3D modelling of the Nechako Basin MT data set

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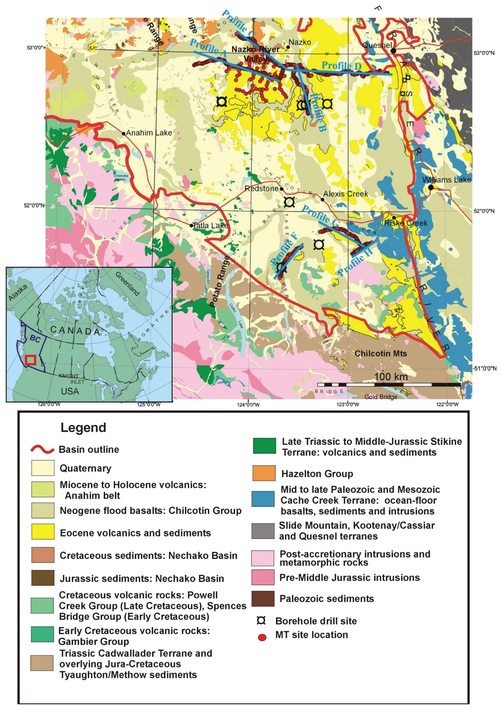
Introduction

The Nechako Basin is an intermontane basin covered in most part by glacial overburden and extrusive volcanics, namely flood basalt. Seismic imaging of the area is rendered difficult by the volcanic covering and so other methods have been required to image the subsurface. Originally these methods involved potential field measurements, however MT is useful because of the stark contrast in conductivity between the volcanic and sedimentary rock. This project examines the potential use for MT data modelling in hydrocarbon exploration through the development of an inversion model of the Nechako conductivity structure.

The Western Coast of Canada is a subduction zone characterized by episodes of compression. Orogeny along this margin has produced a series of mountain ranges and basin complexes. Sediment is characterized by accretion of successive island arcs, back arc basins, erosion during uplift, and glaciation.

Cretaceous sediment in the Nechako results from uplift in the East due to accretion in the West. The basalt covering was produced during volcanic episodes in the Eocene and Neogene during extensional tectonic periods.



Geological map of the Nechako Basin from Spratt & Craven 2008

Inversion Process

Inversion models are being developed with a number of different meshes and sets of frequencies.
Input mesh dimensions are:

50 X 50 X 50	75 X 75 X 75
62 X 62 X 62	87 X 87 X 87

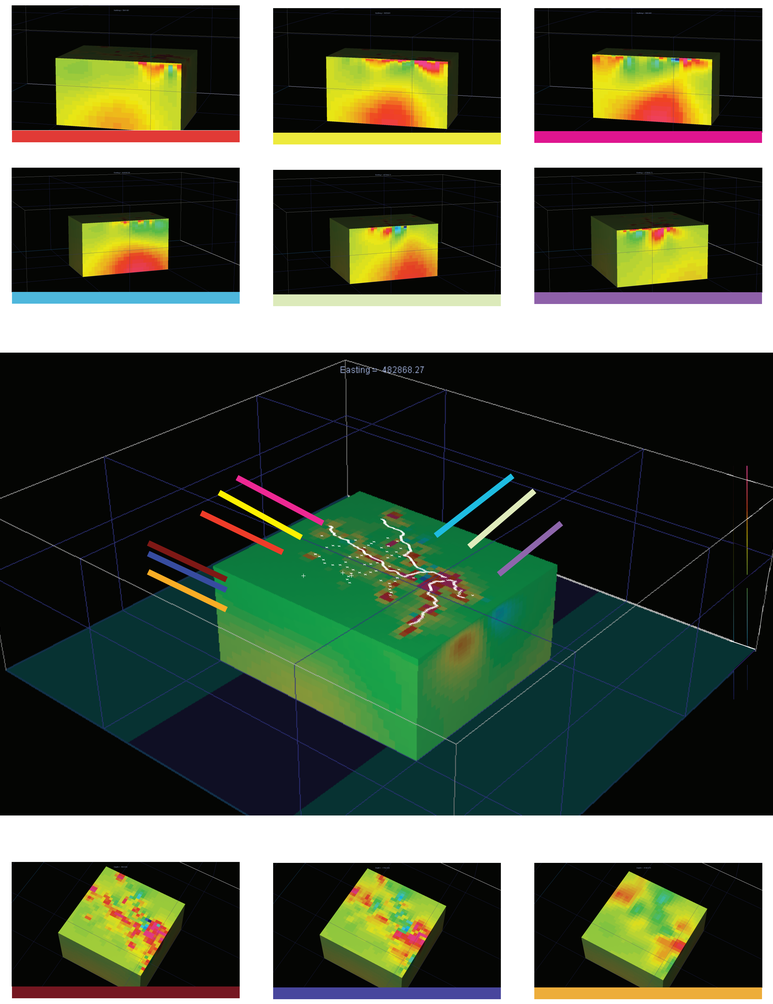
Input frequency sets are picked at logarithmic intervals in the measurement band:

- 8 frequencies in range [6.9e-04 , 6.0e+03]
- 16 frequencies in range [4.2e-04 , 7.2e+03]
- 34 frequencies in range [3.4e-04 , 8.8e+03]

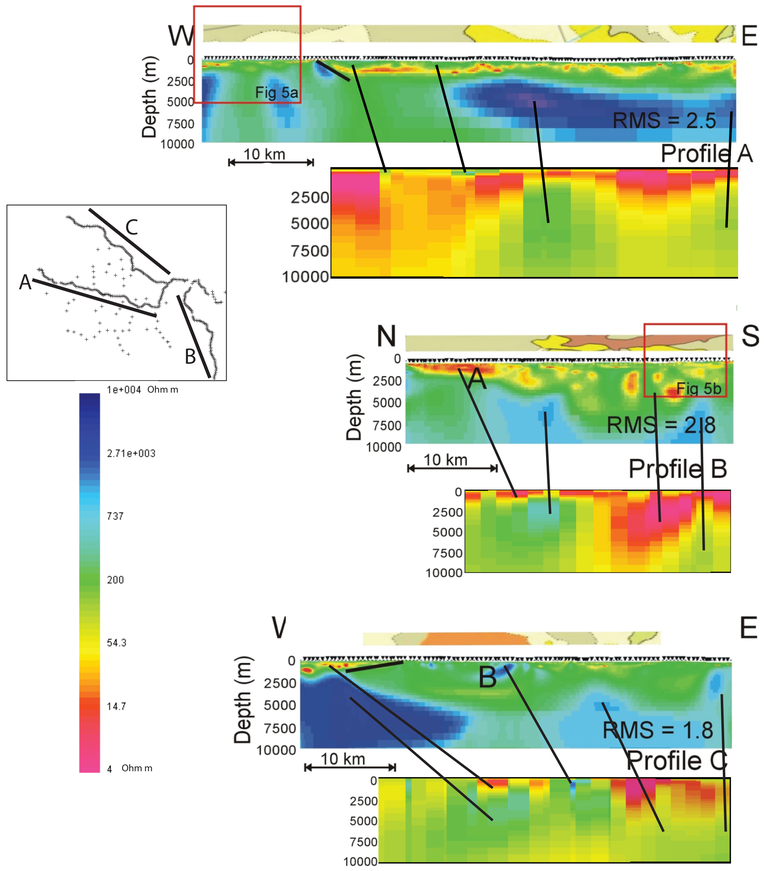
Each inversion scheme was also run twice due to uncertainty in the rotation from complex measurement axes to complex inversion modelling axes. One version of the rotation required a sign change, the other did not. These made for 24 instances of the mt3dinv inversion modeller running on parallel computation setups around Atlantic Canada, called ACEnet, and another at Memorial University called ROX.

One preliminary inversion model is presented here. The starting model was a homogeneous half space with initial resistivity 100 ohm m. Mesh dimensions are 50 X 50 X 50 with data from the 16 frequency range. The region of interest extends from 4.1e+05 to 4.75e+05 m East and 5.8275e+06 to 5.8875e+06 m North. Resolution is 2166.67 m in the East-West direction, 2000 m in the North-South direction, and 200 m in the vertical direction to a depth of 2400 m. Padding cells extend to the East and West of the block by 5.46e+04 m and to the North and South by 4.99e+04 m. The mesh also has 2.25e+04 m of air above ground level and below the 2400 m mark cell height grows by an exponential factor of 1.1.

3D Minimum Structure Inversion

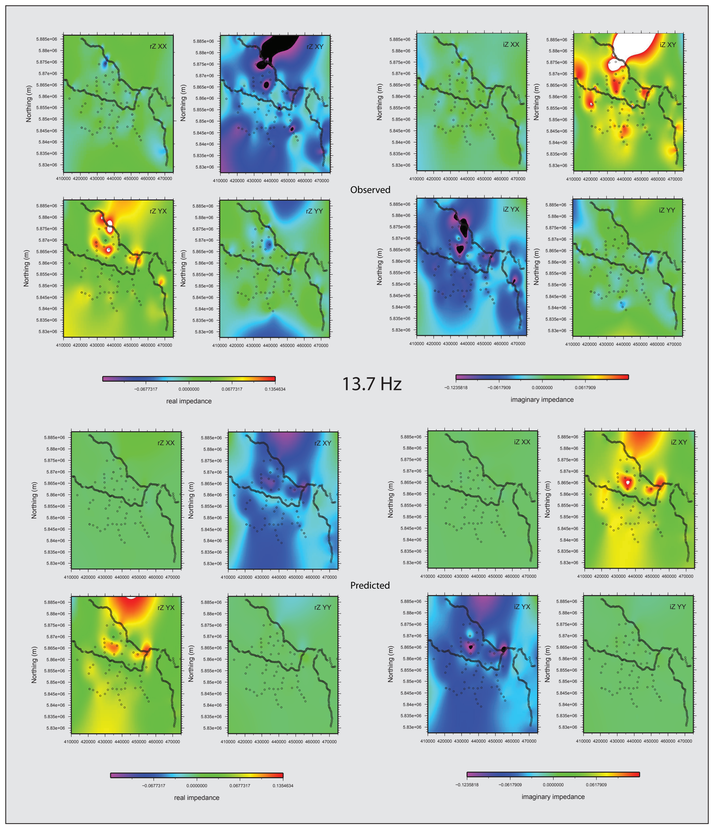


Comparison with 2D



*2D Sections from Spratt & Craven 2008

Observed and Predicted Impedances



References

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