Airborne Gravity Data

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EOSC 556B Final presentation on Virgin River
Outline

• Geology outline of the Virgin River area
• Introduction to the FALCON gravity system
• Data processing
• Virgin River survey
• Inversion results
• Discussion
Regional geology

Athabasca group
LZ – Lazenby Lake formation (LZs, LZc, LZh)
MF – Manutou Falls formation (MFd, MFd-m, MFc, MFw, MFb)
S – Smart formation

Archean rocks
Ra – felsic plutonic gneiss unit
Rgn – Granodiorite gneiss
Z – Mylonitic gneiss
Mv – Metavolcanics
Mf – Felsic plutonic gneisses

AREA UNDER STUDY
Sentential deposit

Dufferin Lake Fault
Virgin River geology
Key geologic features for inversions

- Unconformity between Athabasca sandstone and basement
- Faults
- Graphitic zones in basement
- Alteration in sandstone
FALCON® Airborne Gravity Gradiometer

- Measures gravity gradient signal
- Unit flown in an airplane or helicopter

Fixed wing FALCON system

Collects gravity, magnetic, DEM and radiometric data on the same lines
Airborne Gravity data processing

• There different methods:
  1. Spatial domain method
  2. Fourier domain method
  3. Equivalent Source method

• Terrain correction
• Transform to traditional gravity components
Virgin River regional gravity

Sits on a edge of:
- Gravity high to the West
- Gravity low to the East
Virgin River
Gravity survey parameters

The Virgin River data
• Flown in fall 2005
• By Sanders Geophysics Ltd
• 159 lines, 2462 line km
• 500m (250m) line spacing
• Line orientation 300°
• Area 70 by 16.5 km

Data for the inversion project
• Portion of the original data set
  ~575 line km (46 lines) of data with ~83700 points
Inversion data

• Equivalent source vertical gravity gradient with 2.4g/cm$^3$ terrain correction

• Equivalent source vertical gravity with 2.4g/cm$^3$ terrain correction

• 10 times down sampling on the data - ~ 8372 points
Error assignment

- Error filtering occurs during processing
- A constant error selected for all data
- Used L-curve to aid with the selection
Mesh design

Mesh discretization
• 150 x 180 x 69 cells
• Total number 1,863,000
• Smallest cell 150x150x150m
• Total area of 60x65x30 km
Equivalent source
Vertical gravity data

- A high to low trend from NW to SE
- A high/low gravity linear contact
Fourier and Equivalent processing

Vertical gravity data

Fourier processed data
8372 data

Equivilant Source processed Data
Inversion results

Fourier vs. Equivalent Source

Equivalent source data

Fourier domain data
3D vertical gravity model

- Depth slice at ~ 600m below the surface
- A contact between basement units
- Correlation between the Dufferin fault and density high ridge
3D vertical gravity model

- Cross section, looking along the Dufferin fault
- A contact between basement units
- Higher density to the West with a near vertical contact with lower density towards the East
3D vertical gravity model

Vertical Gravity

Vertical Gravity Gradient
3D vertical gravity gradient model

Vertical gravity

Vertical gravity gradient
Discussion

• Good correlation between inversions of vertical gravity gradient and vertical gravity
• Boundaries of density contrast matches with known fault boundaries
• Virgin River deposit sits in a smaller scale gravity low in larger scale gravity high