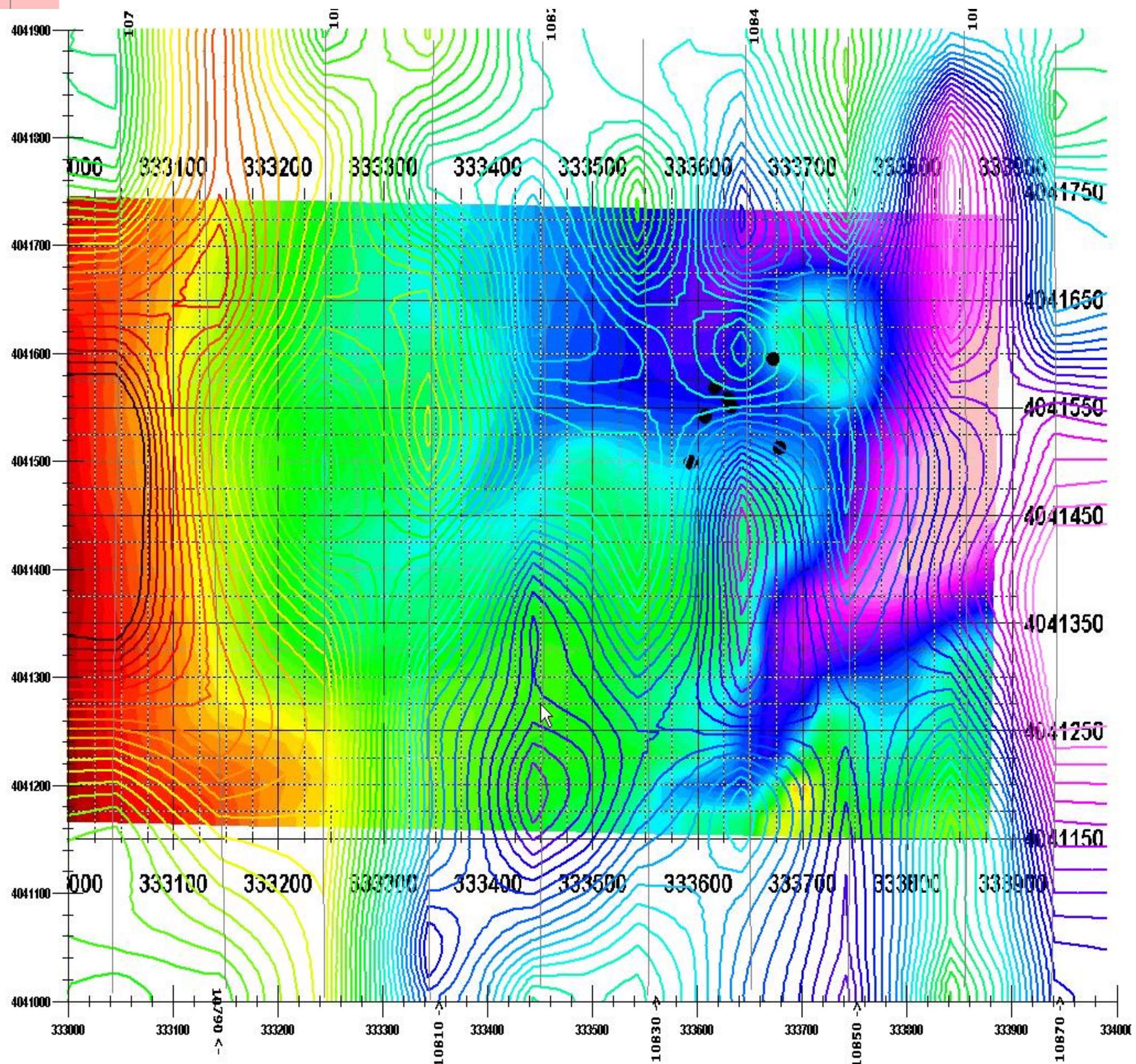
GeoTEM (2007) merged data windows

Early Time (just after turnoff of current)

The early time response shows a strong correlation with topography.



Early Time GeoTEM

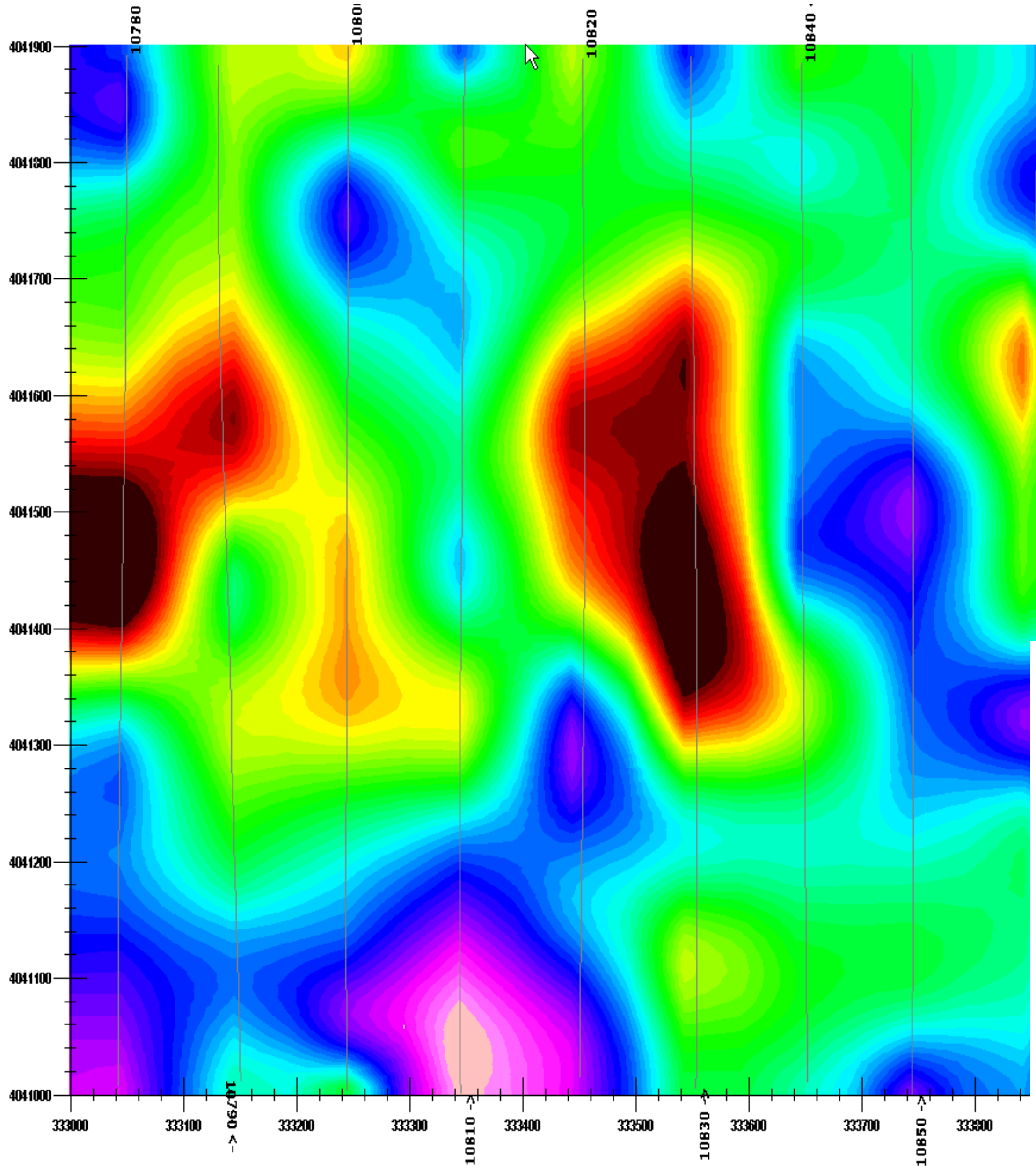


Early Time GeoTEM over DEM

GeoTEM (2007) merged data windows

Midtime response)

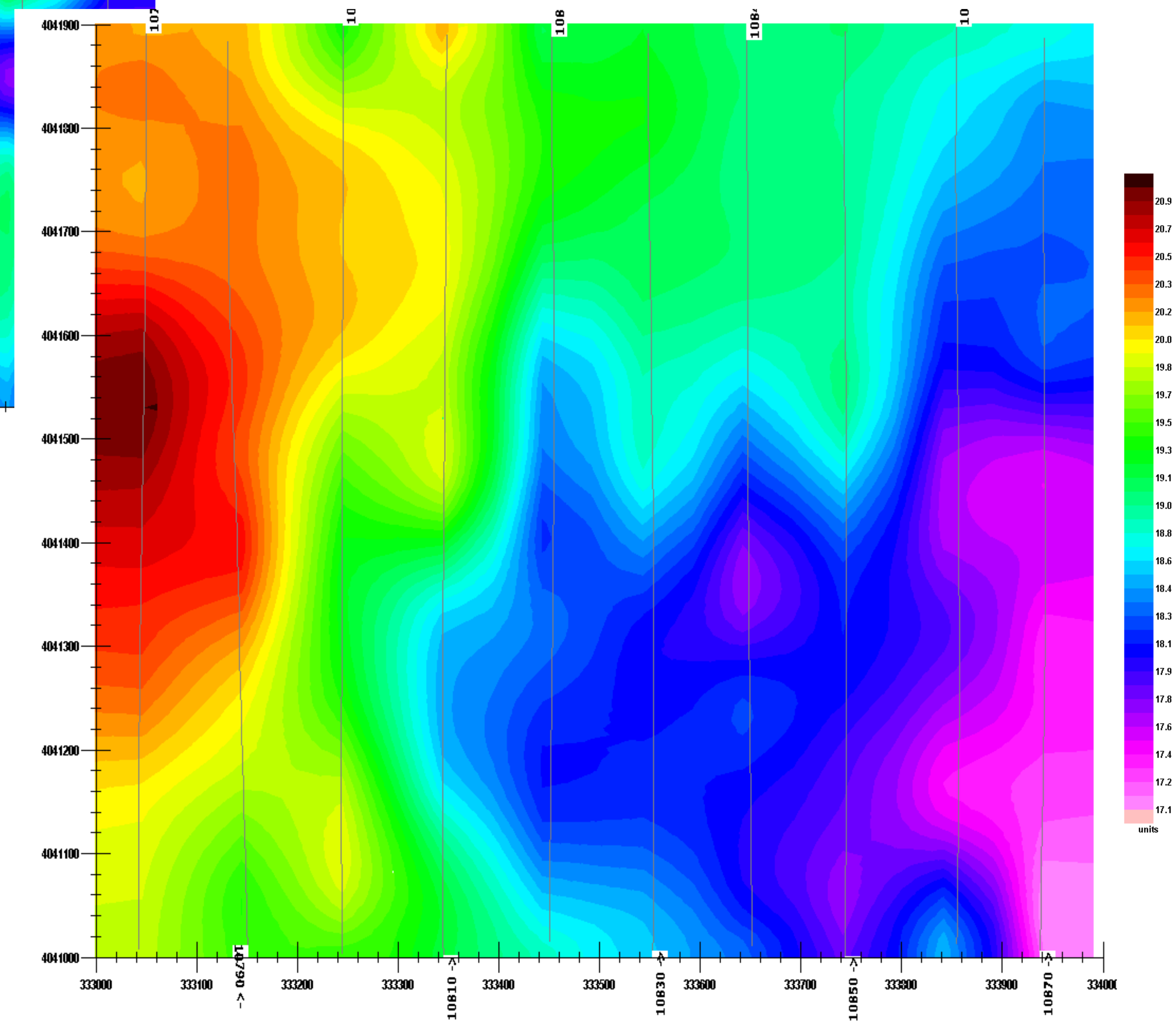
The later time responses(deeper) show more correlation with the magnetic anomalies and the known structure.



Midtime GeoTEM

Early to mid-time decay rates

The decay rates which are less prone to individual noise in the measurements show a more conductive material under hill with a low (conductive material) near the centre of the magnetic anomaly as indicated by the analytic signal (Pg 5).

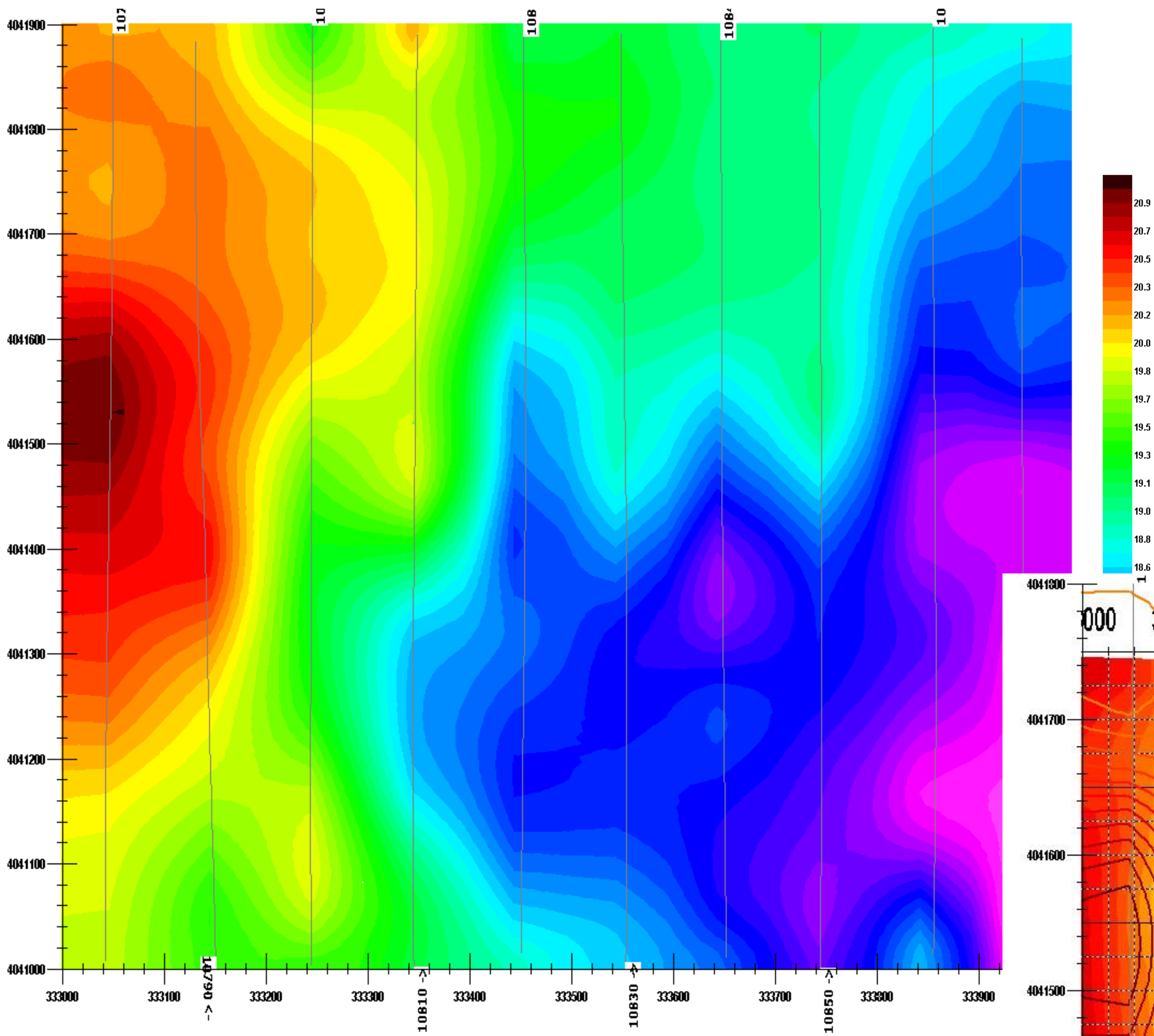


Decay Rate early to mid-times

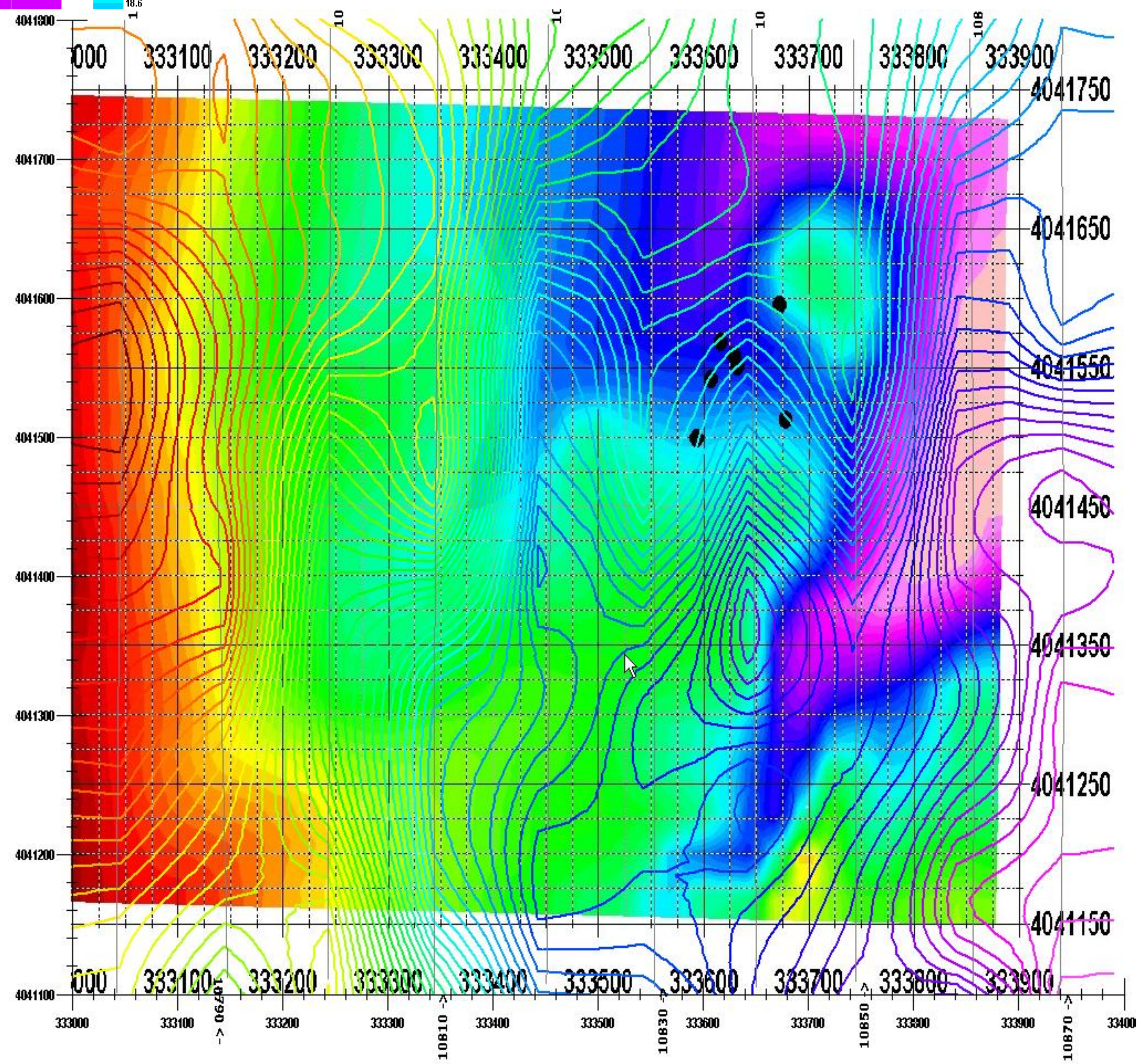
GeoTEM (2007) merged data windows

Early Time (just after turnoff of current)

The early time response shows a strong correlation with topography.

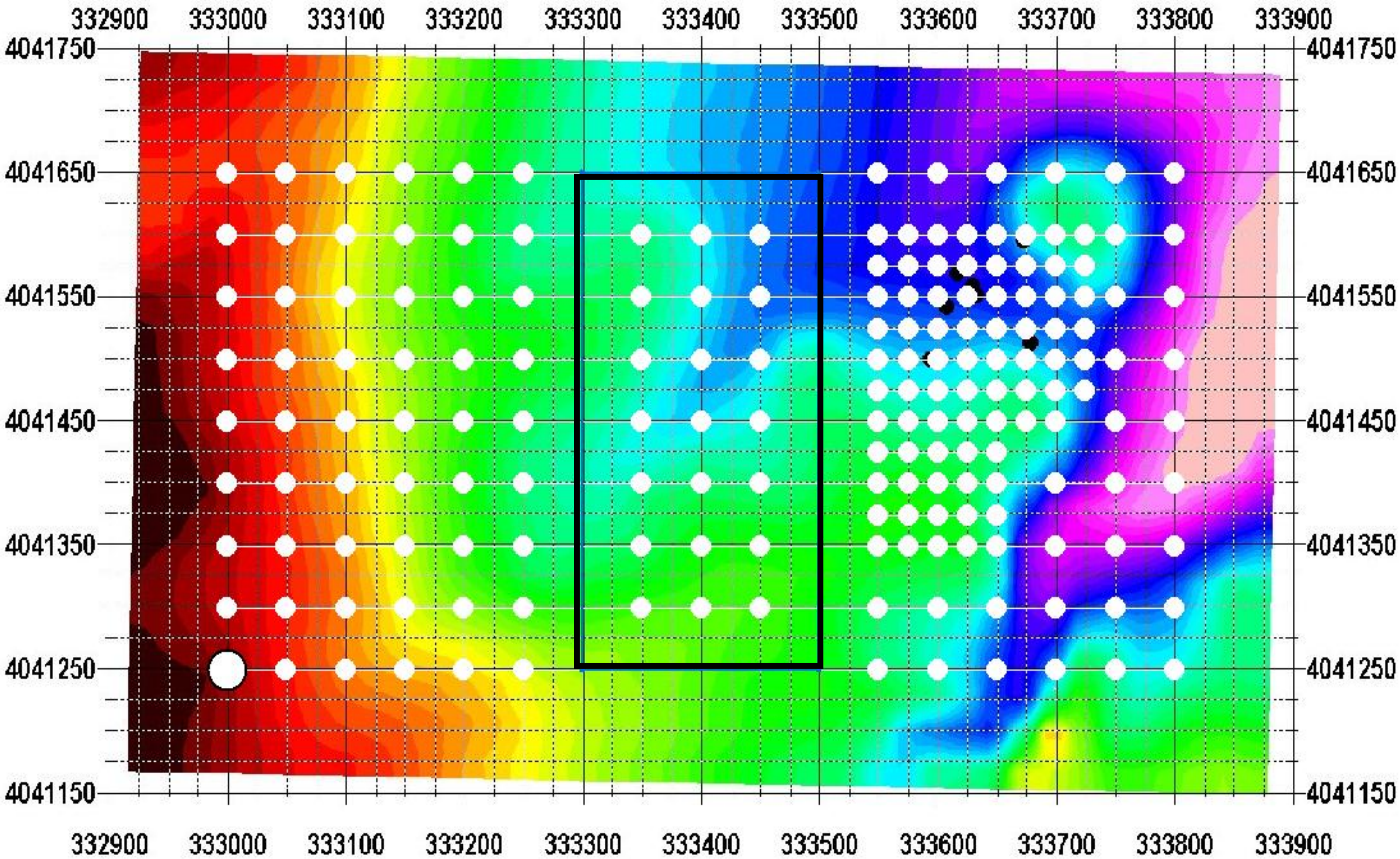


Midtime GeoTEM



Decay Rate early to mid-times

Ground TEM (2007)

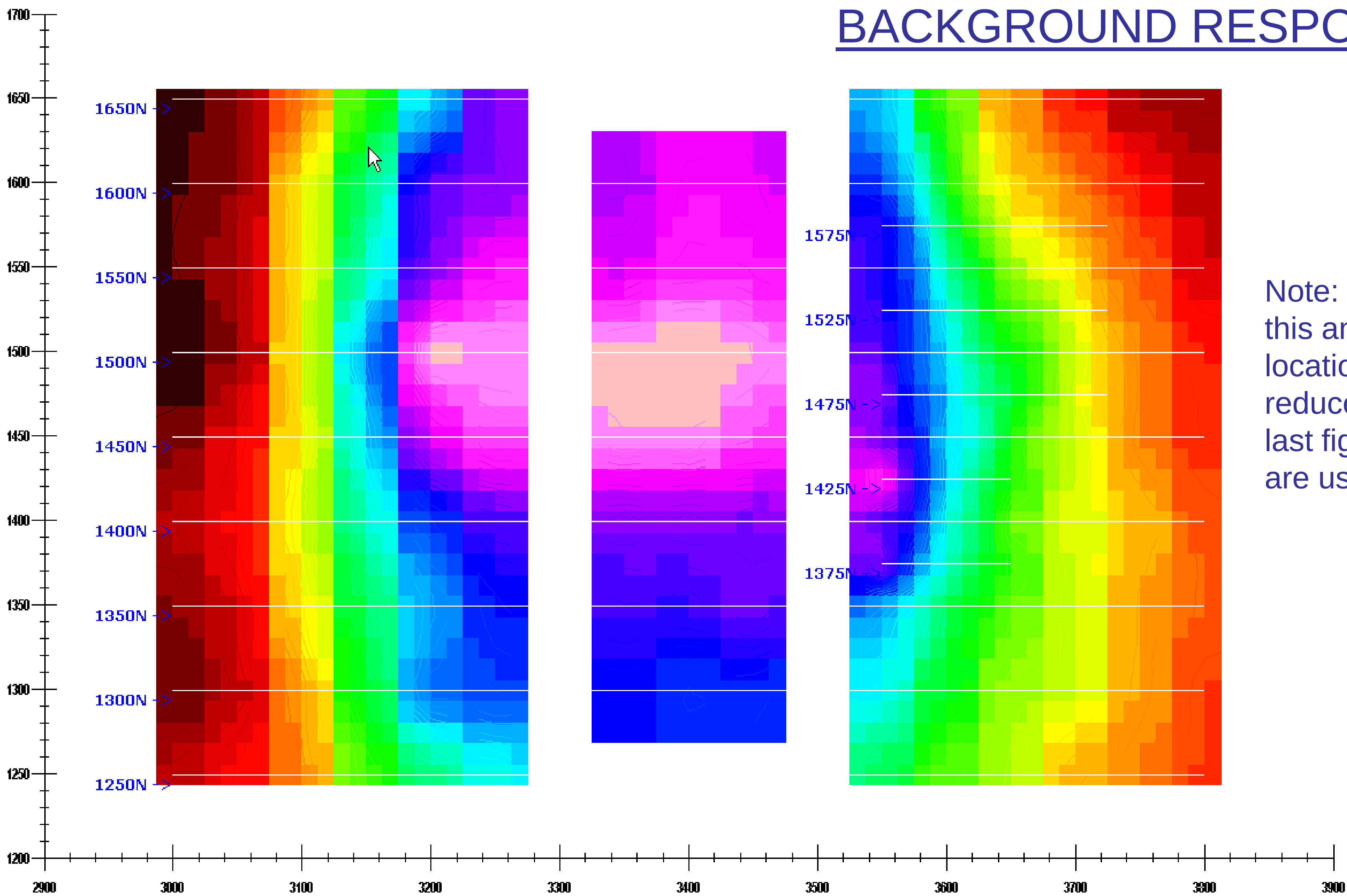


PROTEM TX Loop (black) and 3 Component RX locations (white dots) , DEM model underlay with 1980's boreholes

Ground TEM

A Geonics Protem EM67 ground system was used in fixed loop configuration. The transmitter current loop was laid out as shown in black on the figure above (200m x 400 m). 9 Lines were read starting at 1250N and proceeding to 1650N at 50m station intervals as shown by the white dots in the display above. A 30Hz basefrequency was used with a standard 20 time windows (measurements) all after the current turn-off. At each station 3 components were read (vertical –Z , inline horizontal (X) and crossline horizontal (Y)).
1 minute stacked readings were used with repeats carried out regularly for quality control purposes. Measurements can not be made on the wire or too close to the wire and thus there is a 100m gap on either side of the loop. A 25m sub-sampling was also done over the original area of drilling as well as on top of the hill, over the magnetic anomaly and the MaxMin anomaly. The 50m stations were repeated during this sub-sampling to ensure quality control.

Ground TEM (2007)
BACKGROUND RESPONSE



PROTEM EARLY TIME DATA

Note: for the purposes of this analyses, the data locations are UTM reduced and only the 4 last figures in the UTM are used.

Ground TEM

The ground data is collected with a fixed transmitter (TX) and moving the receiver (RX) unlike the airborne data in which the TX and RX move together in a fixed geometrical offset. Thus, for the ground data the response is dominated by the variation of the RX from the TX loop and thus the first job in interpretation is is find a background model that represents the overall ground under the loop and in the area of the loop.

Ground TEM (2007) Background Responses

Ground TEM background response

A background model was developed to explain the primary responses for all RX orientations and locations at all time windows.

The model is indicated below:

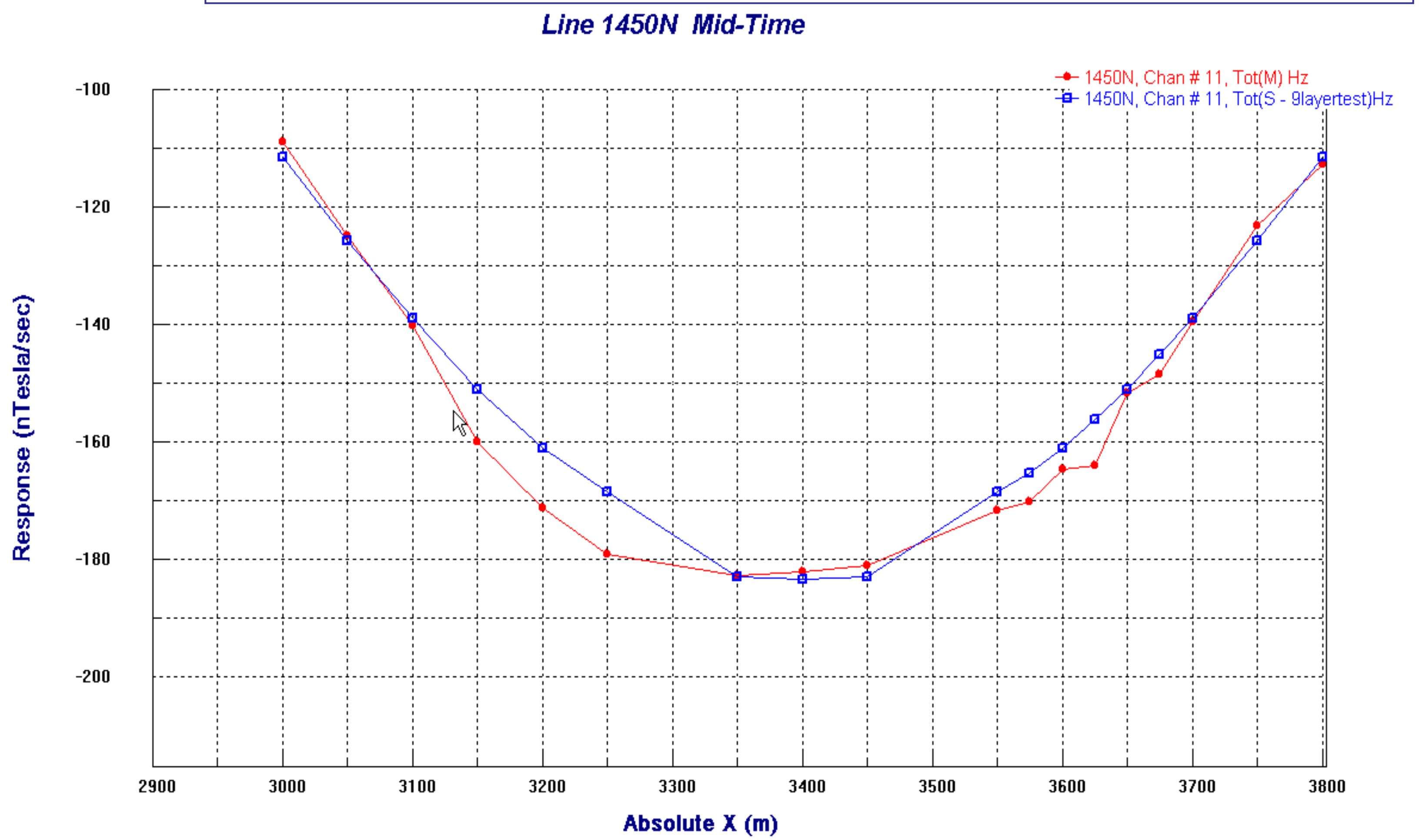
Resistivity (Ωm)	Thickness (m)	Depth to Bottom (m)
245	80	-8
323	48	-128
271	40	-168
347	60	-228
180	100	-328
100		

Model M36

Ground TEM background response

To illustrate what is attempted, we have the plot below. The display is for the Rx measurements along Line 1450N (UTM 4041650N) for the measured vertical component at Channel 11 which is near the middle of the time windows and thus is due to material relatively deep in the strata. You will note that the stations 3300N and 3500N are missing as that is where the loop wire crossed. Also, you will notice a thickening in the centre of profile indicating apparently a lateral anomaly at depth at the centre and slightly south of the loop.

This background response is now subtracted from the data to determine lateral variations in the structure.



PROTEM Mid-time data vs Background Model

Ground TEM (2007) Background Responses

Ground TEM background response

A background model was developed to explain the primary responses for all RX orientations and locations at all time windows.

The model is indicated below:

Resistivity (Ωm)	Thickness (m)	Depth to Bottom (m)
245	80	-8
323	48	-128
271	40	-168
347	60	-228
180	100	-328
100		

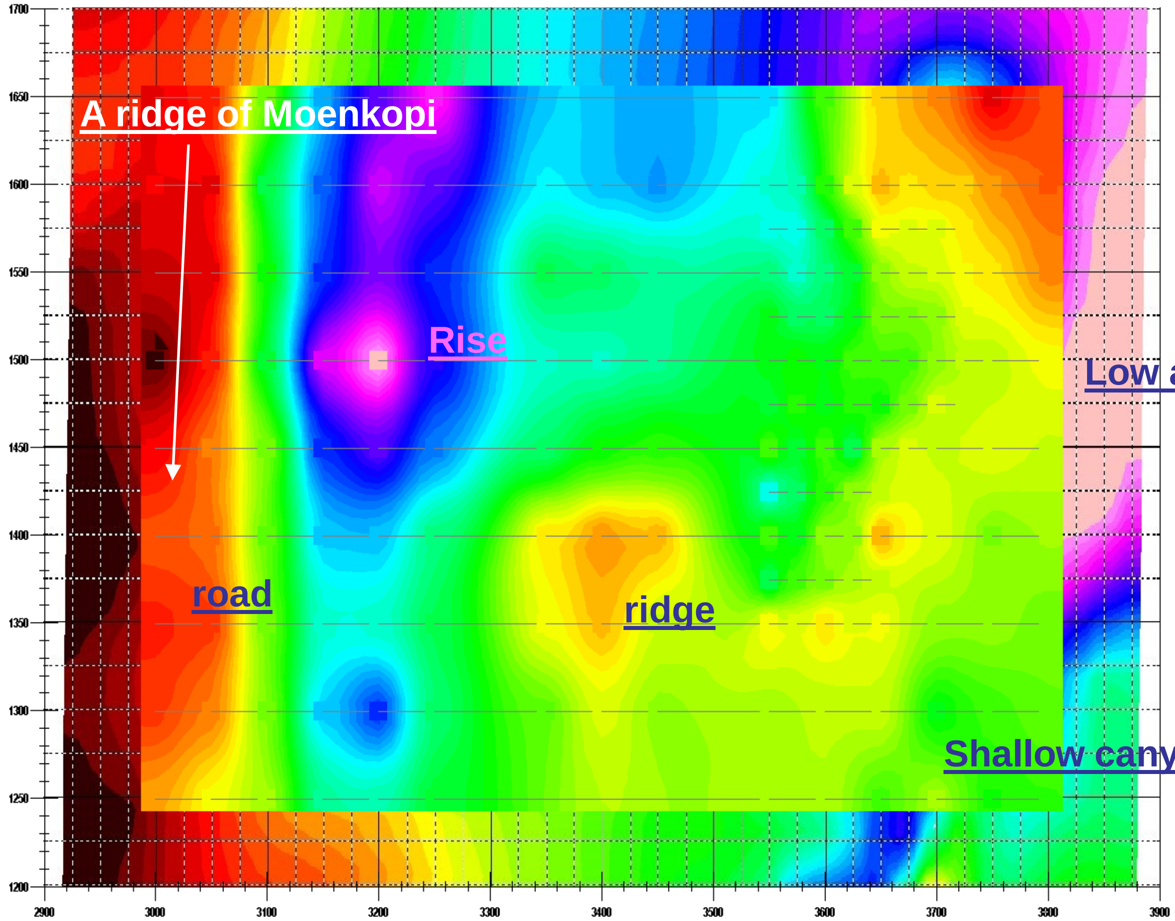
Model M36

The primary purpose of this model is not to find exactly the resistivity and depths of the formations but rather to obtain a background response in order to reduce the data to indicate anomalous regions. However, it is important to note that the resistivities of the shallow structures are quite carefully constrained by the data. Thus, the Kaibab Limestone which is exposed over the region or has very little Moenkopi cover is indicated a lower resistivity than expected (200 – 300 Ohm-m).

Also, the data does not require any relatively high resistivities (of the order of 1000 Ohm-m). Finally, the data does require a decreasing resistivity with depth.

All of these issues need to be explored more to help control the inversions and also to indicate the ability of such data to target the pipes.

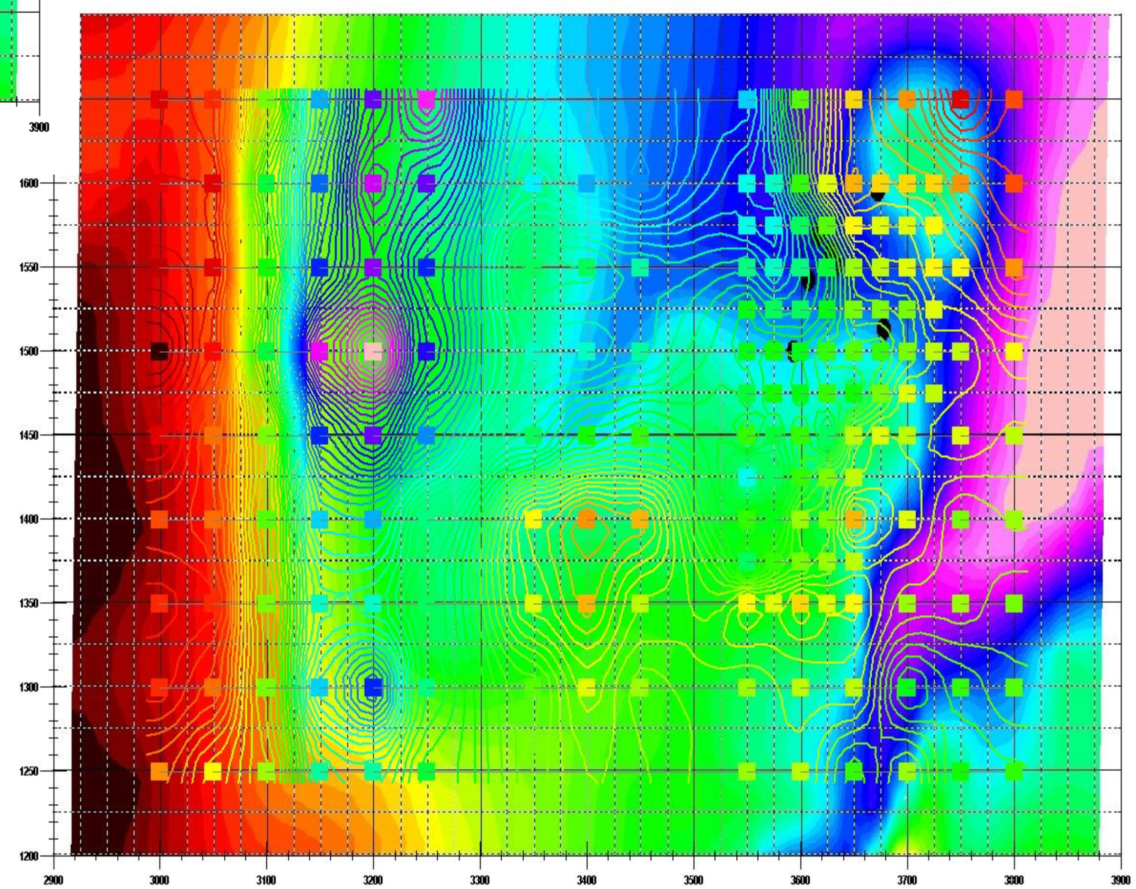
Ground TEM (2007)
Anomalous Responses



Residual Response in early-time – Ch3 – DEM underlay

The 2 figures show the residual data at an early time channel. The data is quite sensitive to shallow changes in structure.

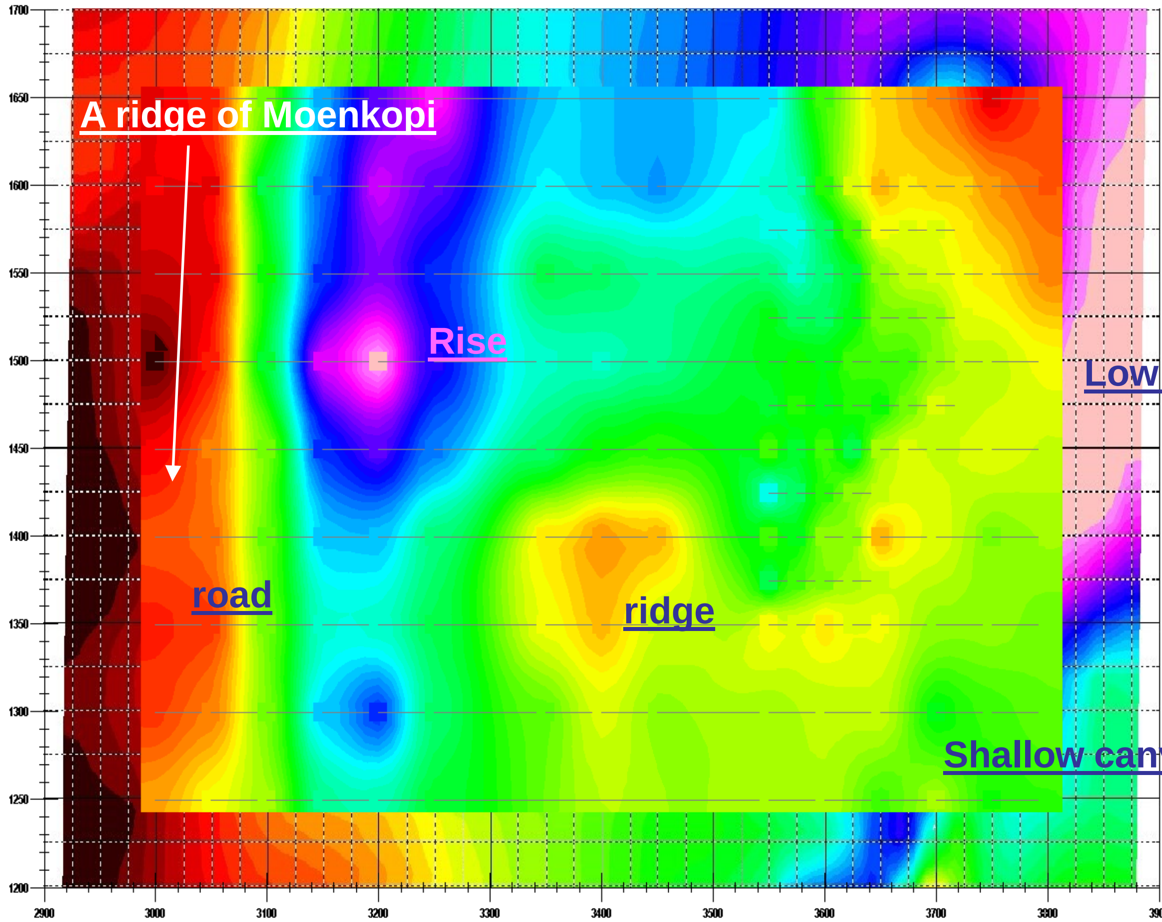
Background Reduced Protem data



Residual Response in early-time – Ch3 – DEM underlay –
squares are measurements with amplitude in the same scale as the contours upper left

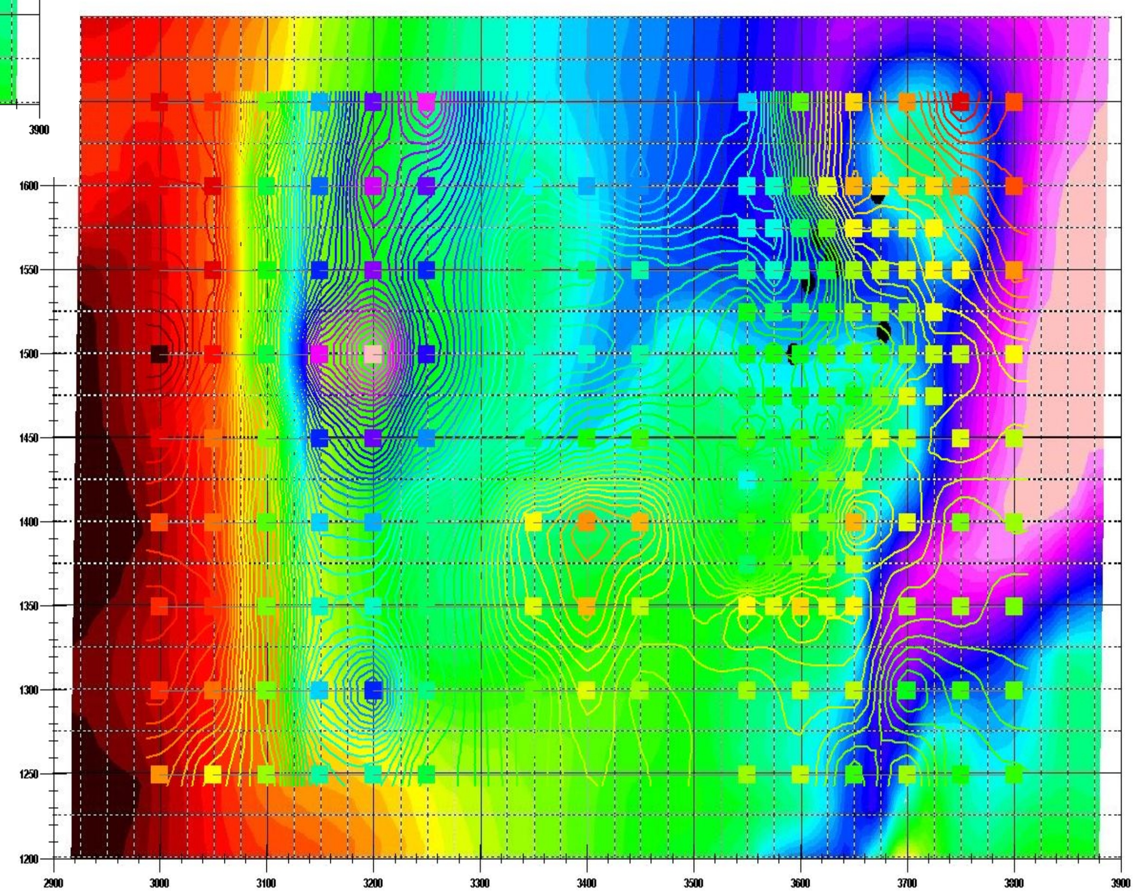
Ground TEM (2007) Anomalous Responses

The 2 figures show the residual data at an early time channel. The data is quite sensitive to shallow changes in structure.



Residual Response in early-time – Ch3 – DEM underlay

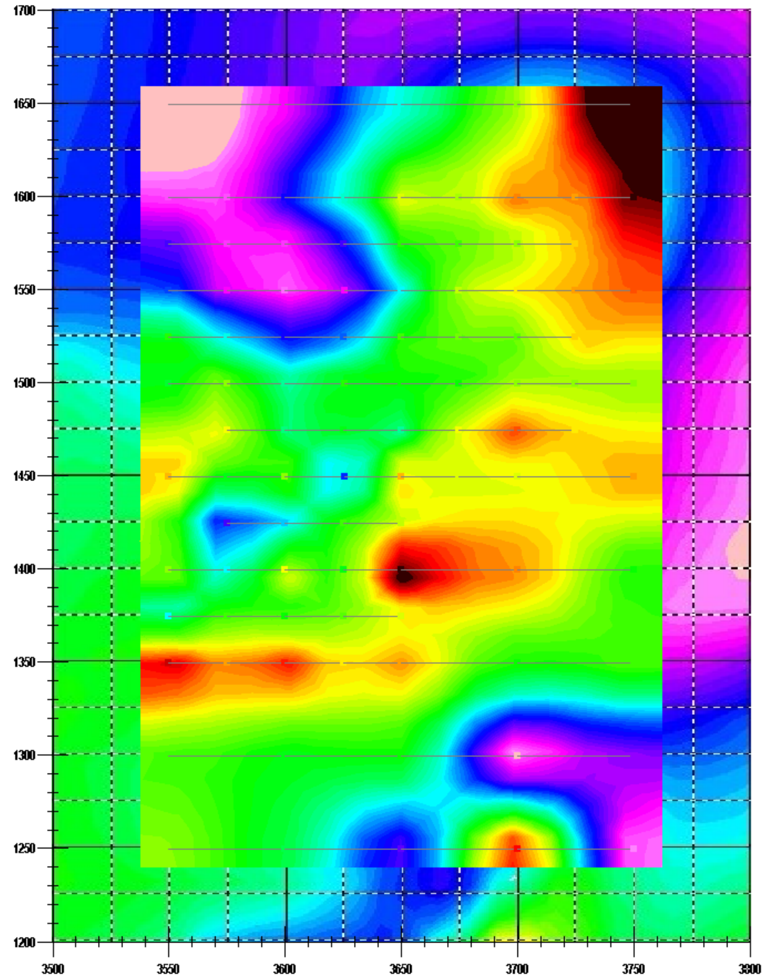
Background Reduced Protem data



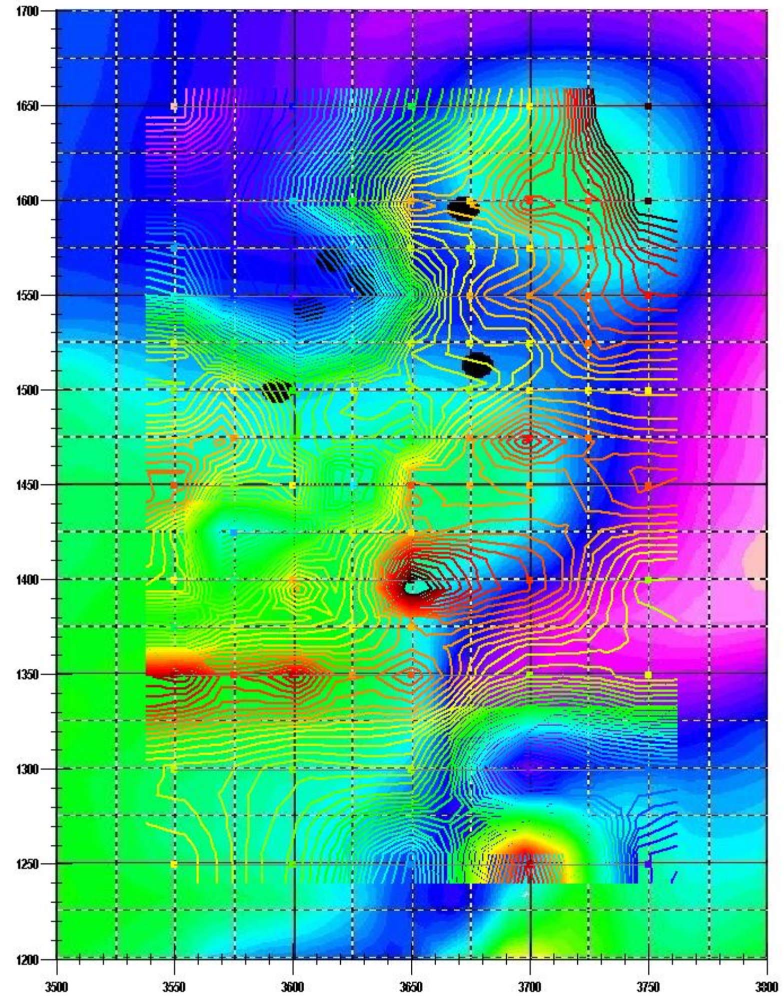
Residual Response in early-time – Ch3 – DEM underlay – squares are measurements with amplitude in the same scale as the contours upper left

Ground TEM residual response

Ground TEM (2007) Anomalous Responses



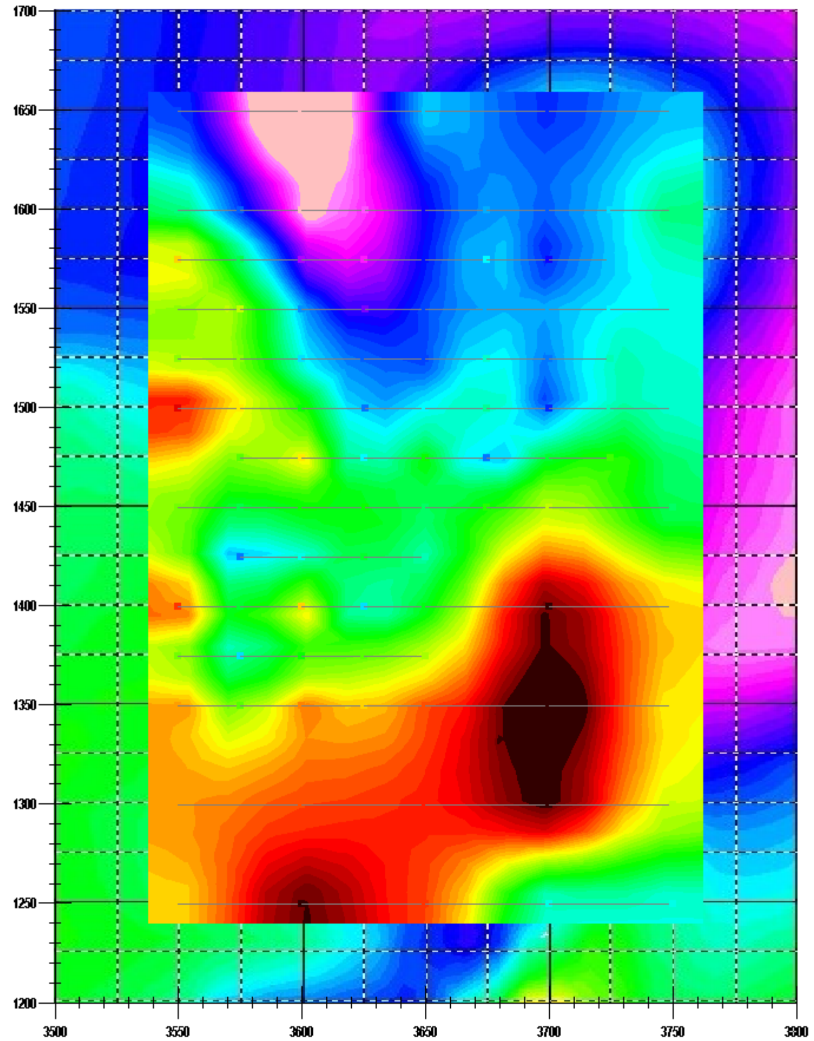
HZ Residual Response in mid-time – Ch8 – DEM underlay



Background Reduced Protem data

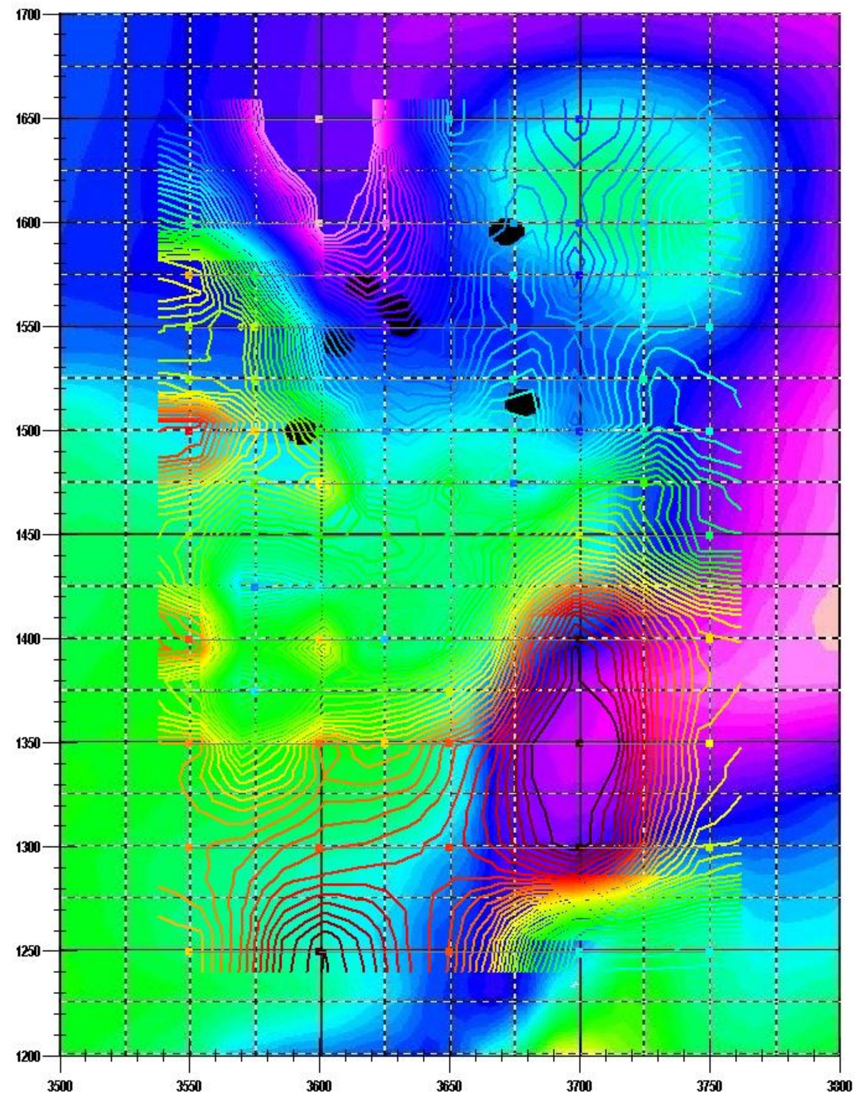
Ground TEM residual response

Ground TEM (2007) Anomalous Responses

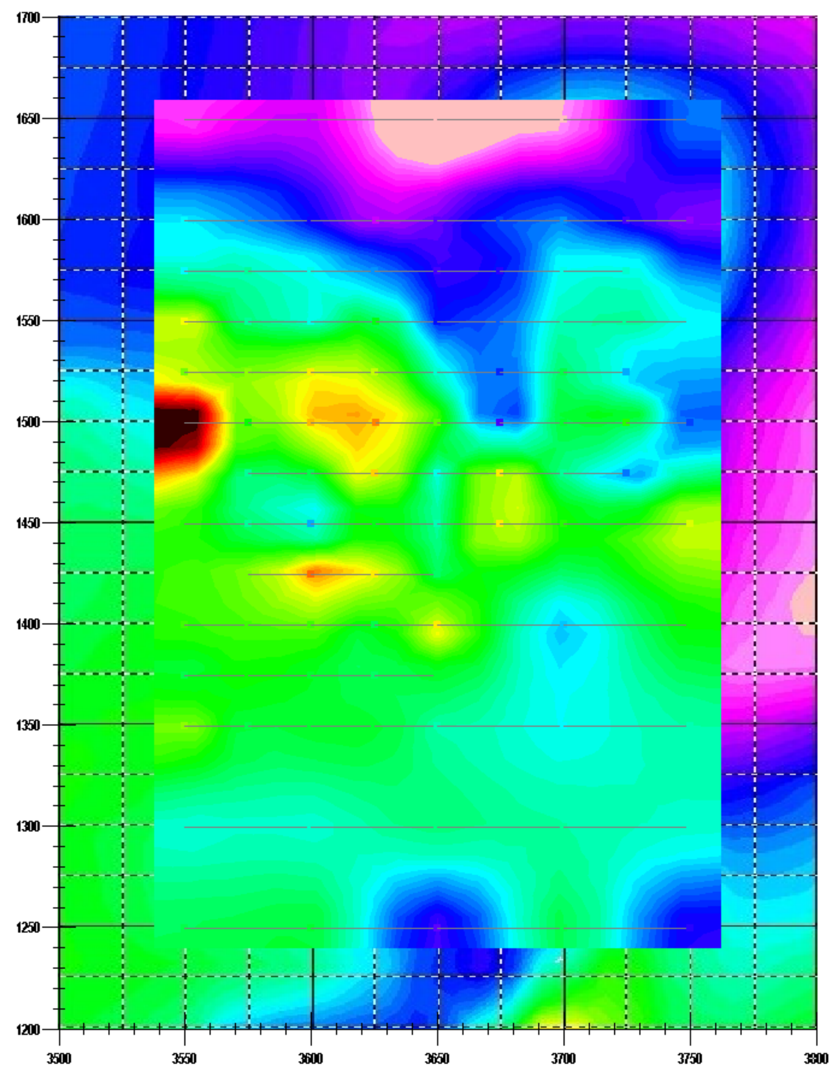


HX Residual Response in mid-time – Ch5 – DEM underlay

Background Reduced Protem data

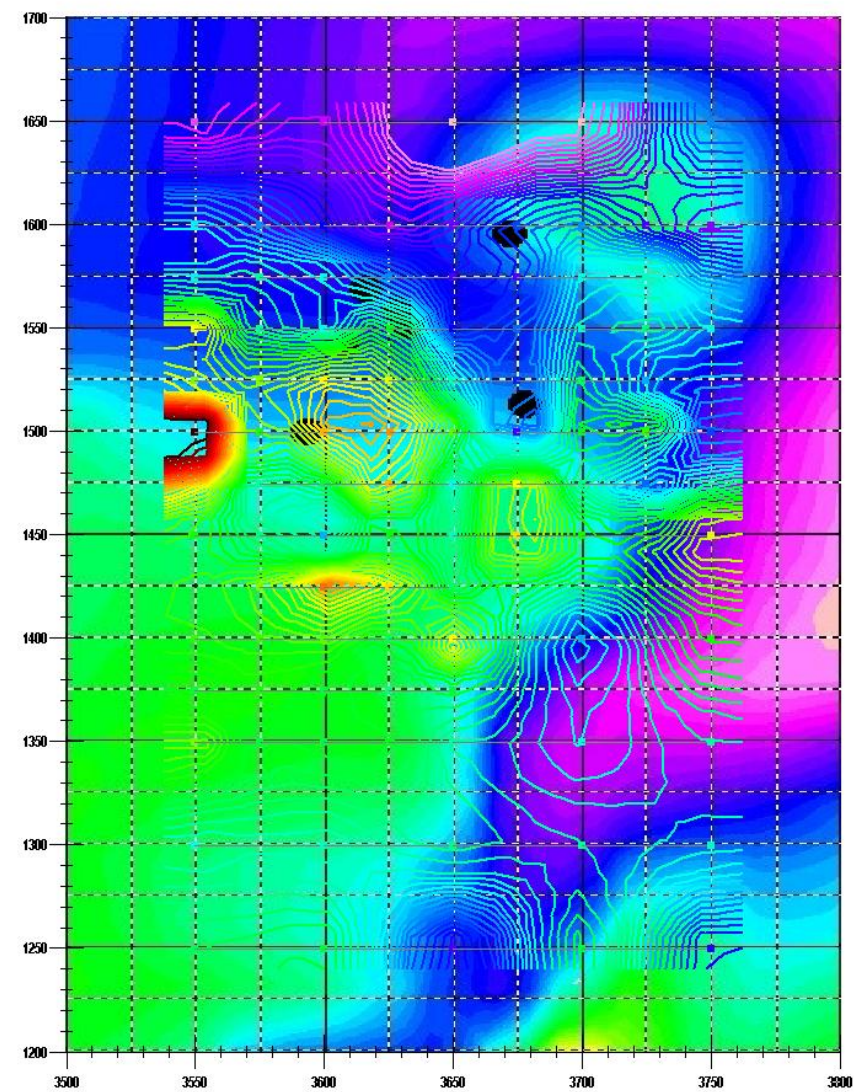


Ground TEM (2007) Anomalous Responses



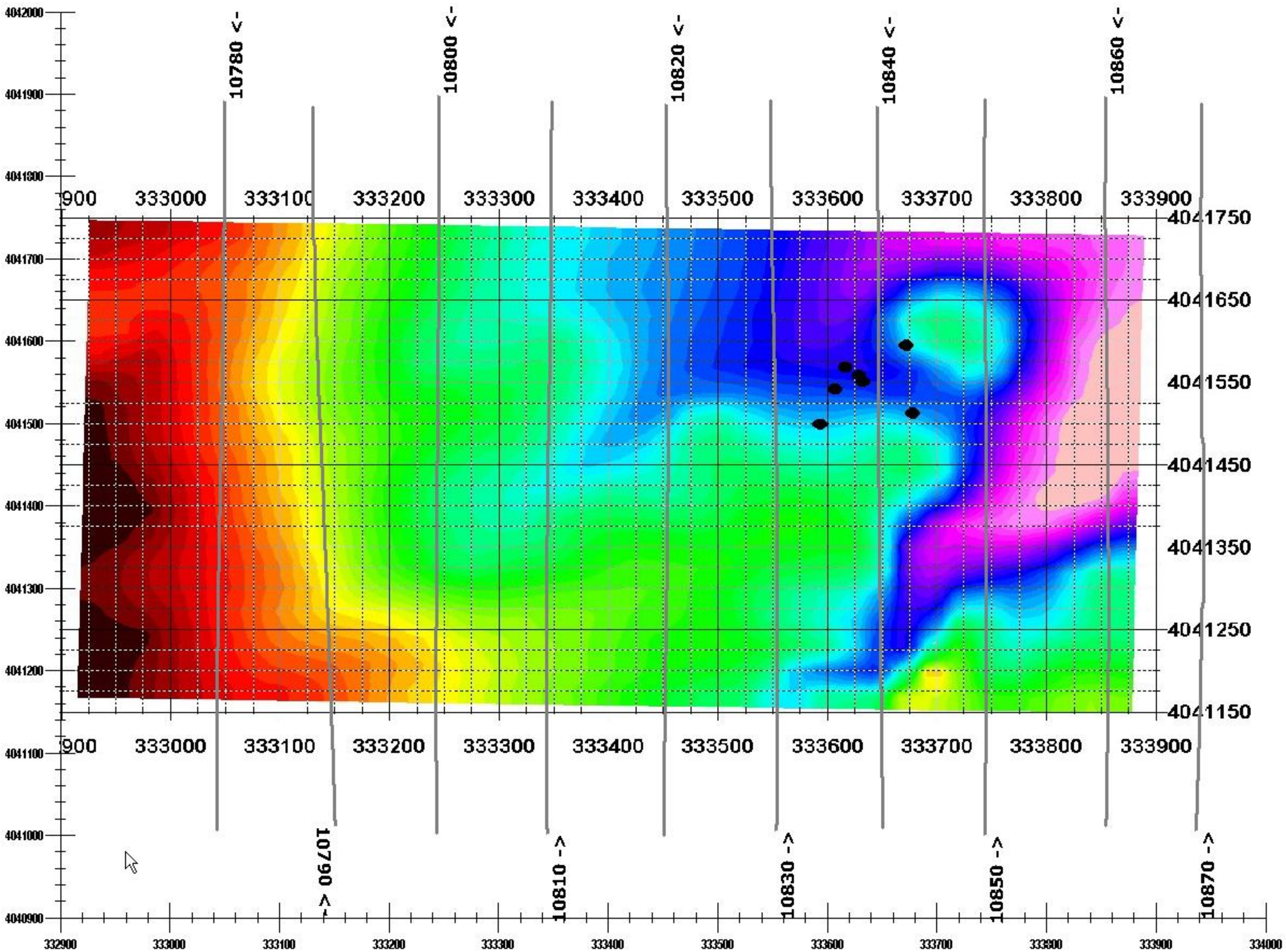
HY Residual Response in mid-time – Ch6 – DEM underlay

Background Reduced Protem data



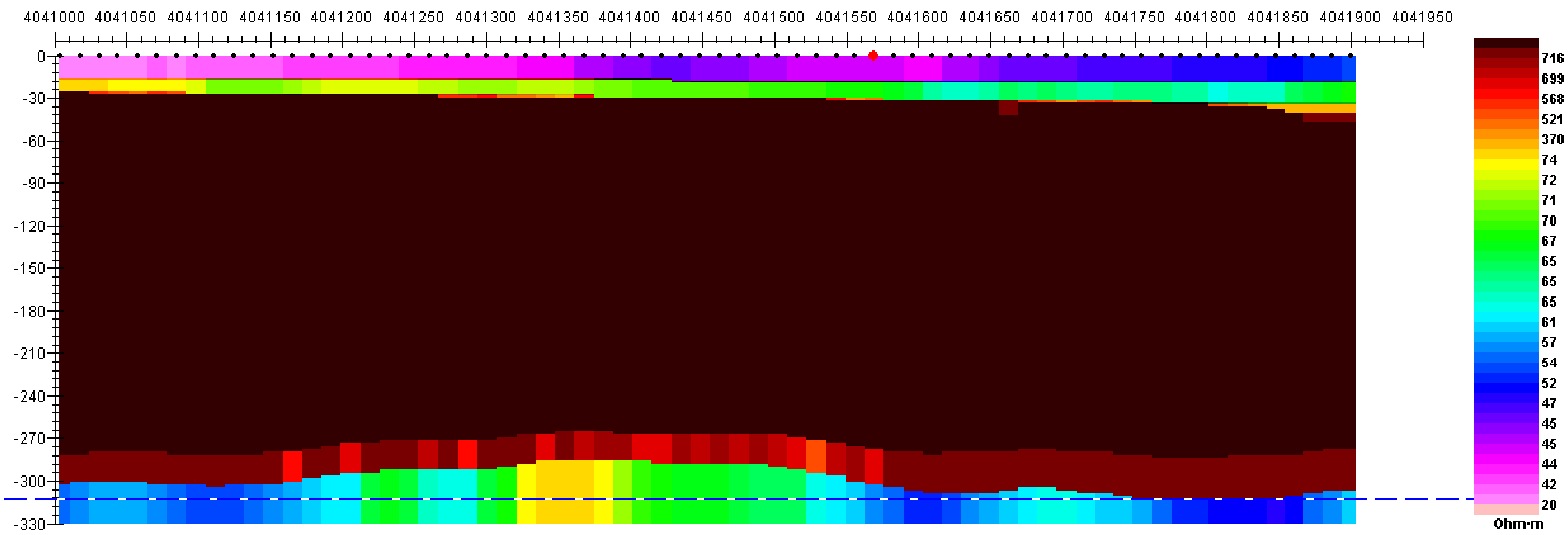
GeoTEM inversions M36

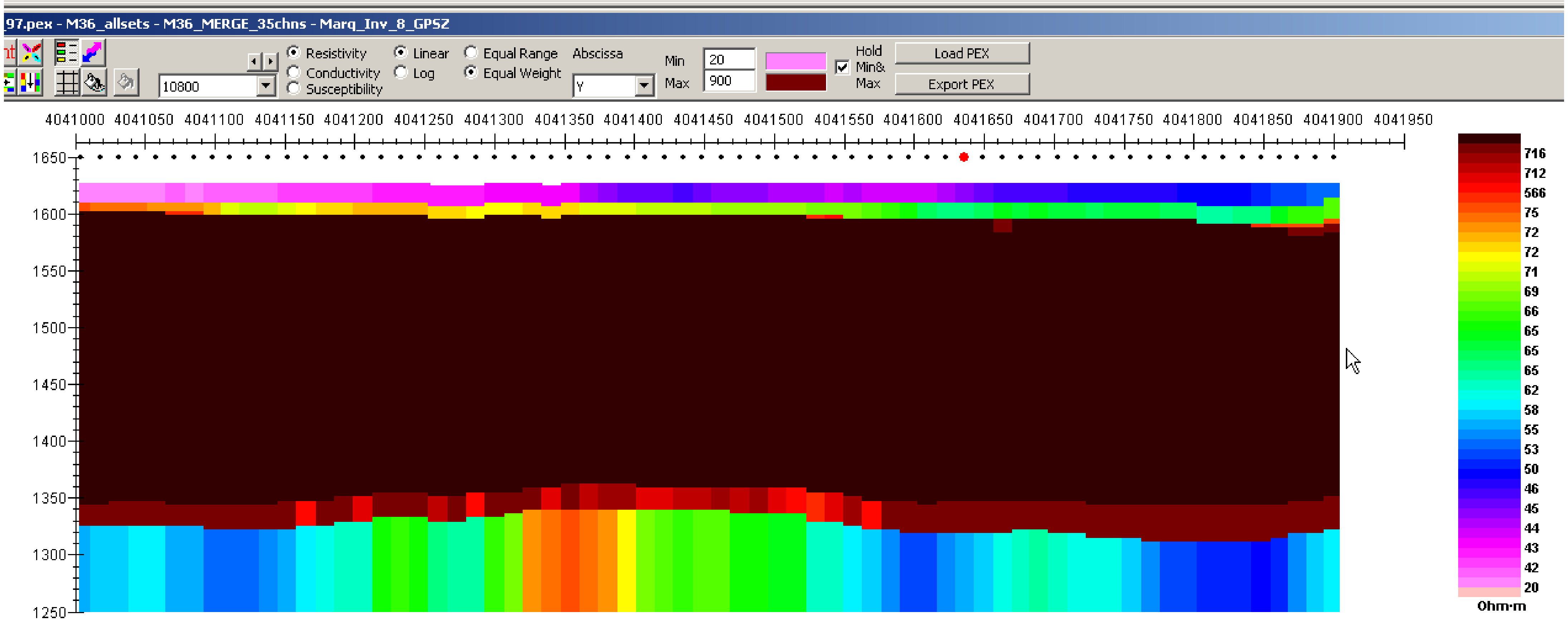
Inversions were performed on the lines shown in the figure below
DEM is shown along with location of 1980's drillholes



GeoTEM inversions M36 with merged channels

Line 10800E – west of pipe region

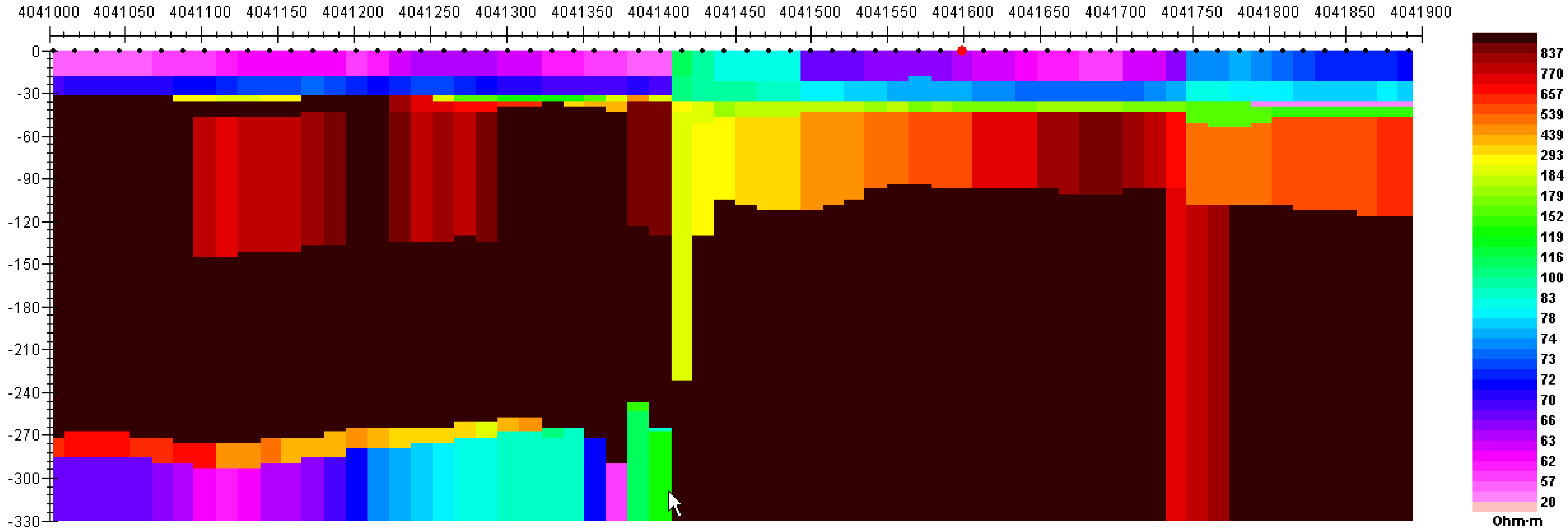


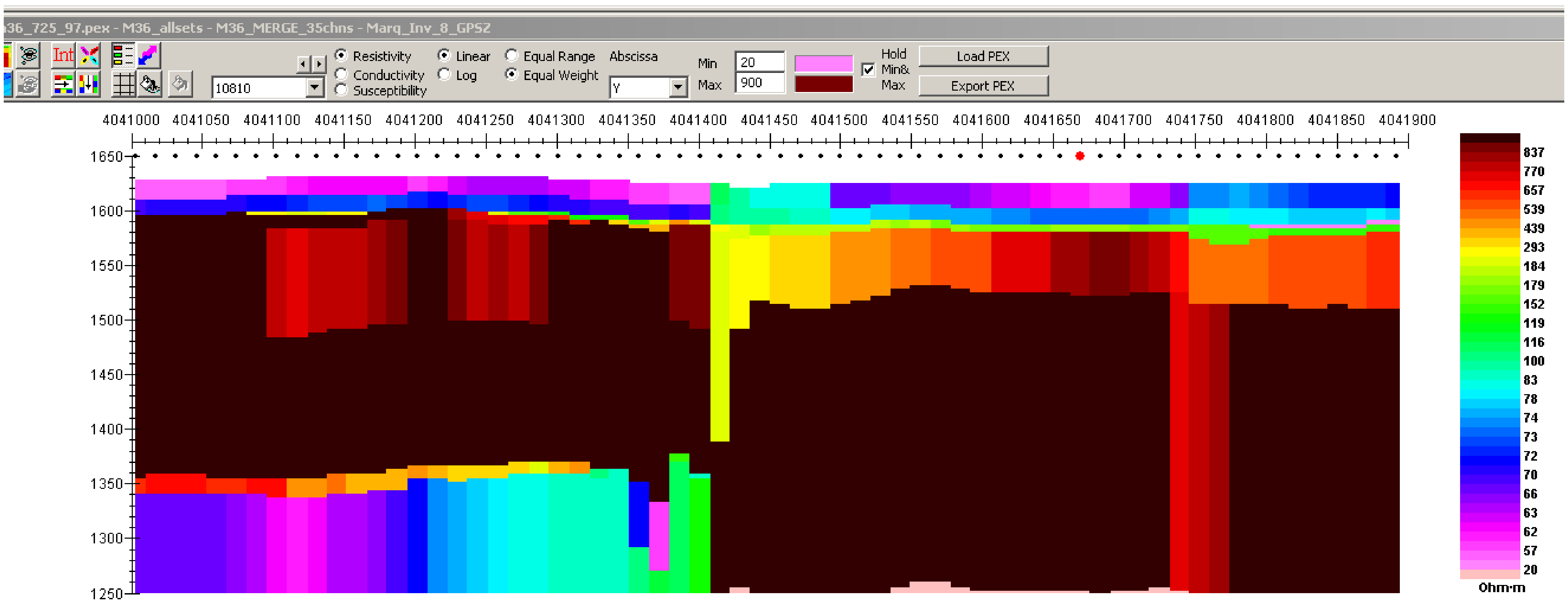


Topography corrected

GeoTEM inversions M36 with merged channels

Line 10810E – edge of hill

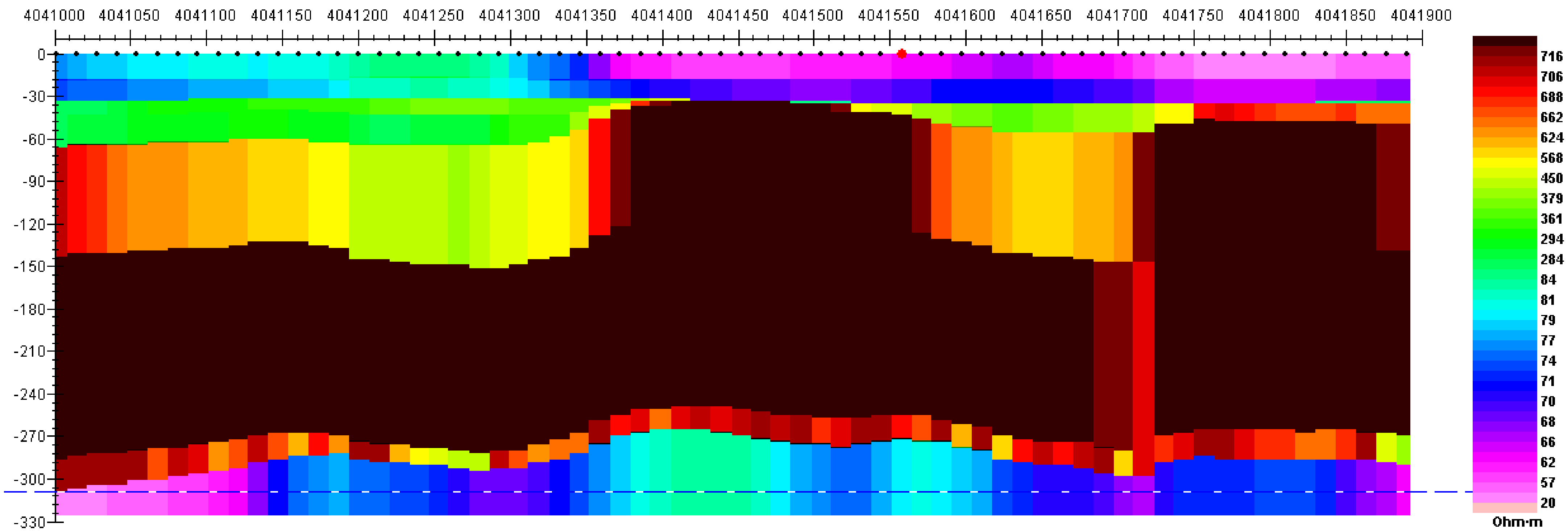


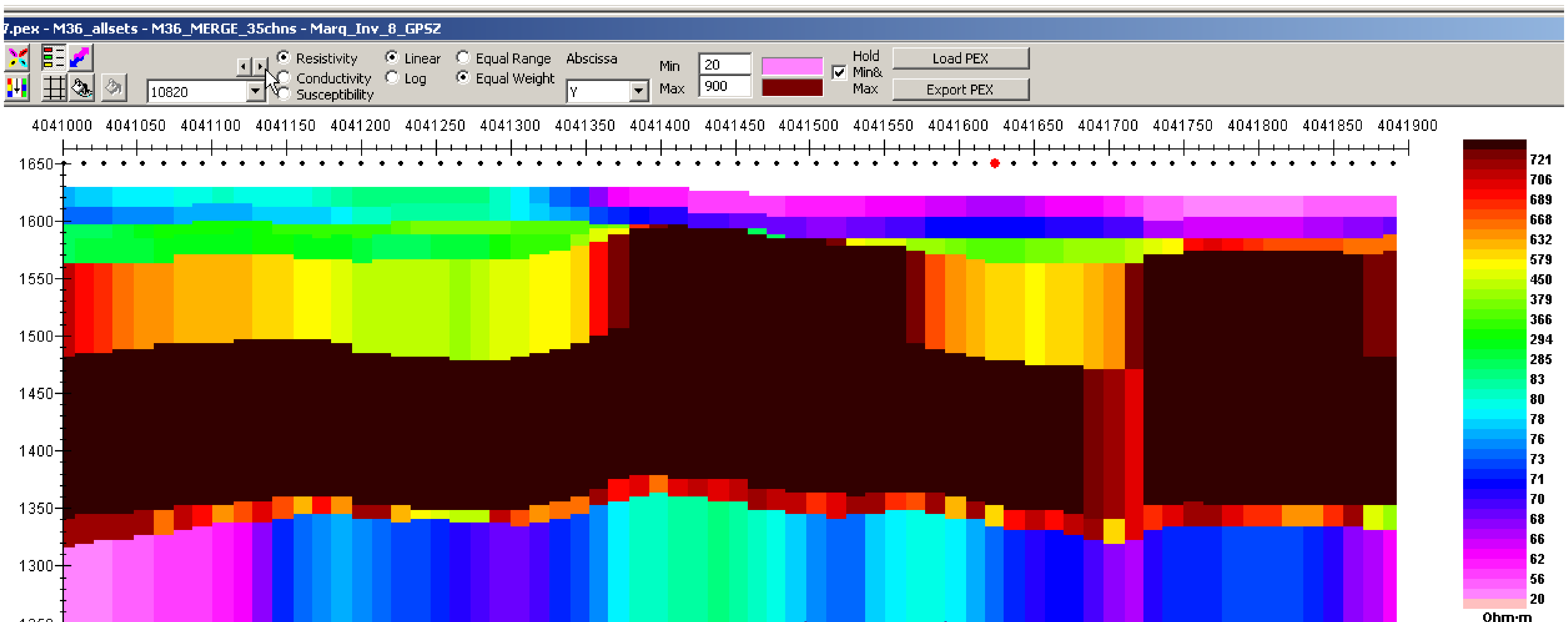


Topography corrected

GeoTEM inversions M36 with merged channels

Line 10820E – on hill

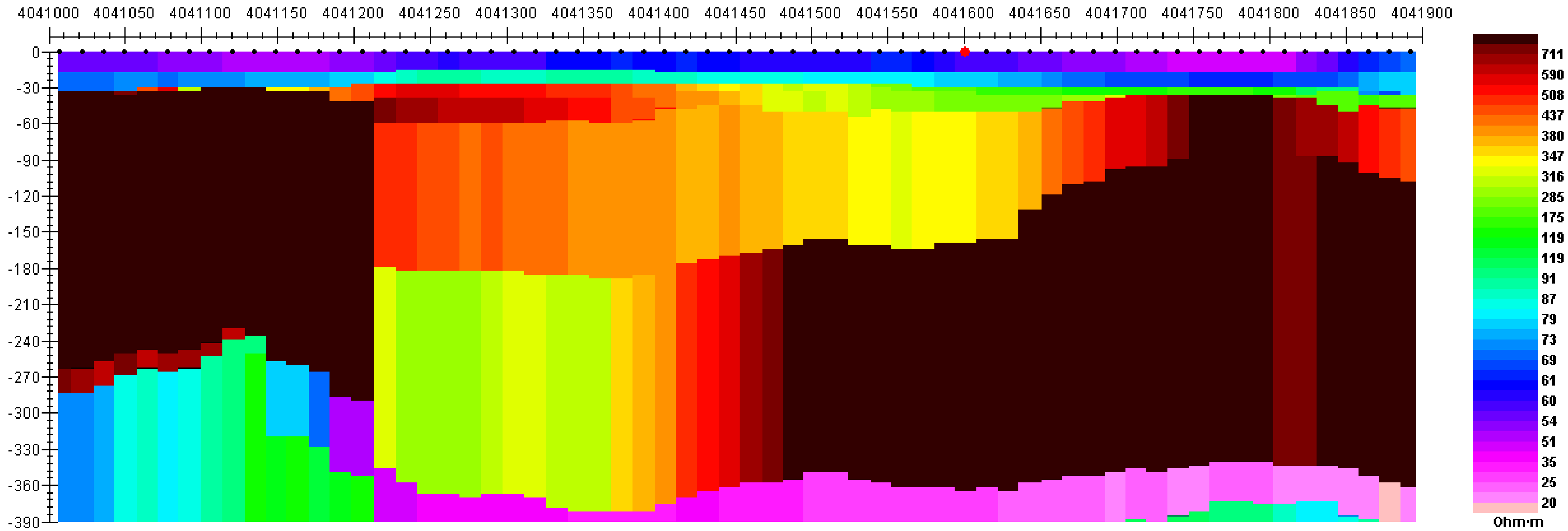


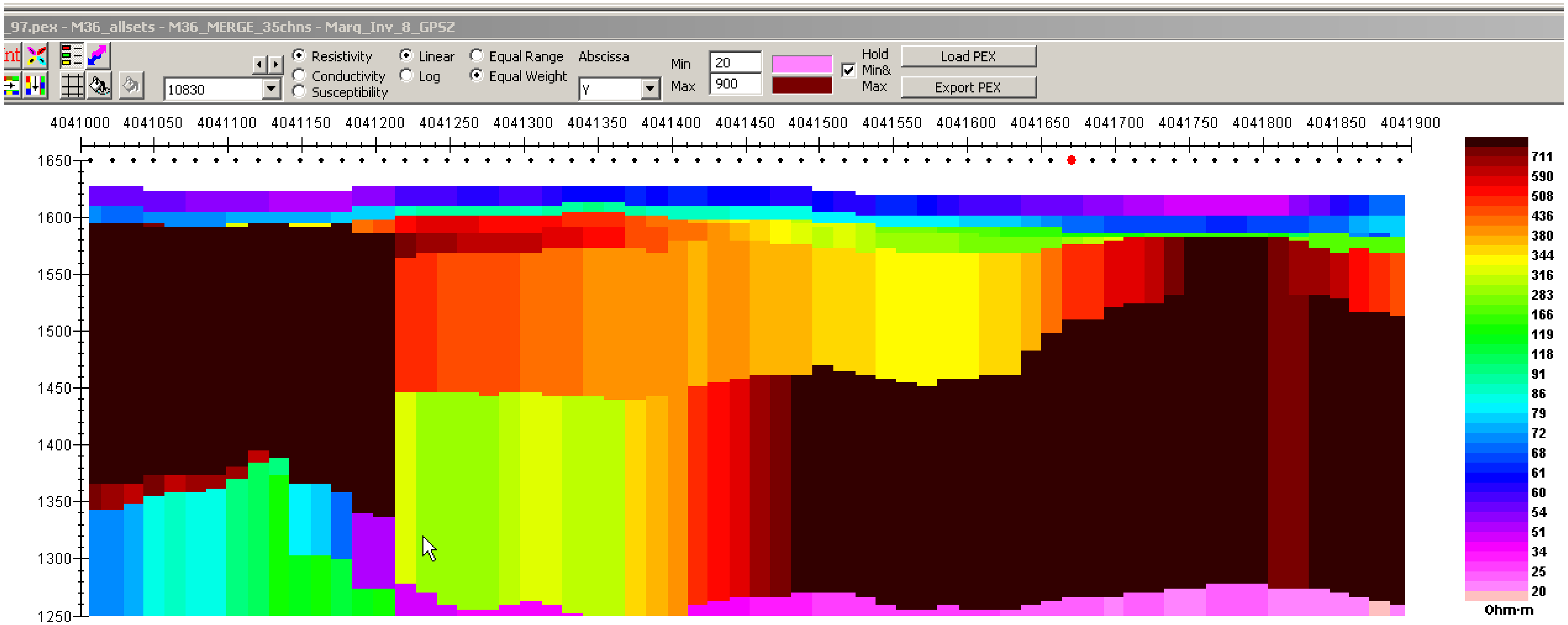


Topography corrected

GeoTEM inversions M36 with merged channels

Line 10830E – just west of drillhole cluster

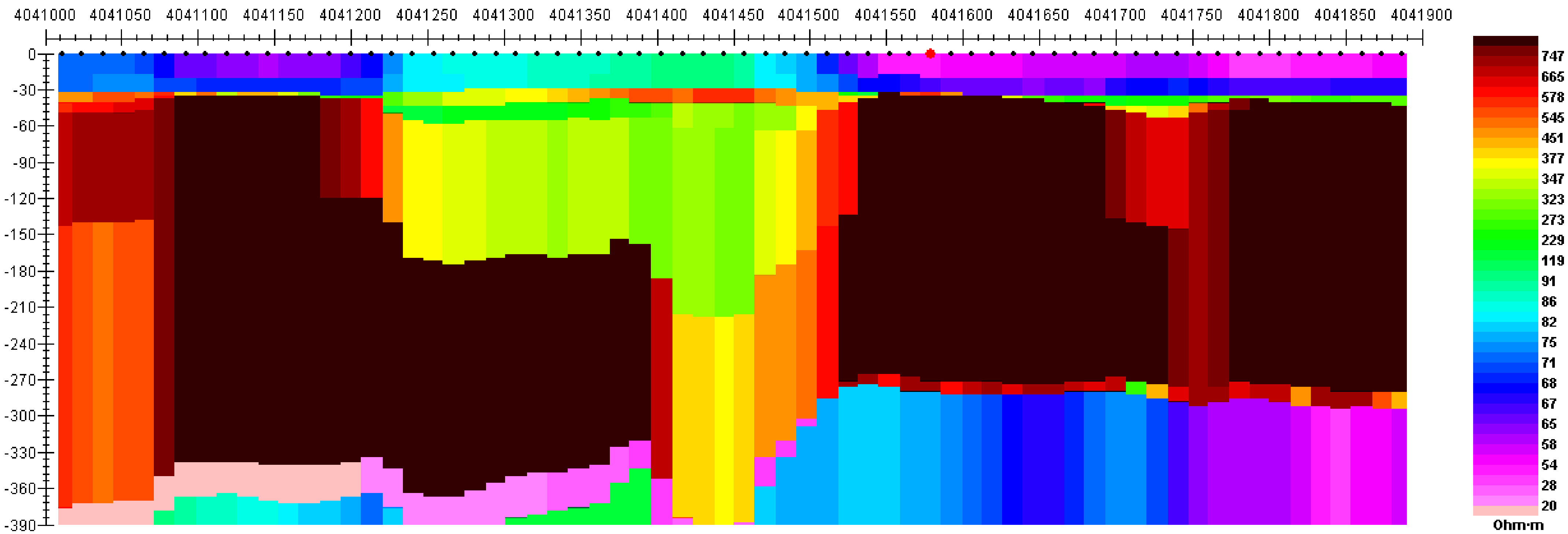


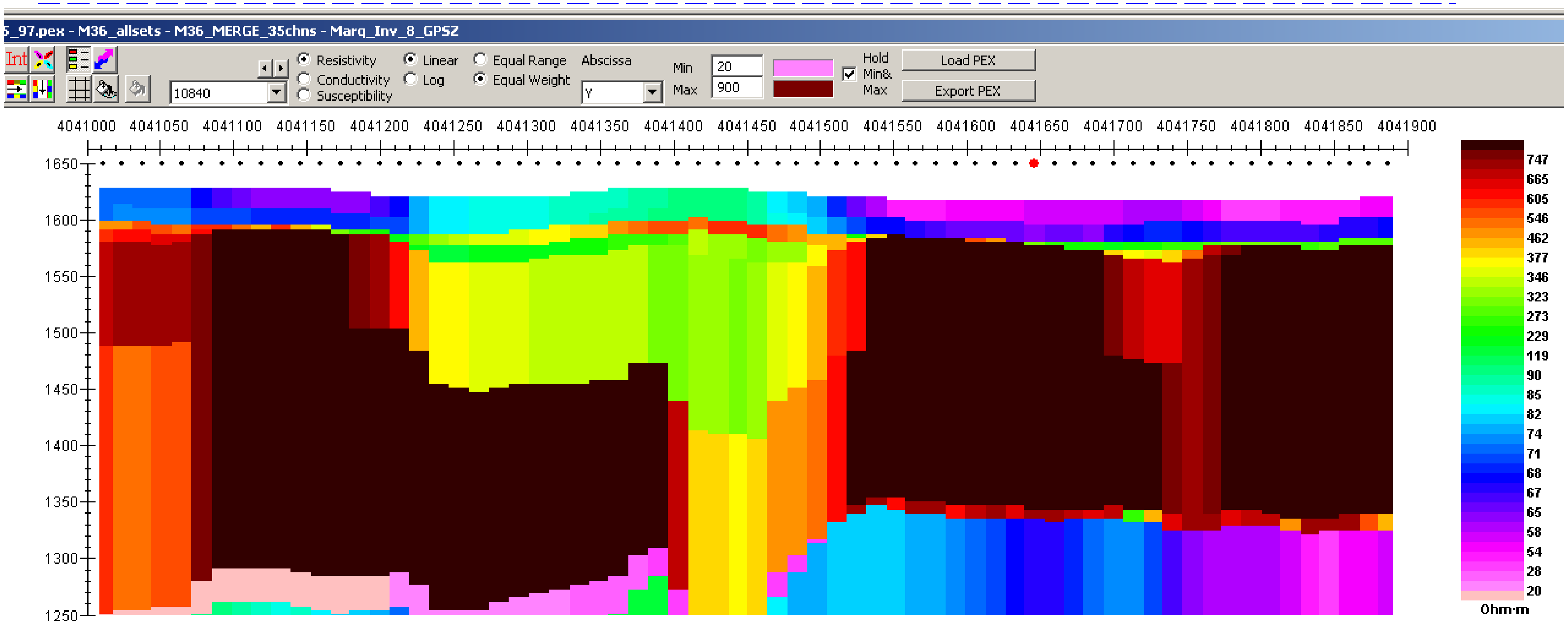


Topography corrected

GeoTEM inversions M36 with merged channels

Line 10840E – over drillhole cluster and magnetic anomaly



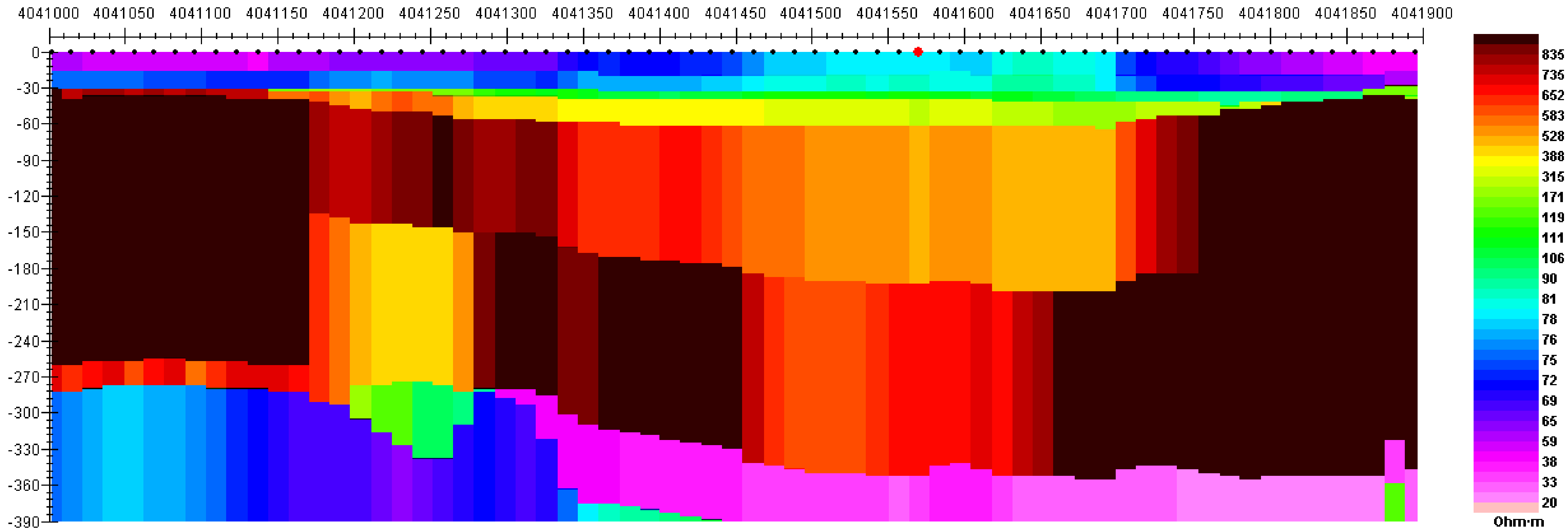


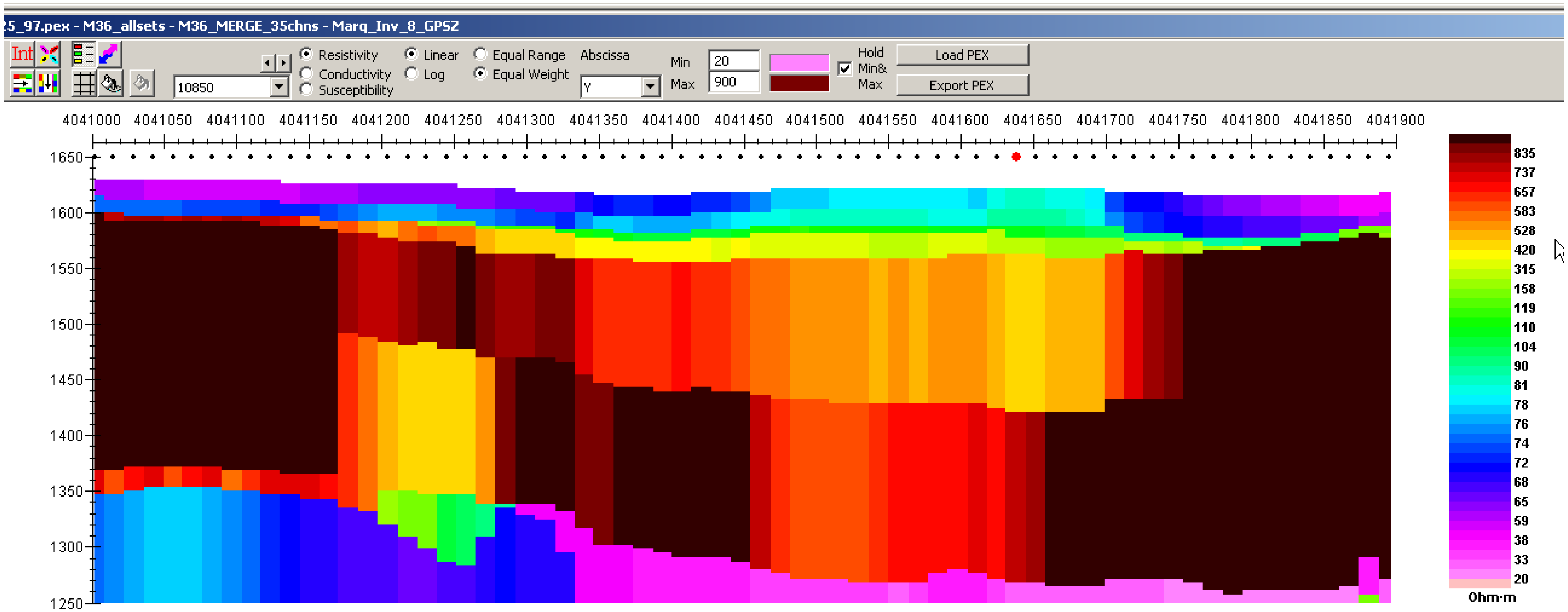
Topography corrected

***** Please note comments at end**

GeoTEM inversions M36 with merged channels

Line 10850E – east of cluster





Topography corrected

Summary

- Inversions of the GEOTEM data performed on the merged data channels provide higher inversion resolution.

- The basic resistivity model defined by the GEOTEM data agrees with the ground TEM data.

- There are definite structural indications given by the ground TEM data but not clear geophysical targets.

- Aeromagnetic data centers the magnetic anomaly in the vicinity of the pipe over the hill above the drillholes and not in the location of the drillholes.

- Inversions of the airborne TEM confirms that the structural anomaly centres on the hill but appears to have a structural deep definition closer to the slope of the hill leading down to the drillholes.

- The structural anomaly imaged in the inversions on L10840 (pg 23) extending to 180m or more in depth over the hill and south of the drillholes is indisputable in the data. However, the apparent south dipping structure beginning at surface at 4041525N and extending to depths of 400m although definite in the shallow depths is less certain at greater depths. Further analyses and care on this area would be required to state indisputably that the structure extends to depths of 400m (1200 ft).