

3D GRAVITY MODELLING

EAST ALBANY–FRASER OROGEN

INTRODUCTION AND AIMS

- The Albany–Fraser Orogen formed on the southeast margin of the Archean Yilgarn Craton during several Proterozoic extensional orogenic events and shortening events (Fig. 1a).
- This work continues from previous 2D work, with the additional constraint of the Moho surface (Sippl et al., in review).
- The aim is to use 3D gravity forward modelling to build a regional geological constrained model that is consistent, to a first order, with gravity anomaly data.
- The model will provide constraints on the 3D geometries and densities of mafic units along the margin, particularly in the middle and lower crust.
- Constraints on the mafic units provide information on the extensional events with which they are associated, and the events that subsequently modified these units.

METHOD

Model constraints

The geological model was constructed in Geomodeller using the following constraints:

- Simplified interpreted bedrock geology map (Spaggiari et al., 2016; Fig. 1a)
- Simplified interpreted deep crustal active seismic lines 12GA-AF1, 2 and 3 (Spaggiari et al., 2014)
- 2D geologically constrained gravity forward models (Murdie et al., 2014)
- Gravity anomaly data (station spacing ~2.5 km; Fig. 1b)
- Moho model from passive seismic data (Sippl et al., in review; Fig. 1c).

Forward modelling

The model was then tested against the free air gravity data. To do this, modelled units have been assigned densities, based partly on petrophysical data, and the gravity response of the model has been calculated. Geometries have been kept consistent with simplified interpreted bedrock geology and active seismic interpretations. In future work inversion methods will be used to achieve better fitting, higher resolution models and geometries will be allowed to vary, particularly at depth and along strike of active seismic constraints.

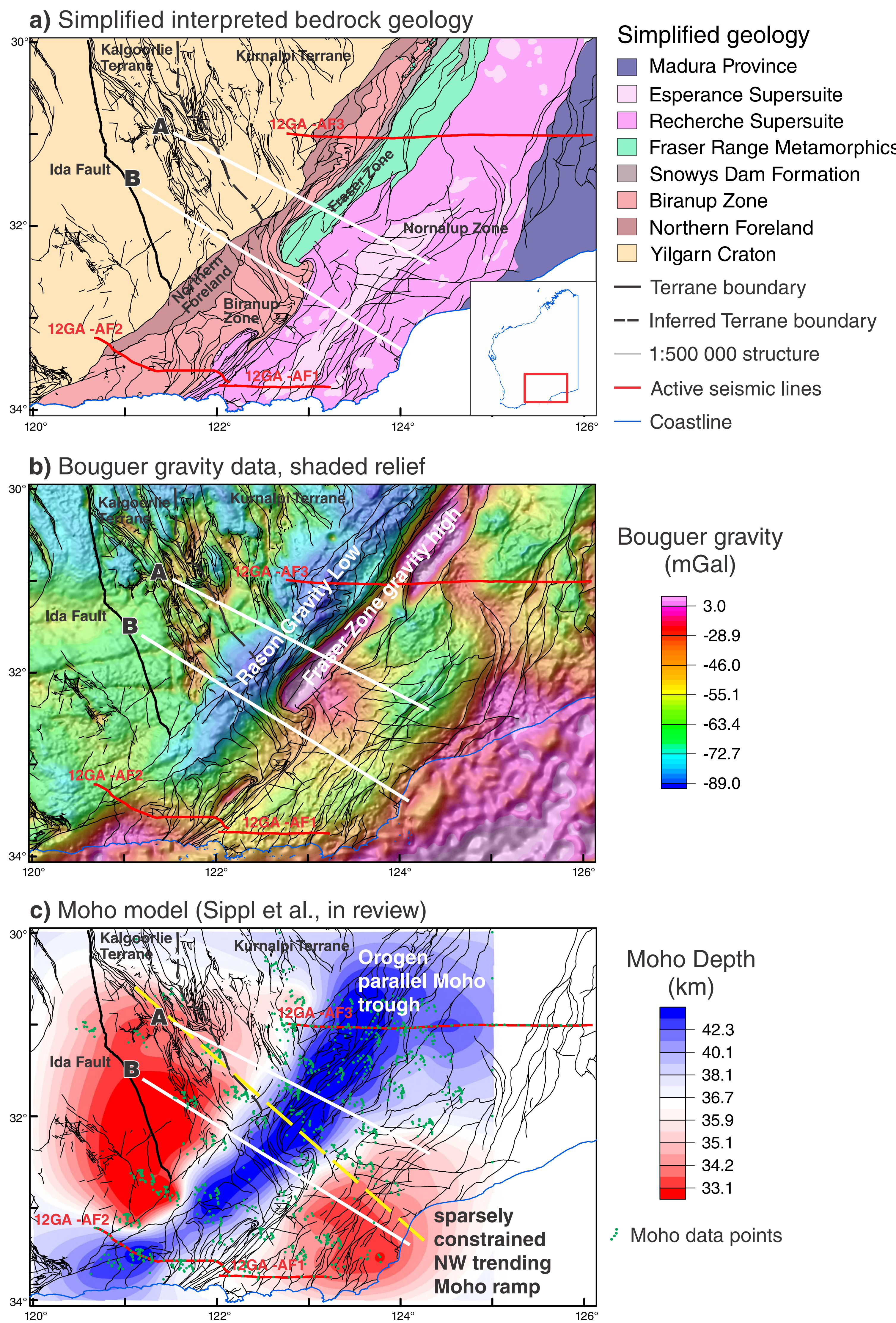


Figure 1. Some of the data sets used to constrain 3D modelling.

3D GRAVITY FORWARD MODELLING RESULTS

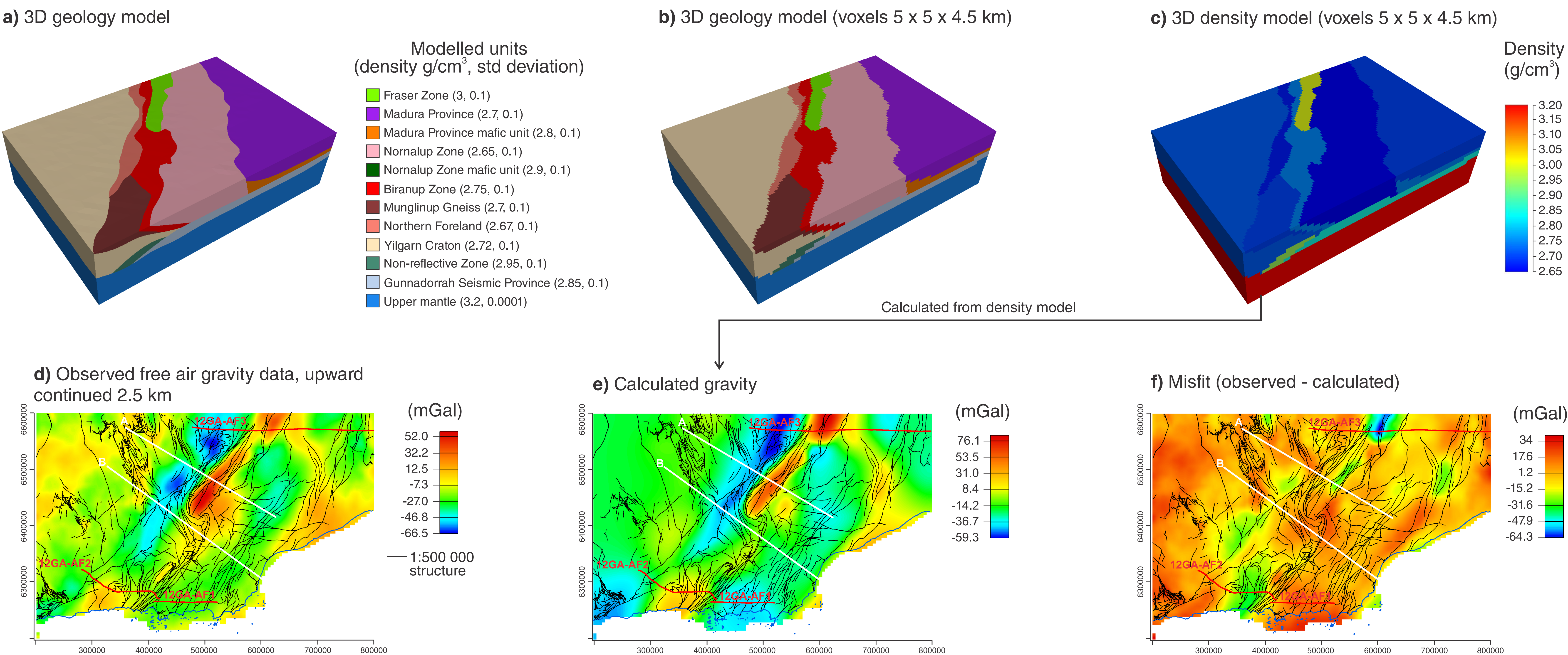


Figure 2. Summary of the method and results of 3D gravity forward modelling.

GEOLOGICAL MODEL FEATURES

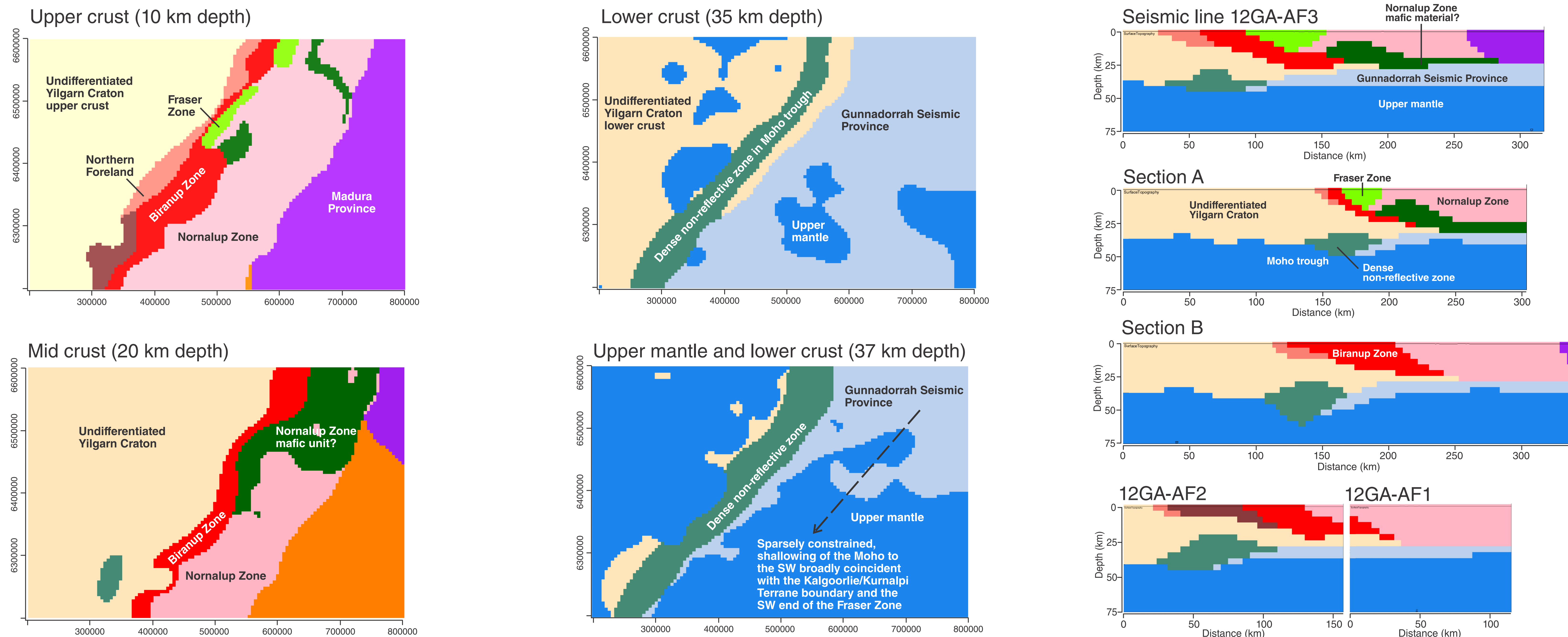
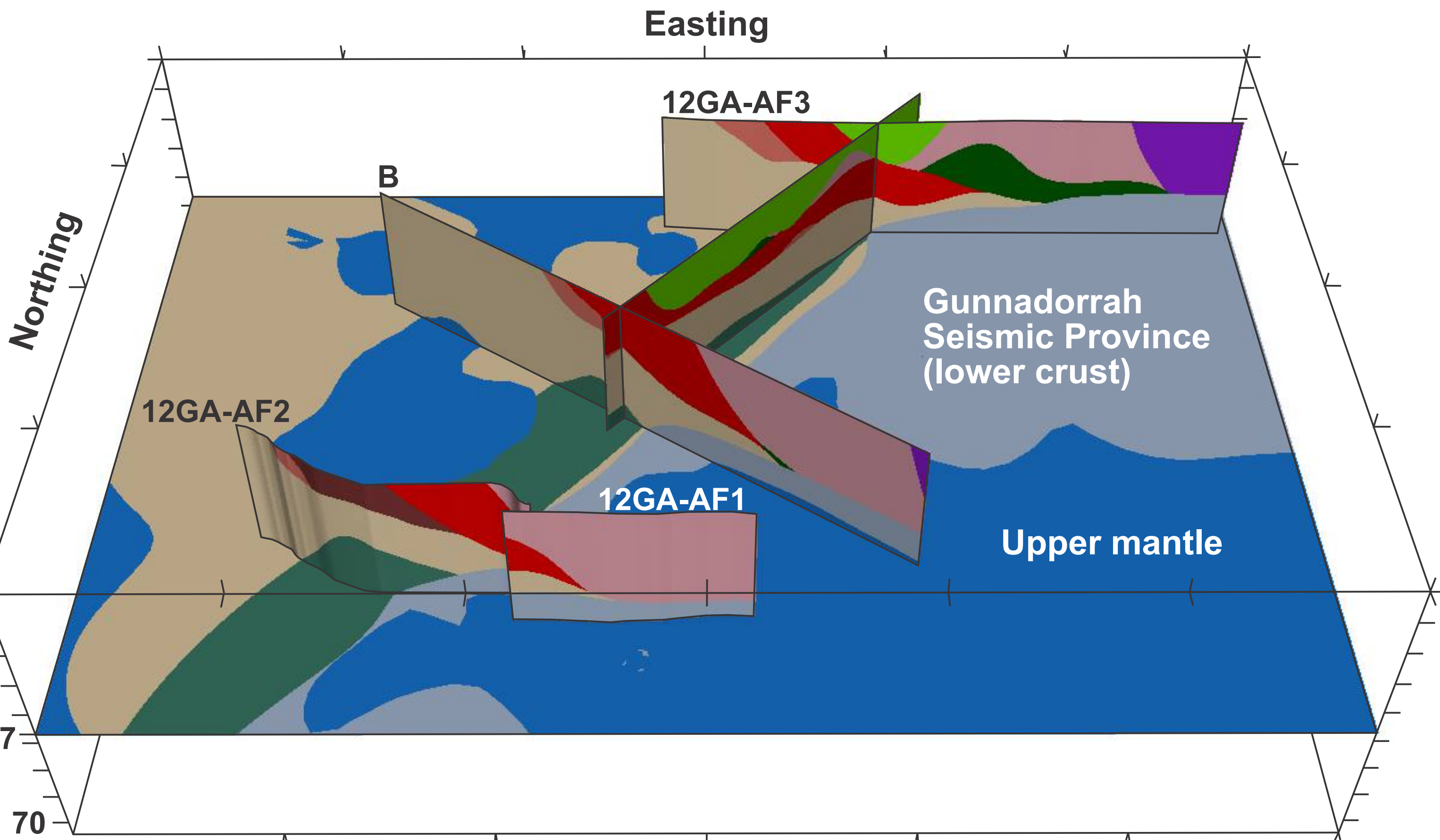


Figure 3. Horizontal and vertical sections through the geology model (voxels = 5 x 5 x 4.5 km) showing some features of the model.

CONCLUSIONS

- Modelling confirms that crustal thickening and the dense non-reflective unit can produce the long wavelength gravity low observed along the margin.
- This dense non-reflective unit may have intruded in the lower crust of the Yilgarn Craton footwall during northwest-southeast extension along the margin.
- Subsequent crustal thickening may have localised on this dense zone in the lower crust.
- The sparsely constrained northwest/west trending Moho ramp is broadly coincident with southwest end of the metagabbro dominated Fraser Zone, and the Kalgoorlie/Kurnalpi Terrane boundary.
- A consequence of the Moho ramp is that the Nornalup Zone is required to be denser in the northeast. One possibility is a mid crustal mafic unit.
- Changes to the southwest margin of the Fraser Zone are required to achieve a better fit to the gravity data.



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