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# DUNCAN MT Survey

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# MT Data Analysis

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# British Columbia

2017

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# 1. INTRODUCTION

Back in the mid-1980's, a large Magnetotelluric (MT) campaign was conducted across the Precambrian Purcell Anticlinorium, in both Canada and the United States; in addition to previous geophysical surveys (seismic and gravity), geological mapping or drilling.

The objective of the MT campaign was to determine the regional electrical conductivity structure of the Foreland Belt, which is the transition between a more conductive crust (the Cordilleran region of North America) and the high resistive crust of the North America craton (***Figure 1***).

The study area lies in the southeastern British Columbia (Canada), the northwestern Montana (USA) and north Idaho (USA), between latitudes 48 and 49.5°N, and longitudes 114.5 and 116.25°W.

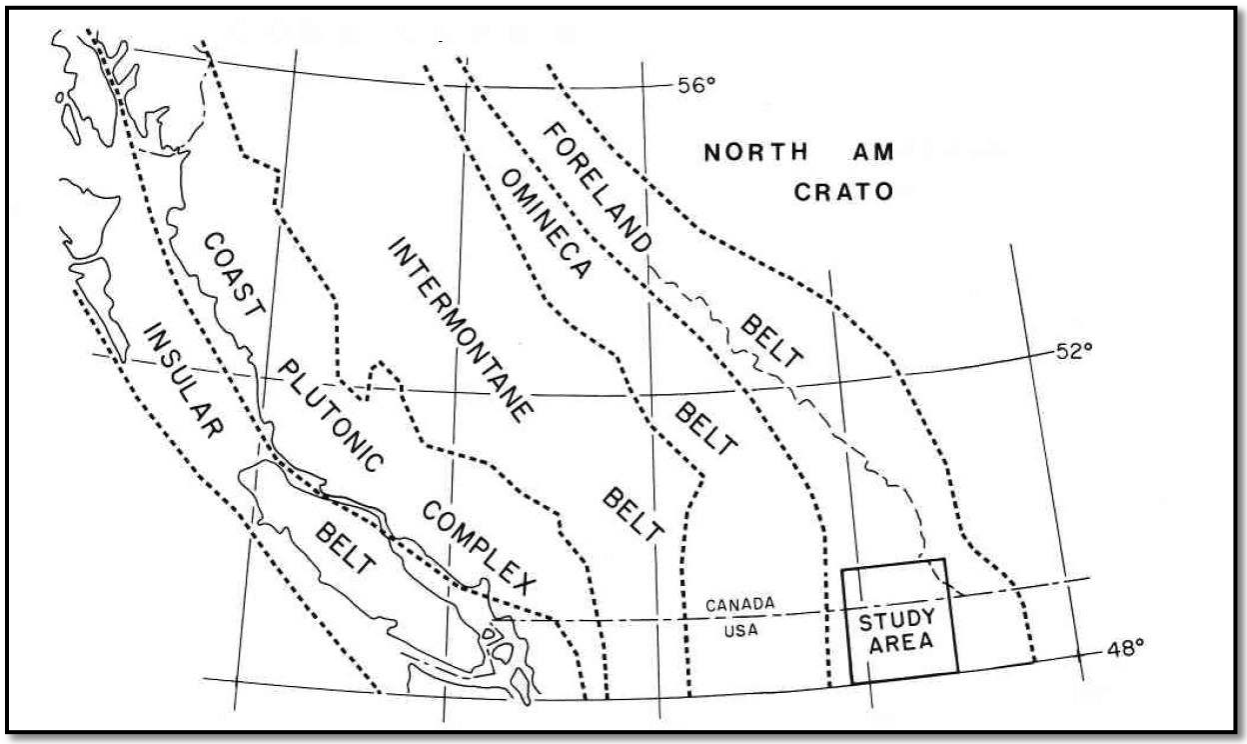


***Figure 1: Study area located in the southern part of the Foreland Belt***

Part of the MT data collection was conducted by Phoenix Geophysics Ltd., for Duncan Exploration Co.

Late 2016, Phoenix has been approached by Mr. Fred Cook from South Spring Imaging Ltd., to perform additional data analysis, focusing on the Canadian side only (***Figure 2***).

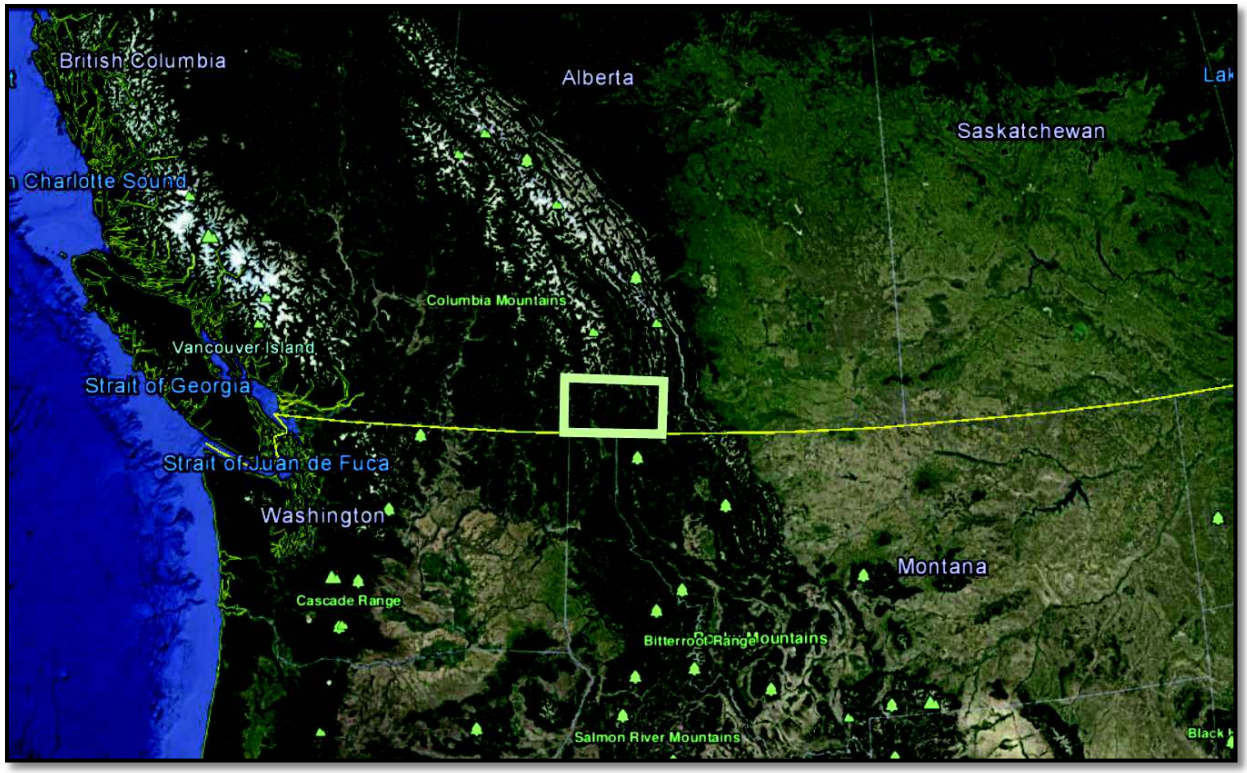


***Figure 2: Map of Canada and USA showing the area of interest in British Colombia***

## 2. DATABASE PREPARATION

All EDI was provided to Phoenix by Mr. Fred Cook. Back in the 1980's, the way to save the data as an EDI, was a bit different from the actual format that all interpretative software can work with. At that time it was saved as "multi-site EDI", while today we use "single-site EDI".

However, Winglink®, the interpretation software used by Phoenix has an option to split multi-site EDI.
After sorting out the large amount of EDI obtained after the split (i.e. 44 145 EDI after the split), we obtained a total of 84 sites, distributed along 6 profiles

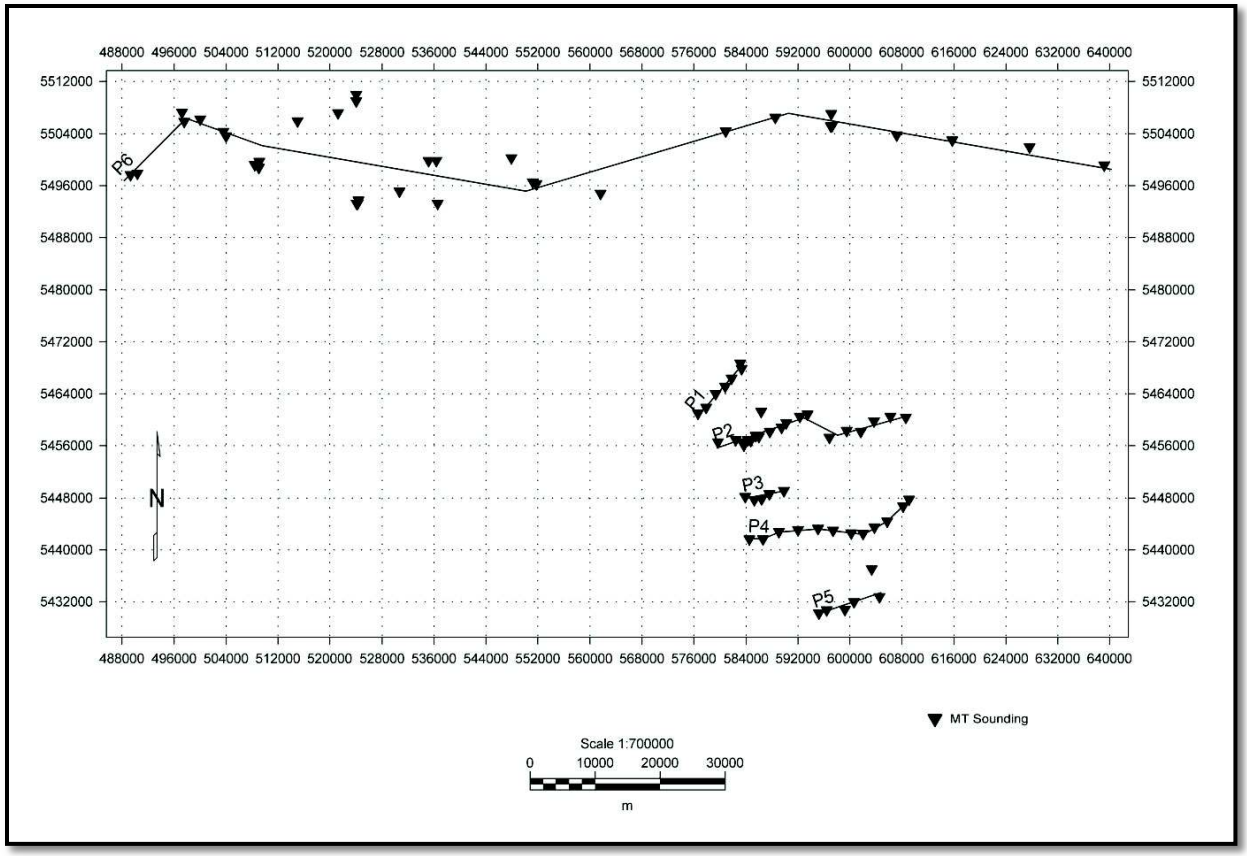


***Figure 3: map of the MT sites location and the profiles***

## 3. EDITING AND SMOOTHING

To produce a reliable smoothing model (Sutarno phase consistent or D+), and before starting our data analysis, we must perform some editing on the MT data to remove any obvious outliers. Some sites will not need it, some others will, depending on the data quality. The following site is a good example to understand why this step is important.

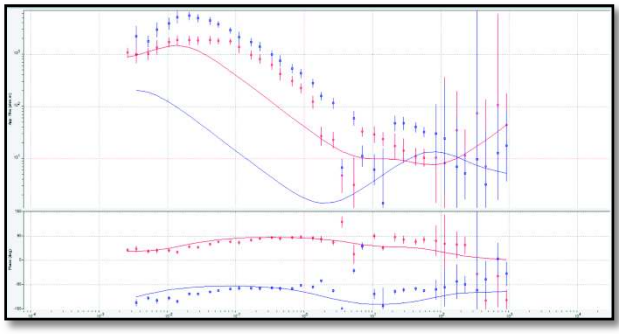

***Figure 4: Site D30 before editing***

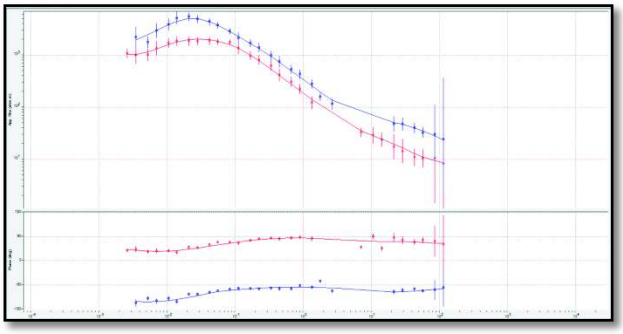

***Figure 5: Site D30 after editing***

# 4. RESISTIVITY and PHASE MAPS

All the following maps are based on the smoothed curves, after editing. Note that all maps have been created with an interpolation radius gridding of 1, which is the minimum value.

## 4.1. RESISTIVITY XY

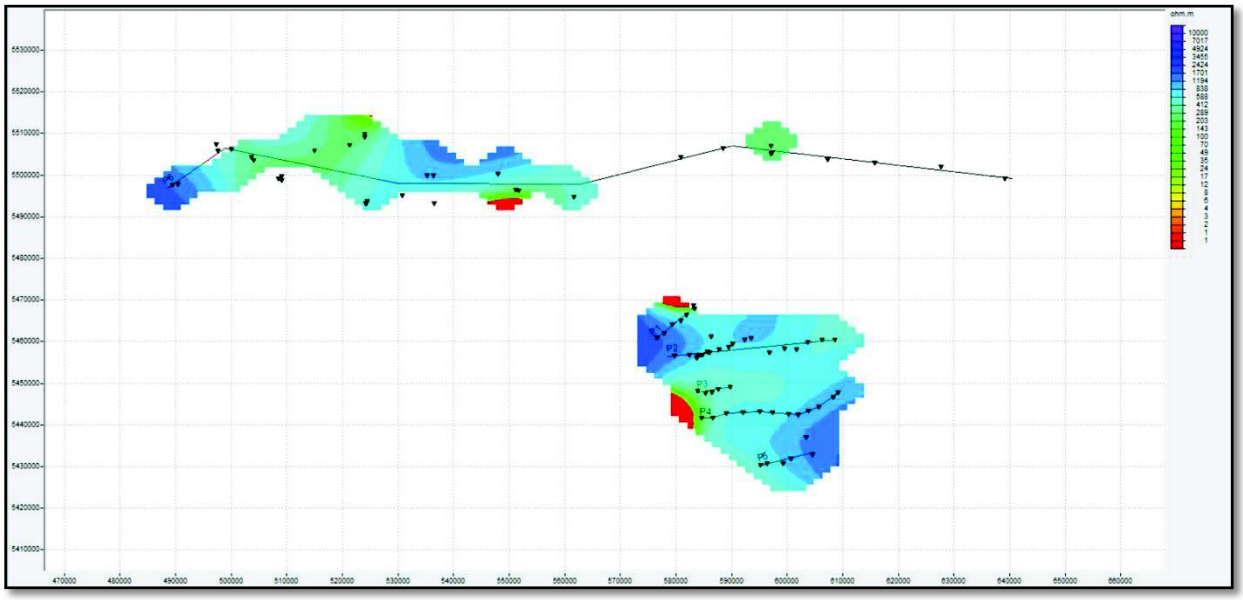

***Figure 6: Smoothed XY Apparent Resistivity at 300 Hz***

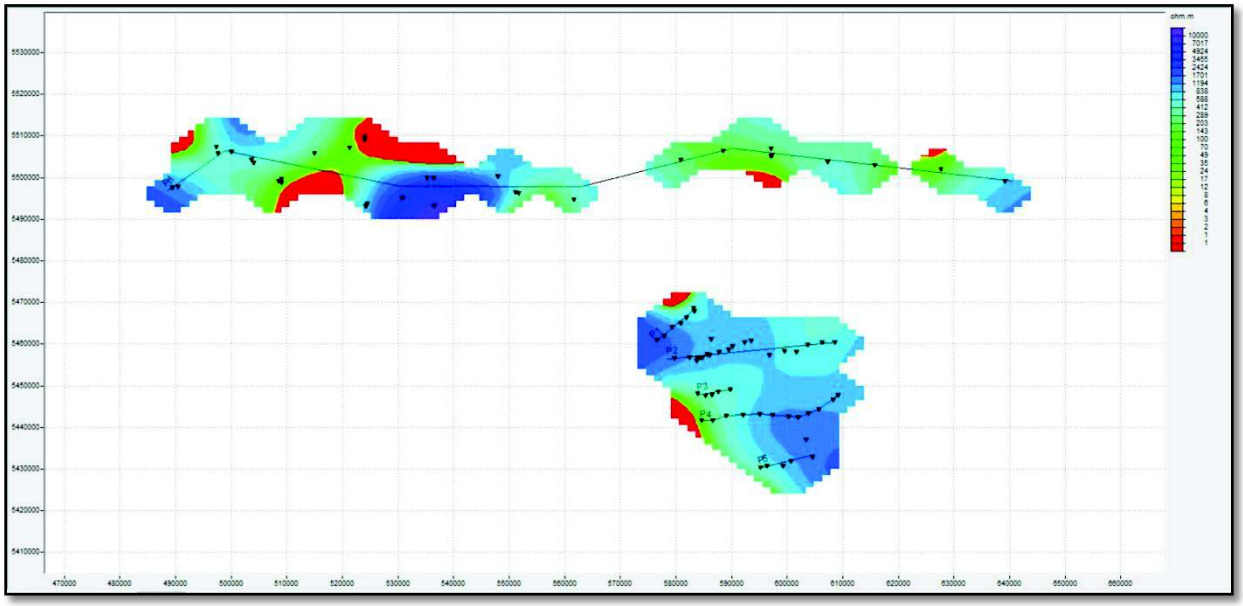

***Figure 7: Smoothed XY Apparent Resistivity at 100 Hz***

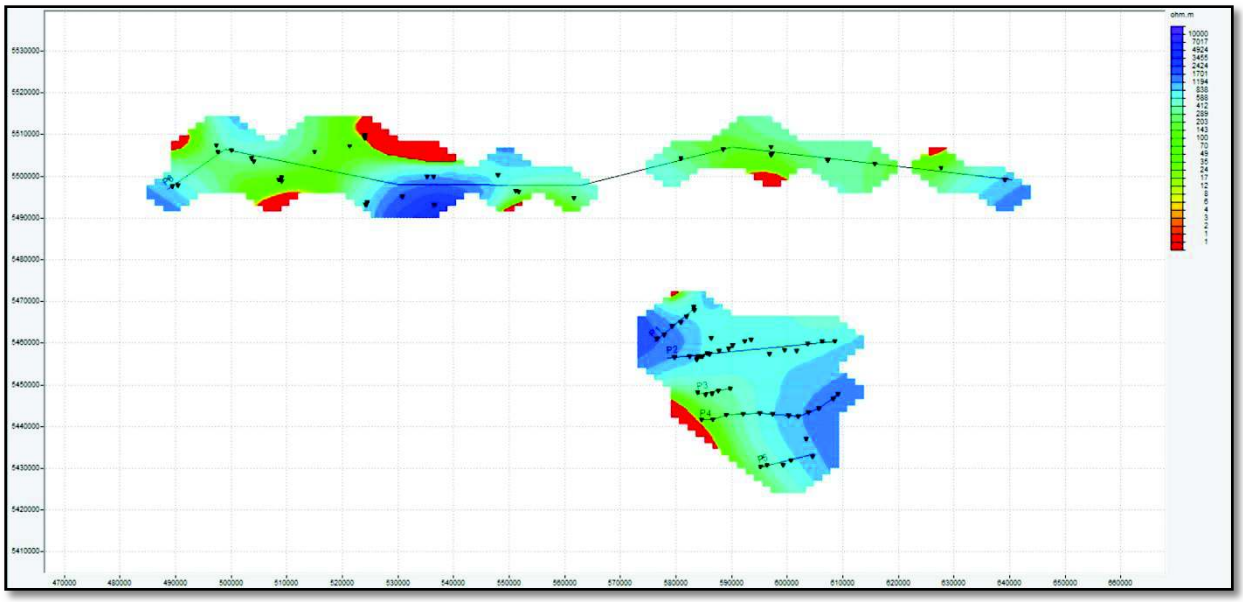


***Figure 8: Smoothed XY Apparent Resistivity at 30 Hz***

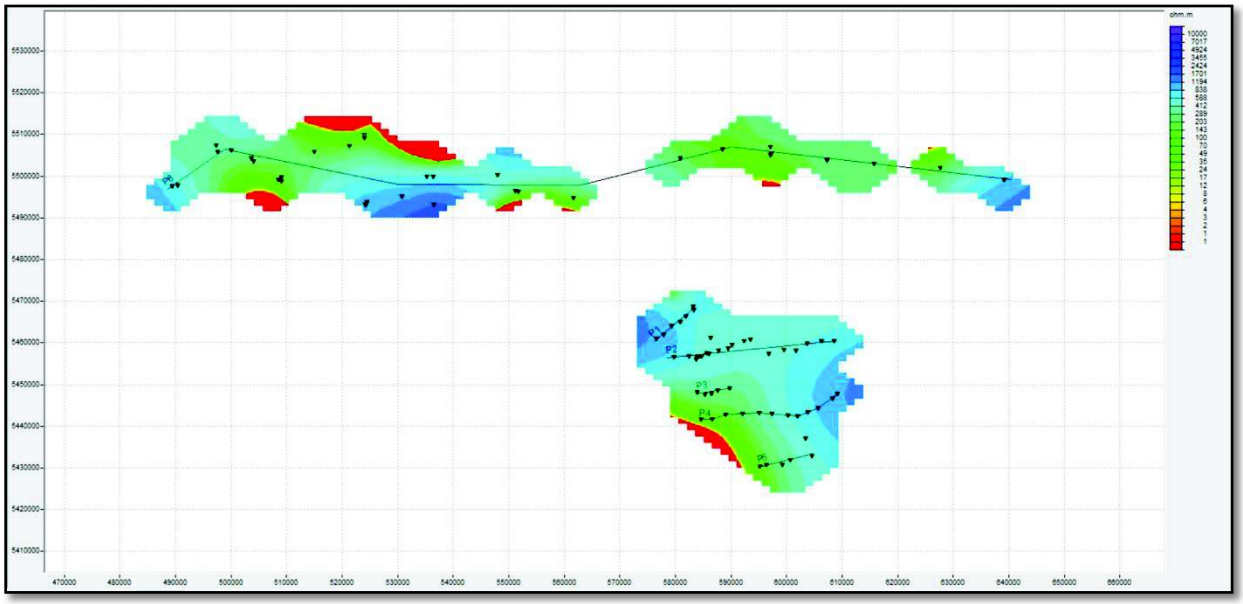


***Figure 9: Smoothed XY Apparent Resistivity at 10 Hz***

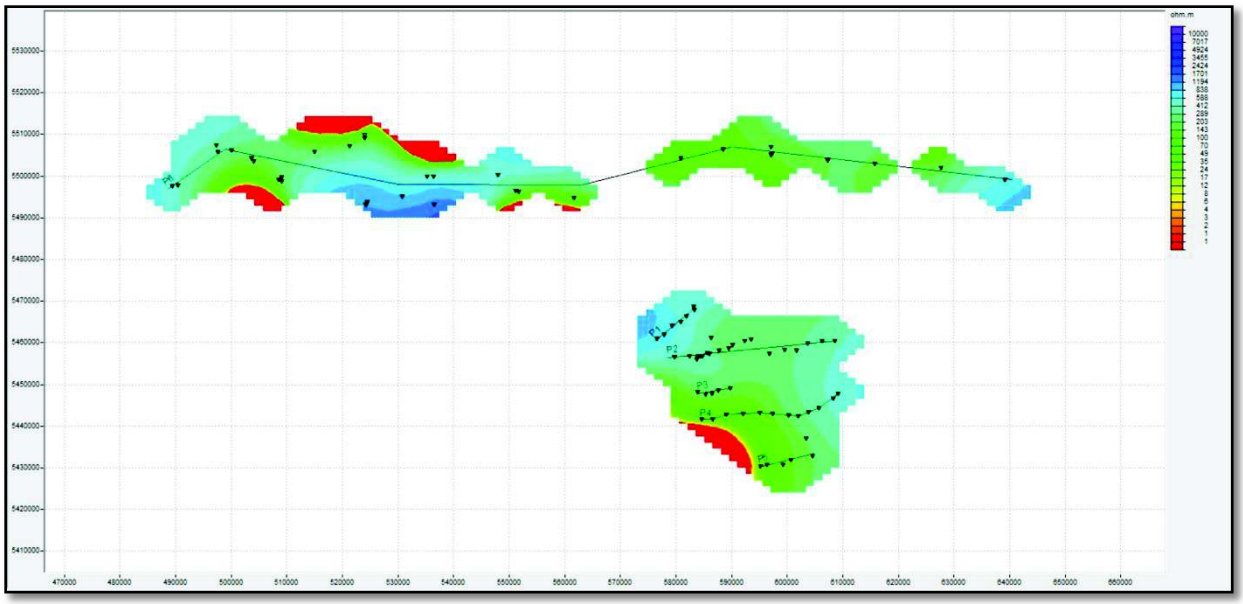


***Figure 10: Smoothed XY Apparent Resistivity at 3 Hz***

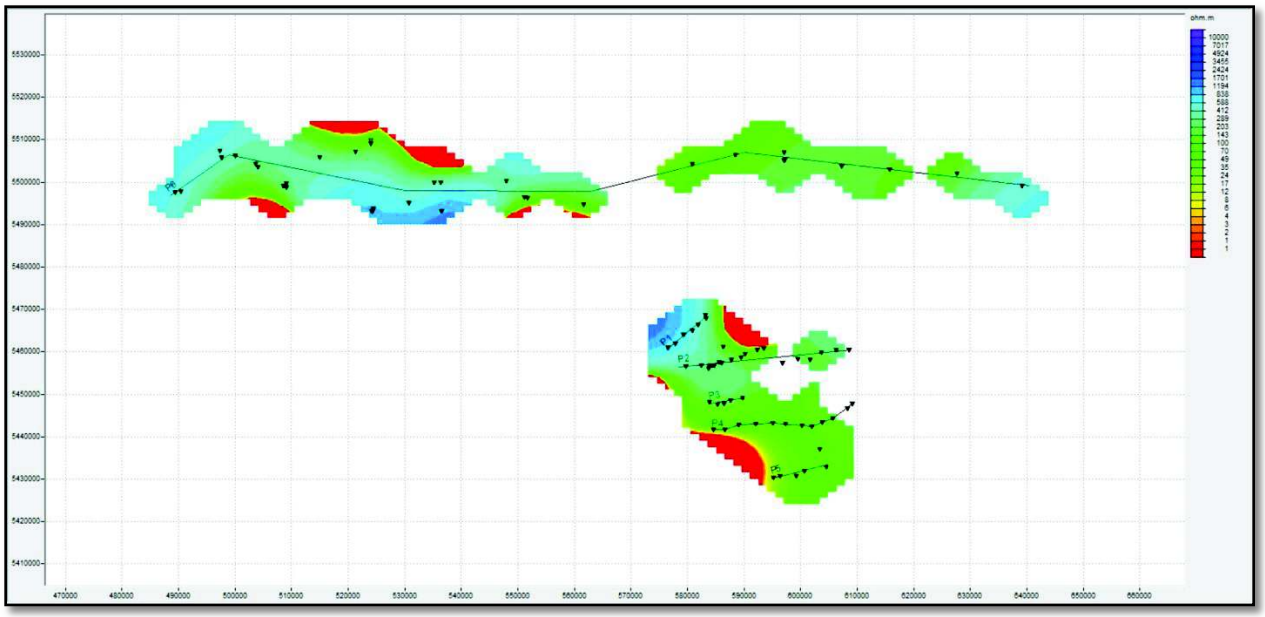


***Figure 11: Smoothed XY Apparent Resistivity at 1 Hz***

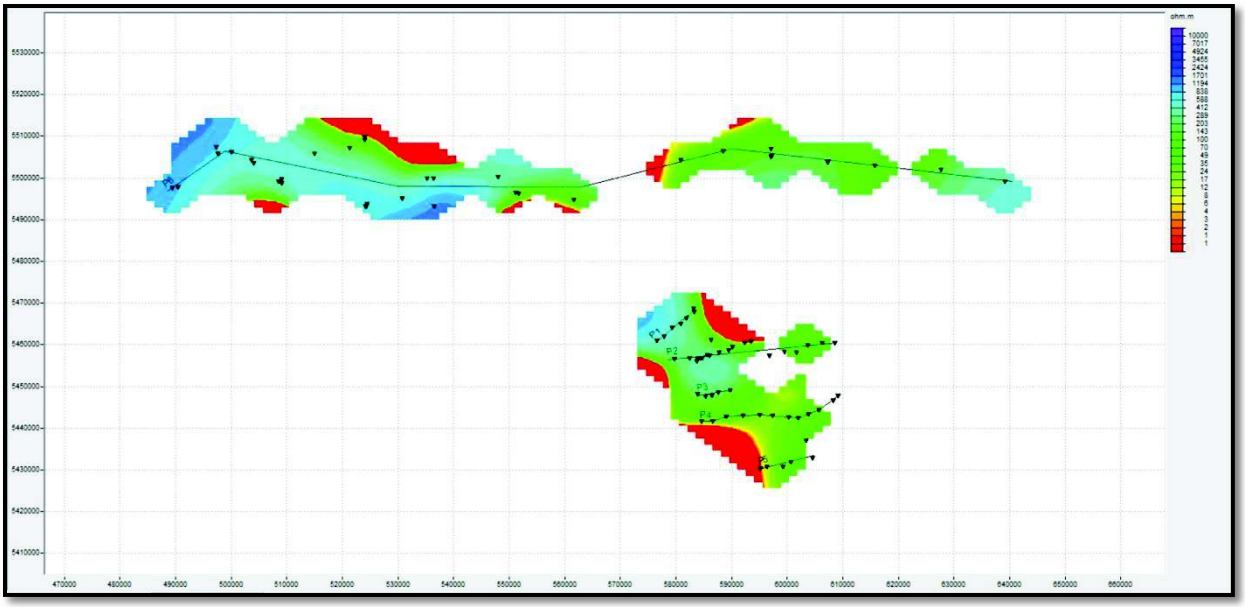


***Figure 12: Smoothed XY Apparent Resistivity at 0.3 Hz***

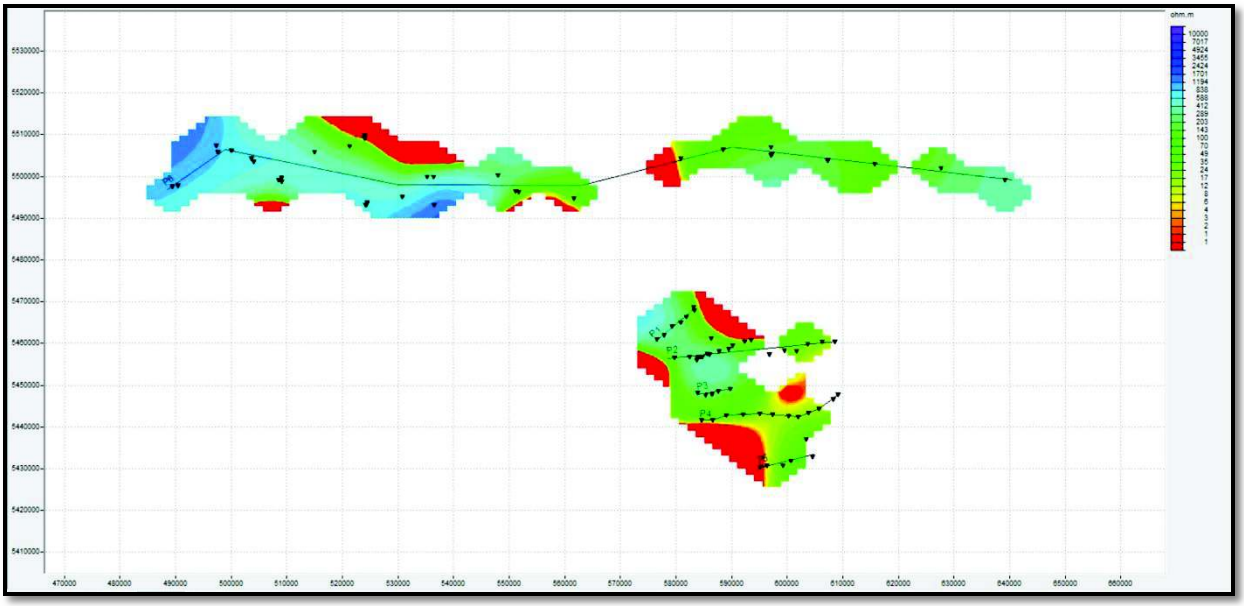


***Figure 13: Smoothed XY Apparent Resistivity at 0.1 Hz***

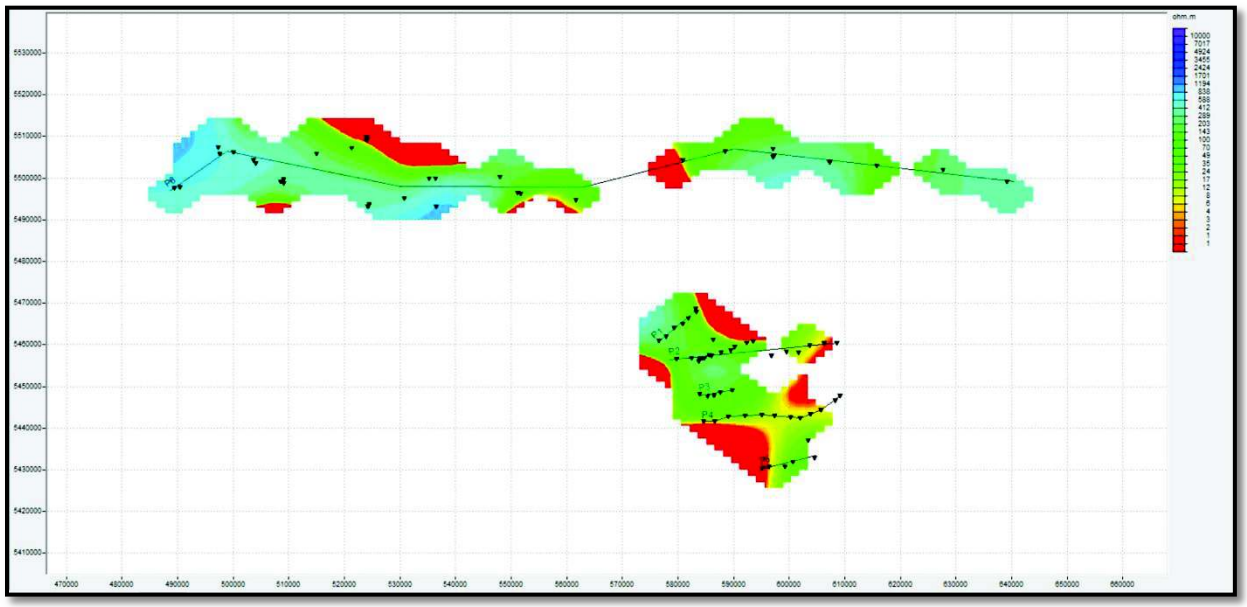


***Figure 14: Smoothed XY Apparent Resistivity at 0.03 Hz***

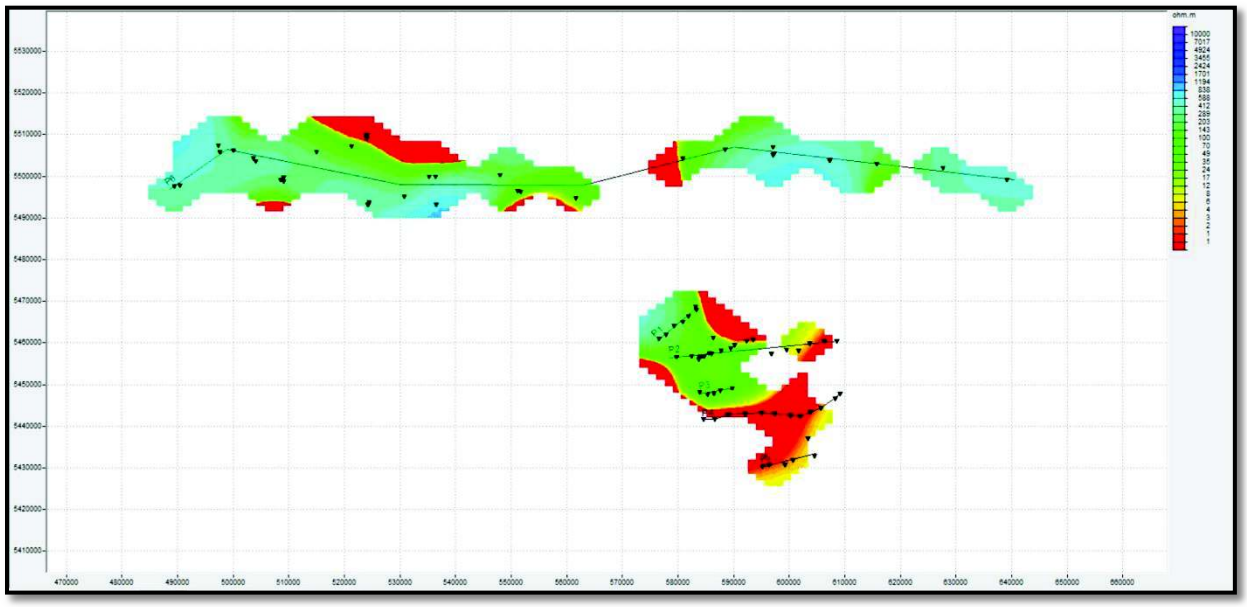


***Figure 15: Smoothed XY Apparent Resistivity at 0.01 Hz***

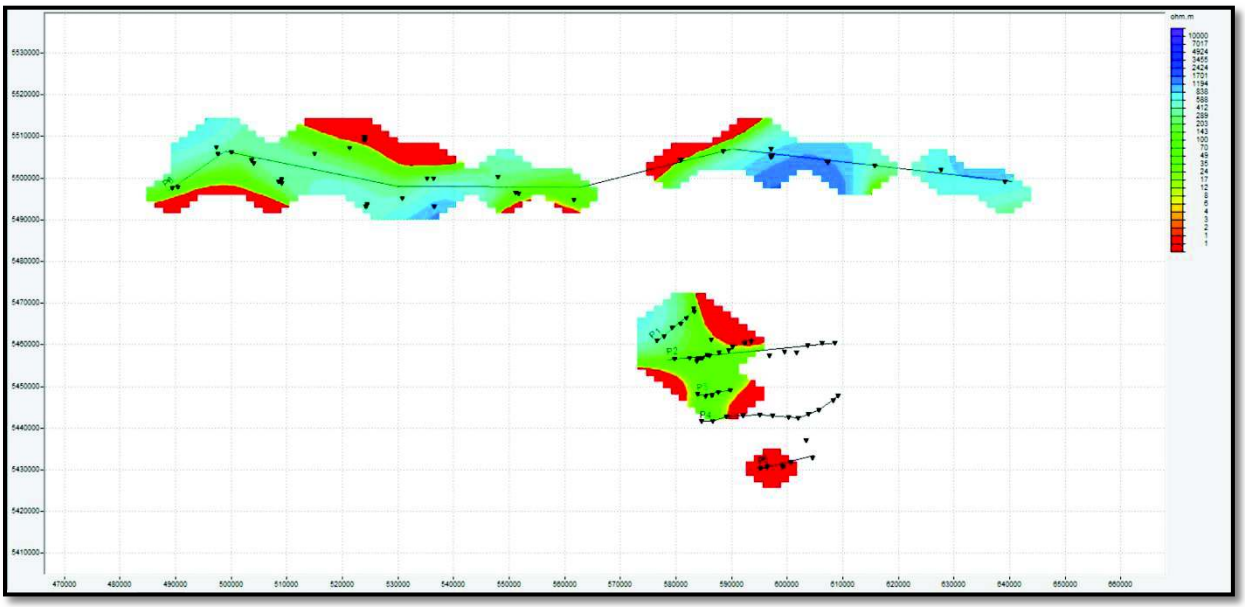

***Figure 16: Smoothed XY Apparent Resistivity at 0.003 Hz***

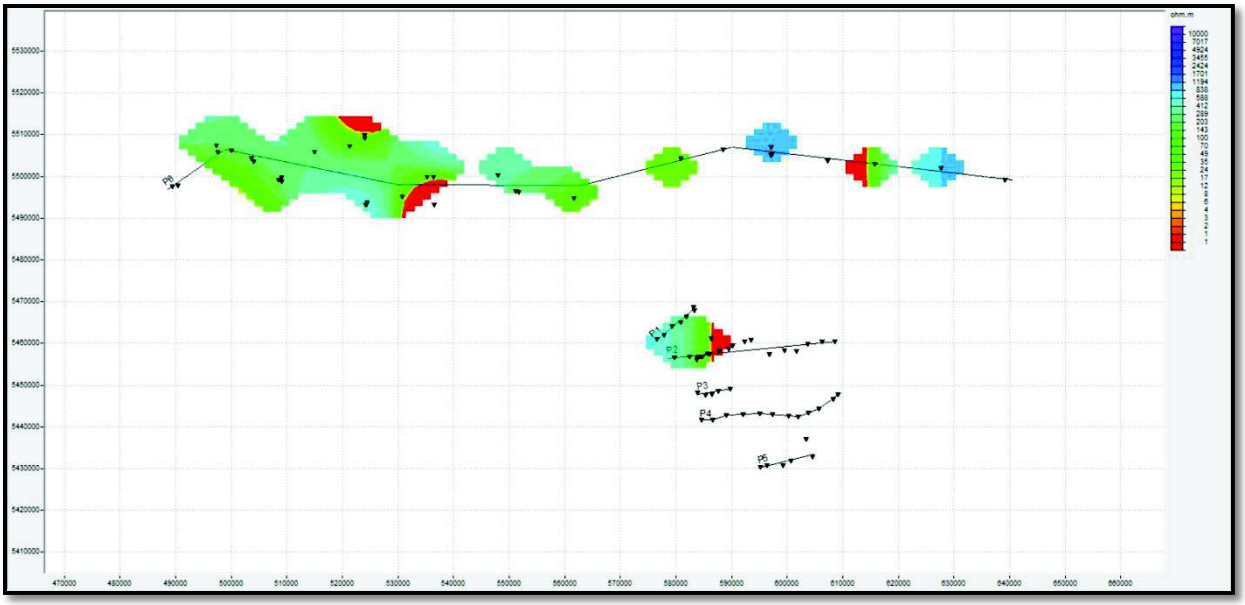

***Figure 17: Smoothed XY Apparent Resistivity at 0.001 Hz***

- Mostly resistive at high frequencies, then it gradually becomes slightly more conductive.
- A SW-NE anomaly (A1) starts to be seen at 0.3 Hz, between profiles P4 and P5.
- A1 increases in intensity and size with depth, dominating most of profiles P4 and P5 at 0.01 Hz.
- A1 seems to remain at lower frequencies, but there is not enough data to confirm.
- A second anomaly (A2) can be observed north of centered part of profile P2.

## 4.2. RESISTIVITY YX

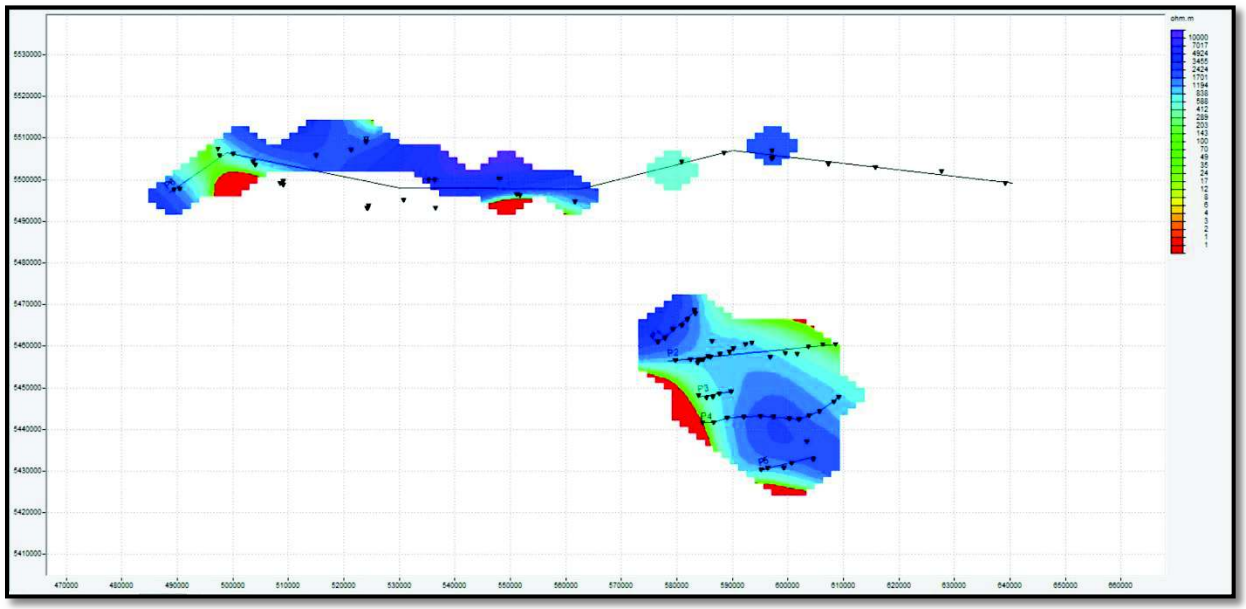


***Figure 18: Smoothed YX Apparent Resistivity at 300 Hz***

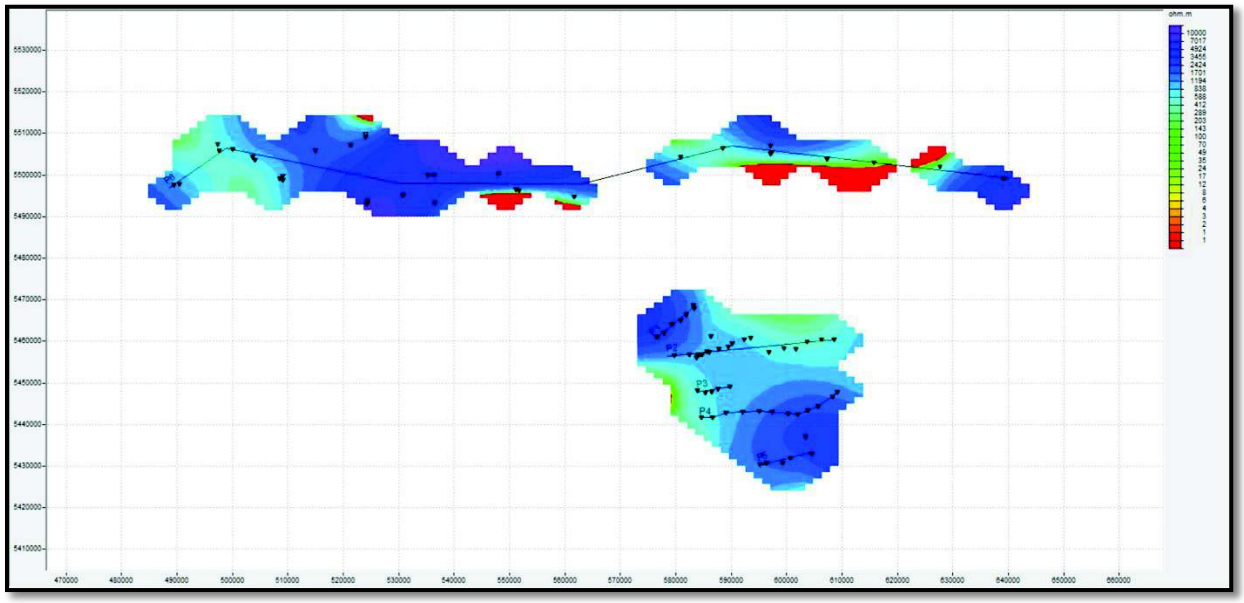


***Figure 19: Smoothed YX Apparent Resistivity at 100 Hz***

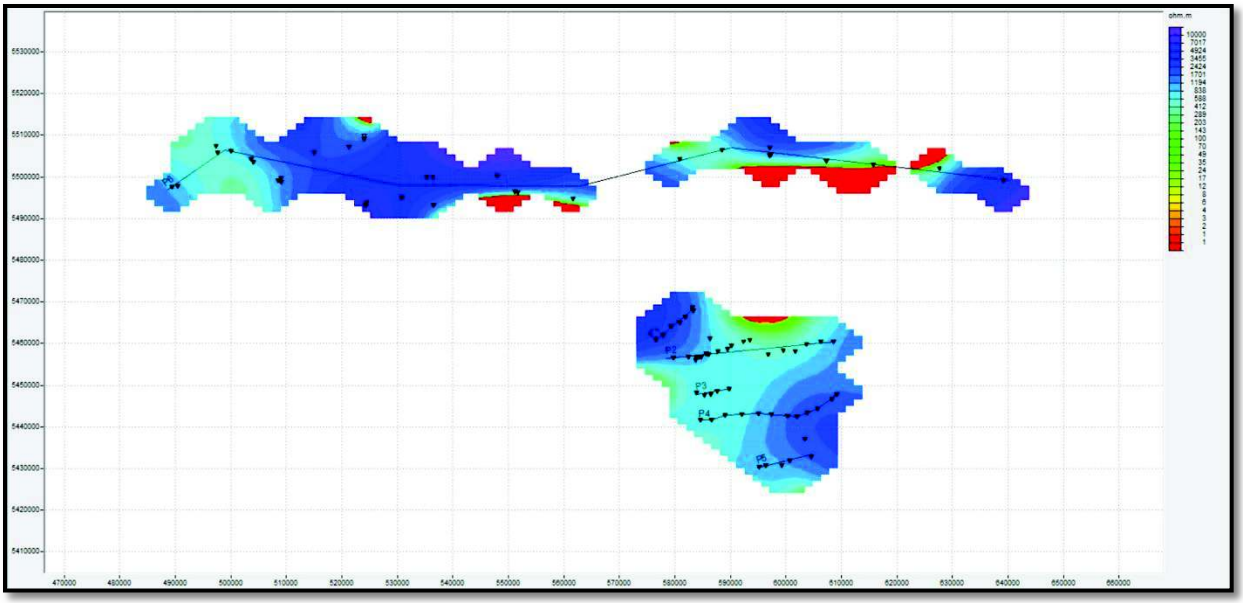


***Figure 20: Smoothed YX Apparent Resistivity at 30 Hz***

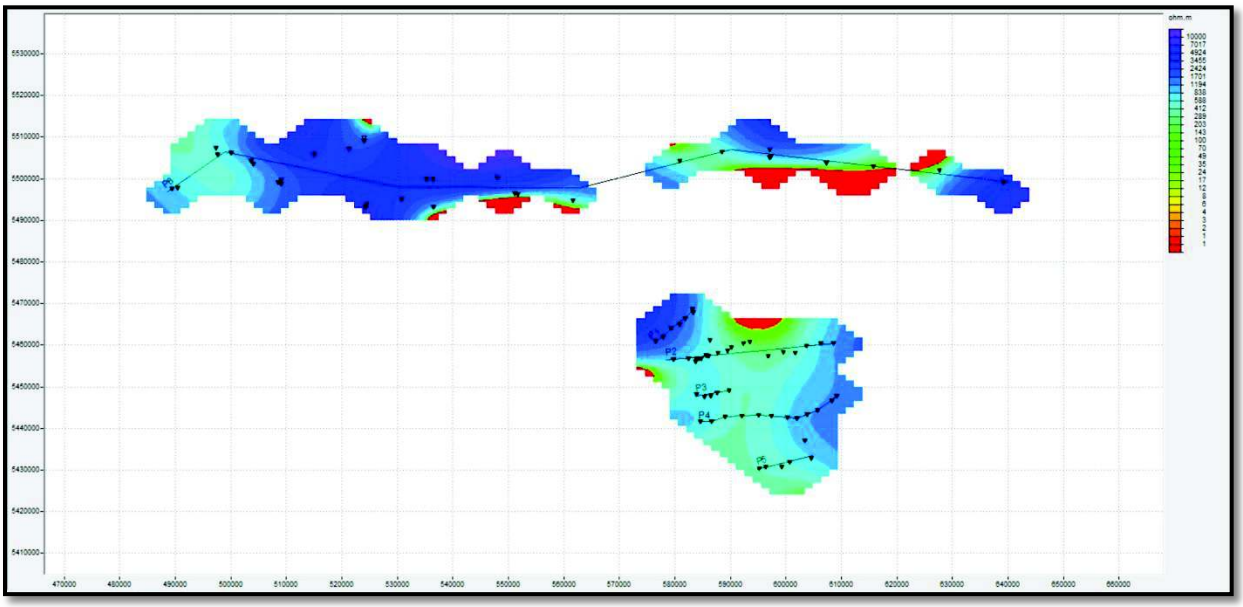


***Figure 21: Smoothed YX Apparent Resistivity at 10 Hz***

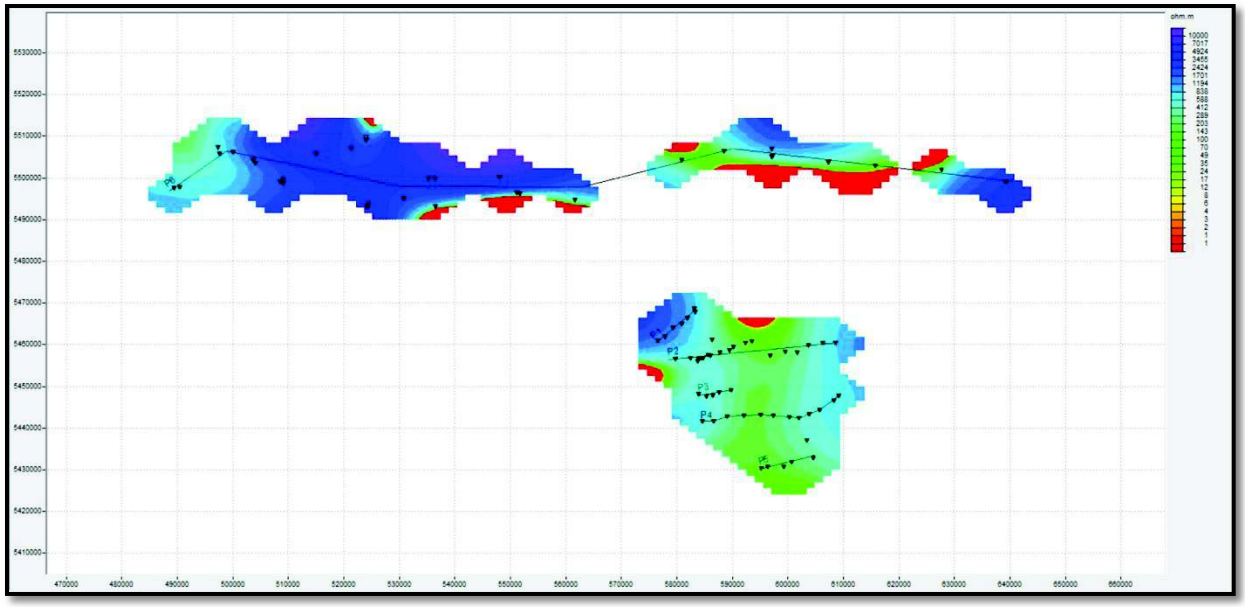

***Figure 22: Smoothed YX Apparent Resistivity at 3 Hz***

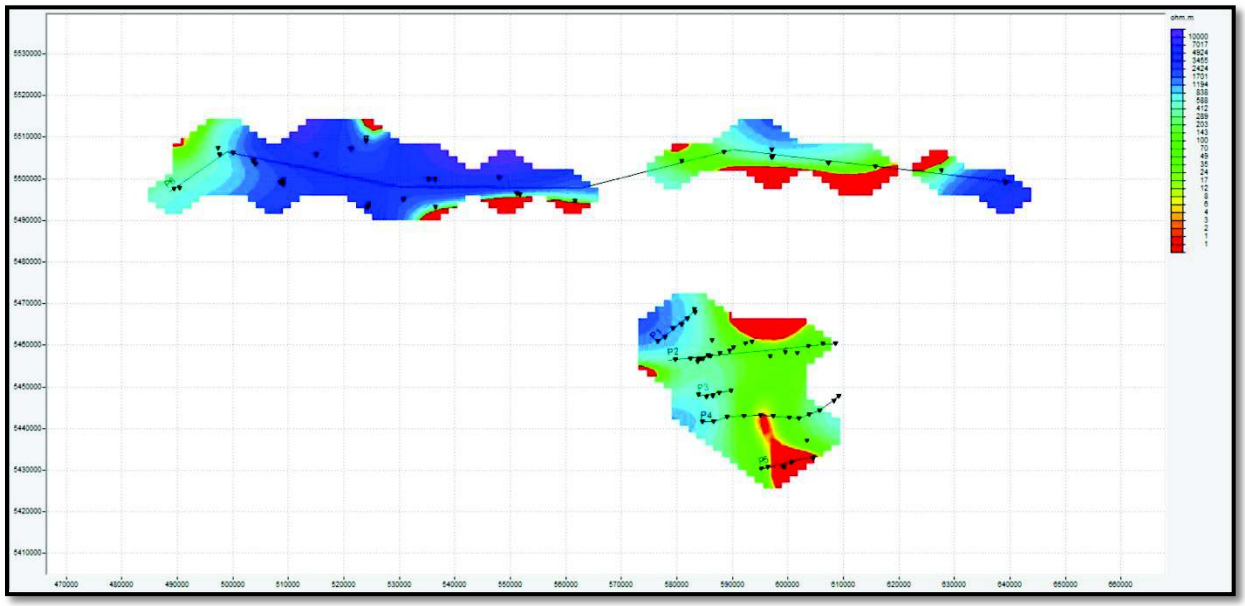

***Figure 23: Smoothed YX Apparent Resistivity at 1 Hz***

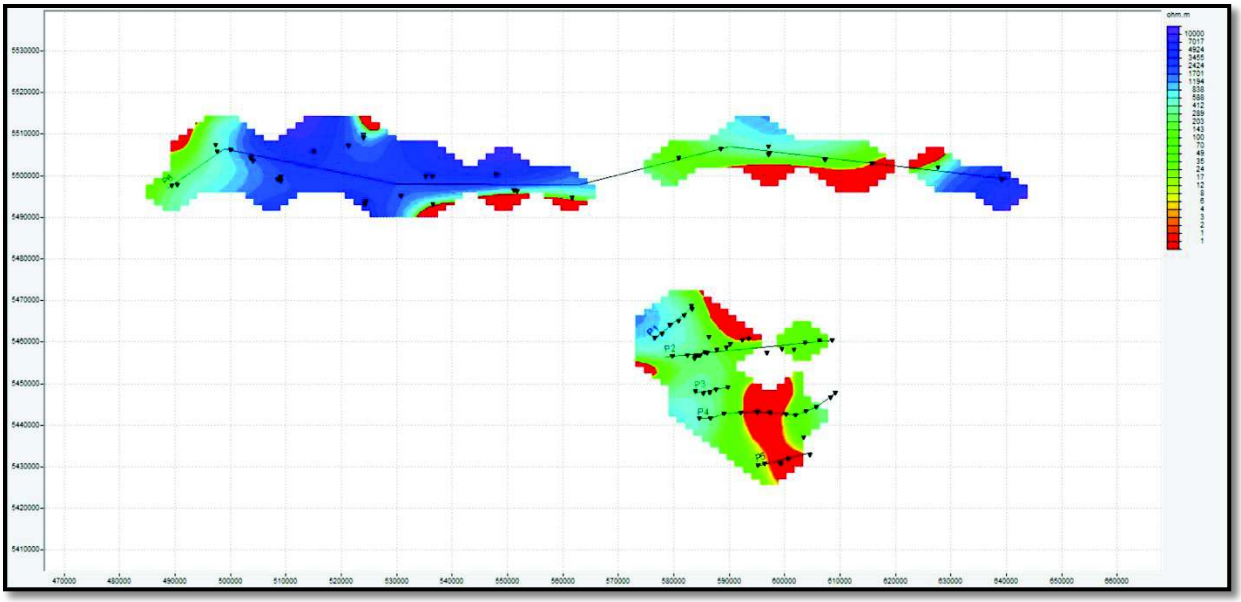


***Figure 24: Smoothed YX Apparent Resistivity at 0.3 Hz***

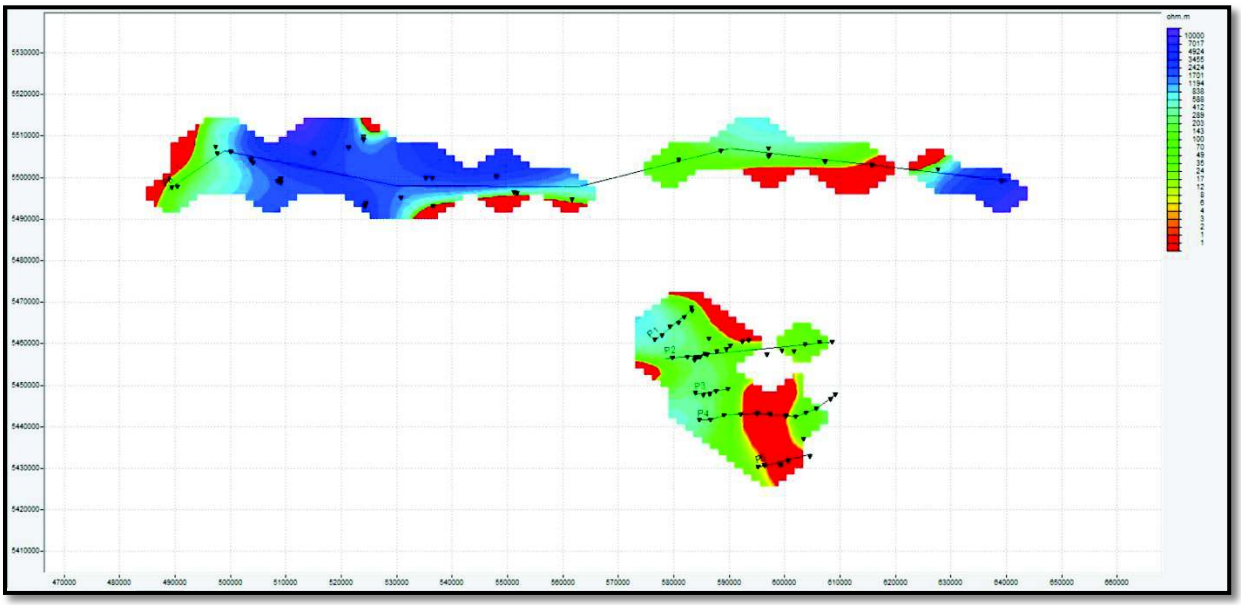


***Figure 25: Smoothed YX Apparent Resistivity at 0.1 Hz***

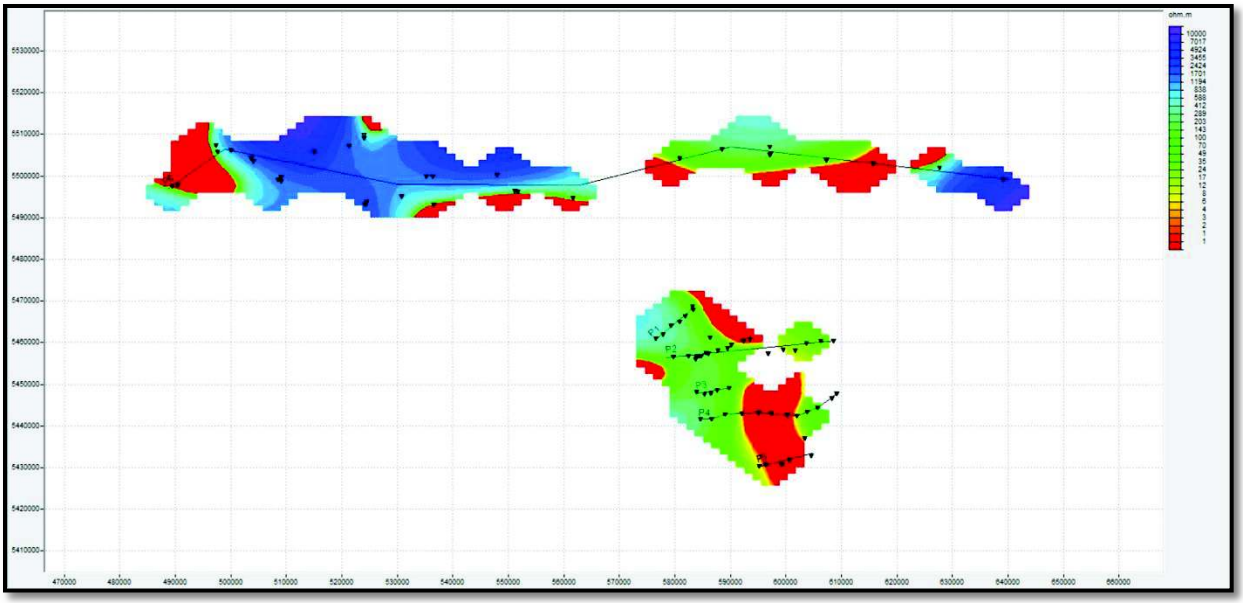


***Figure 26: Smoothed YX Apparent Resistivity at 0.03 Hz***

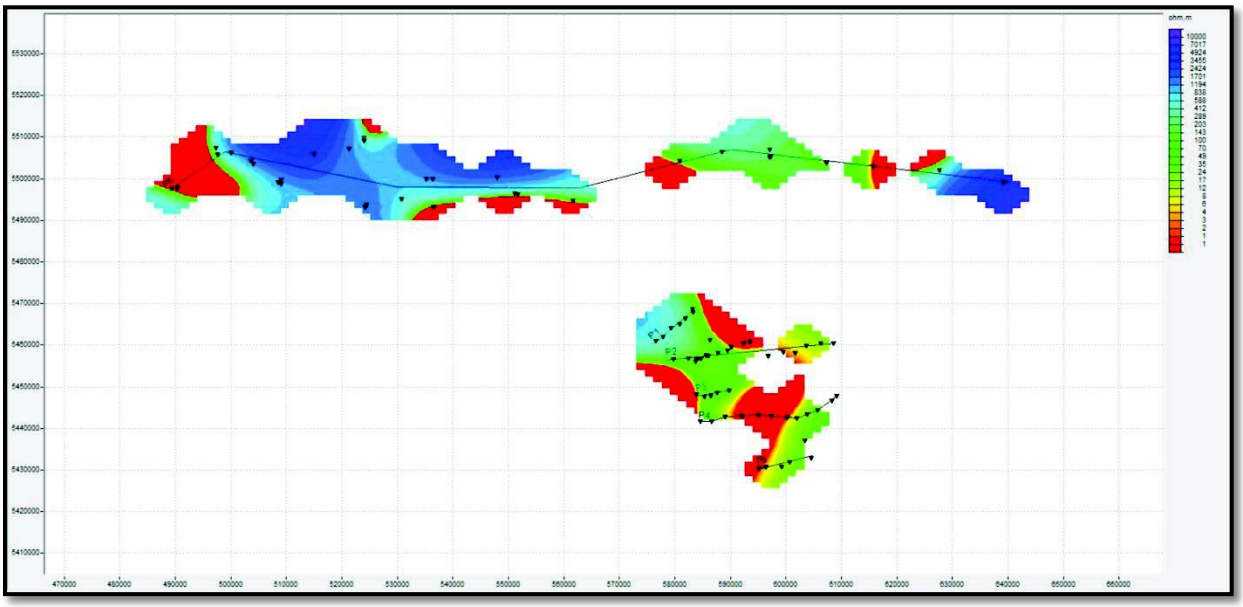


***Figure 27: Smoothed YX Apparent Resistivity at 0.01 Hz***

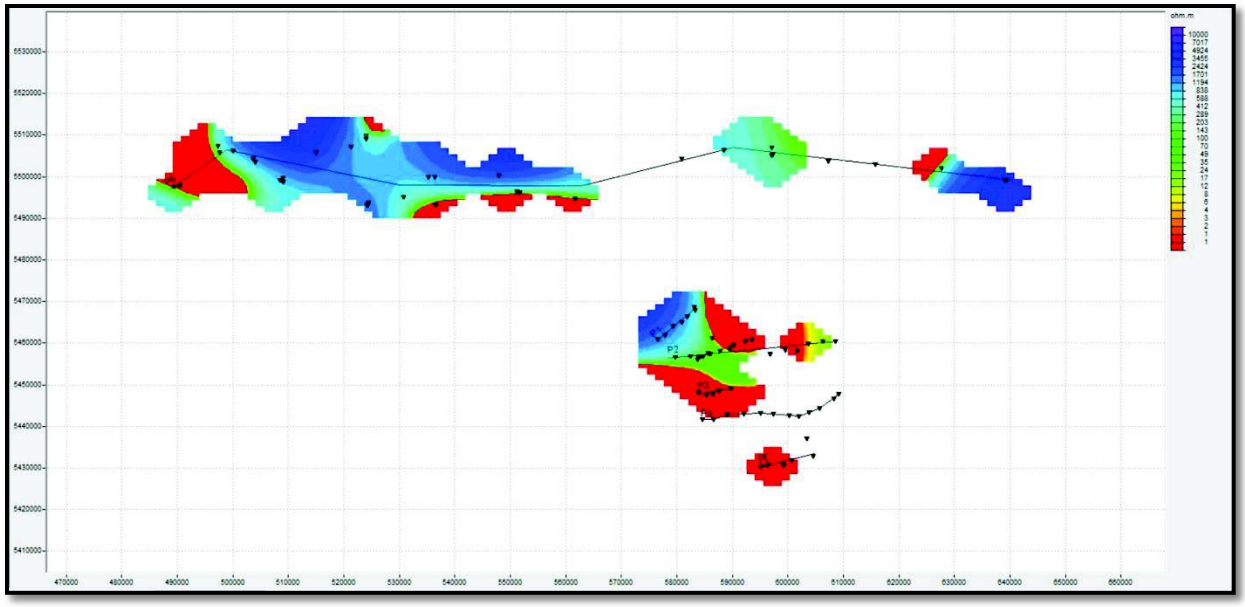

***Figure 28: Smoothed YX Apparent Resistivity at 0.003 Hz***

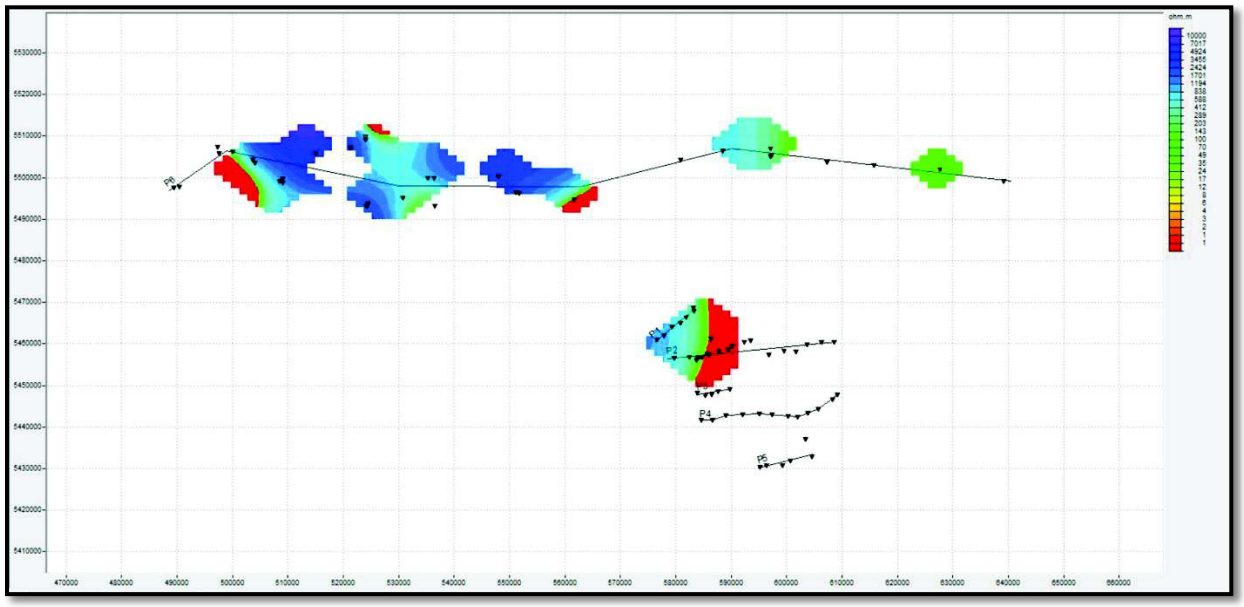

***Figure 29: Smoothed YX Apparent Resistivity at 0.001 Hz***

- In general, YX mode is more resistive than XY mode at high frequency, and down to 10 Hz.
- 3 Hz and lower, we have to different signatures along P6: a resistive western part and a more conductive eastern part.
- 1 Hz and lower, conductive anomaly (A1) starts to be observed on profile P5, then both P4 and P5. This NS elongated anomaly is mostly present on those two profiles, and it can be observed on profiles P3 on the very low frequencies. Unfortunately, we do not have very low frequency data on profiles P4 and P5, to follow that anomaly at lower frequencies.
- Anomaly A2 starts to appear at 0.3 Hz, but the lack of low frequency data on station D-104 (on profile P2) doesn't allow us to say if A1 and A2 are linked at deeper depth.

## 4.3. PHASE XY

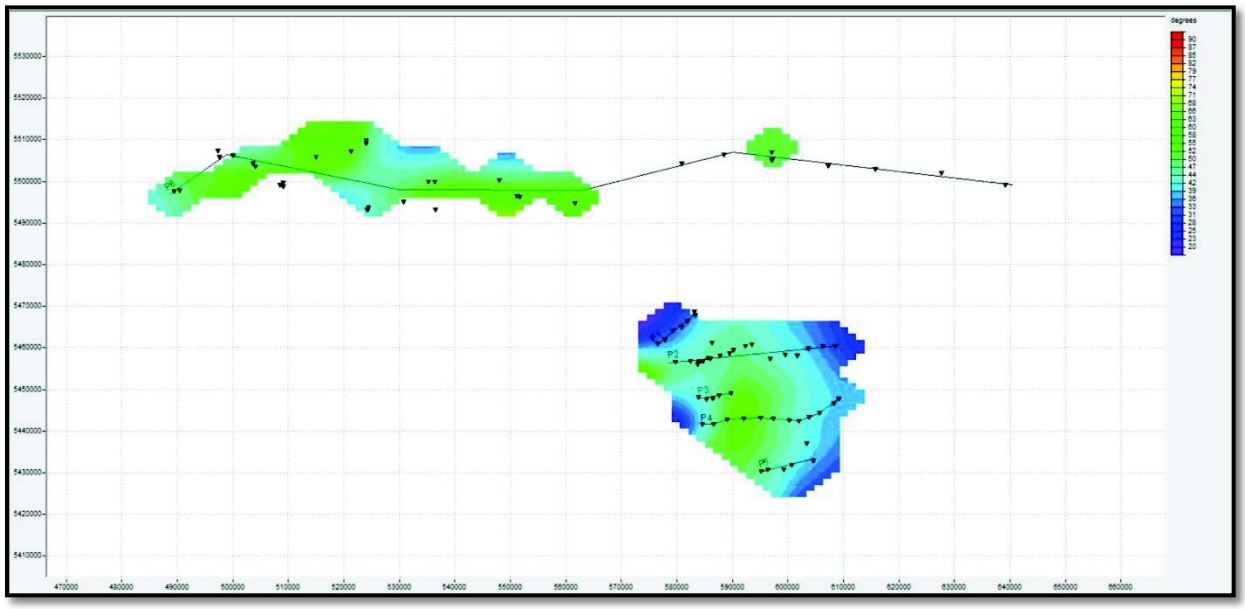


***Figure 30: Smoothed XY Phase at 300 Hz***

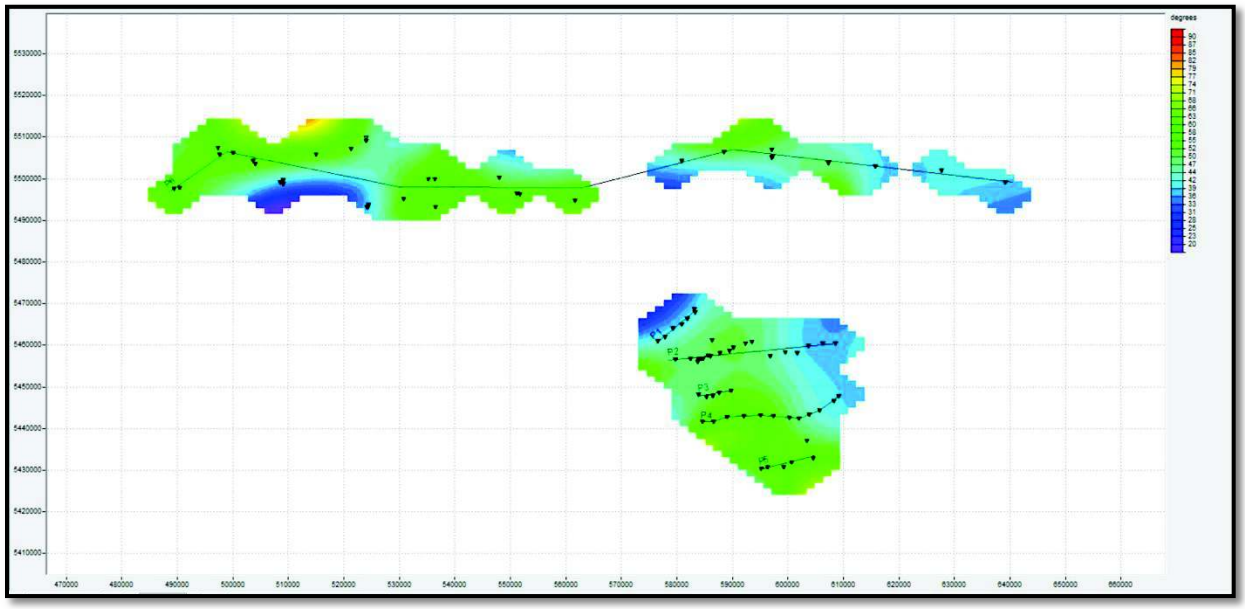


***Figure 31: Smoothed XY Phase at 100 Hz***

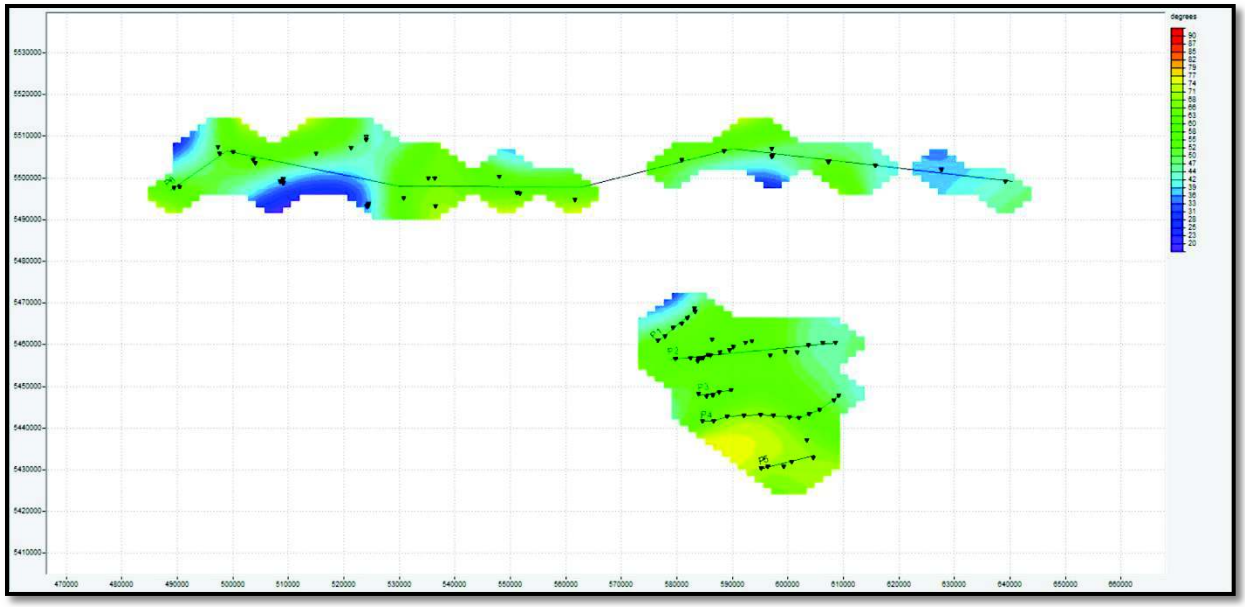


***Figure 32: Smoothed XY Phase at 30 Hz***

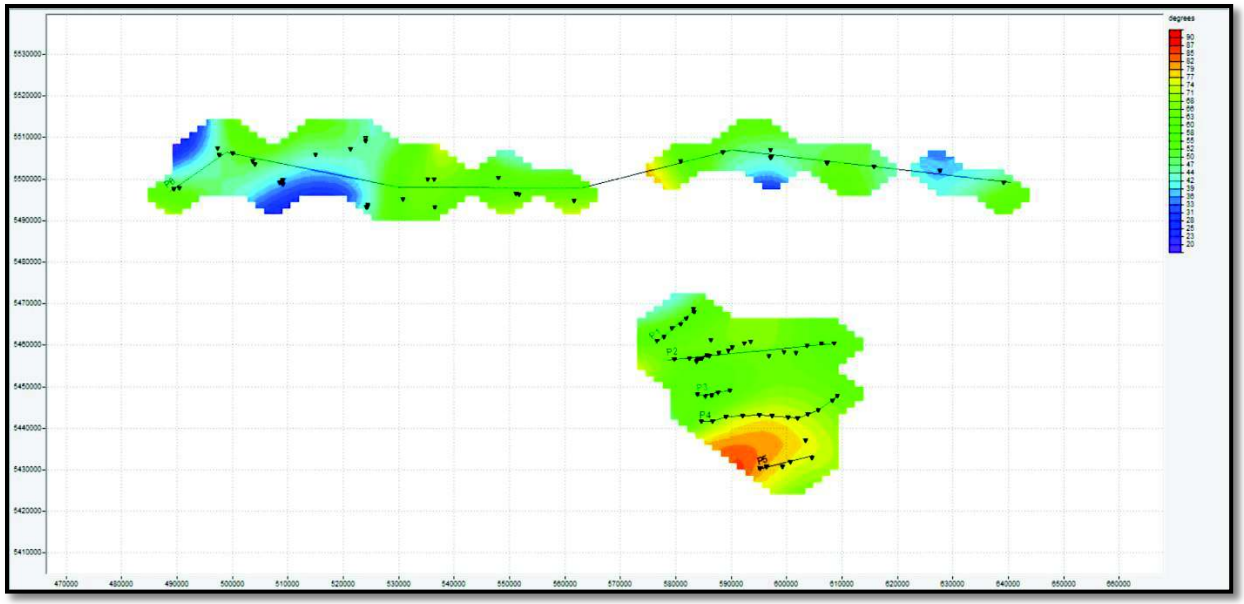


***Figure 33: Smoothed XY Phase at 10 Hz***

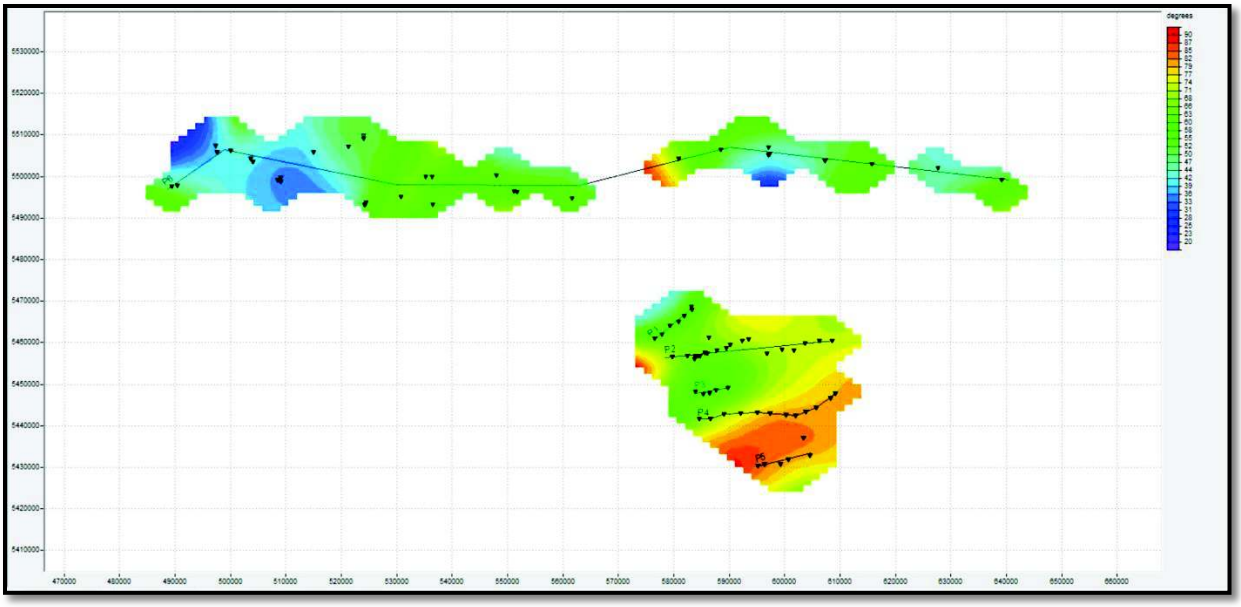


***Figure 34: Smoothed XY Phase at 3 Hz***

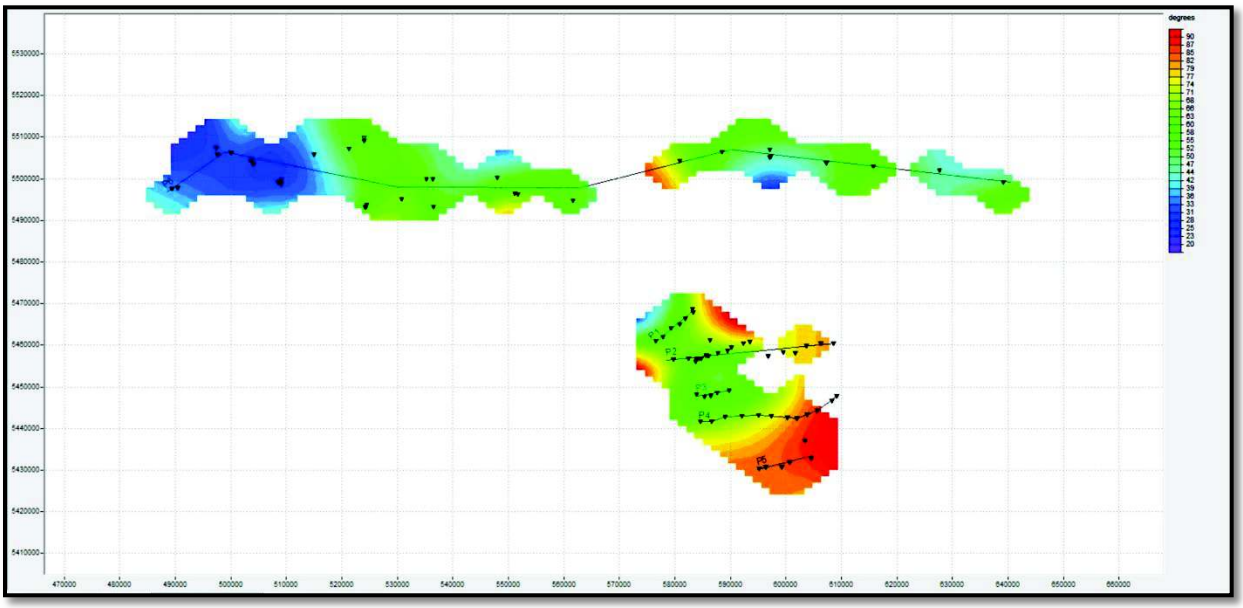


***Figure 35: Smoothed XY Phase at 1 Hz***

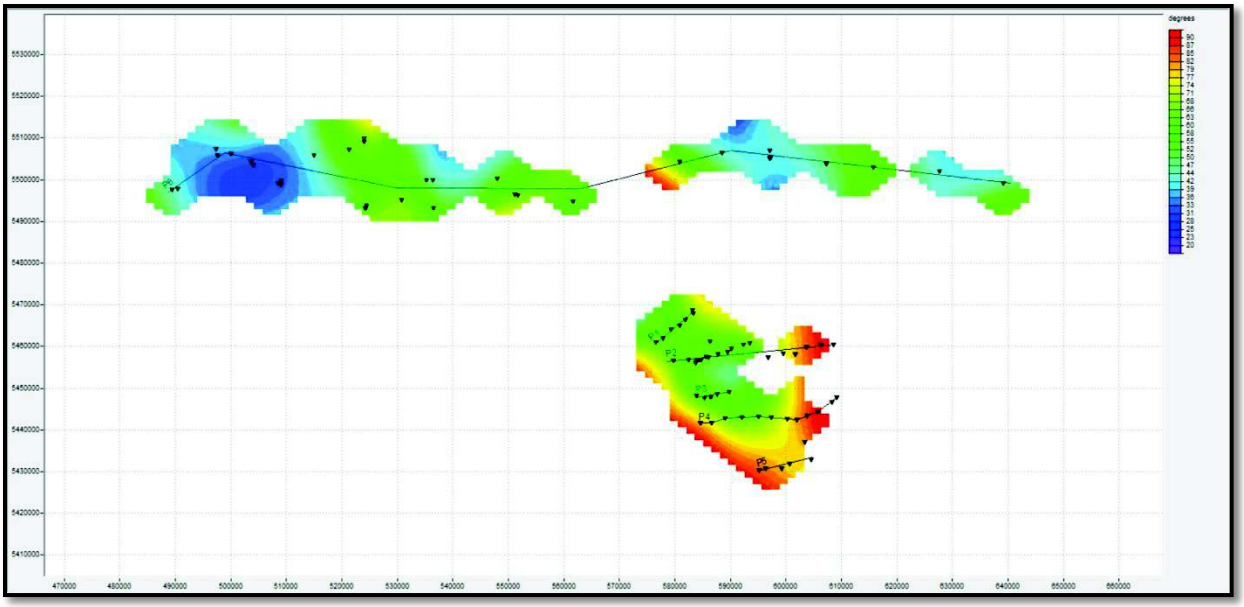


***Figure 36: Smoothed XY Phase at 0.3 Hz***

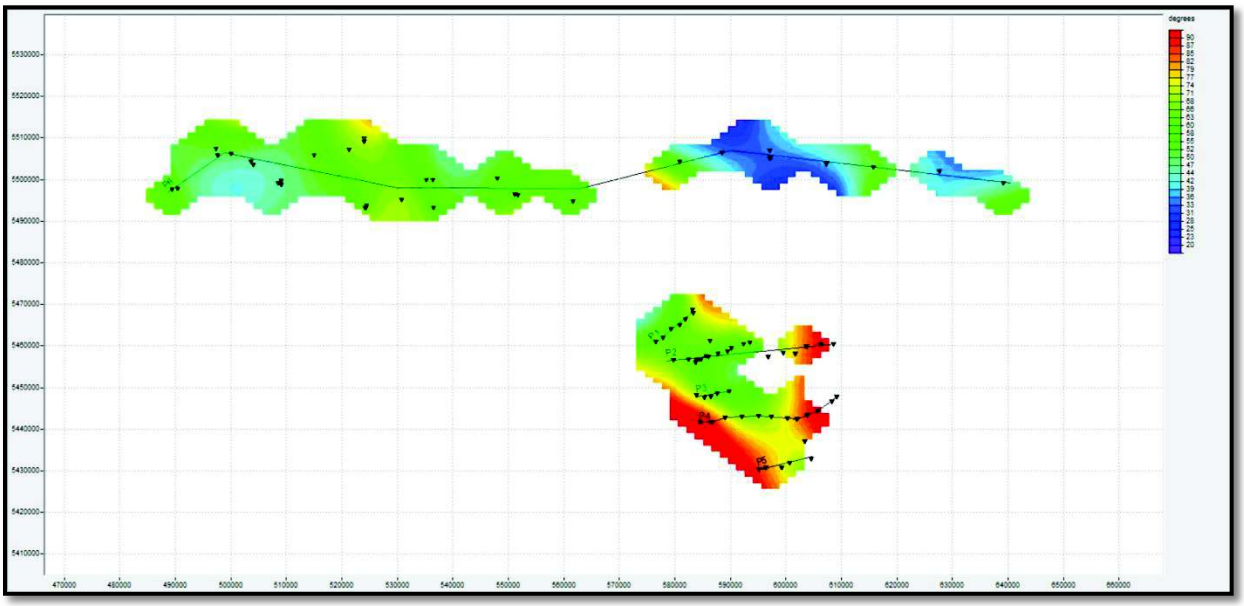


***Figure 37: Smoothed XY Phase at 0.1 Hz***

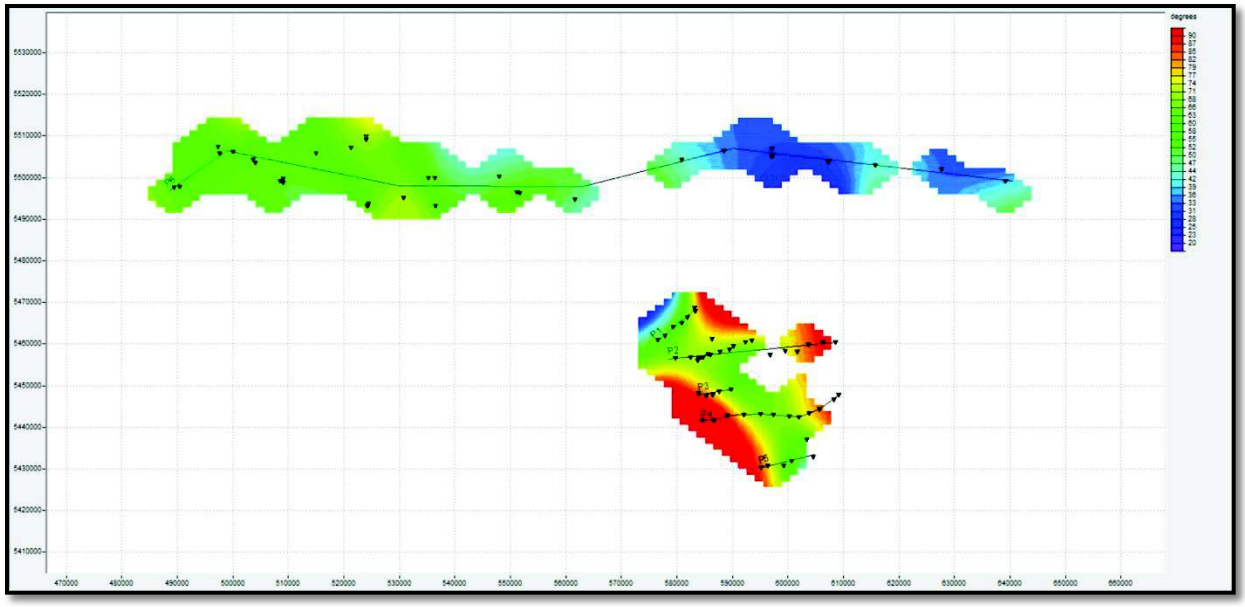


***Figure 38: Smoothed XY Phase at 0.03 Hz***

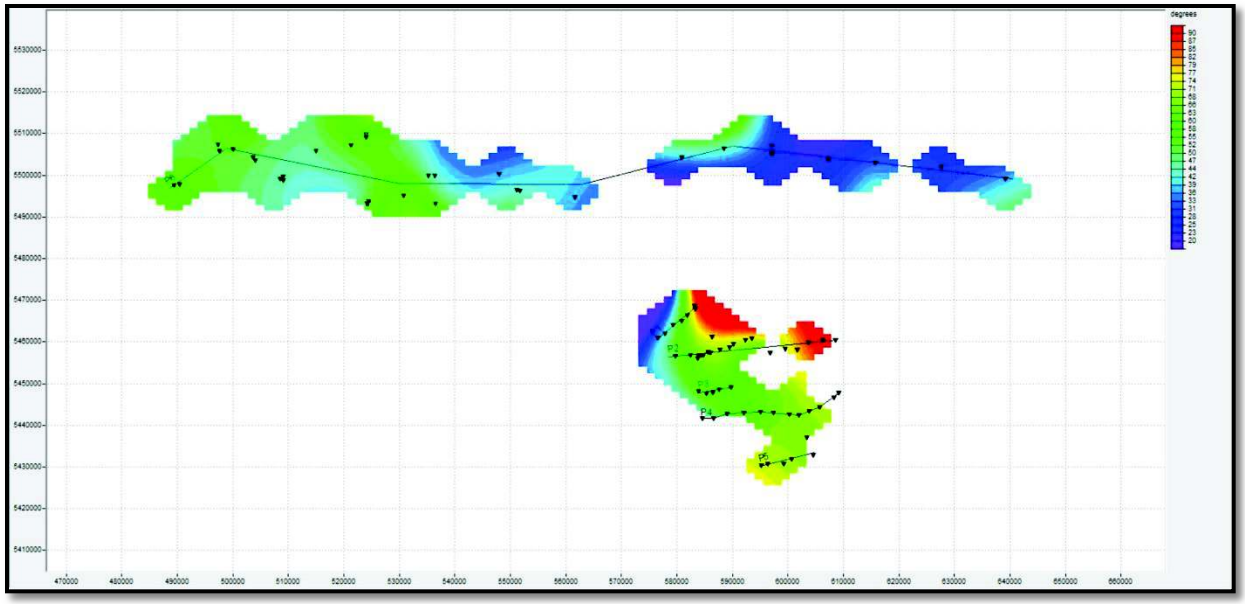


***Figure 39: Smoothed XY Phase at 0.01 Hz***

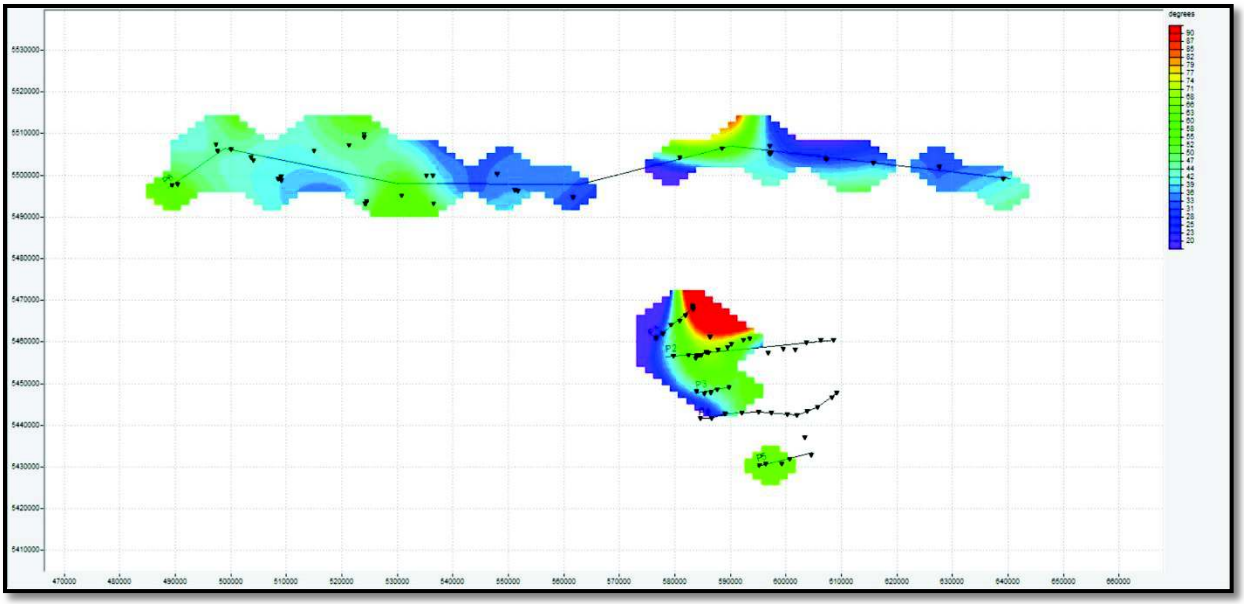


***Figure 40: Smoothed XY Phase at 0.003 Hz***

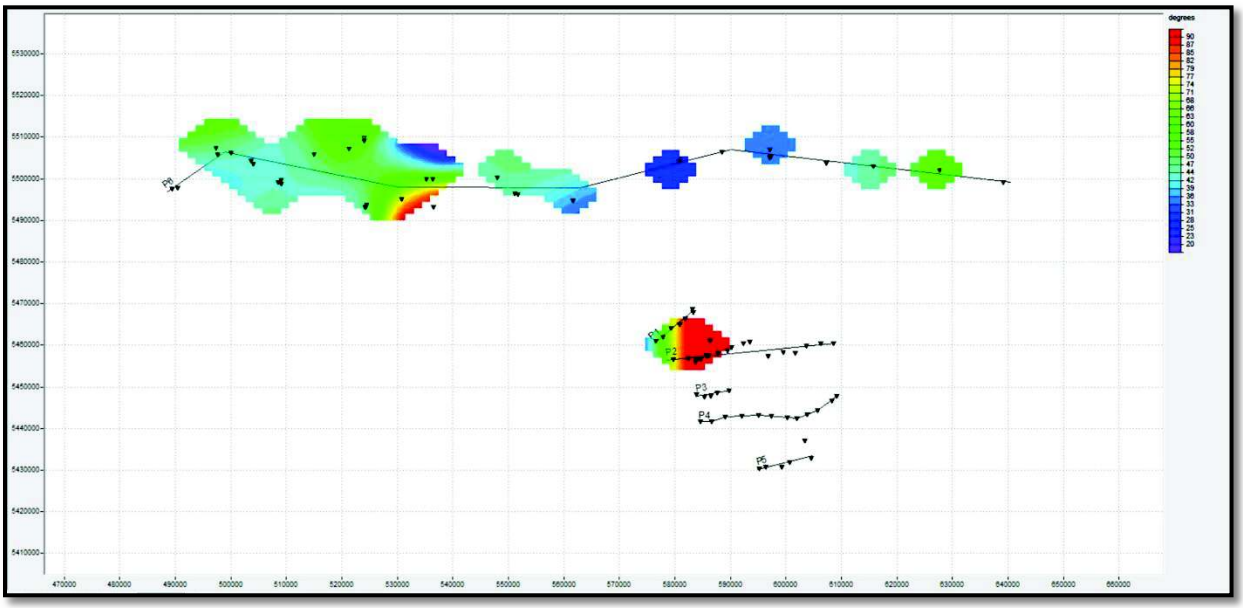


***Figure 41: Smoothed XY Phase at 0.001 Hz***

## 4.4. YX PHASE

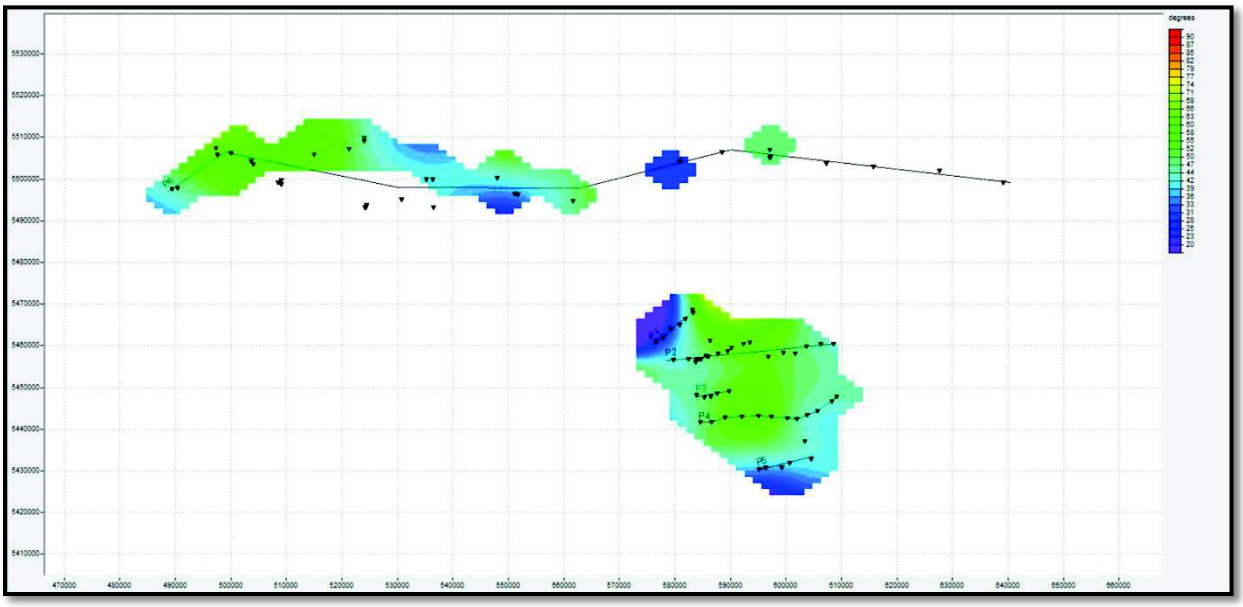


***Figure 42: Smoothed YX Phase at 300 Hz***

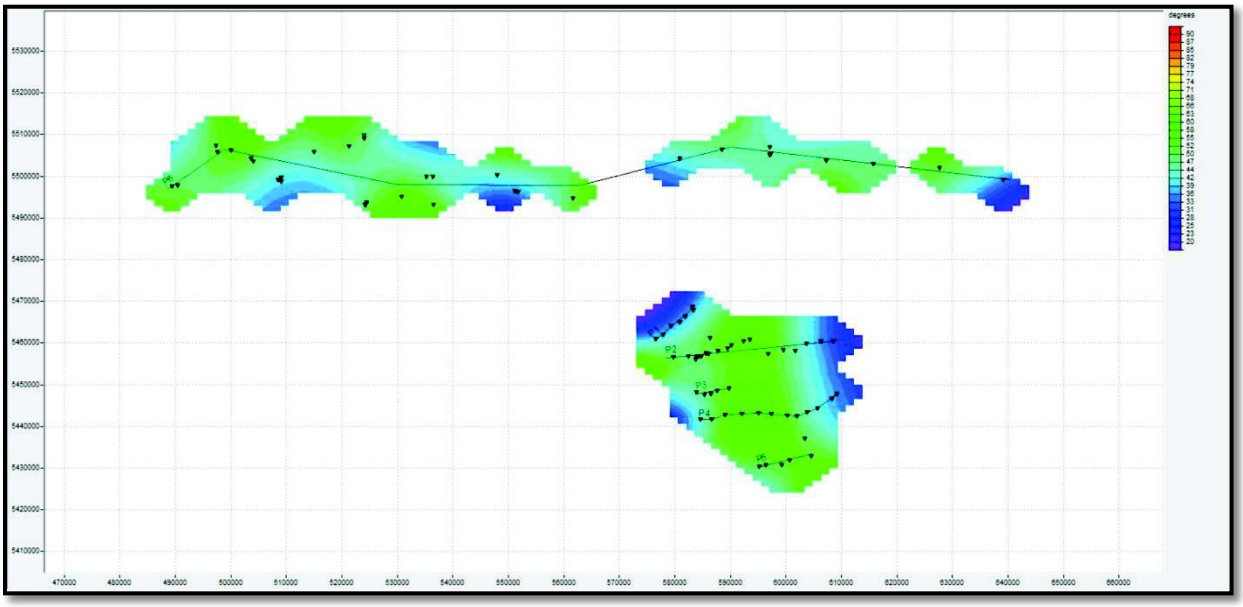


***Figure 43: Smoothed YX Phase at 100 Hz***

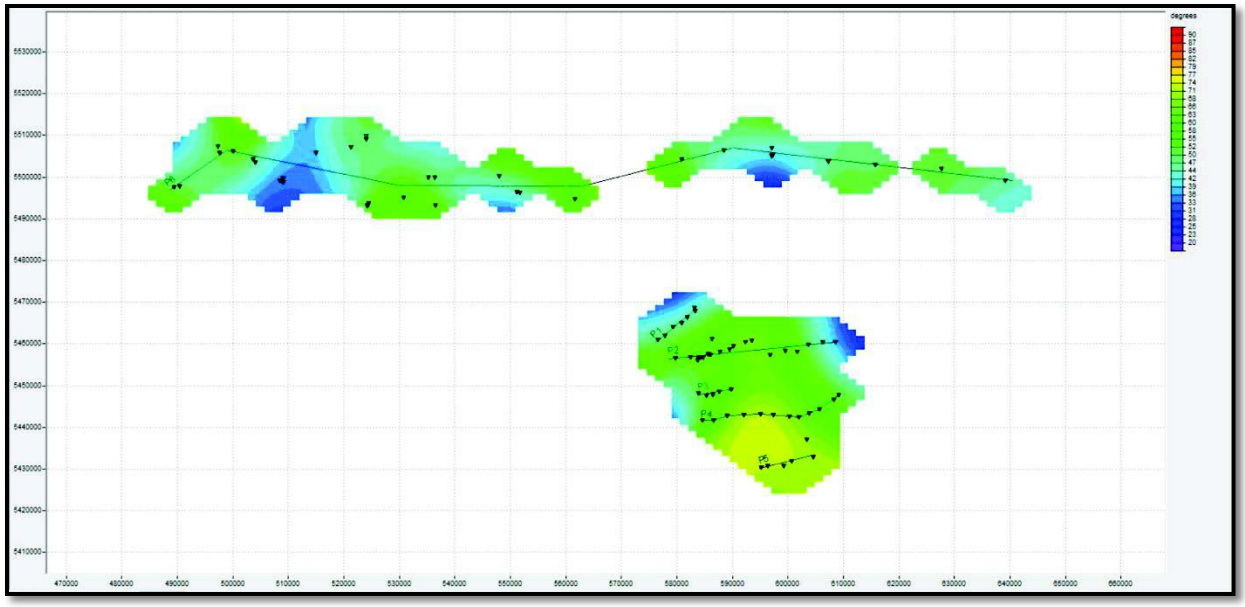

***Figure 44: Smoothed YX Phase at 30 Hz***

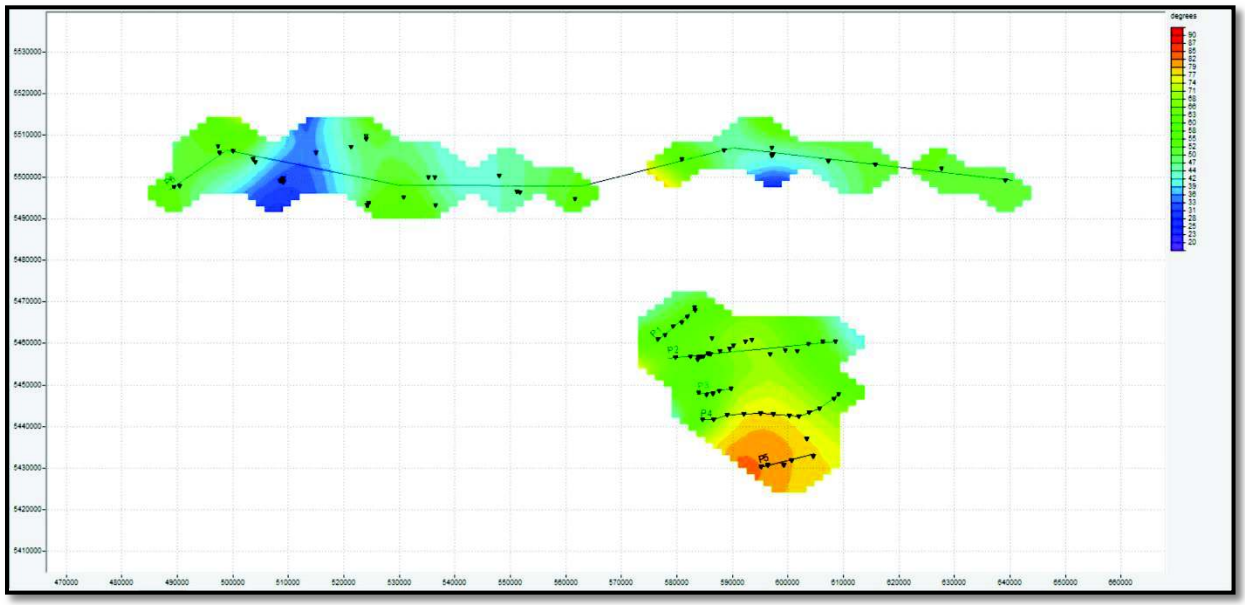

***Figure 45: Smoothed YX Phase at 10 Hz***

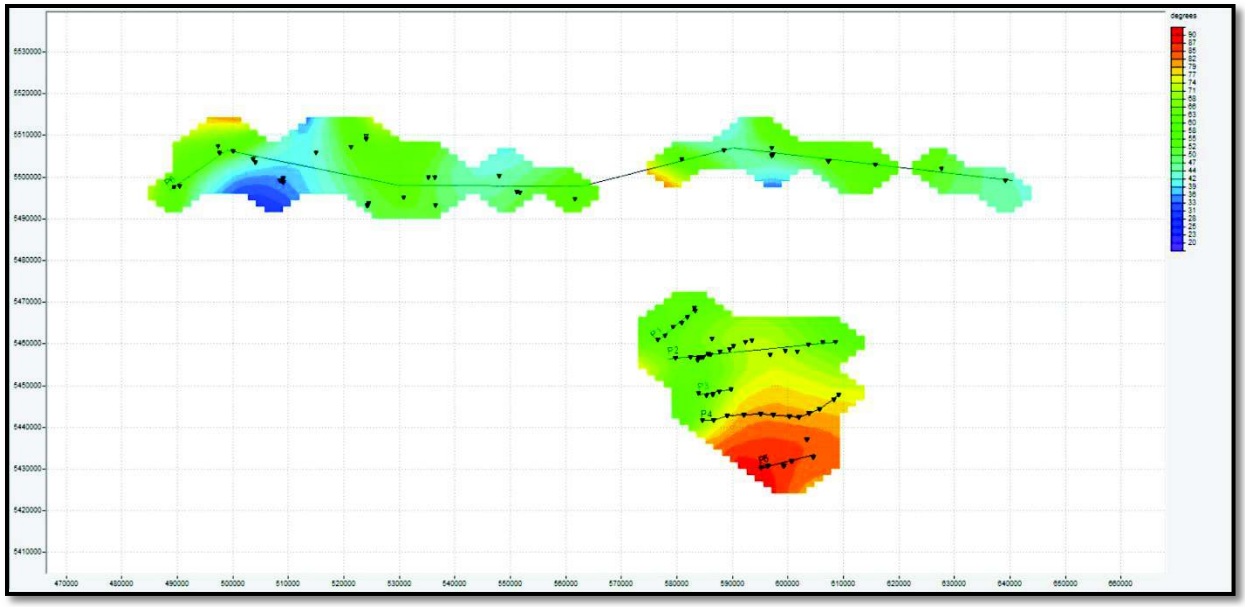


***Figure 46: Smoothed YX Phase at 3 Hz***

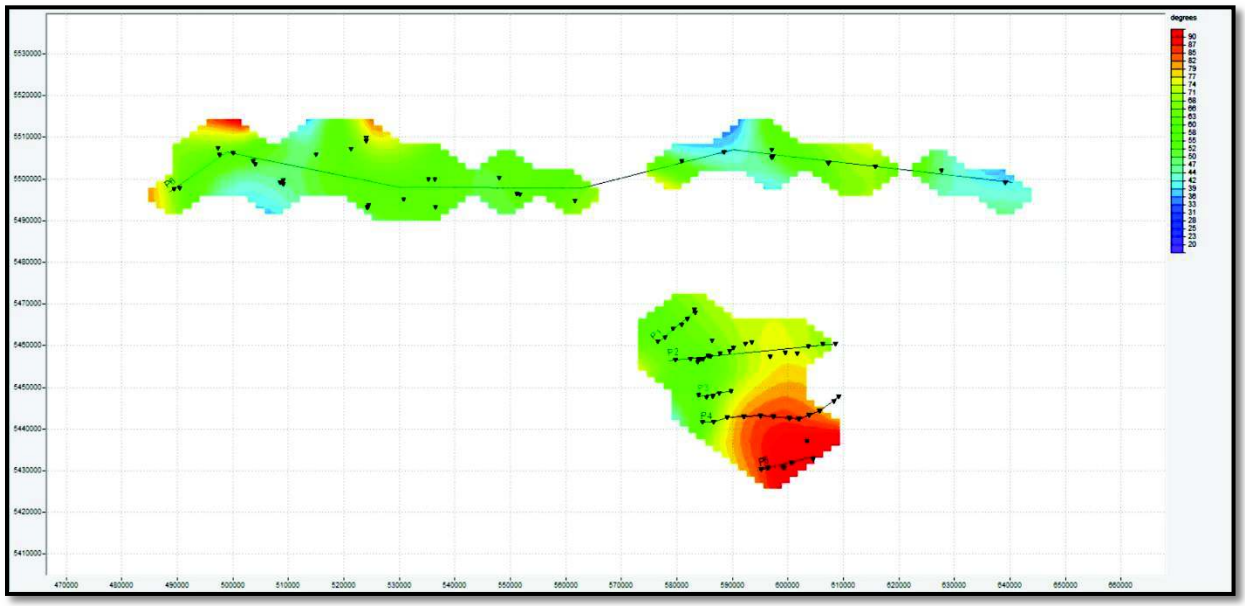


***Figure 47: Smoothed YX Phase at 1 Hz***

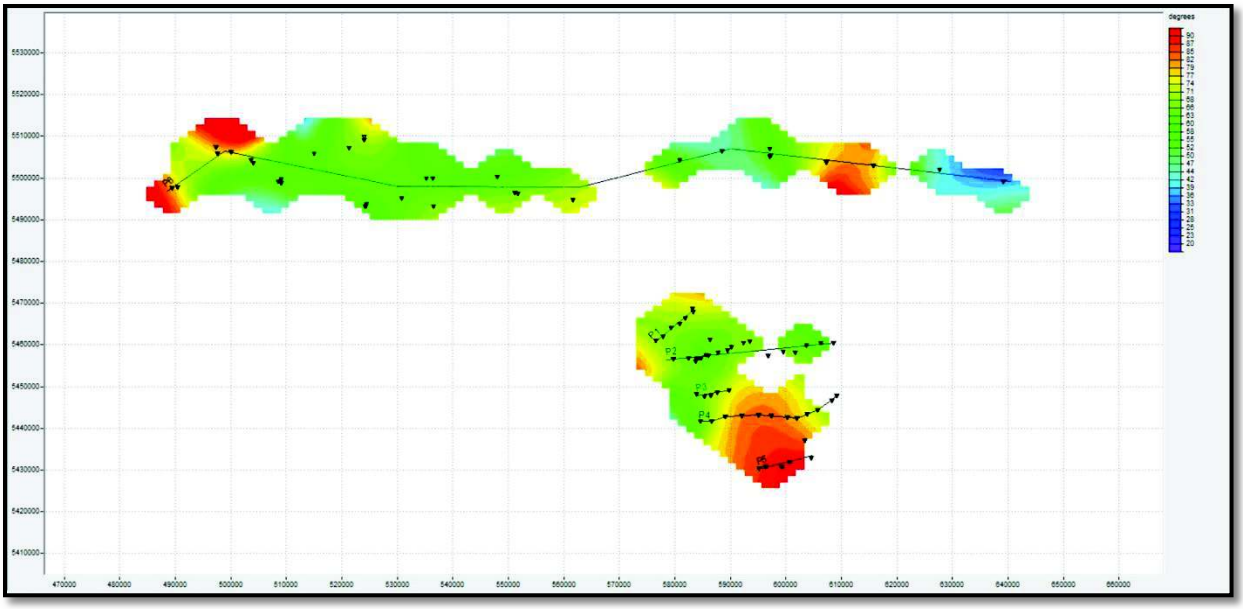


***Figure 48: Smoothed YX Phase at 0.3 Hz***

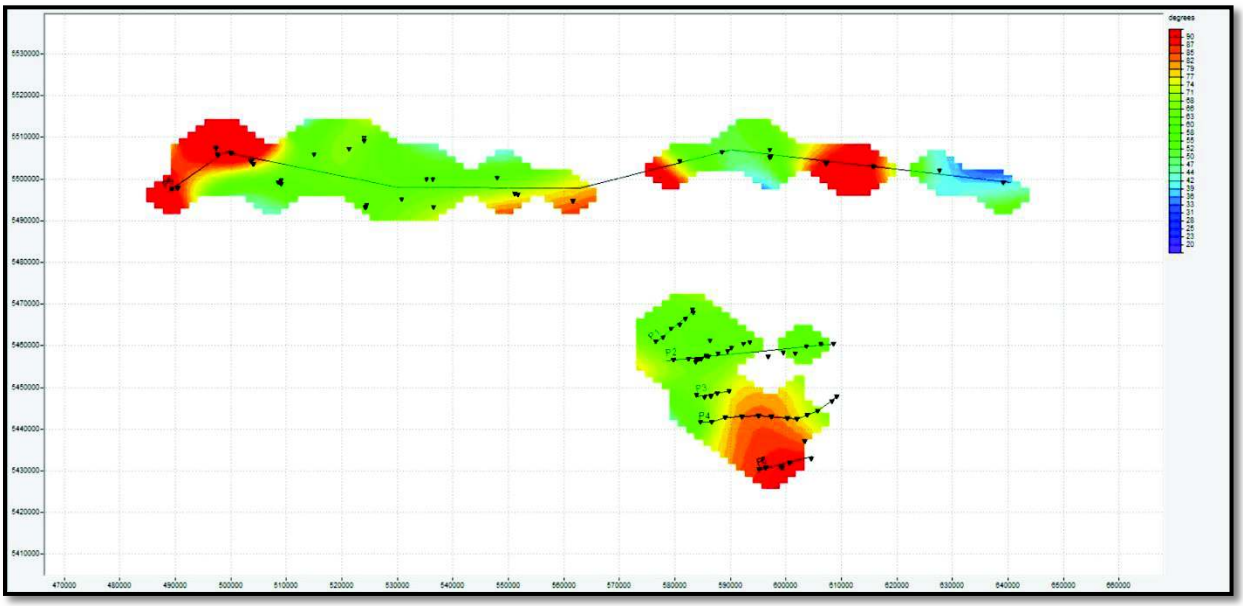


***Figure 49: Smoothed YX Phase at 0.1 Hz***

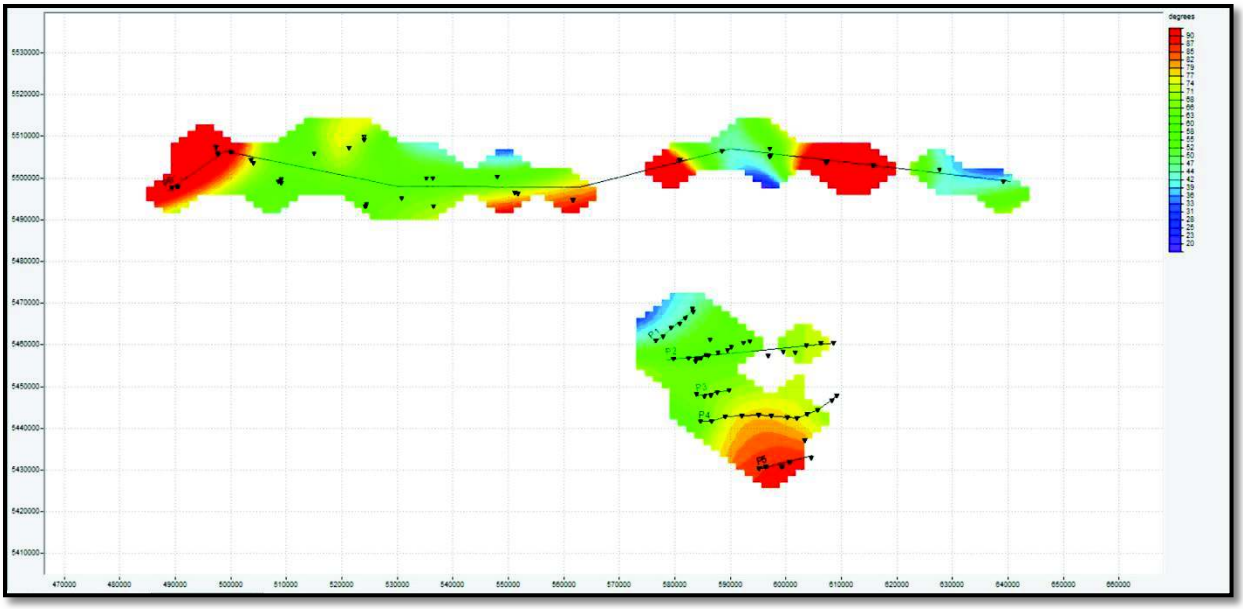


***Figure 50: Smoothed YX Phase at 0.03 Hz***

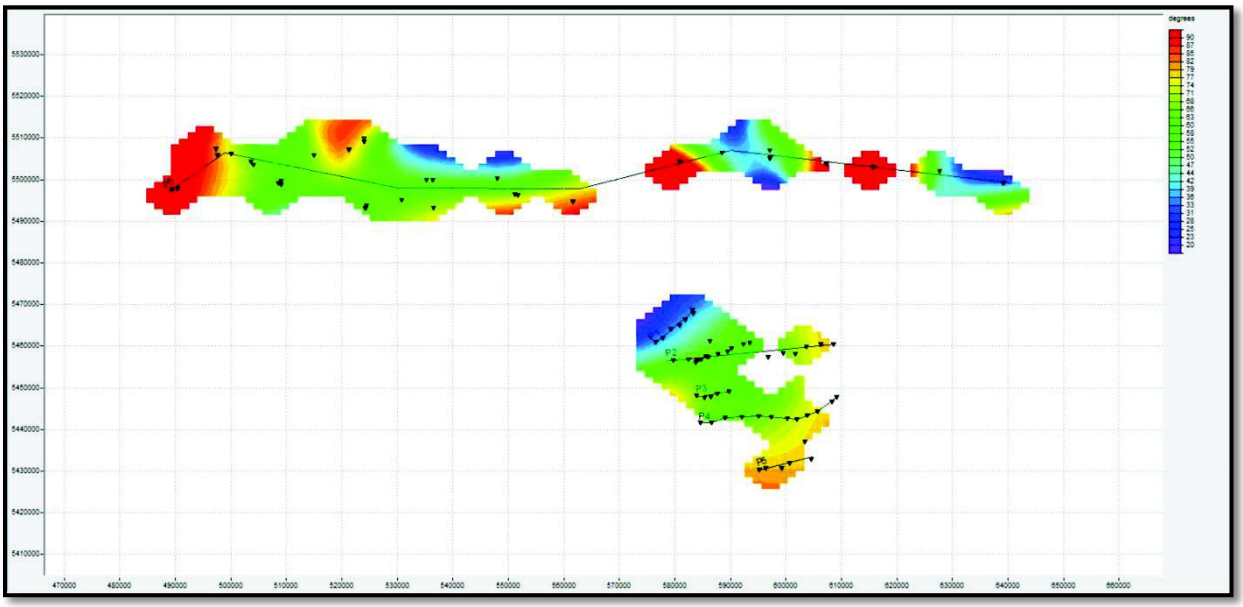


***Figure 51: Smoothed YX Phase at 0.01 Hz***

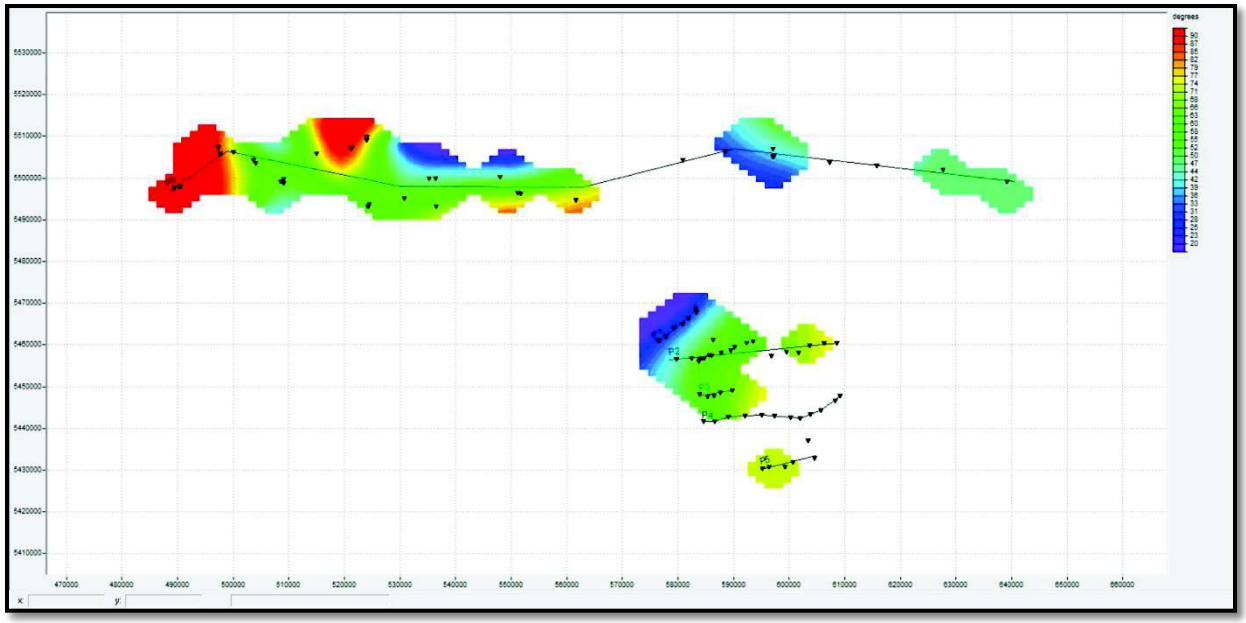


***Figure 52: Smoothed YX Phase at 0.003 Hz***

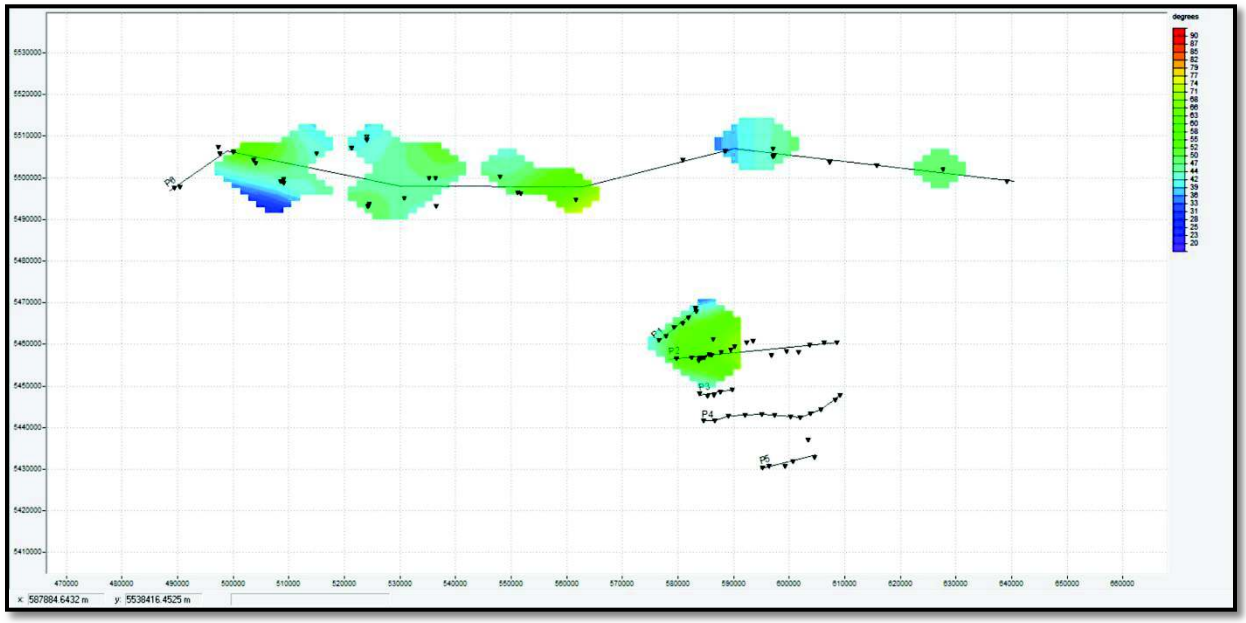


***Figure 53: Smoothed YX Phase at 0.001 Hz***