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Regional 3D Inversion Modelling of Airborne Gravity, Magnetic, and Electromagnetic Data in British Columbia

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**Mineral Exploration Roundup
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Inversion models in context

Disclaimer: Geophysical inversions are non-unique.

Be aware of this and invert responsibly.

Logical (non-geologic) constraints are a good starting point and add value to the data.

Use prior information to further narrow down the range of suitable models.

Common Earth Models that honour all the data provide a clear, quantitative view of the subsurface.

Mining Regions of BC and Regional Geophysical Survey Coverage



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Objectives

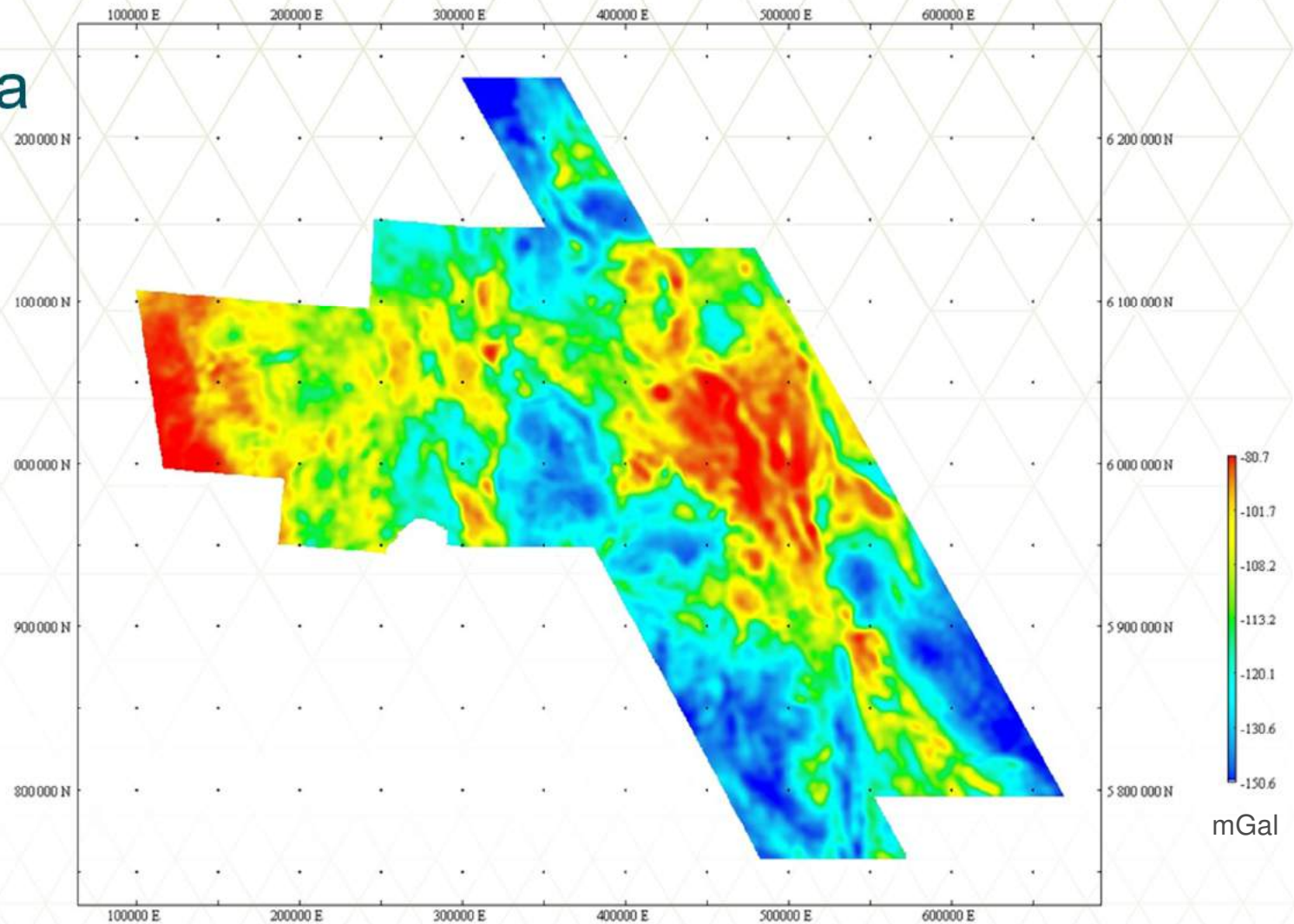
- Provide useful 3D physical property products
- For direct employment in regional exploration
- Provide guidance to the regional structure
- Help geologic mapping
- Help target prospective geology, alteration, or mineralization.
- Exploration criteria for different styles of mineralization can be applied based on multiple physical properties.
- Guide detailed follow-up survey design

Summary of data

- Sanders airborne gravity
- GSC gravity compilation
- (Geotech magnetic)
- Aeroquest magnetic
- GSC magnetic compilation
- (Geotech VTEM data)
- Aeroquest AeroTEM data

Gravity Data

Terrain Corrected
Bouguer Anomaly
(2.67 g/cm^3)



Airborne acquisition by Sander Geophysics
East-West lines with 2000m line spacing

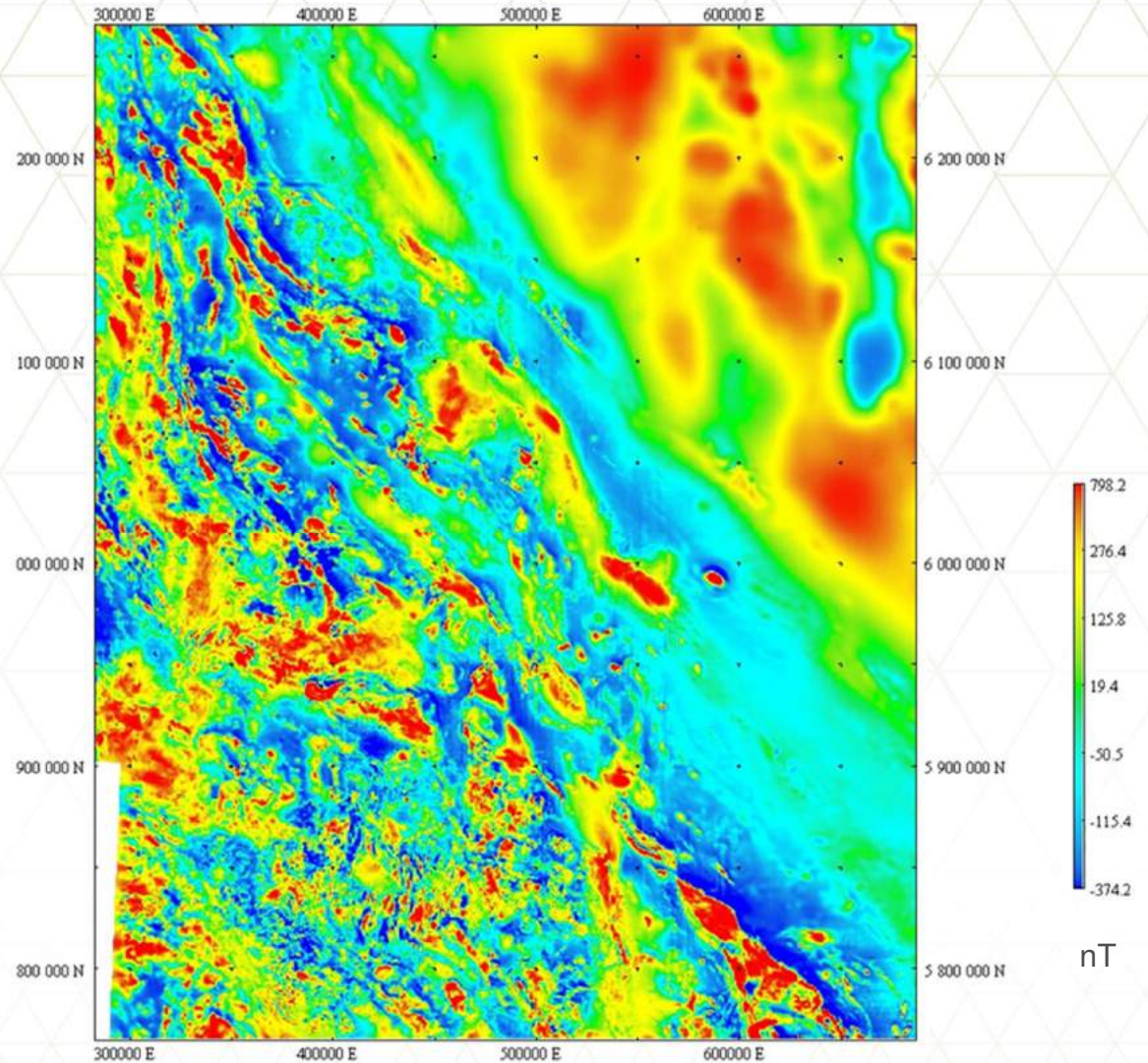
Regional GSC data also used for regional signal



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Magnetic Data

Total Magnetic Intensity



Airborne acquisition by Geotech and Aeroquest
East-West lines with 4000m line spacing

Regional GSC data also used for regional signal

Summary of Models

Four large survey areas and 6 small infill areas:
Bell, Endako, Equity, Huckleberry, Granisle, and Morrison.

Potential Fields:

- 3D Density Contrast Model (UBC-GIF Grav3D)

- 3D Magnetic Susceptibility model (UBC-GIF Mag3D)

- 500m x 500m x 250m cells

- Tiled inversions (full compilation = ~100 million cells)

Airborne EM

- Late time conductivity map

- 3D (interpolated) conductivity model (UBC EM1DTM)

- Depth of system penetration estimate

- Conductive Plates (EMIT Maxwell)

GIS compilation in Gocad



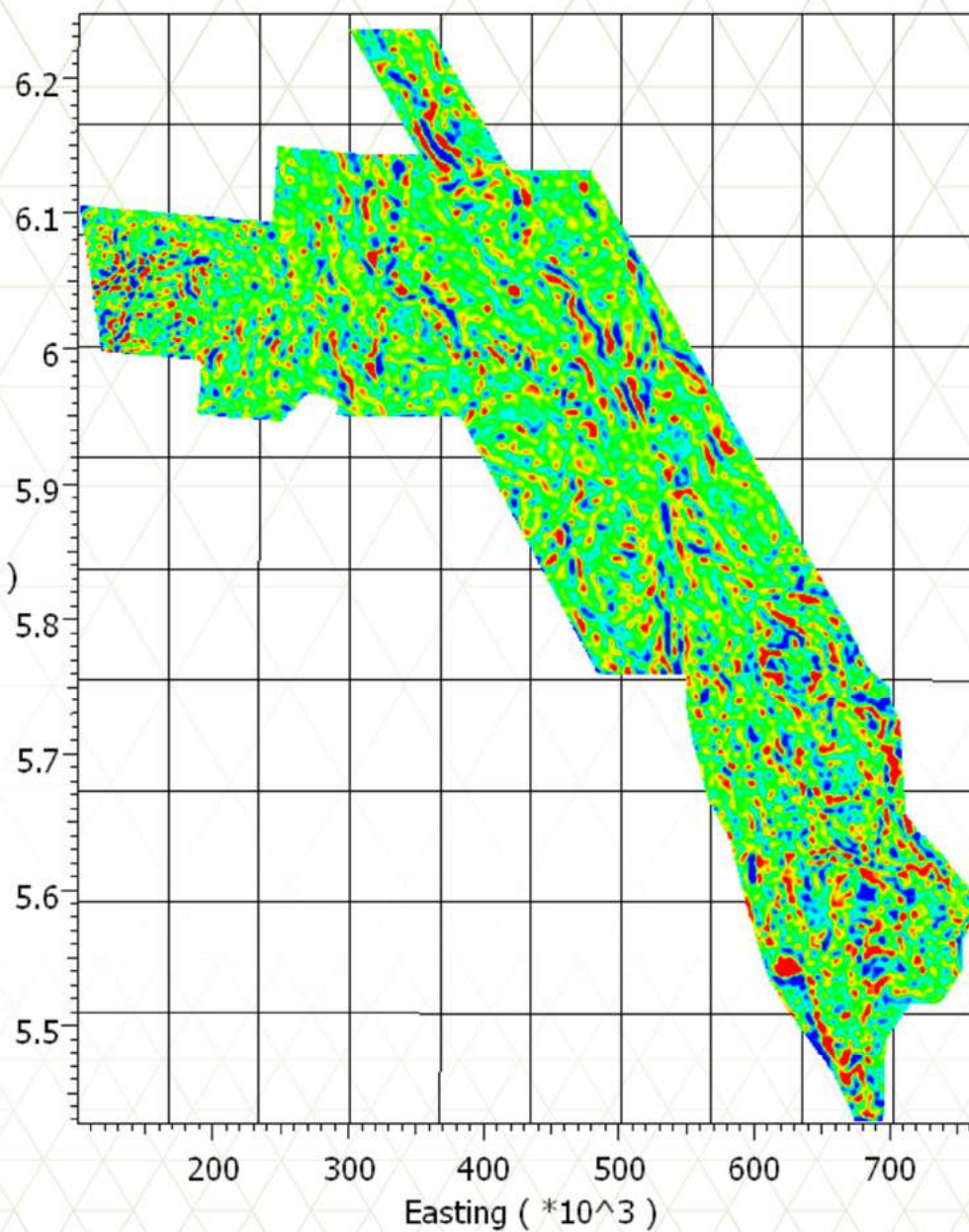
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Density
Contrast
Model

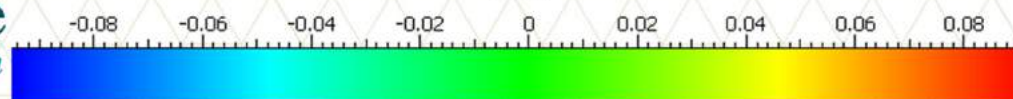
g/cm^3

0m elev.

Northing ($\times 10^6$)



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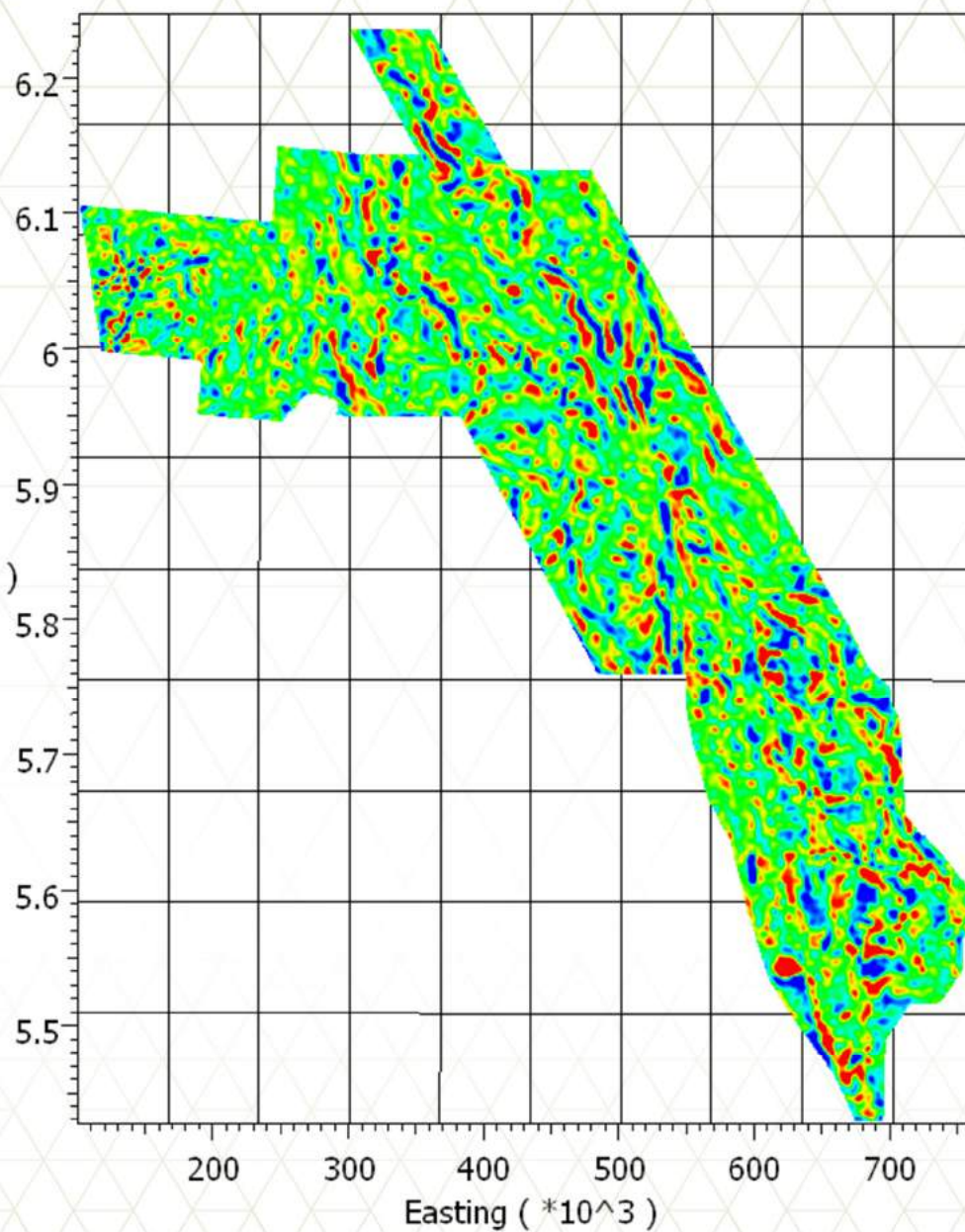


Density
Contrast
Model

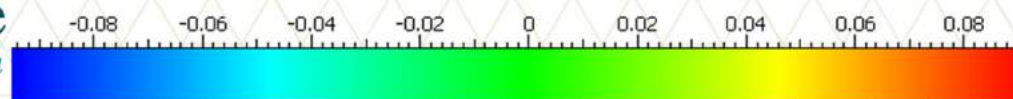
g/cm^3

-2000m elev.

Northing ($\times 10^6$)



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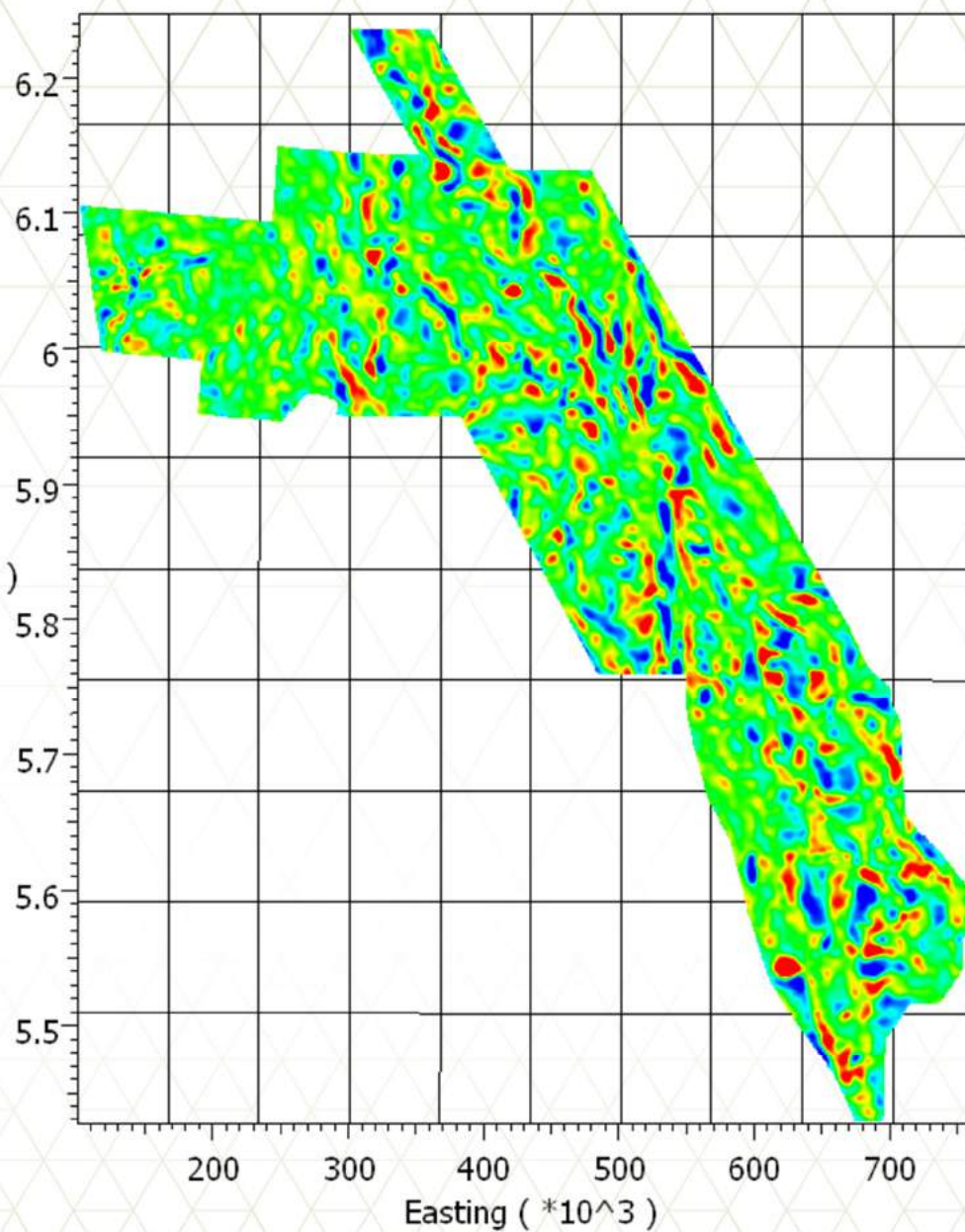


Density
Contrast
Model

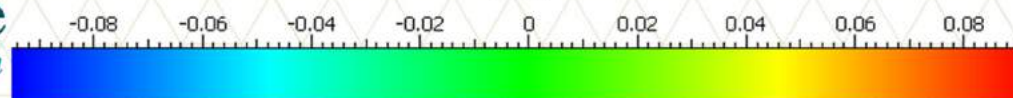
g/cm^3

-4000m elev.

Northing ($\cdot 10^6$)



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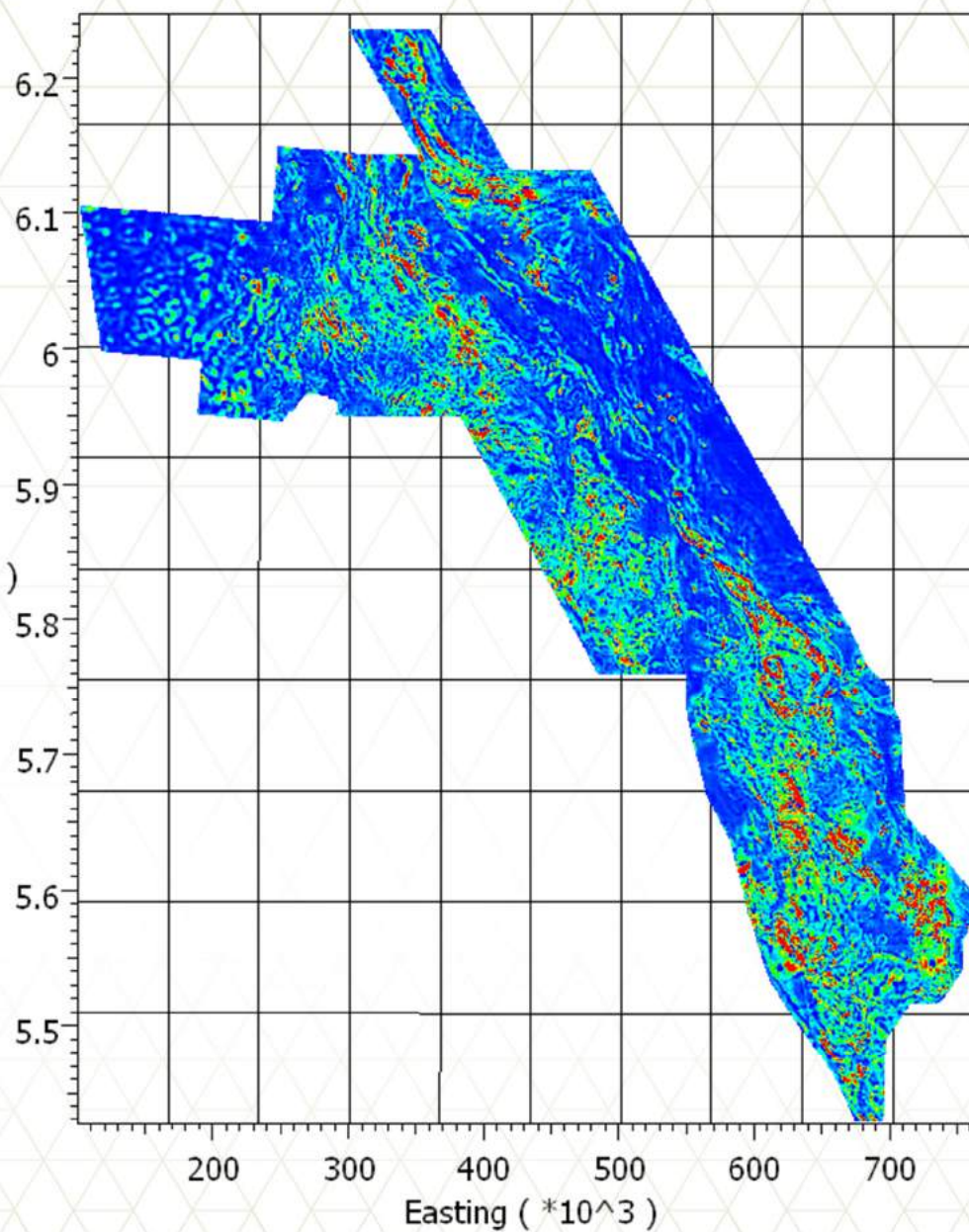


Magnetic
Susceptibility
Model

S.I.

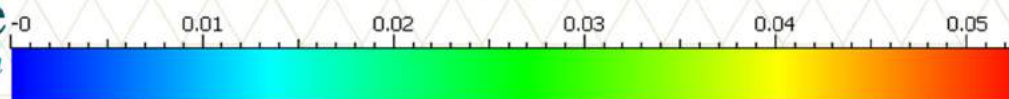
0m elev.

Northing ($\times 10^6$)



Easting ($\times 10^3$)

Susceptibility



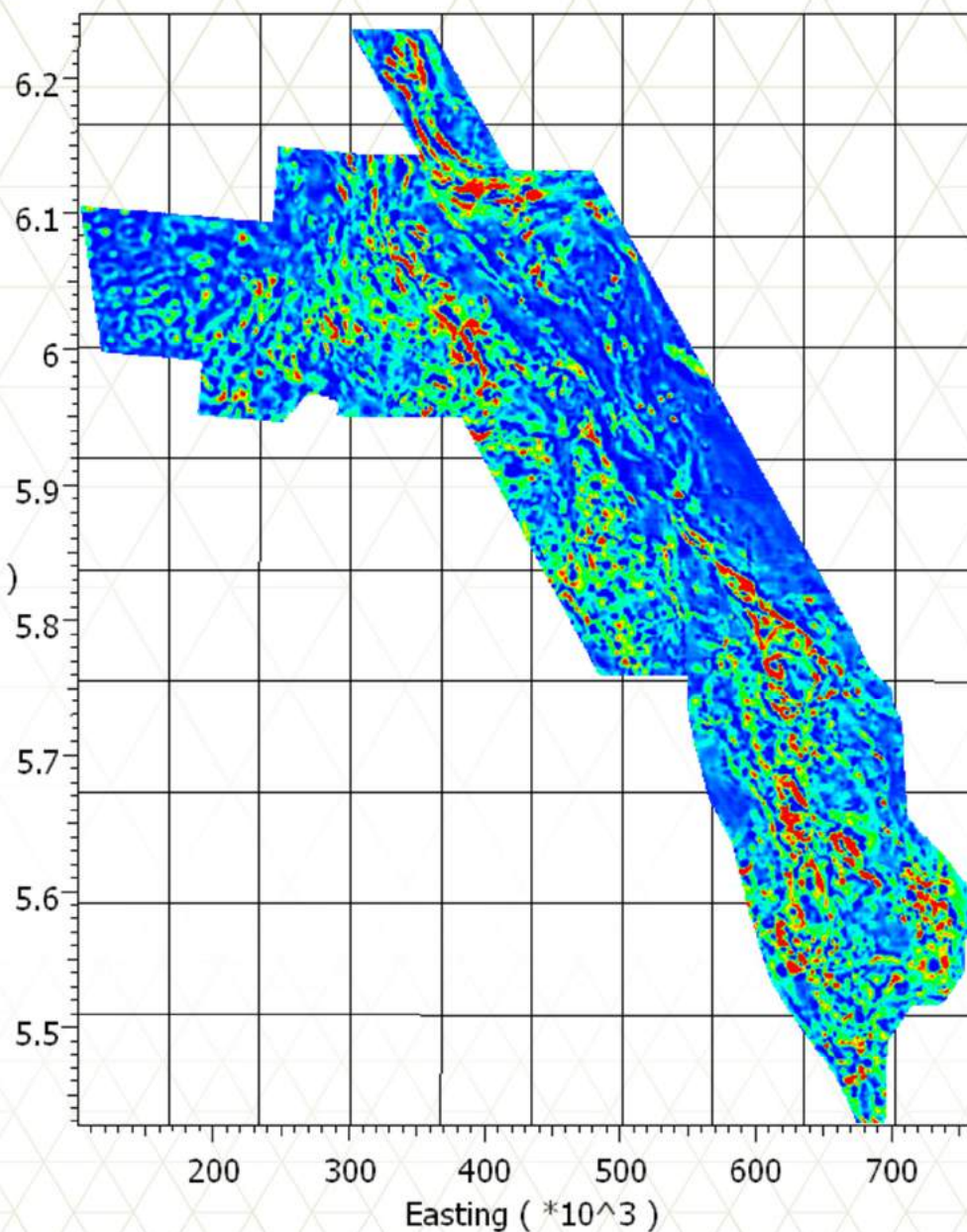
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Magnetic Susceptibility Model

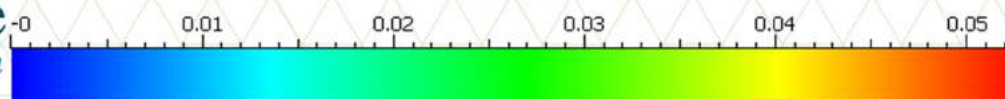
S.I.

-2000m elev.

Northing ($\times 10^6$)



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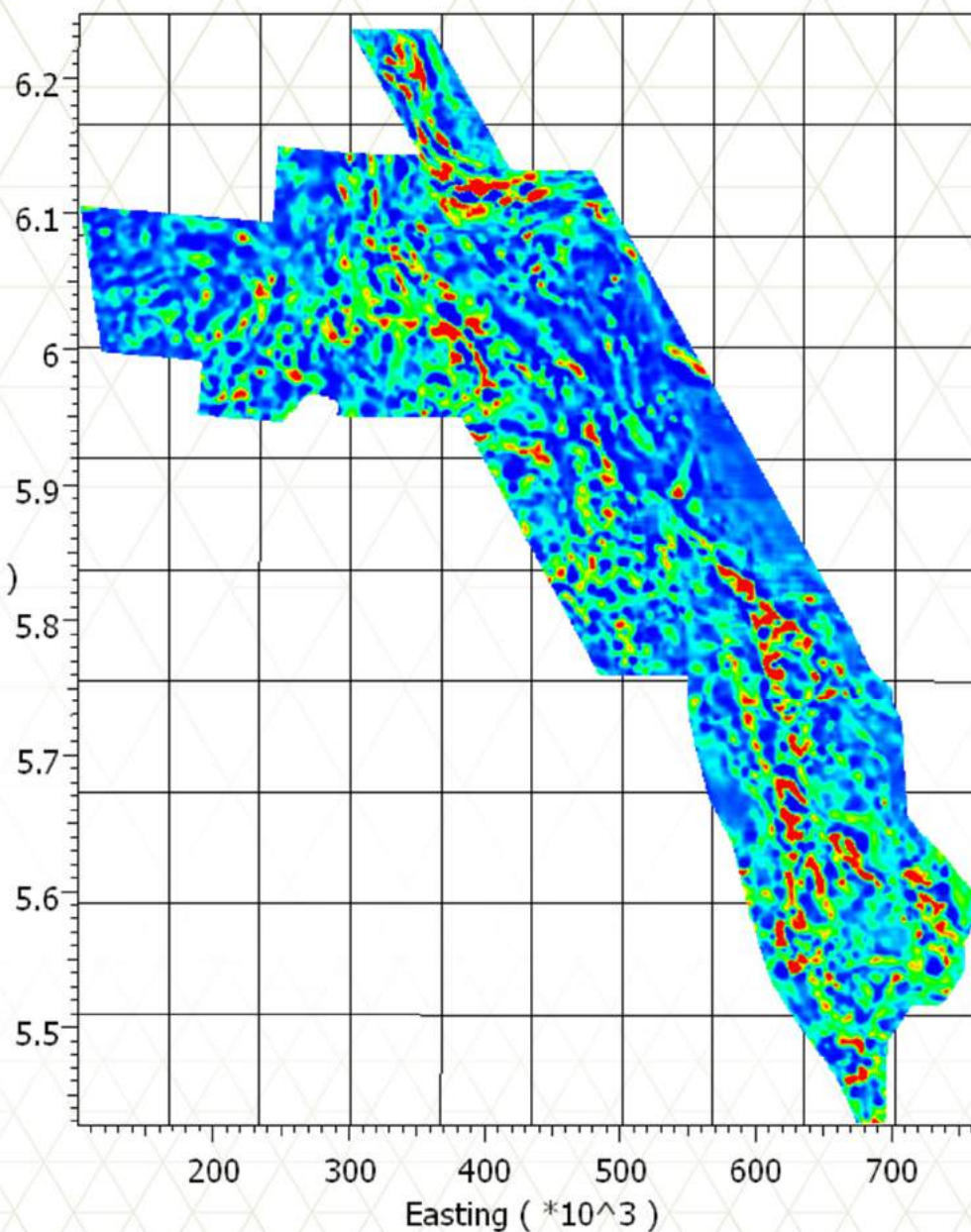


Magnetic Susceptibility Model

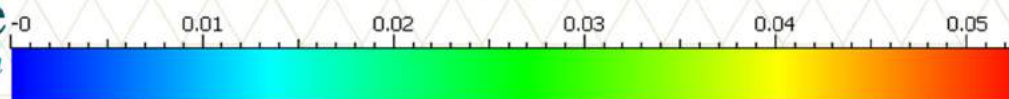
S.I.

-4000m elev.

Northing ($\times 10^6$)



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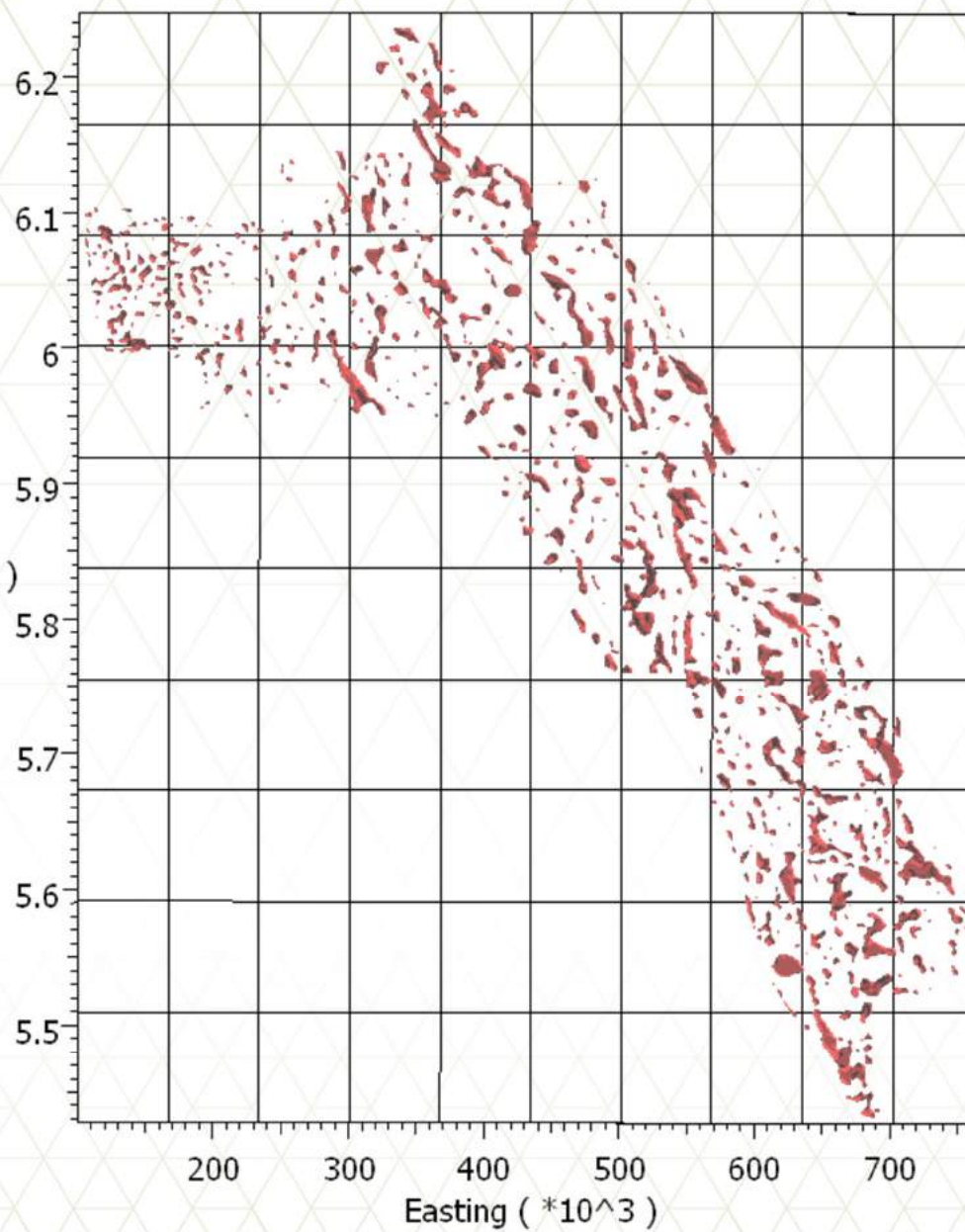


Density Contrast

3D isosurface

cut-off 0.05 g/cc

Northing ($\times 10^6$)



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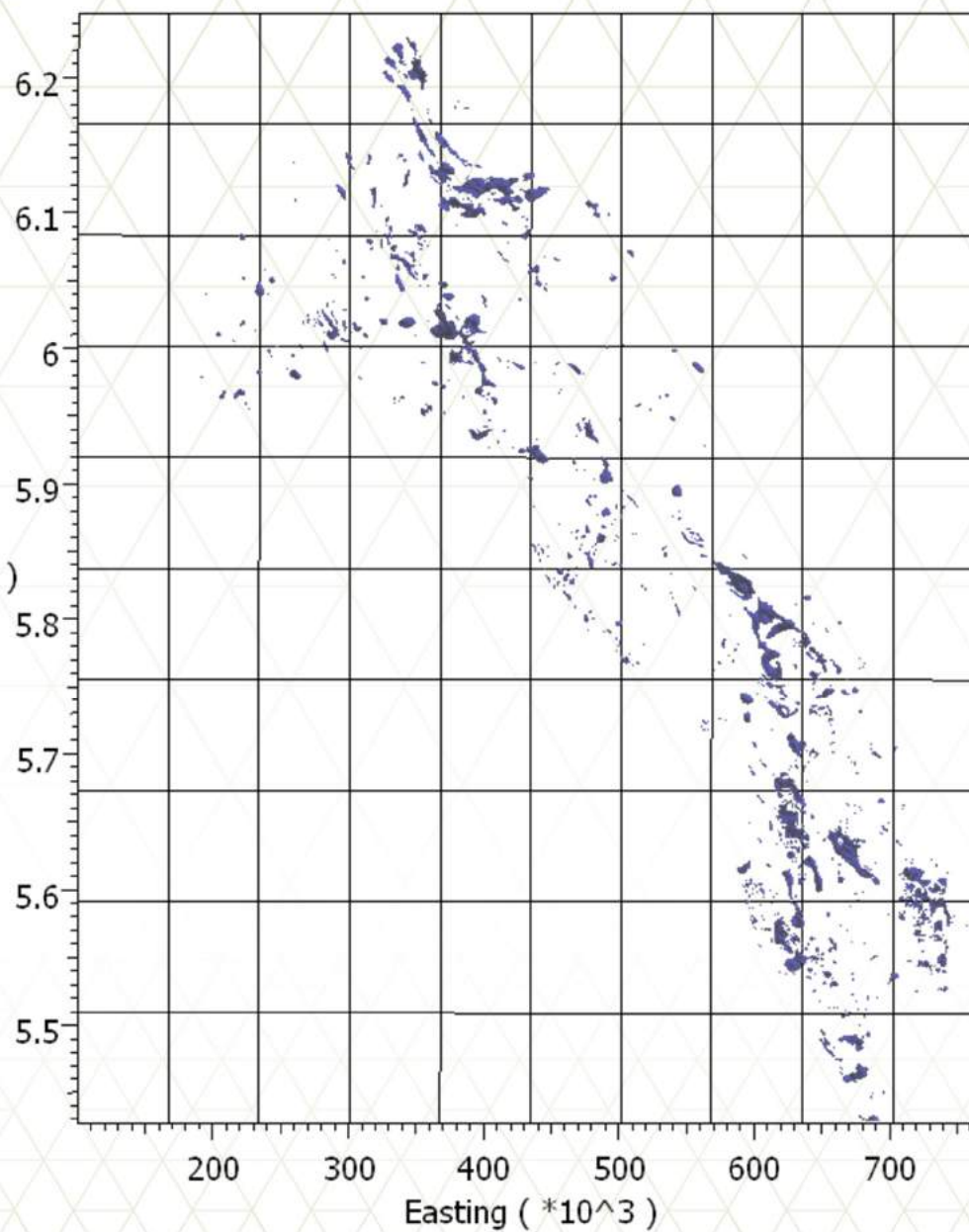


Magnetic susceptibility

3D isosurface

cut-off 0.05 S.I.

Northing ($\times 10^6$)

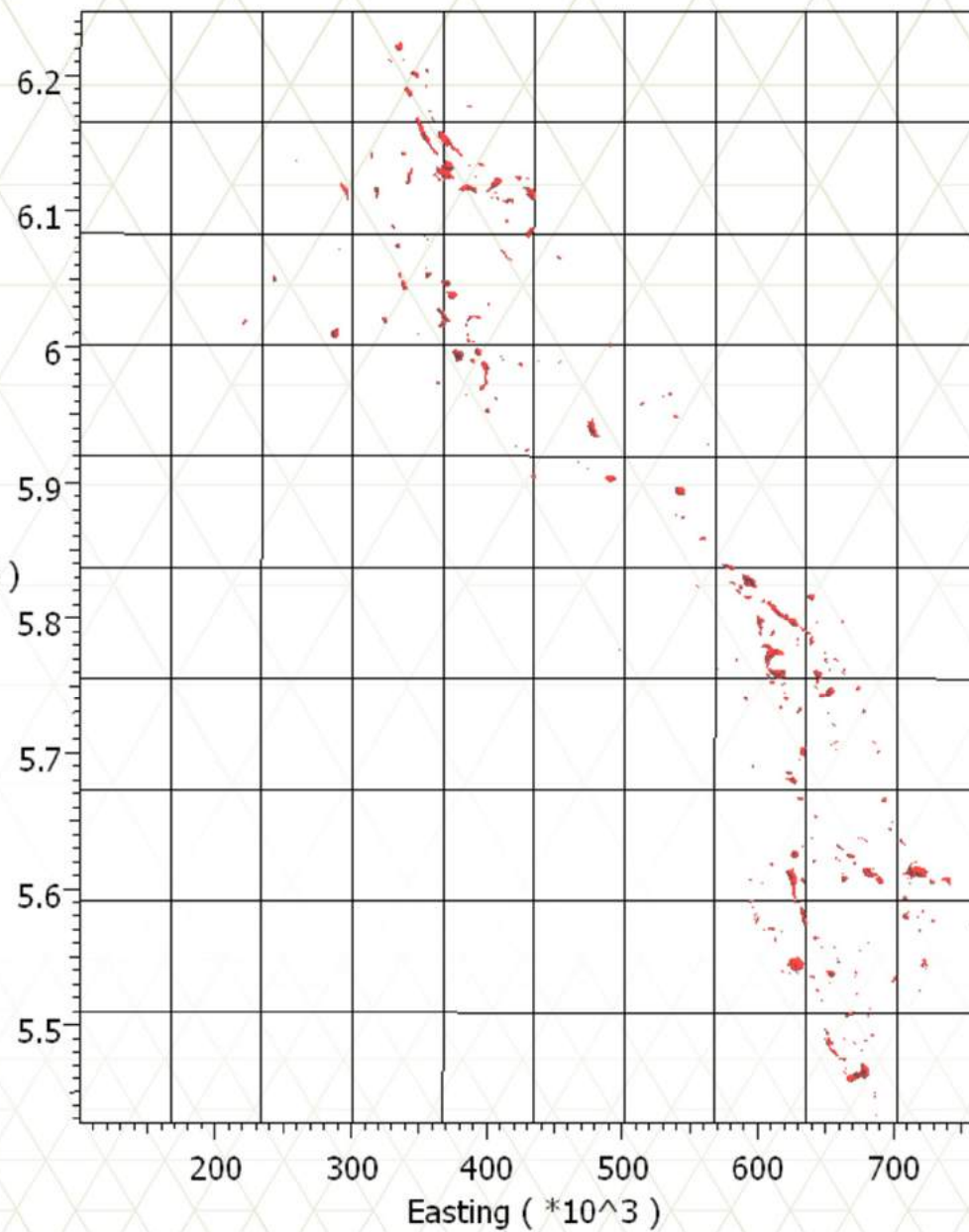


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Prospective regions of
High density contrast
and high magnetic
susceptibility.

Northing ($\times 10^6$)



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Airborne EM Modelling

1D Inversions

Inversion for a smoothly varying heterogeneous 1D conductivity distribution

Laterally Constrained → Inversion parameters are tuned to the changing geology

Background/Late-Time Conductivity

Depth of Investigation based on cumulative conductance

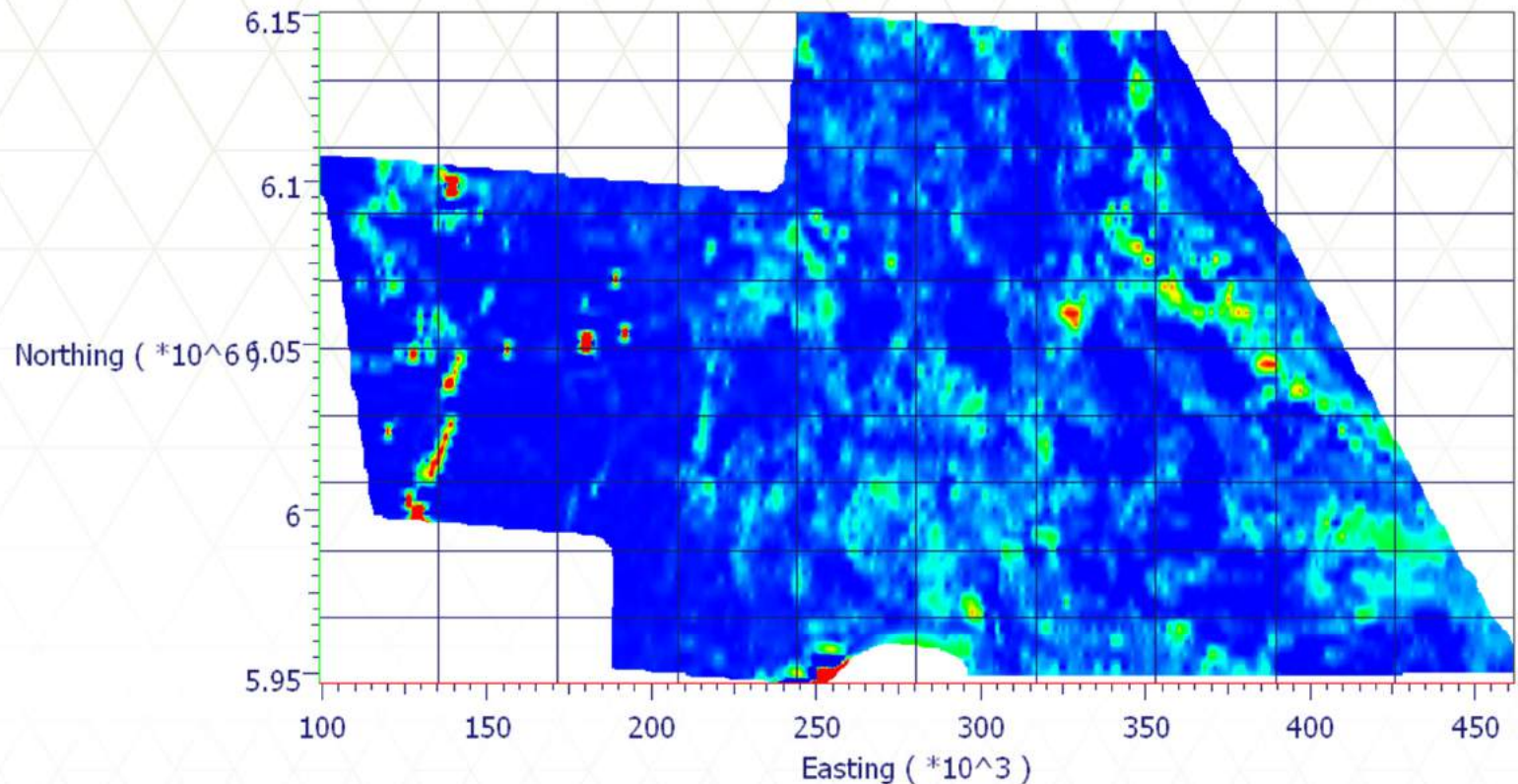
Plate Modelling

Alternative to the 1D interpretation for use when the layered earth assumption is inadequate.



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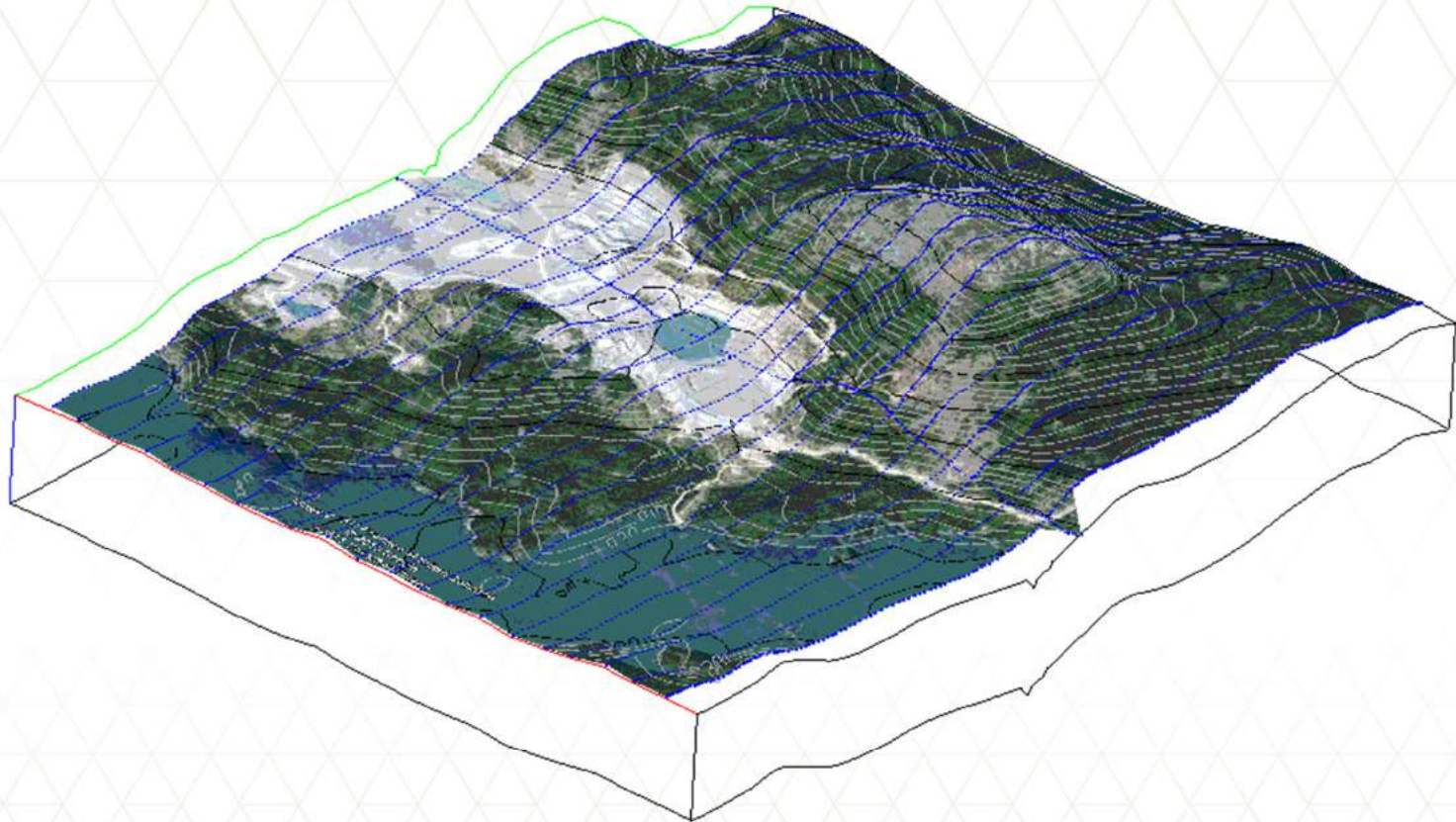
AeroTEM modelling: Late-time Background Conductivity (Quest West)



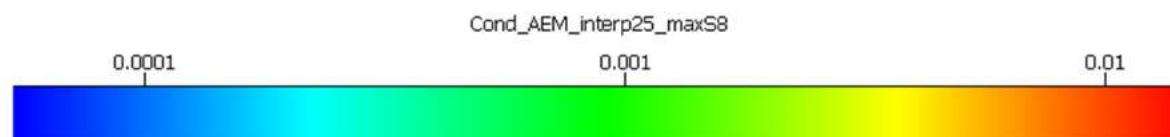
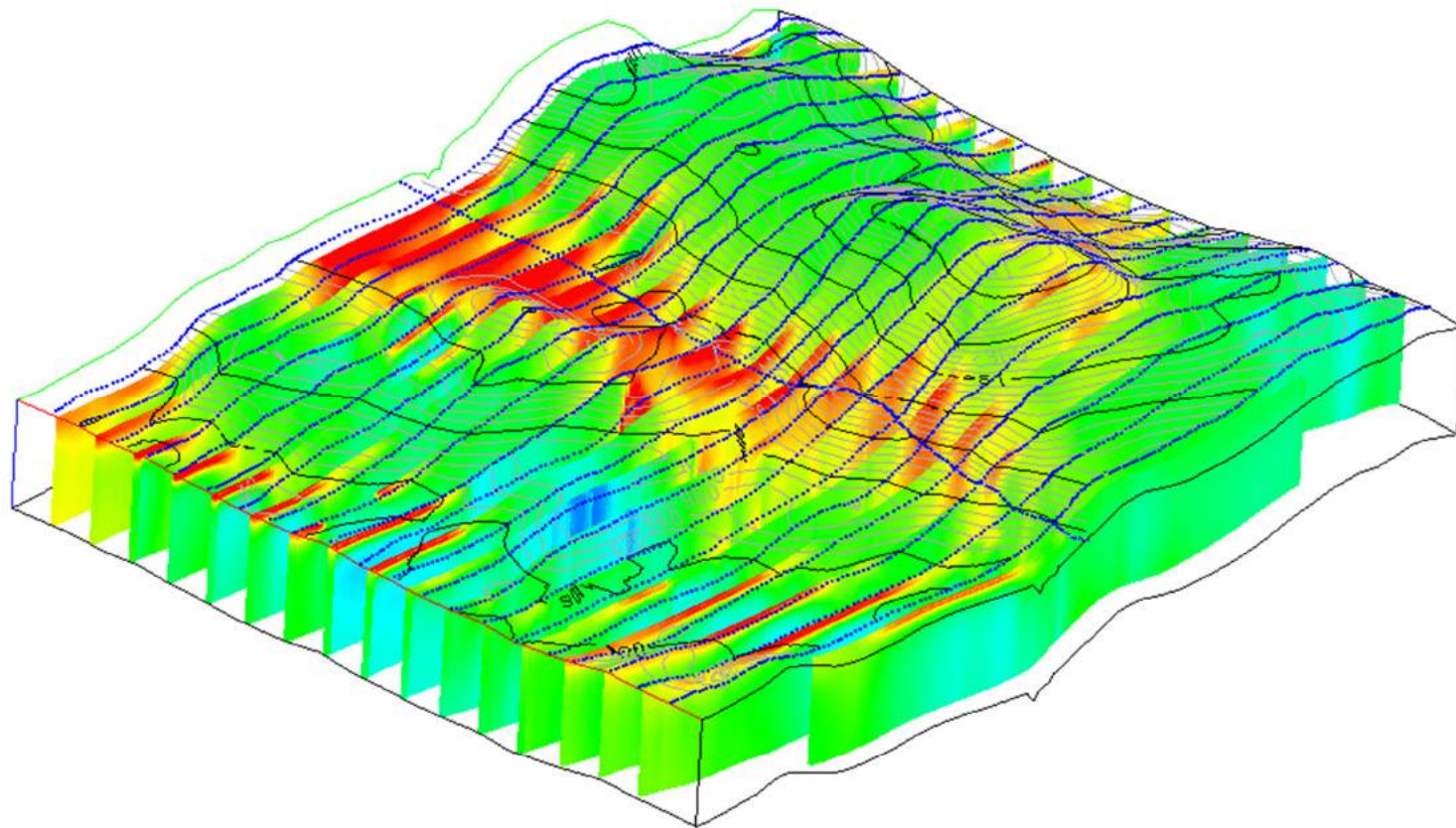
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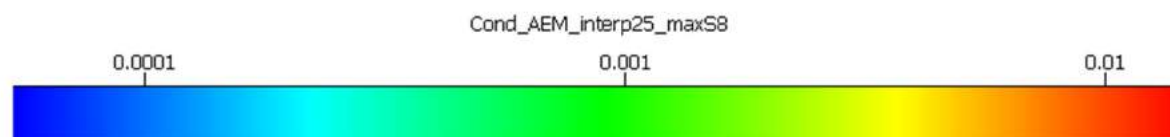
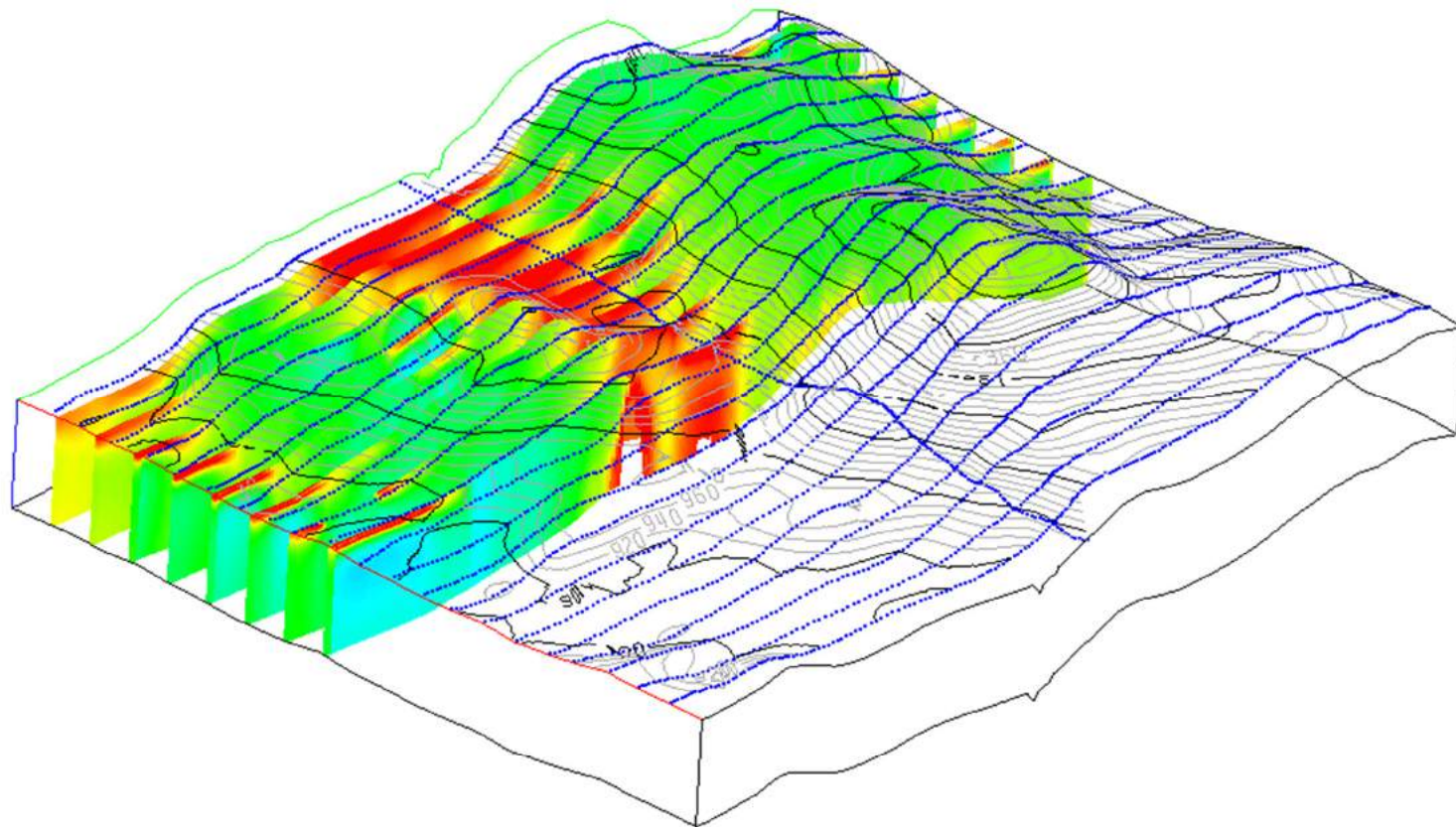
AeroTEM modelling: Huckleberry Mine Infill Area



AeroTEM modelling: Huckleberry Infill Area Conductivity Model

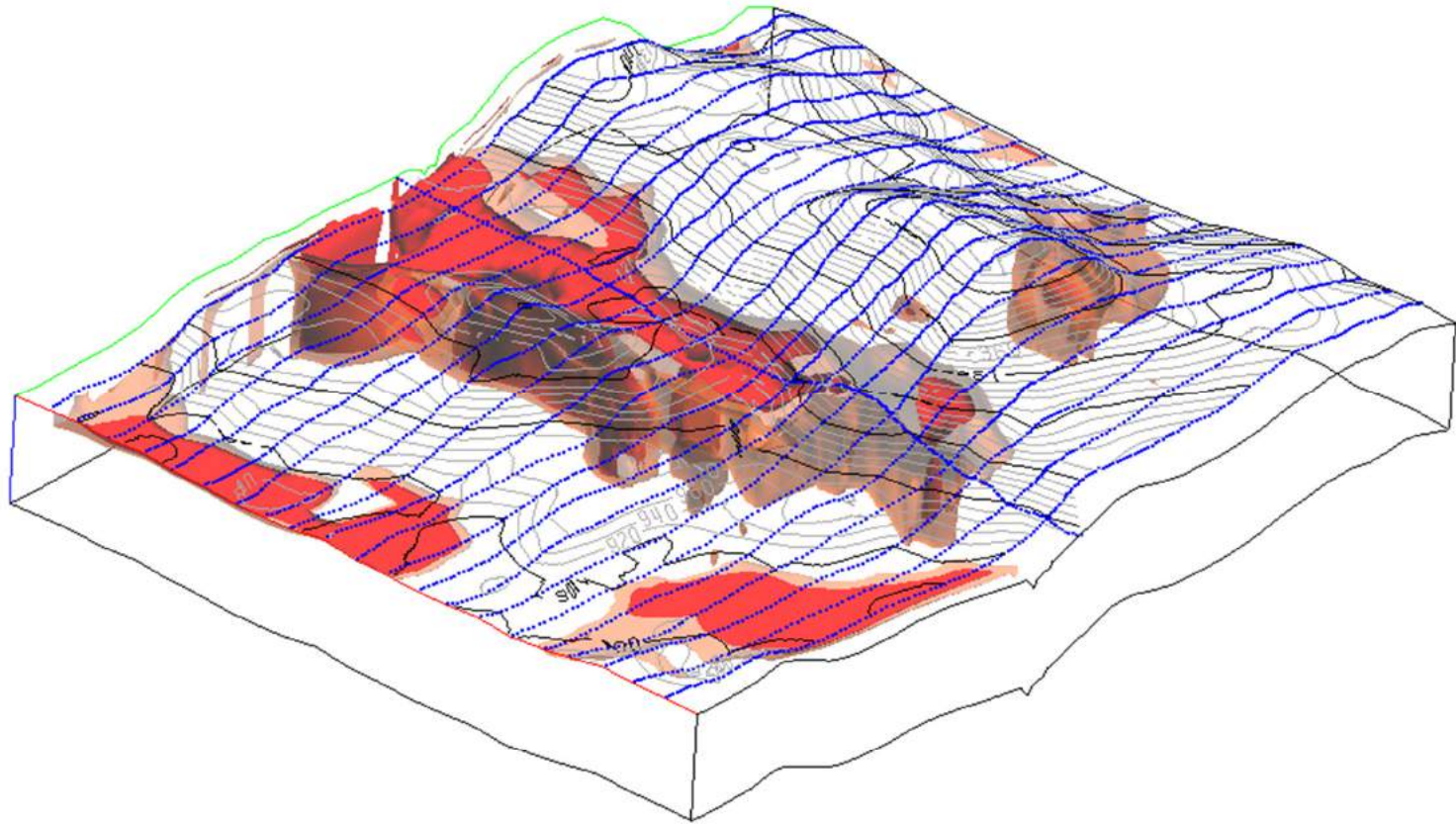


AeroTEM modelling: Huckleberry Infill Area Conductivity Model



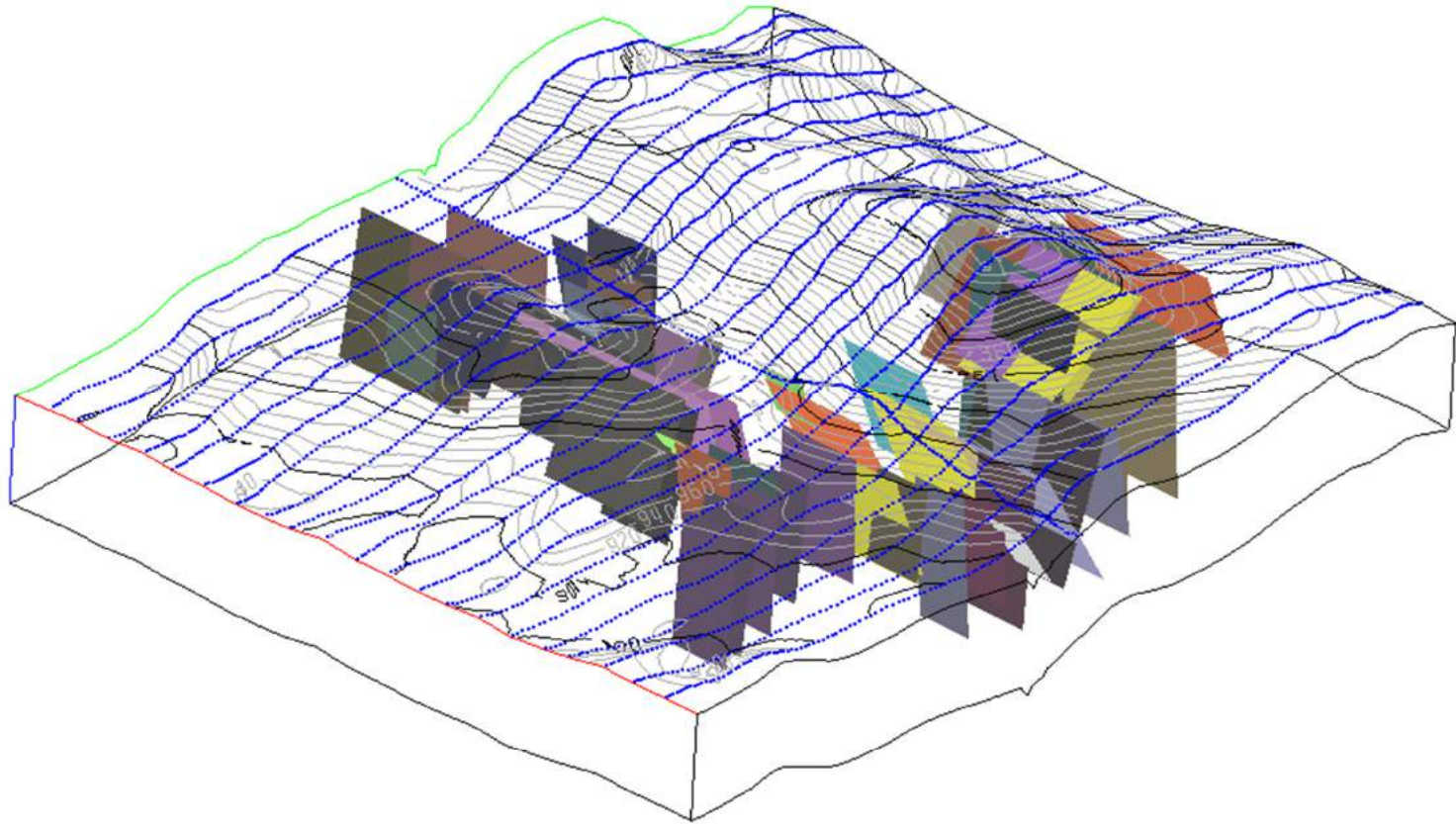
AeroTEM modelling: Huckleberry Infill Area

Conductivity Model - isosurfaces



AeroTEM modelling: Huckleberry Infill Area

Conductivity Model - plates



Summary

3D density contrast, magnetic susceptibility, and conductivity models have been produced.

The models provide more useful information than the data alone.

While being aware of the limitations, the models can be used to promote detailed follow-up through 3D-GIS targeting analysis.

The infill areas provide examples of what information can be extracted from these data.

Introduce new information as it is acquired to test the validation of these models, and to help improve upon them.

...to be released by Geoscience BC very shortly.

Acknowledgements

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