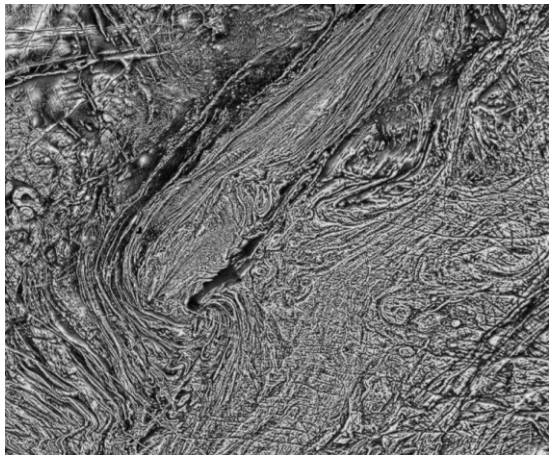
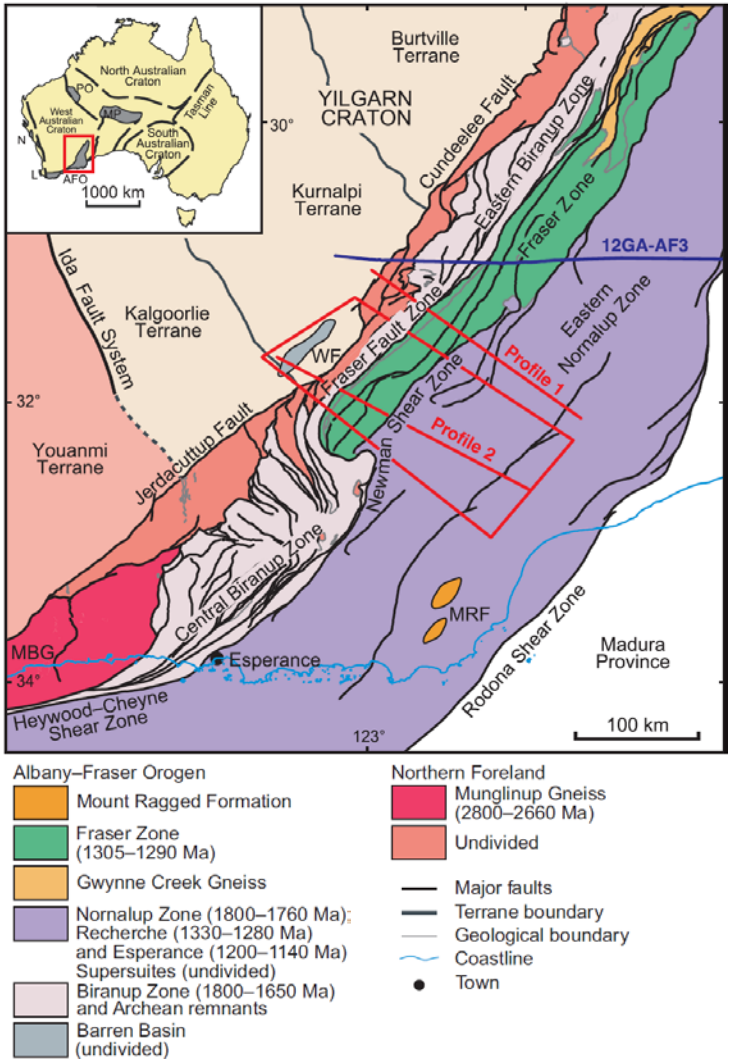
Integrating outcrop, aeromagnetic and gravity data: models of the east Albany–Fraser Orogen



By L Brisbout, CV Spaggiari and ARA Aitken

Introduction

- Interpret crustal architecture from outcrop, aeromagnetic and gravity data
- Architecture described in:
  1. Structural interpretation (map view)
  2. Forward modelling (section view)
- This architecture provides an interpretation along-strike of seismic line 12GA-AF3



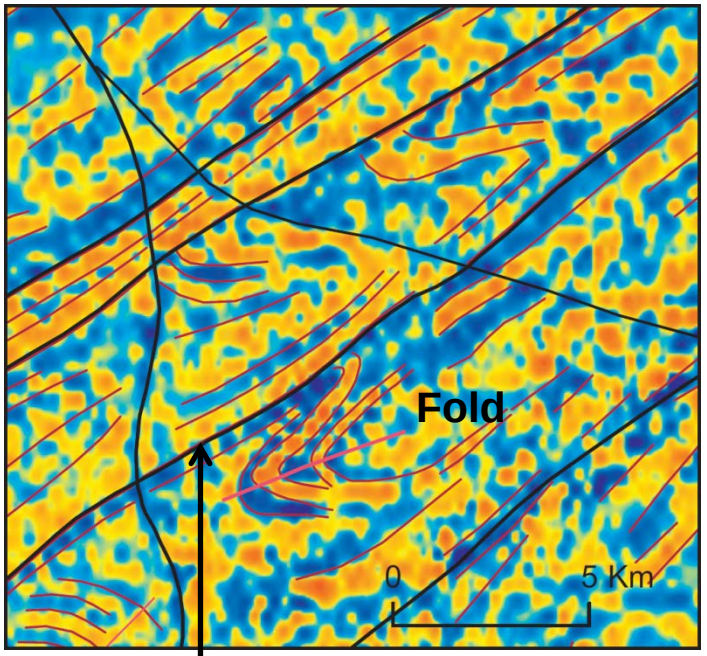
Datasets used for map and modelling

- Geological Data
  1. 1:250 K and 1:100K mapsheets
  2. WAROX database
  3. GSWA geochronology
- Geophysical Data
  1. 50 – 400 m line-spacing aeromagnetic data
  2. 2.5 to ~ 5 km grid gravity data
  3. Geophysical datasets has been enhanced by the application of various filters

Method – Structural interpretation

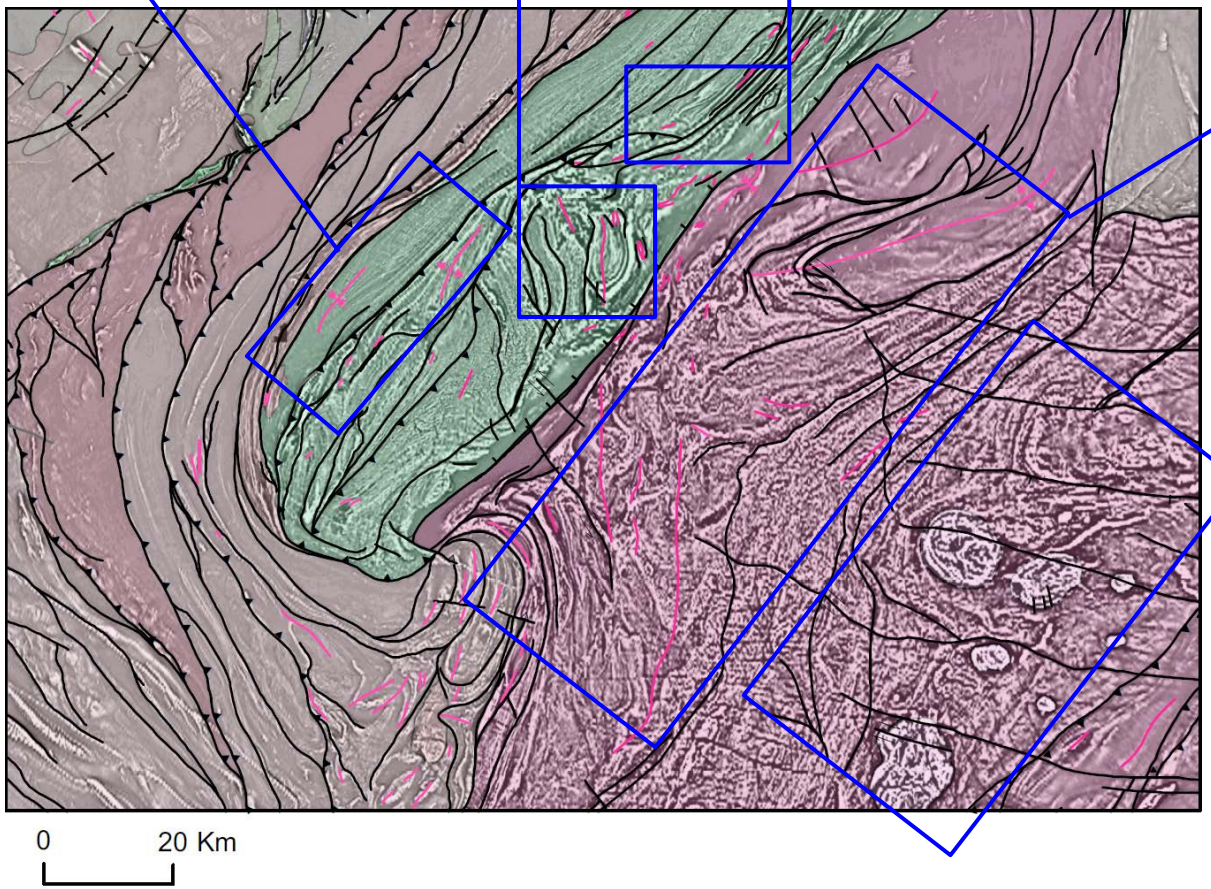
- In map view structures have largely been interpreted from aeromagnetic data
- For example:
  1. Faults and shears
  2. Folds
  3. The plunge of fold axes have been constrained using the field-based structural observations and the asymmetry of magnetic gradients
- Large-scale structures have also been interpreted from gravity data
- Where possible, GSWA geochronology has been used to constrain the age of magnetic fabrics

Nornalup Zone



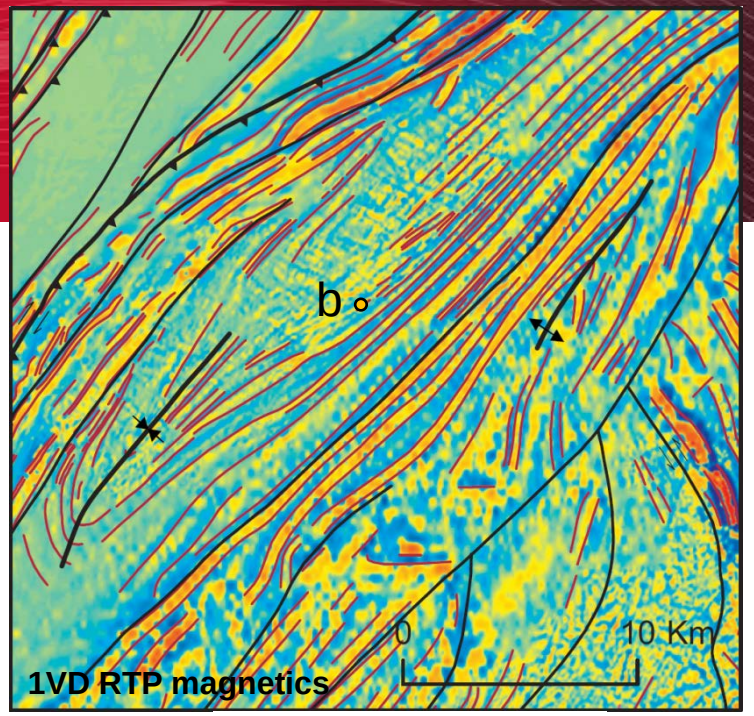
Demagnetised shear

Structural interpretation

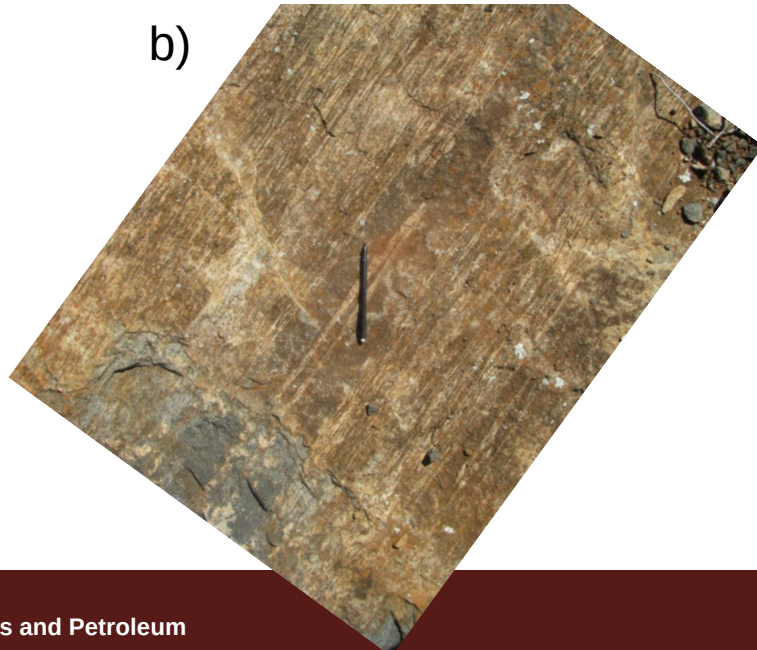


Fraser Zone – NE trending folds

- Magnetic fabric is dominated by linear, NE trending horizons, common regional NE trending folds
- Correlated with NE trending, steeply dipping gneissic to mylonitic foliation that contains intrafolial folds
- Foliation formed during Stage I peak metamorphism (c. 1290 Ma, c. 850 °C, 7–9 kbar; Clark et al., 2014)
- Regional scale folds and outcrop scale folds formed in a progressive deformation event during Stage I

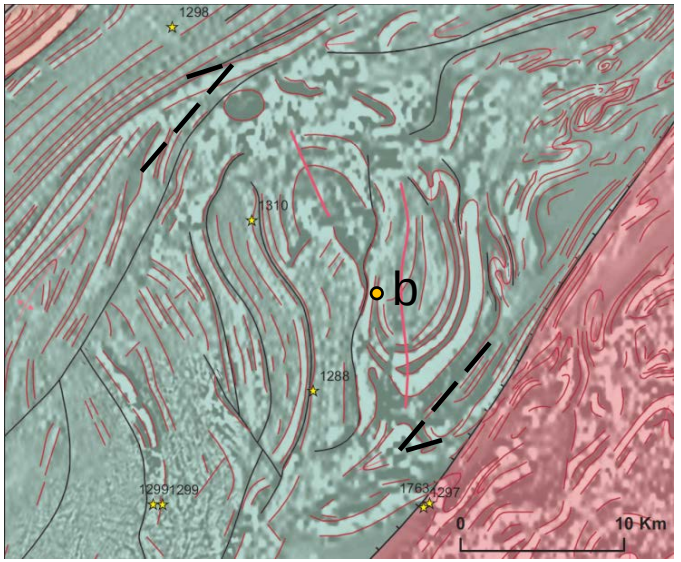


b)



Fraser Zone – N and NNW trending folds

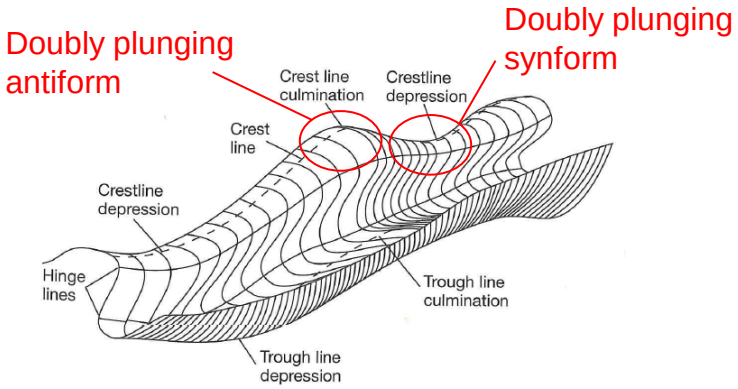
- In the centre of the study area, magnetic horizons appear to be folded around N/NNW trending axial traces
- ~ orthogonal to the dominant NE trend
- Foliation parallel to magnetic horizons, no Stage II metamorphism
- Interpreted dextral movement on the bounding NE trending shears
  - Supported by dextrally asymmetric folds observed in metagabbro
- Alternatively, produced by NE-SW shortening



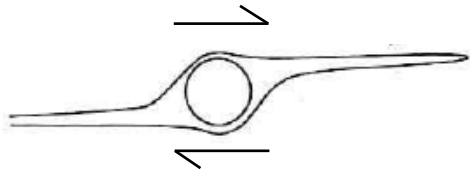
b)

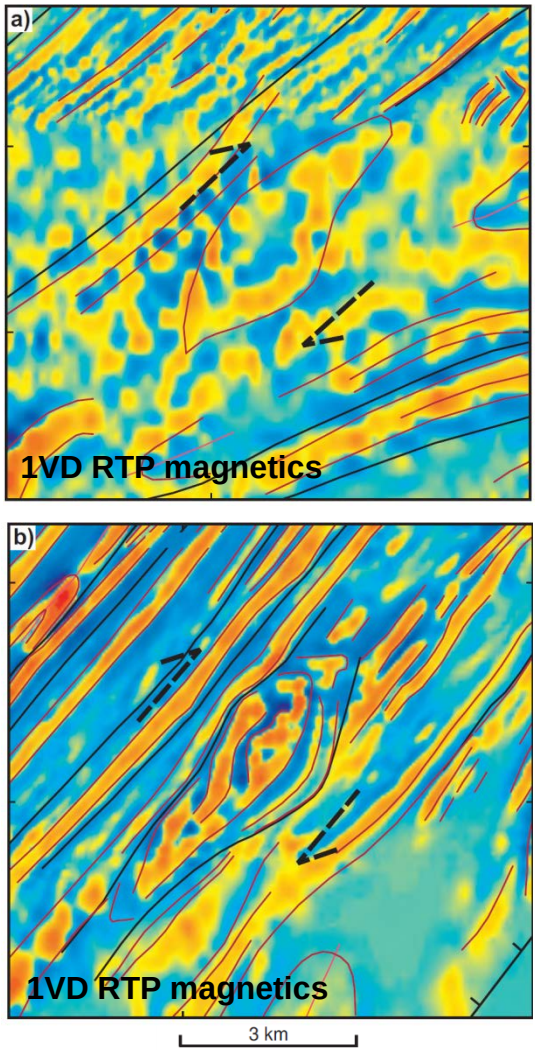
Fraser Zone – ‘Eye’ features

- The Fraser Zone contains ‘Eye’ shaped magnetic features
- These features can be interpreted as:
  1. Doubly plunging antiforms or synforms of non-cylindrical folds



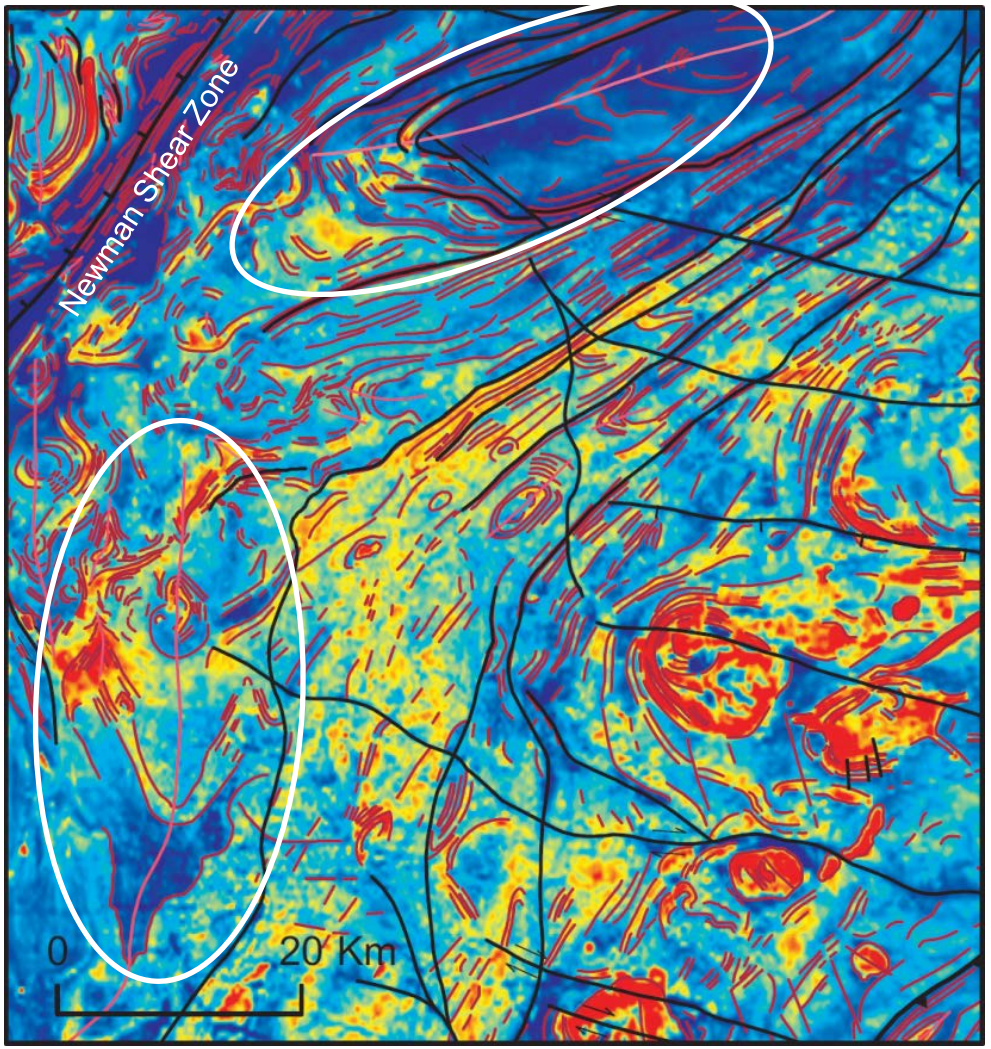
  2. Magnetic porphyroclasts





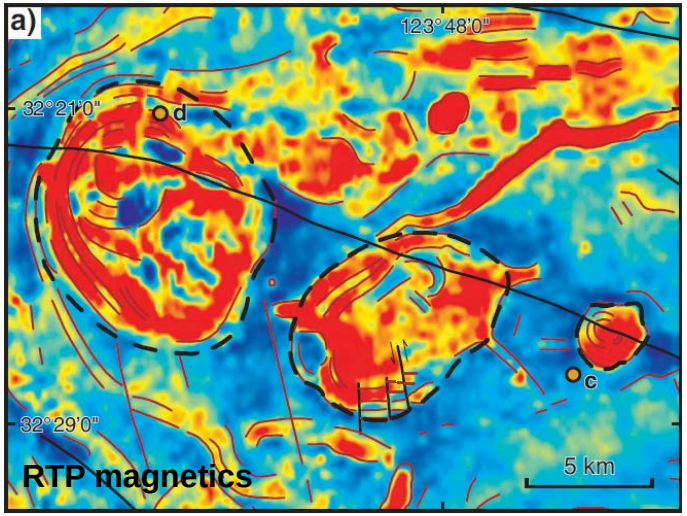
Nornalup Zone – Structural trends

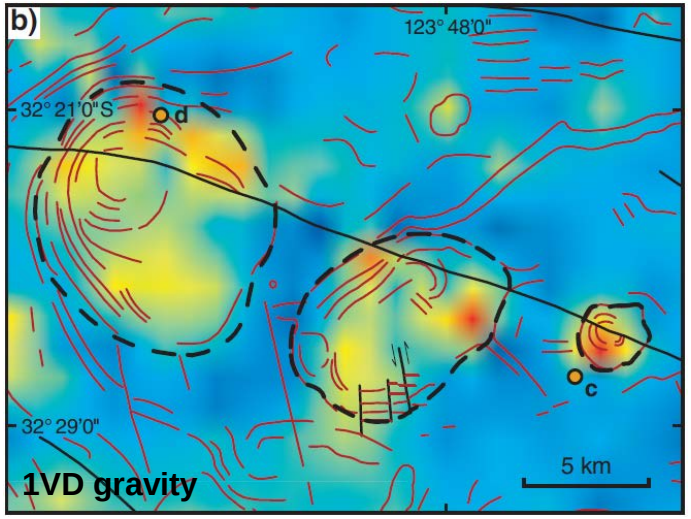
- The NW of the Nornalup Zone contains regional scale folds (~ 15 km)
  - Folds have NE and N trending axial traces
  - Chaotic magnetic fabric at the intersection
  - Paleoproterozoic material and Recherche Supersuite
  - Age of folding Stage I/II
- In the SE of the Nornalup Zone, NE of the Tagon SZ, the magnetic fabric is dominated by magmatic trends



SE Nornalup Zone – Magmatic trends

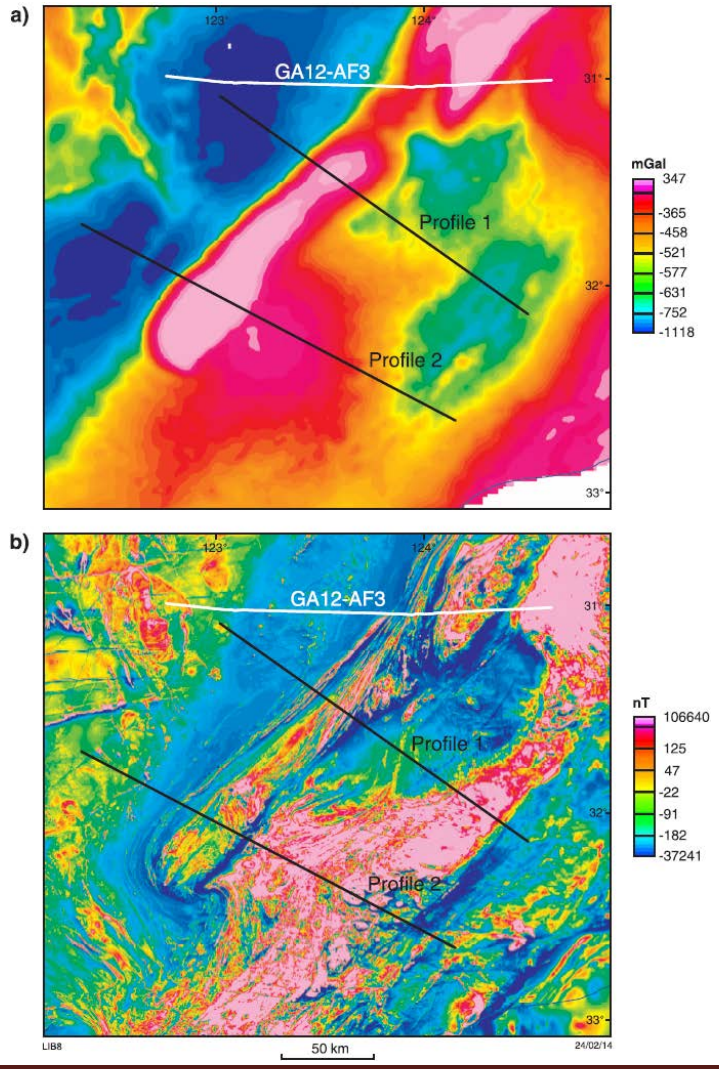
- **Magnetics:** Intensely magnetic, circular, intermediate intrusives, coincident gravity anomalies
- **Outcrop:** Intrusive porphyritic monzogranite, interpreted to be Esperance Supersuite, commonly intrudes migmatitic basement of unknown age
- Balladonia Rock (1135 ± 56 Ma)



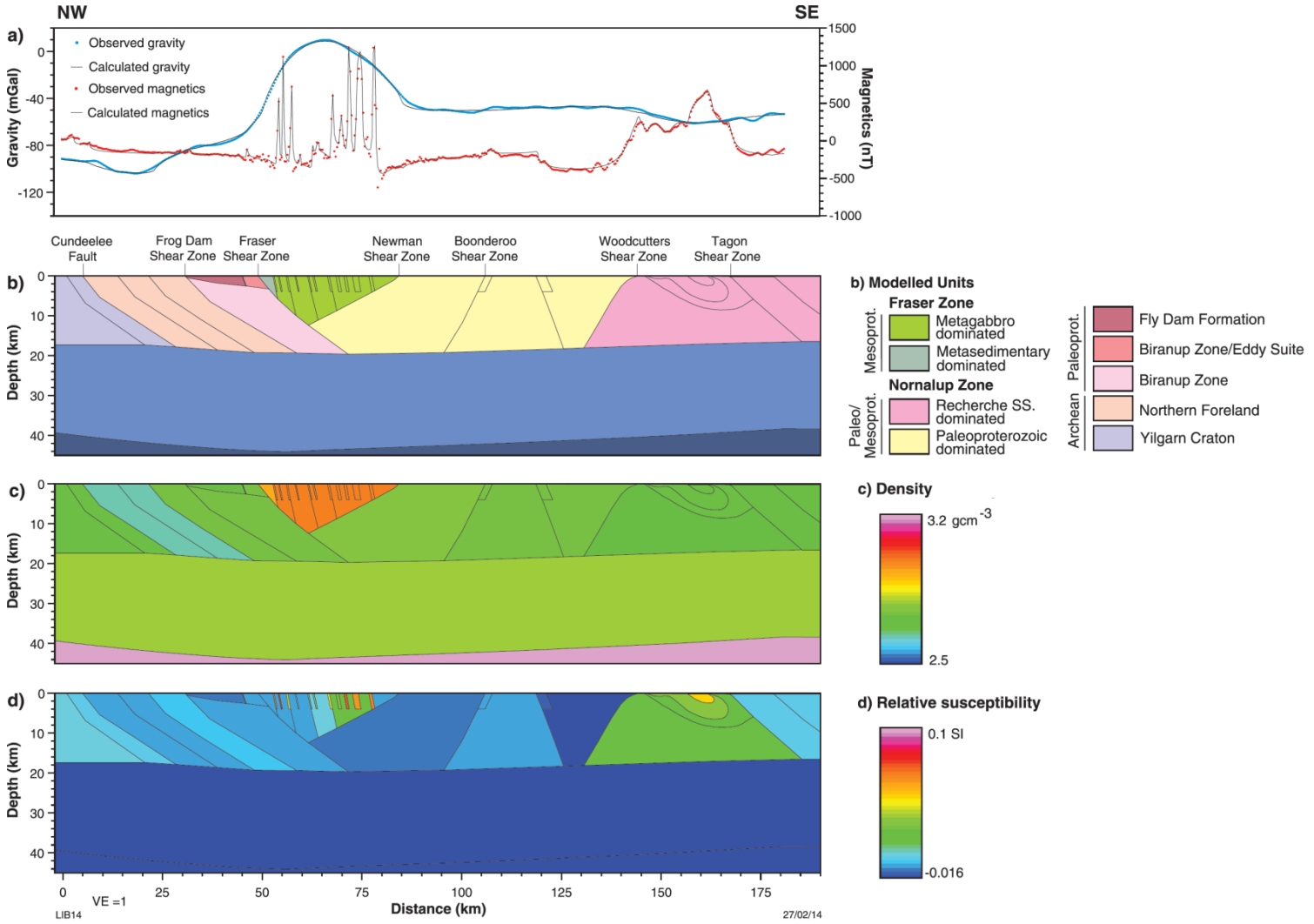


Forward Modelling – Method

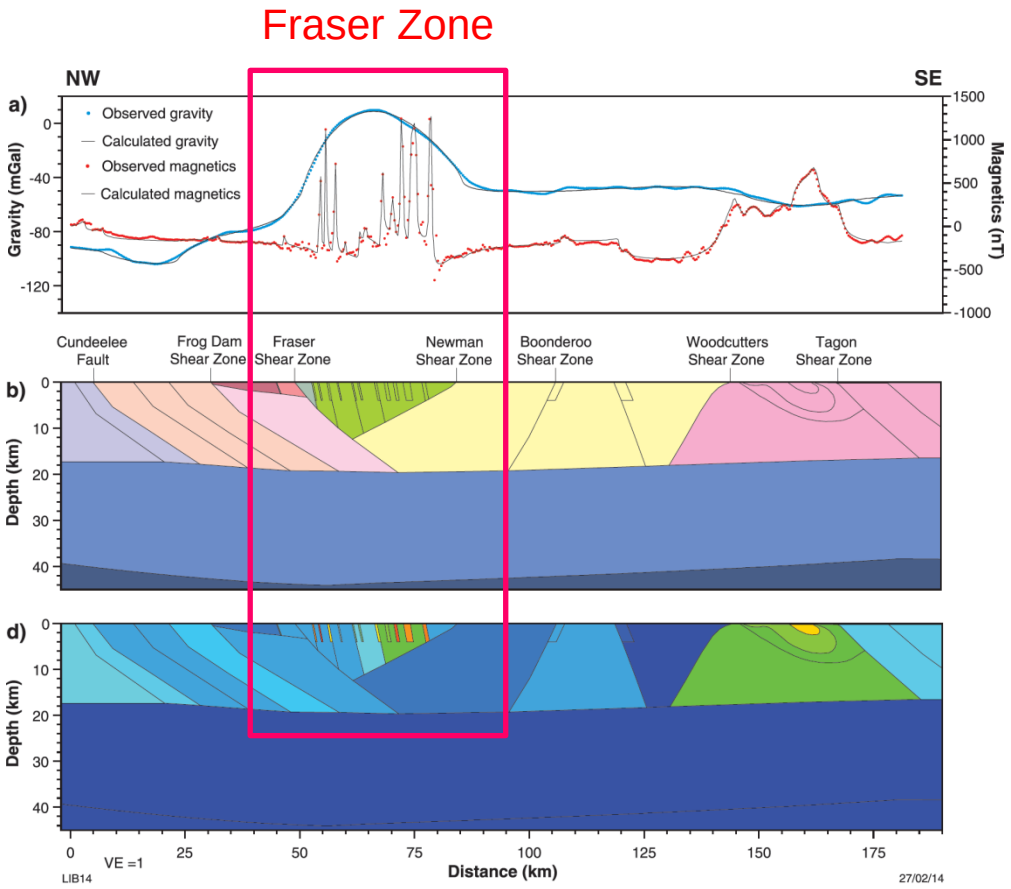
- 2.5 D, magnetic and gravity forward models, southwest of 12GA–AF3
- Forward modelling involved:
  1. Sampling magnetic and gravity data at 500 m spacing from a Bouguer gravity grid (cell size 1 km) and an RTP magnetic grid (cell size 75 m)
  2. Geometries constrained by geological information
  3. Physical properties constrained by specific gravity and susceptibility data from the east Albany–Fraser Orogen



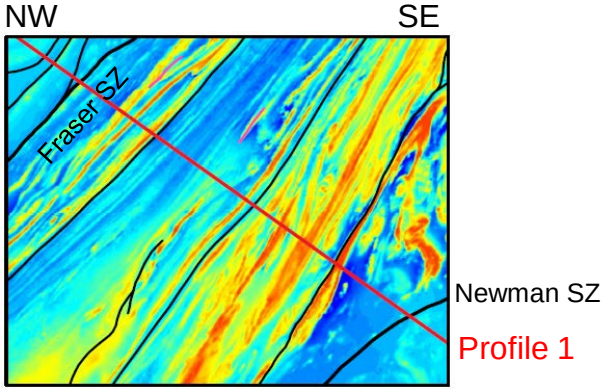
Profile 1 – Forward model



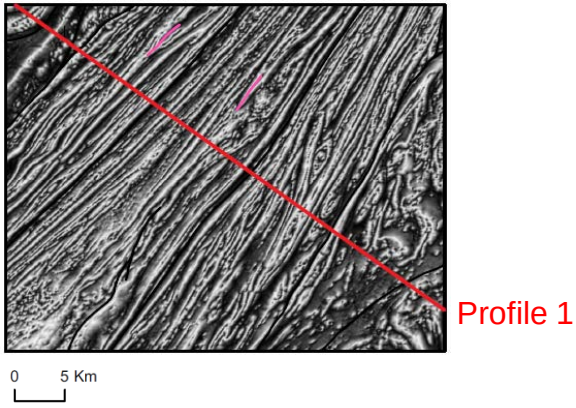
Fraser Zone – Magnetic modelling



RTP magnetics



Analytic signal



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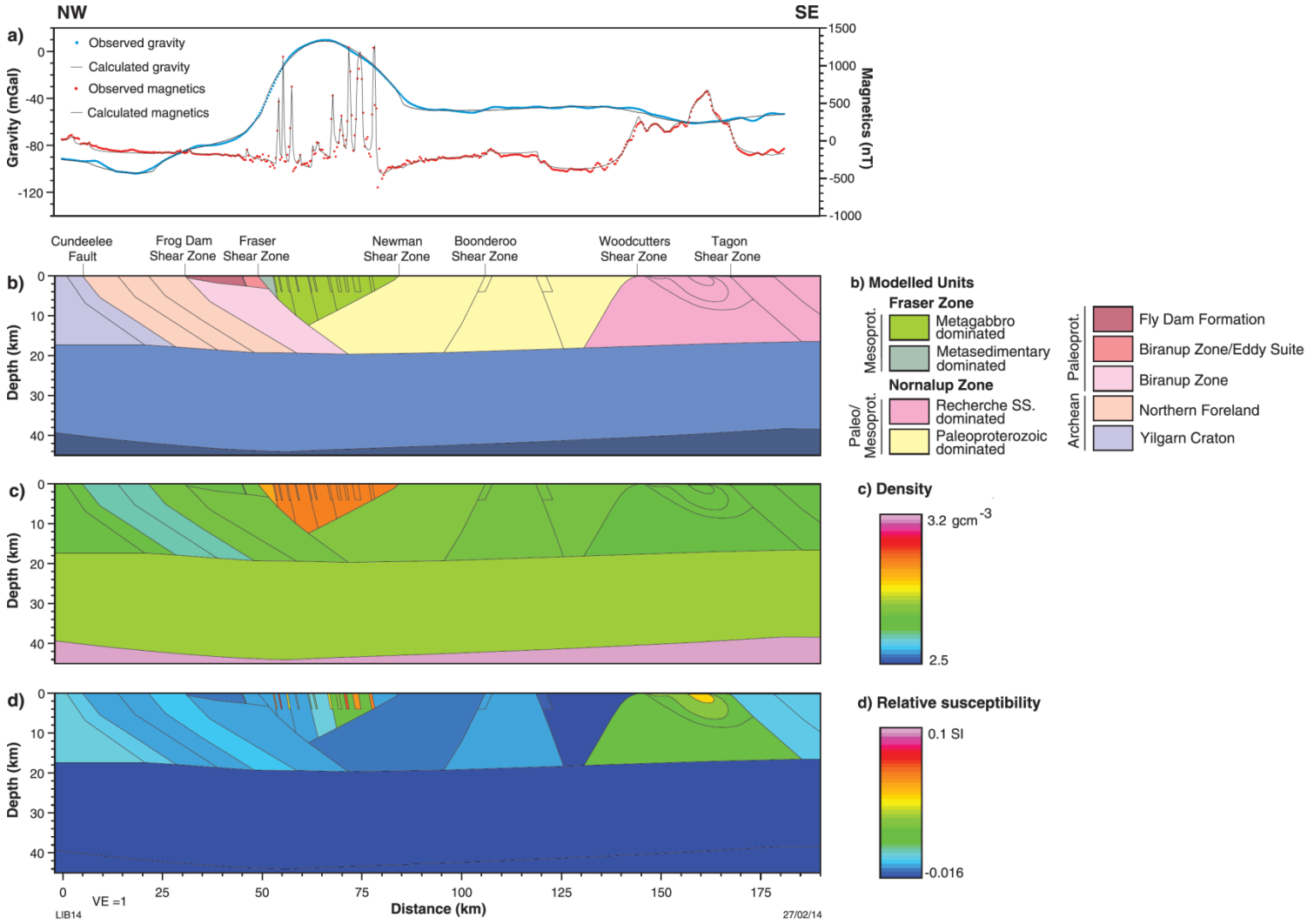
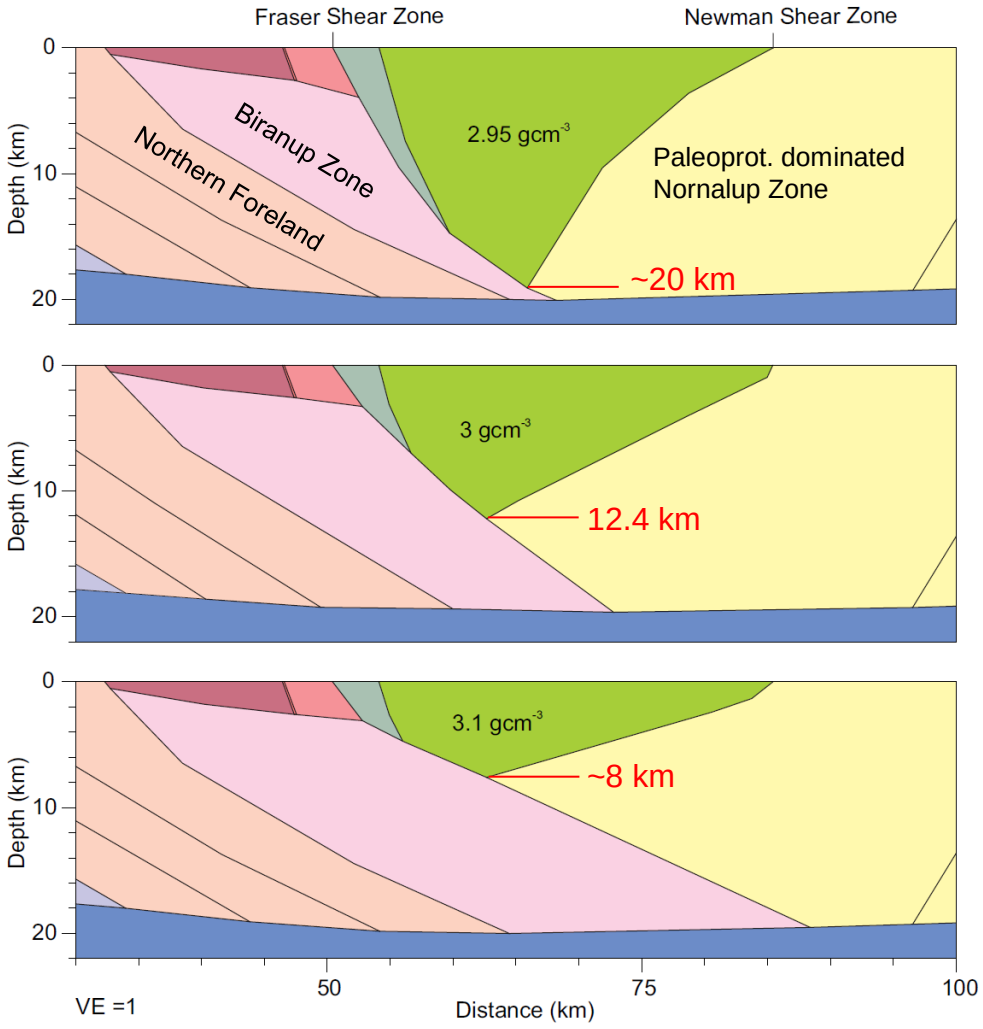
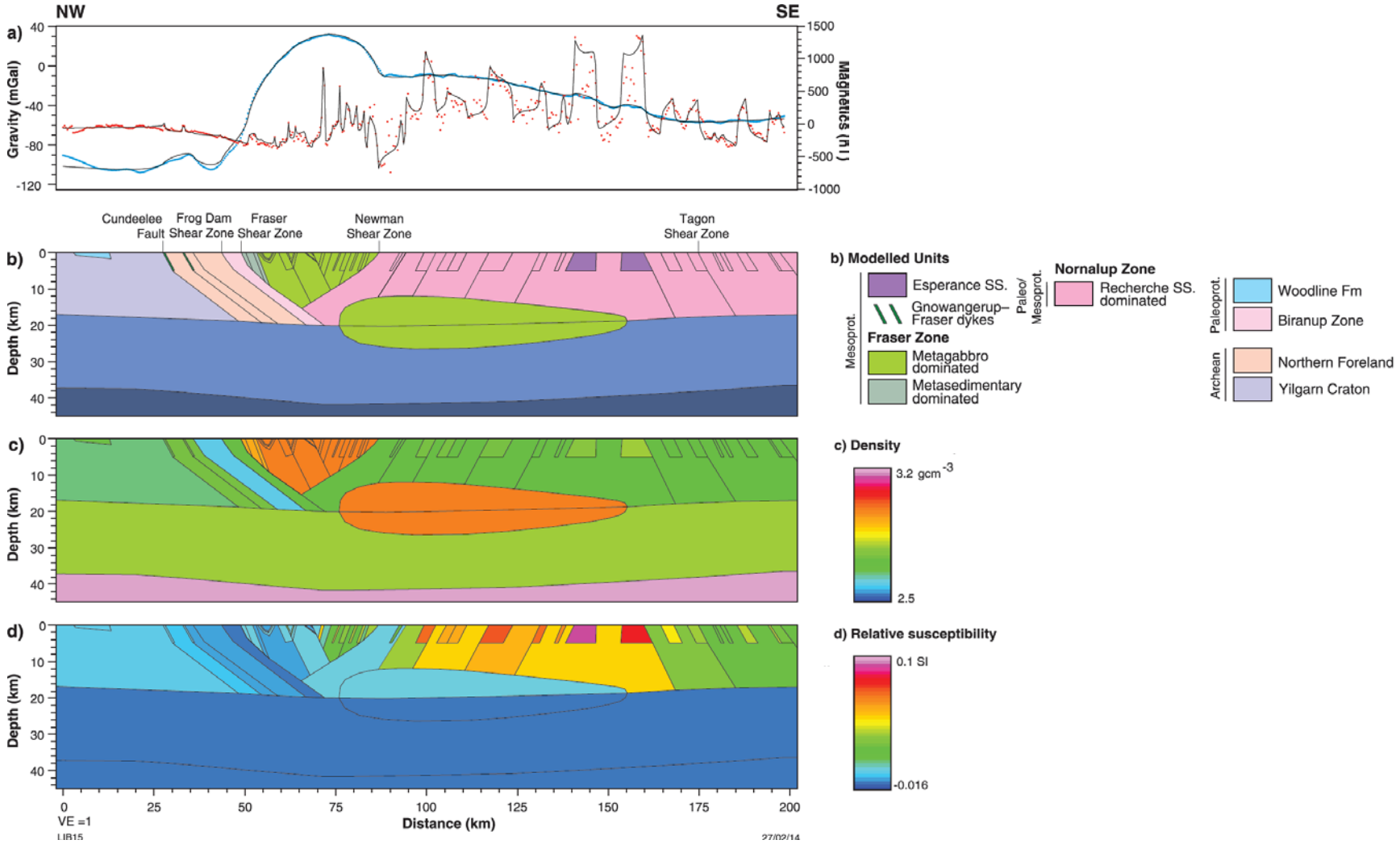


Fraser Zone – Sensitivity testing

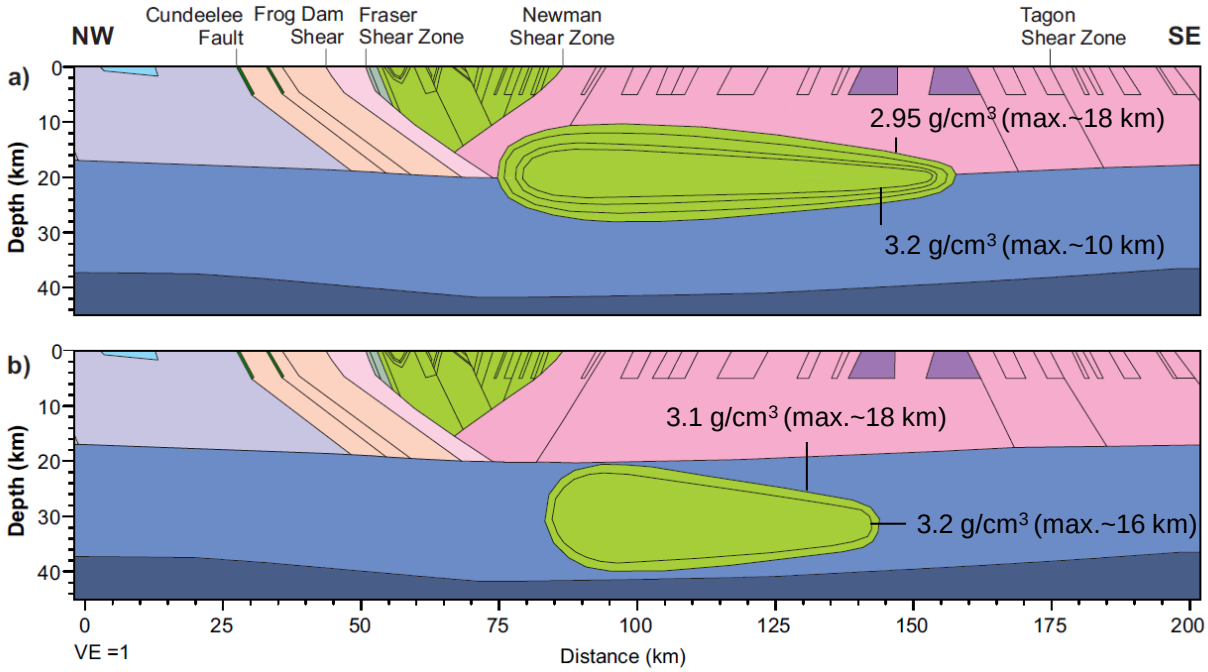
- Sensitivity testing: producing a range of models that satisfy the specific gravity and surface geology
- With the median specific gravity for all Fraser Zone samples (3 gcm^{-3}) the Fraser Zone extends to a depth of 12.4 km
- With a lower density the Fraser Zone extends to a greater depth
- With a higher density the Fraser Zone extends to a shallower depth

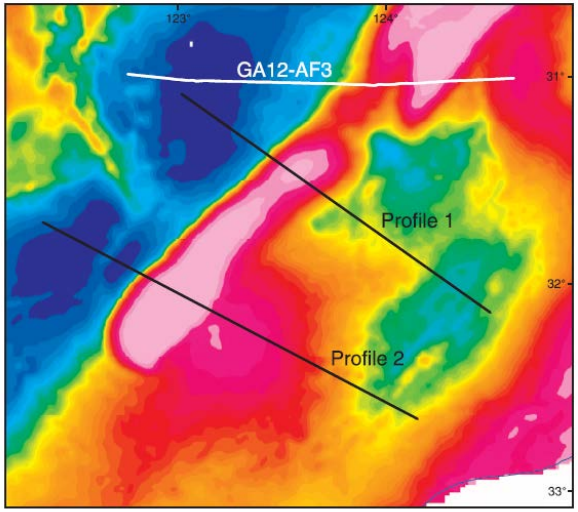


Profile 2 – Forward model



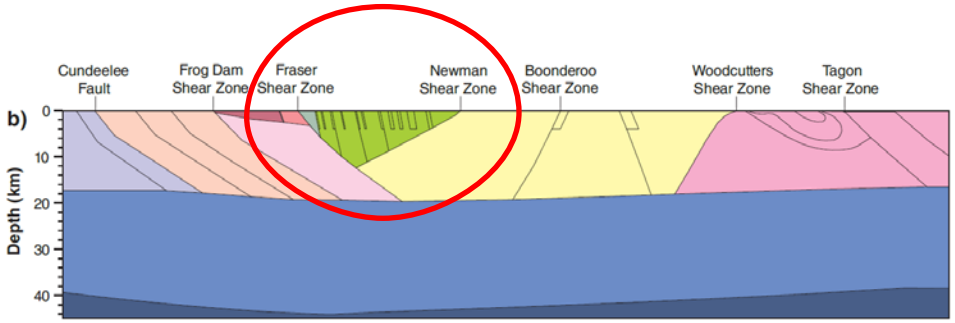
Long wavelength gravity anomaly – Sensitivity test



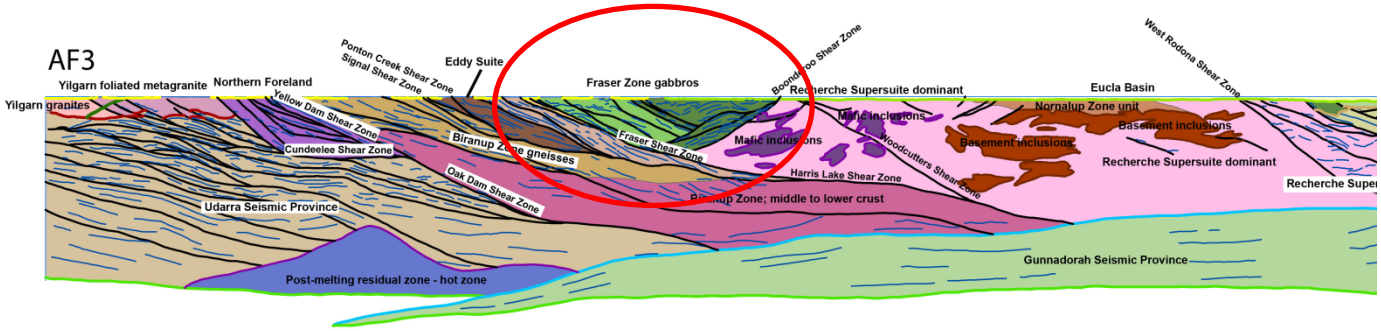


Imaging the Fraser Zone: Gravity and deep crustal seismic

Forward Modelling



Deep Crustal Seismic (GA12–AF3)



Conclusions

- Fraser Zone contains regional NE trending folds, interpreted to have formed during Stage I and coeval structures produced by dextral movement on NE trending shears
- In section view, the Fraser Zone is near triangular in shape and extends to a depth of 12.4–14.5 km
- The long wavelength anomaly to the southeast of the Fraser Zone can be modelled as a sill-like body of mafic material
- This interpreted sill is located in the mid-crust and has a maximum thickness of 14.5 km