Australian Government
Geoscience Australia

Northern Territory Government

Potential-field studies supporting the seismic data in the Georgina Basin-Arunta Province region, Northern Territory

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Outline

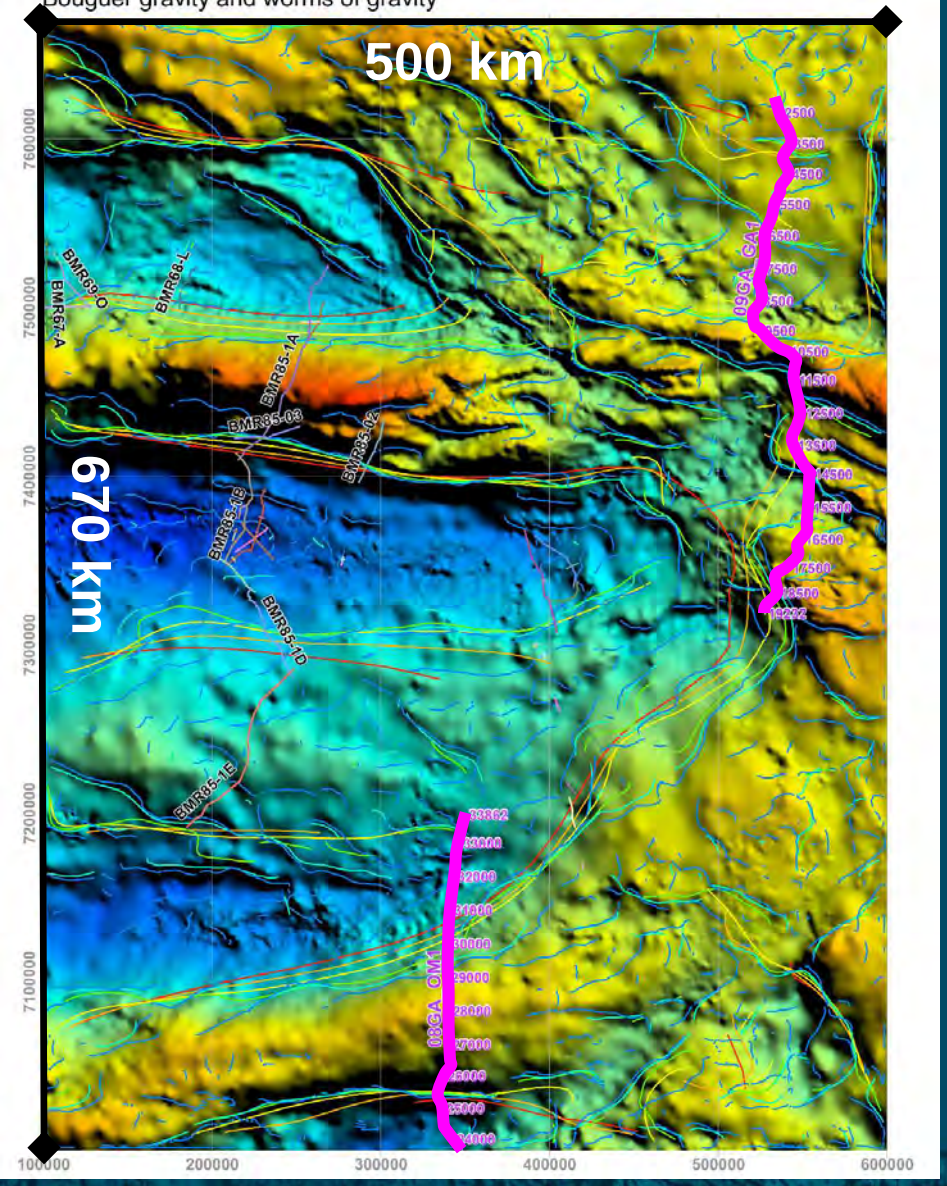
- 3D map of Georgina-Arunta area
- Worming of potential-field data
- Additional image processing of potential-field data
- Forward modelling of 09GA-GA1 seismic line
- Inverse modelling in 3D map area

3D map

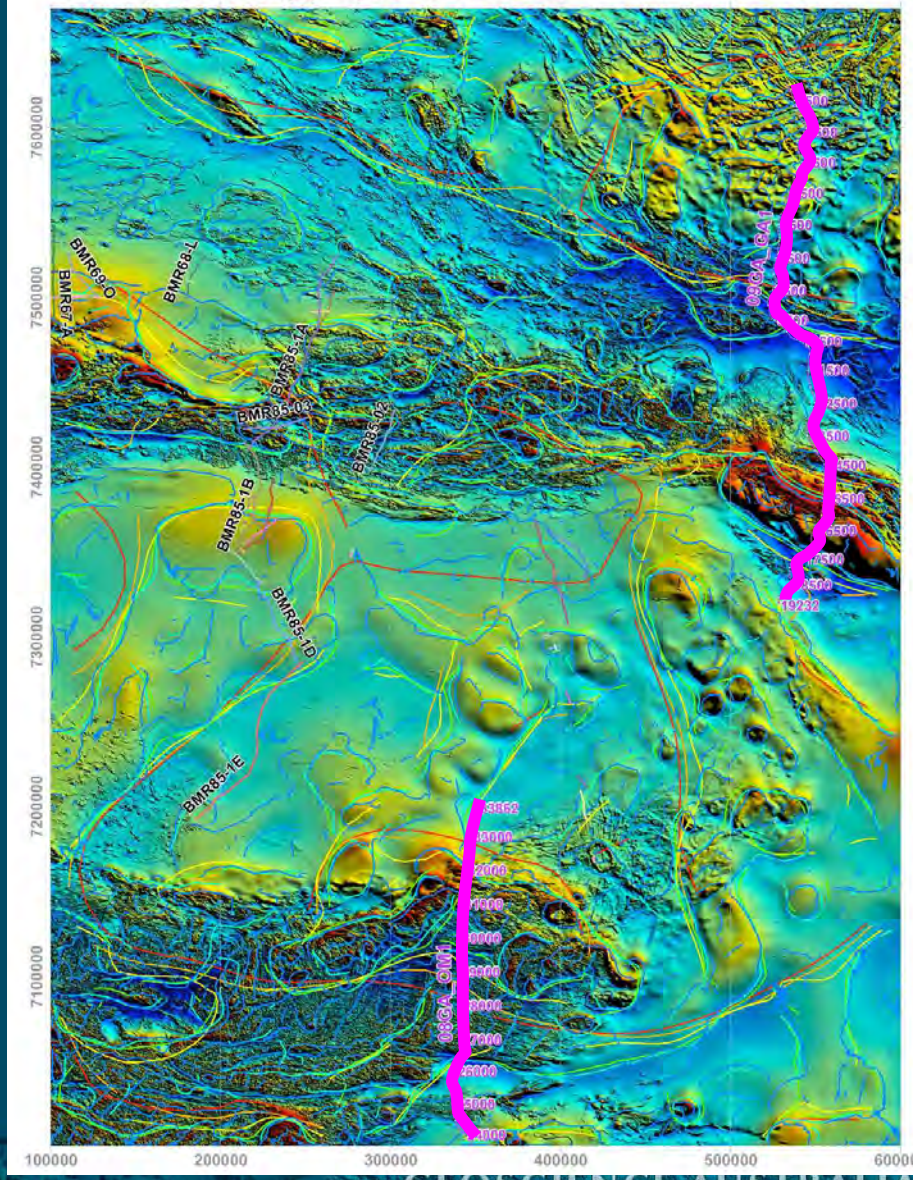
- 3D map is being constructed in the Georgina-Arunta region by Geoscience Australia and the NTGS
- Compiles available geophysical data and geological interpretations in the region in their true 3D positions
- Project area encompasses these seismic lines:
  - 2009 Georgina-Arunta
  - Northern portion of the 2008 Gawler-Officer-Musgrave-Amadeus seismic line
  - Older seismic data in the Arunta region
- Aim is to produce a 3D geophysical map by end June 2011

3D map & available potential-field data

Georgina-Arunta project area:
Bouguer gravity and worms of gravity



Georgina-Arunta project area:
Total magnetic intensity (TMI) and worms of TMI



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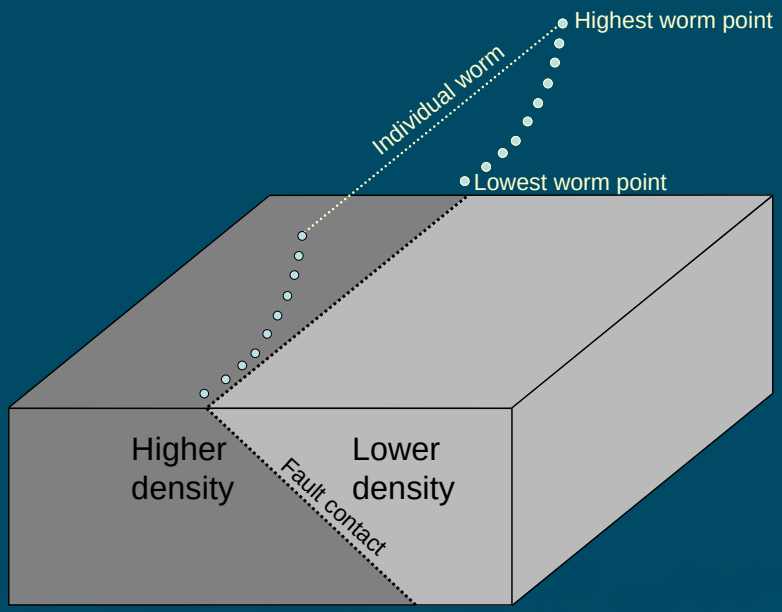
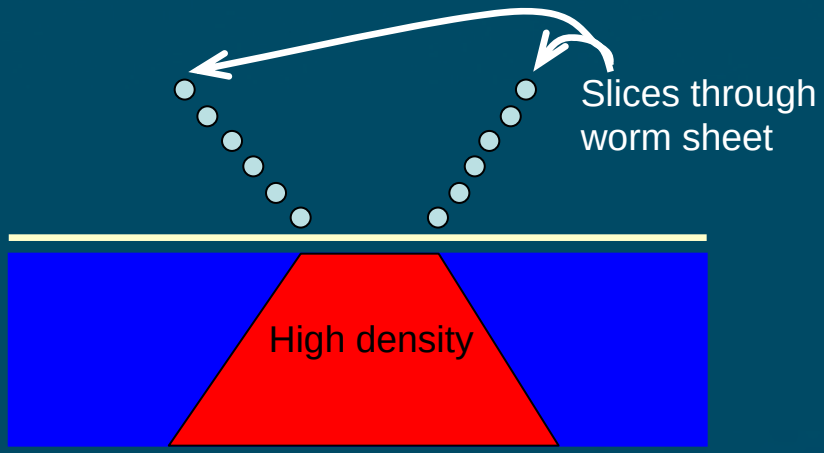
AGES 2011: Chopping et al., potential-field studies in the Georgina-Arunta region

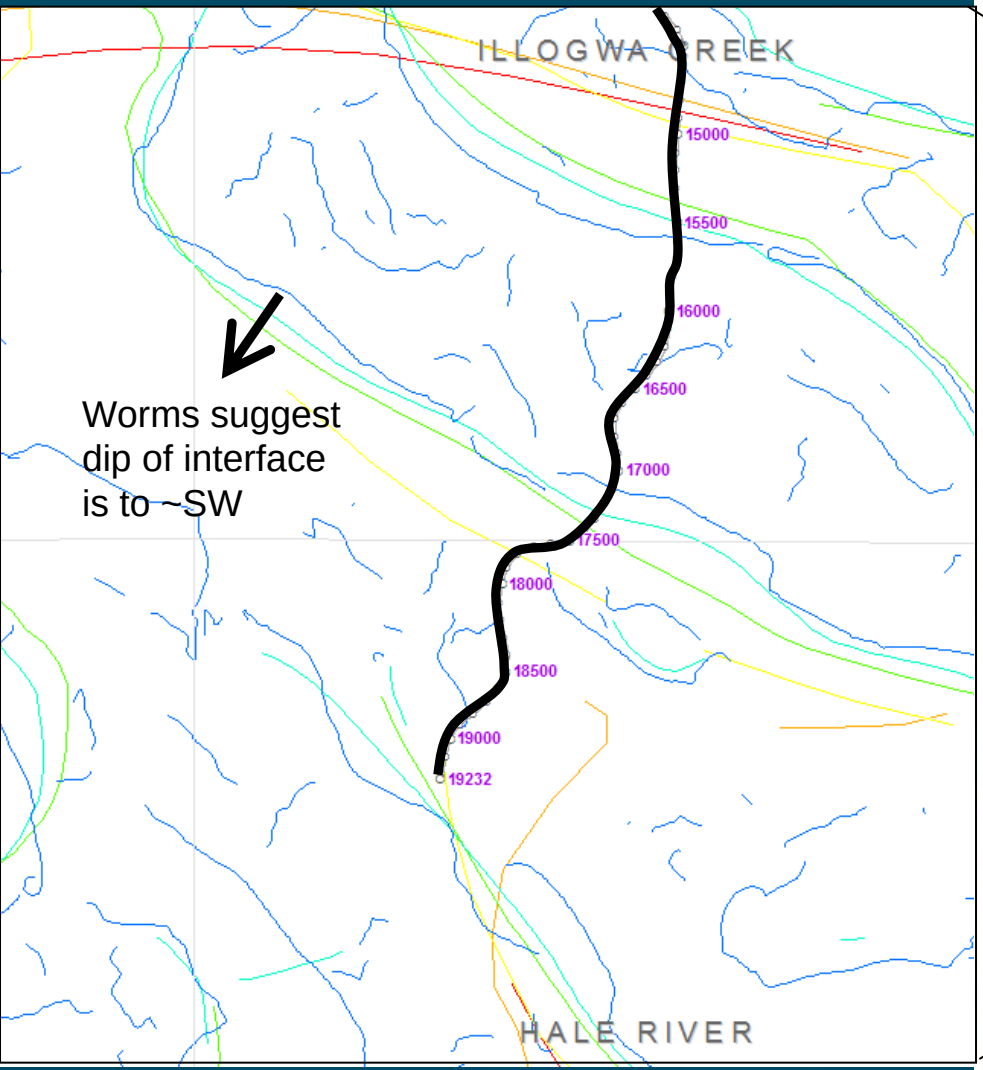
Worming of potential-field data

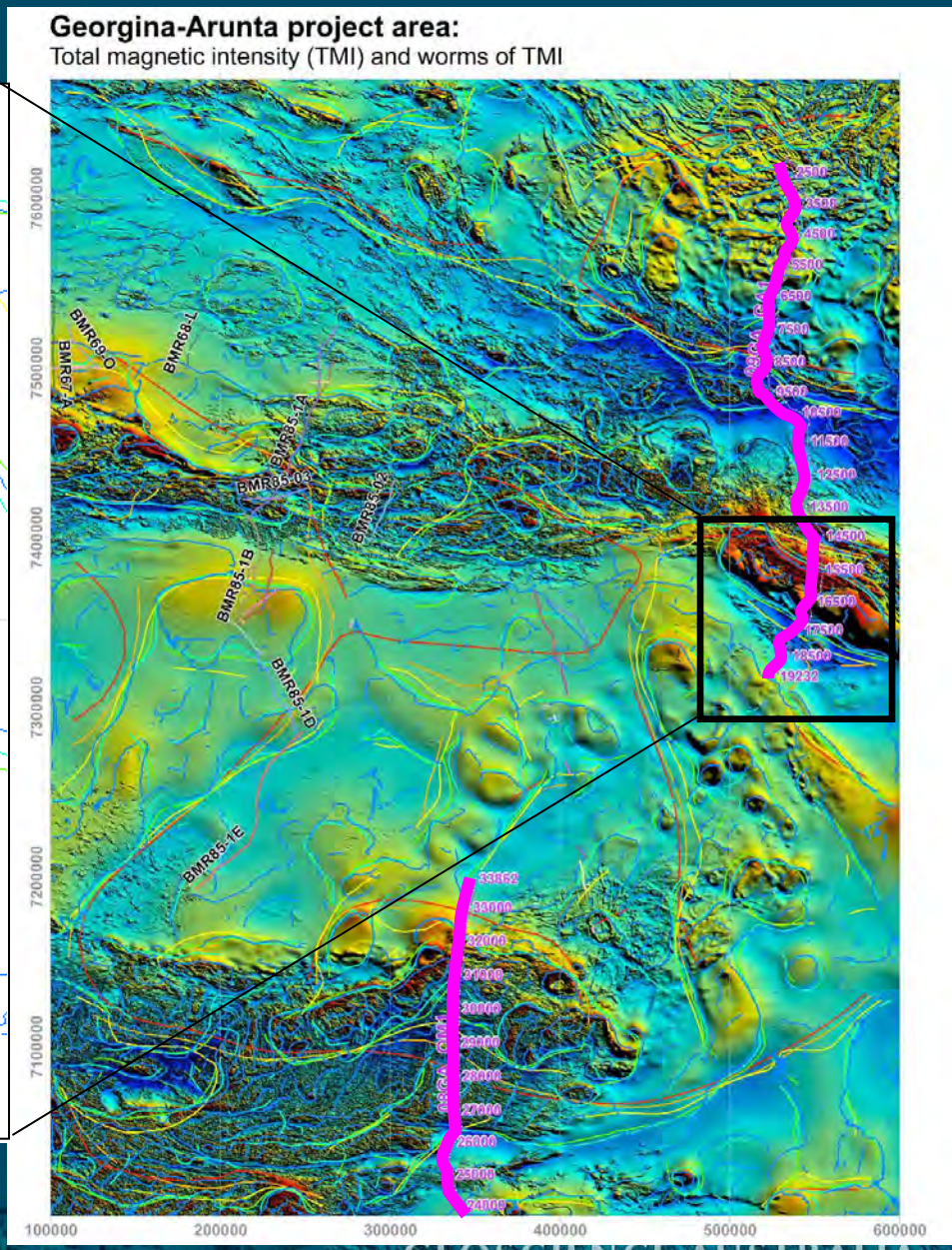
- Shown on the previous slide were ‘worms’ of the gravity and magnetic data
- These highlight edges of structures plus allow inference of dip of these structures
- Worms migrate upwards in the mirror-image of the dip of a structure





Worms

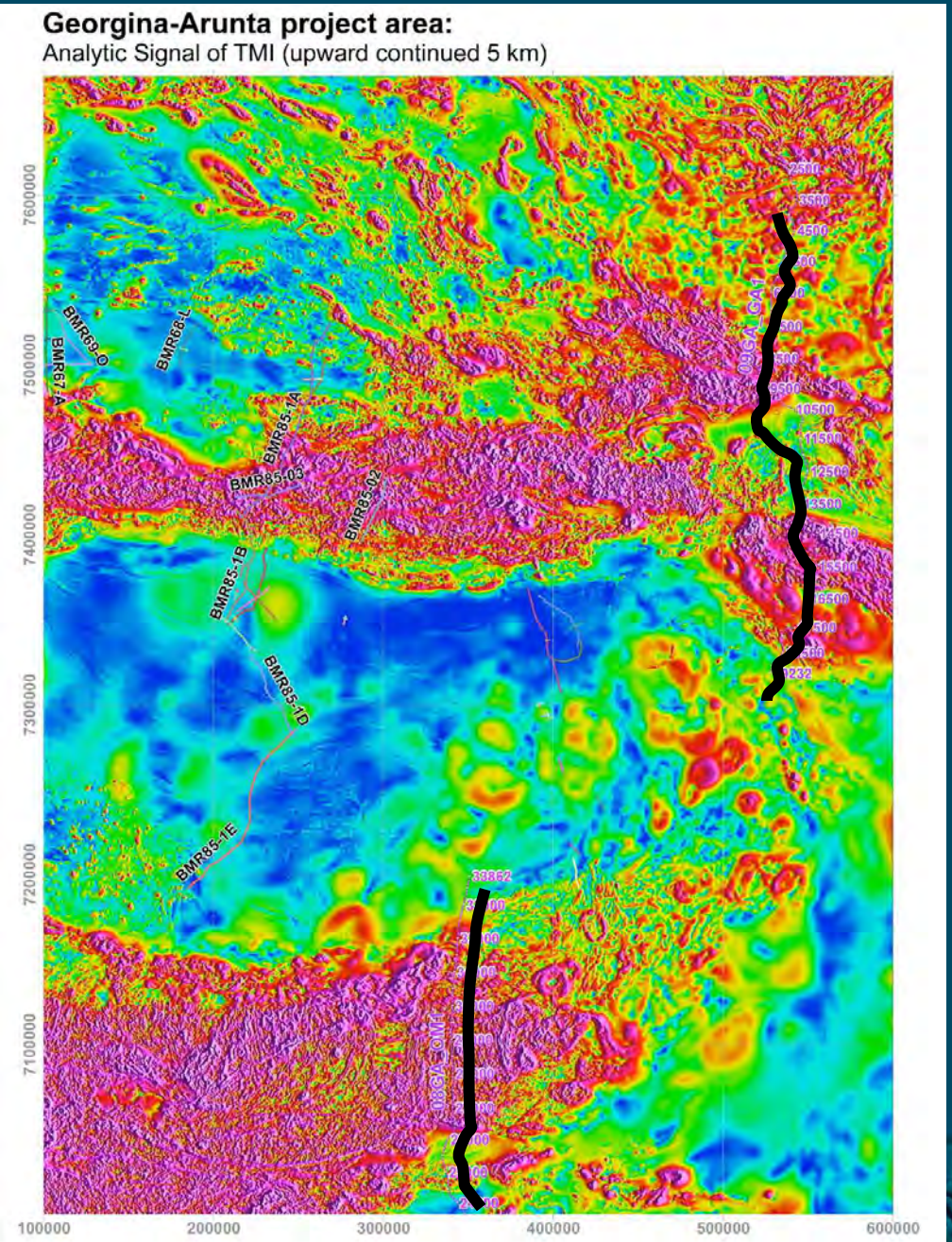

ILLOGWA CREEK
15000
15500
16000
16500
17000
17500
18000
18500
19000
19232
Worms suggest
dip of interface
is to ~SW
HALE RIVER


Georgina-Arunta project area:
Total magnetic intensity (TMI) and worms of TMI
BMR69-O
BMR68-L
BMR87-A
BMR85-1A
BMR85-1C
BMR85-1B
BMR85-1D
BMR85-1E
7600000
7500000
7400000
7300000
7200000
7100000
100000
200000
300000
400000
500000
600000

Additional processing

- Aim is to produce images to assist in the interpretation of structural trends away from the seismic line
- Many possibilities:
  - Upward-continuation
  - Reduction to the pole (RTP) for magnetics
  - Analytic signal
  - Tilt derivatives
- Analytic signal of TMI provides a useful guide to trends away from seismic data

3D map & available potential-field data

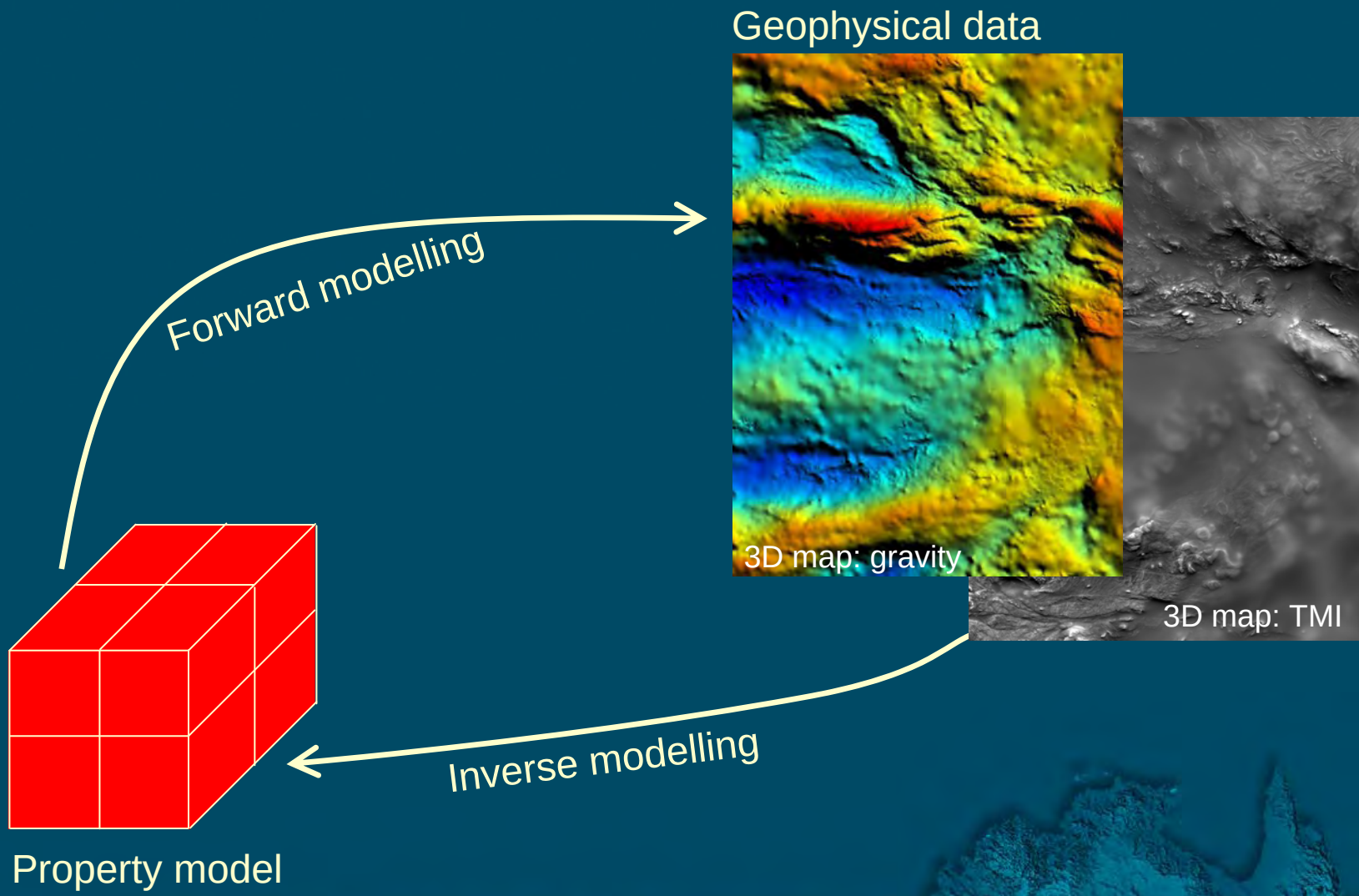


- Provides a clearer picture (compared with TMI) of features such as Casey Inlier heading underneath Amadeus Basin on S end of 09GA-GA1 seismic line
- Useful product for interpretation of surface boundaries of provinces and of surface trace of major faults
- Assists in constraining 3D geometries away from seismic lines

Forward modelling

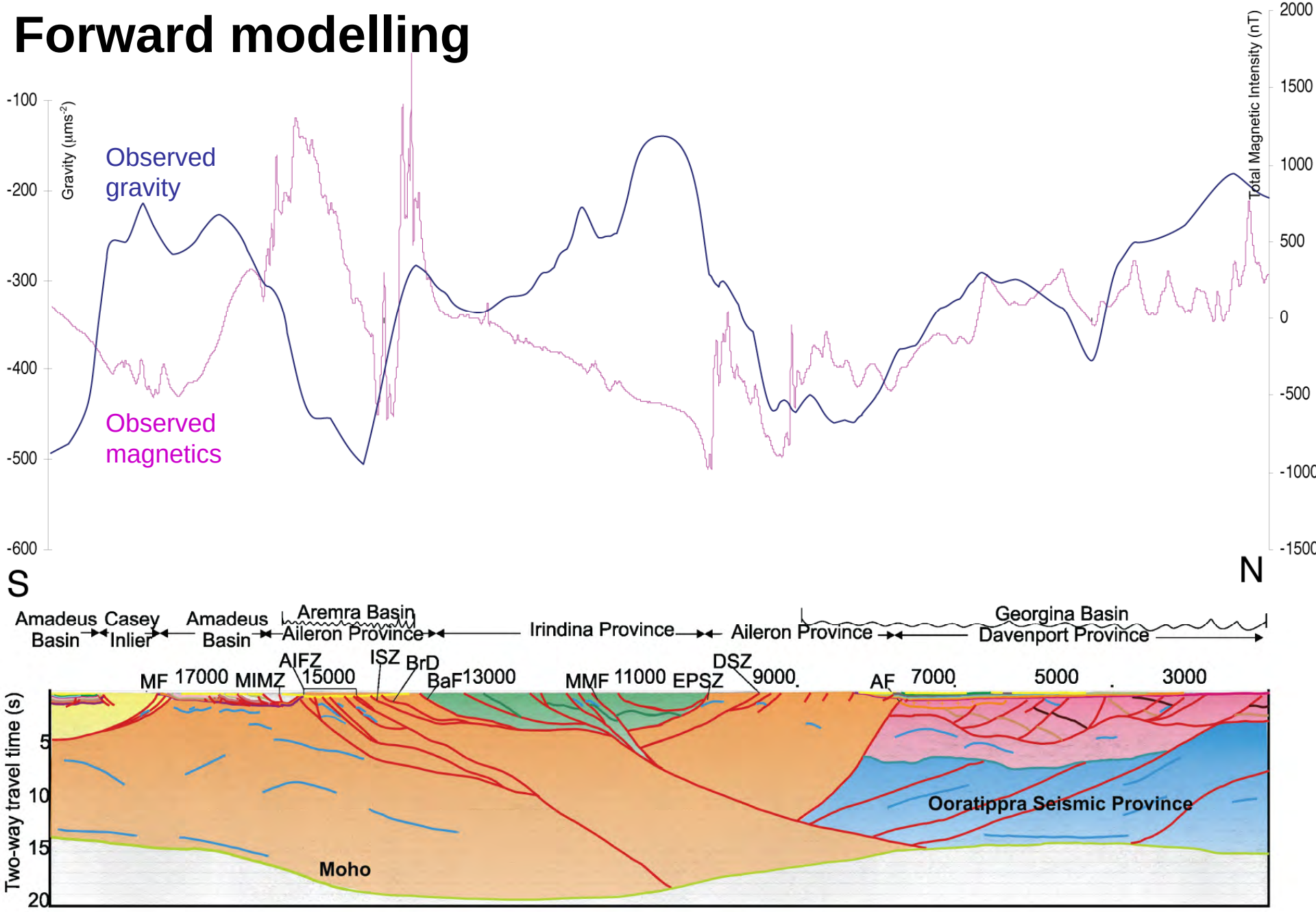
- Forward modelling is where a geological model, attributed with physical properties, has its geophysical response calculated
  - Gravity is more sensitive to deeper features and is preferred for crustal-scale investigations
  - Nevertheless, magnetic data often provides signals of significant faults
- Geophysical response compared to known geophysical response extracted along a line

Forward versus inverse modelling



AGES 2011: Chopping et al., potential-field studies in the Georgina-Arunta region

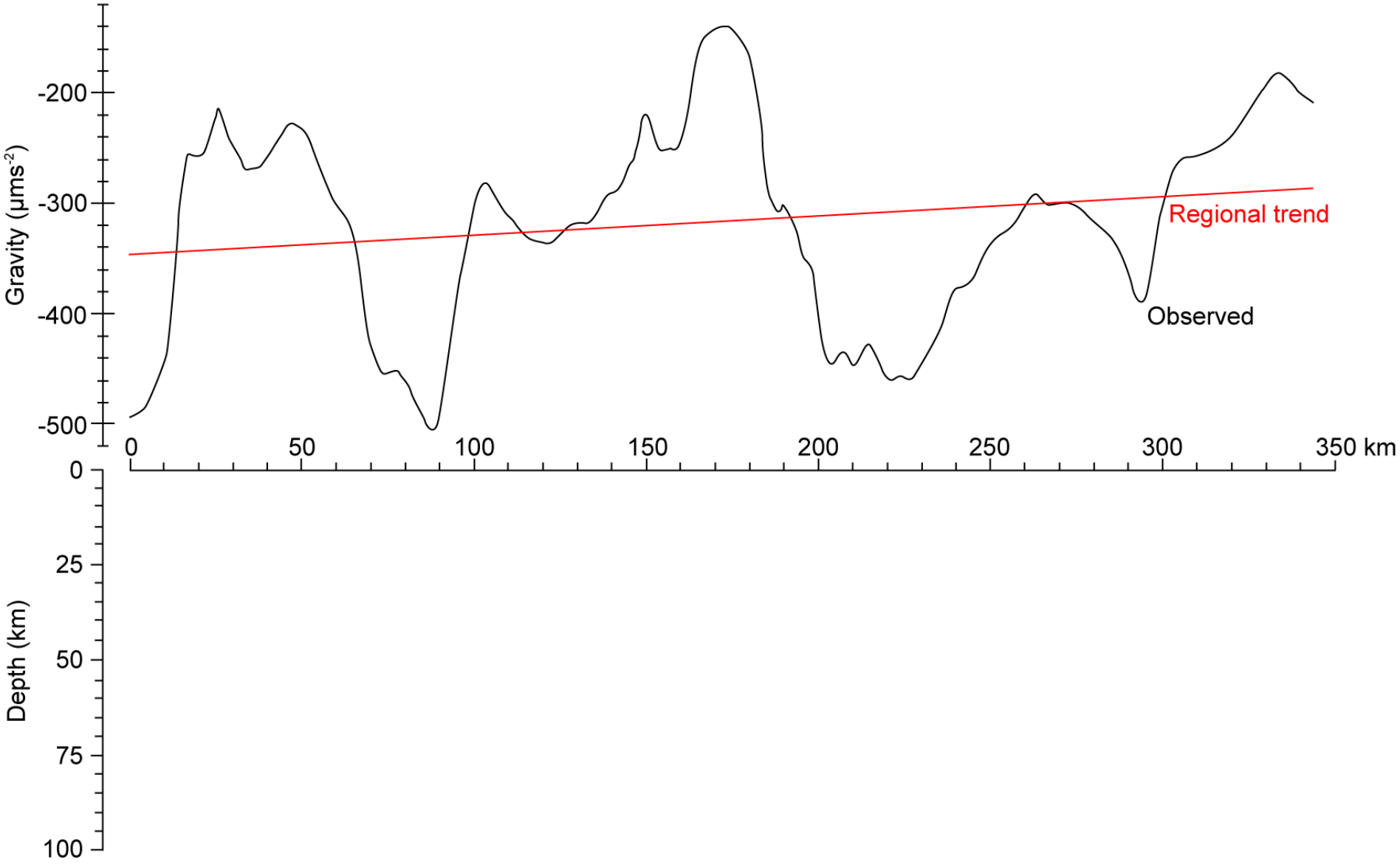
Forward modelling



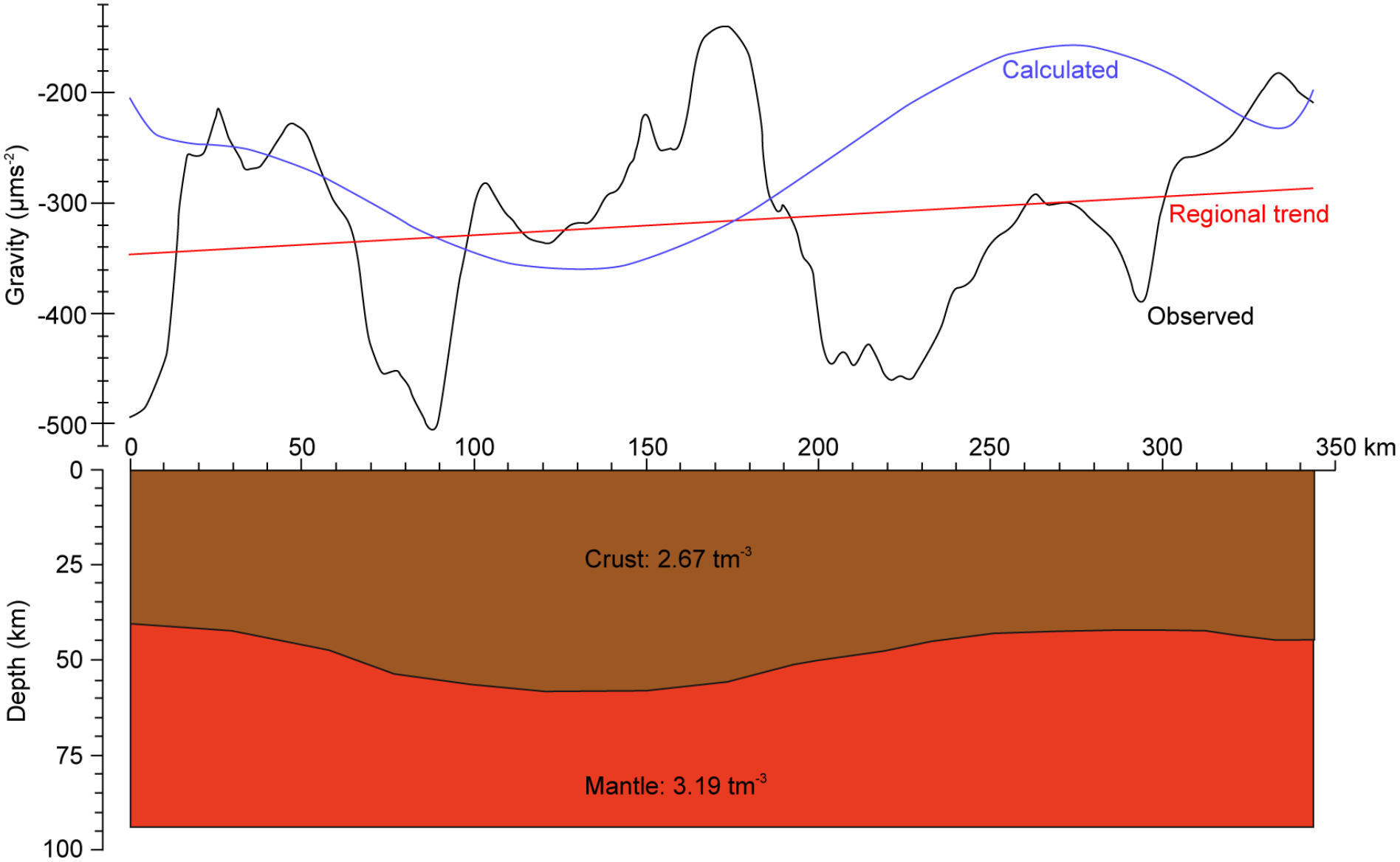
Forward modelling

- Work in progress
- Forward-modelling is an iterative process
  - 1st pass combination of seismic interpretation and gravity constraints added
  - Generally only subtle changes required
  - Geometries require further refinement
  - Multiple hypotheses regarding geometries need further evaluation

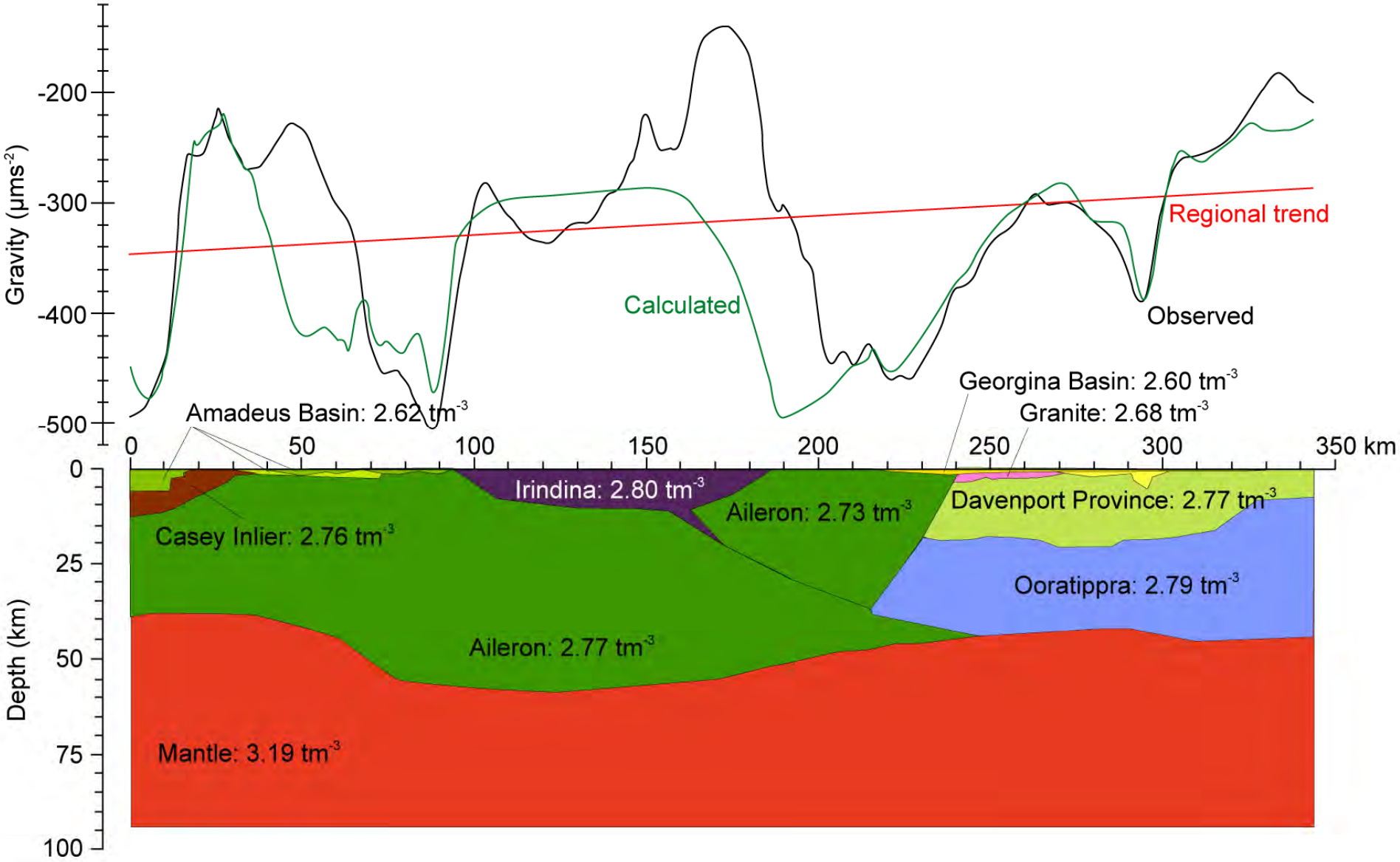
Forward modelling: ‘blank slate’



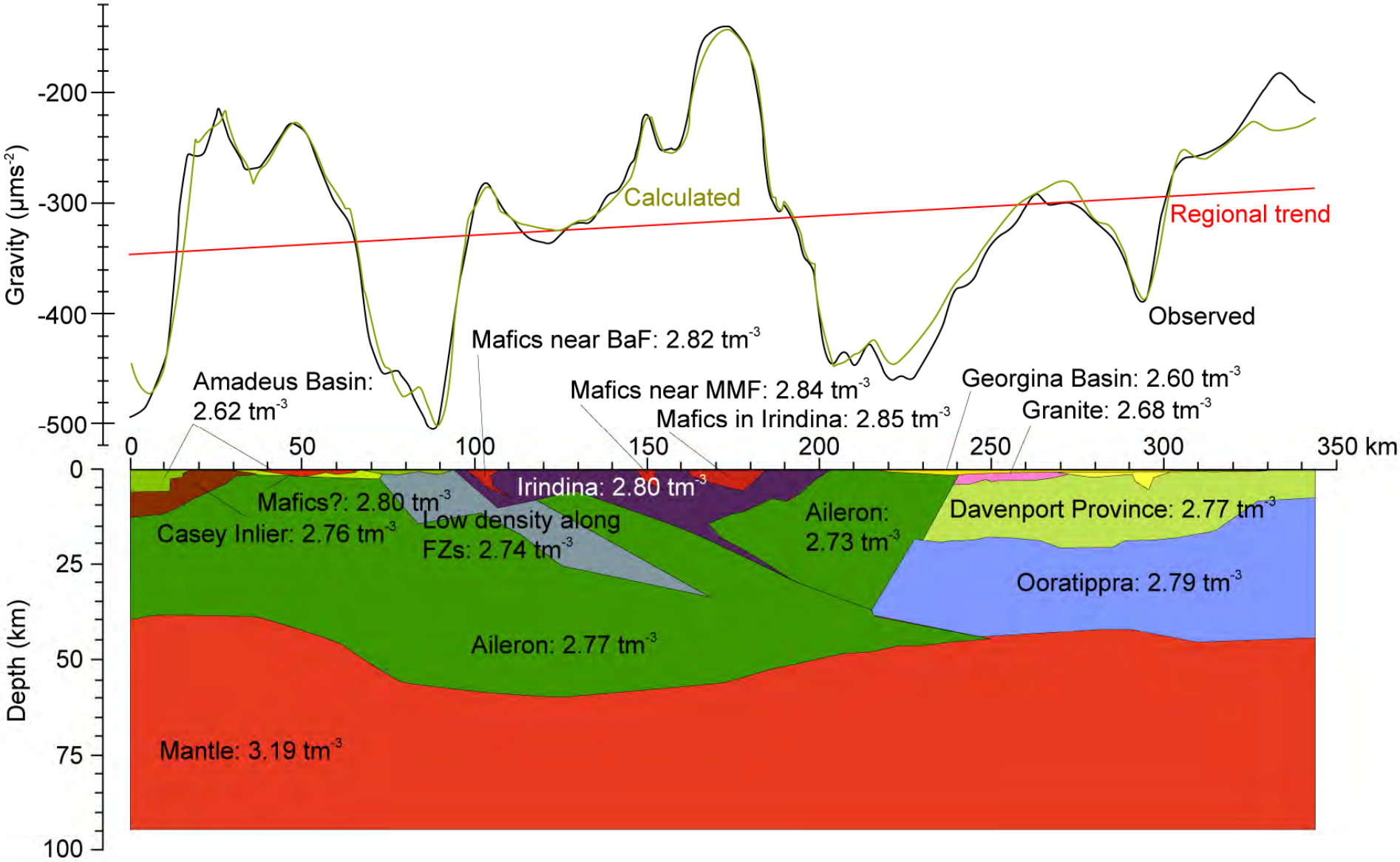
Forward modelling: 2 layer model



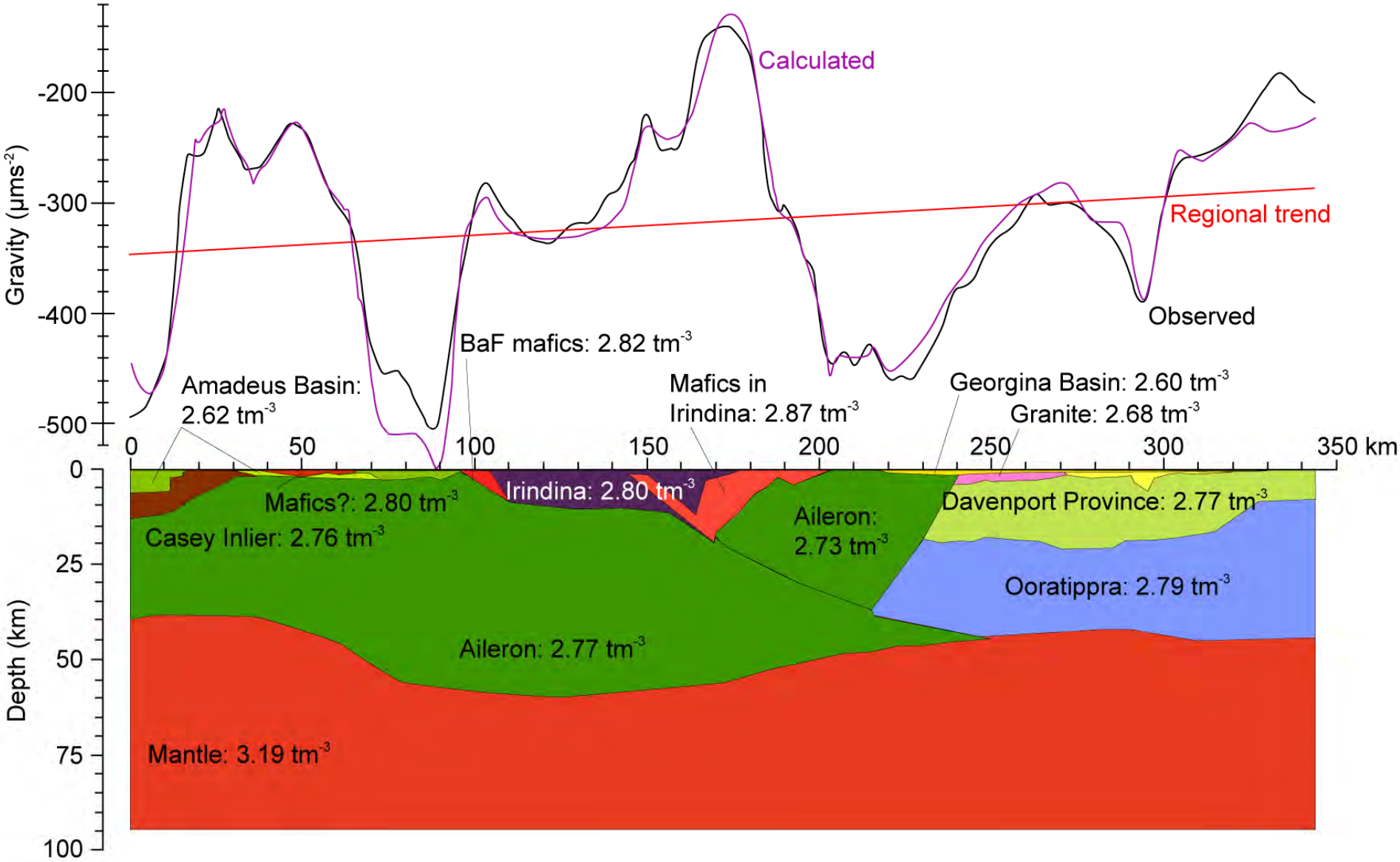
Forward modelling: initial fit to seismic



Forward modelling: hypothesis 1



Forward modelling: hypothesis 2



Forward modelling: conclusions

- General fit of seismic interpretation to observed gravity is good
- Refinements required to account for smaller-scale features such as mafic intrusions in the Irindina
  - Several geometries to these intrusions explain both the seismic and the gravity
- Incorporation of more detail in basins will help to refine geometries of these basins

Summary and conclusions

- 3D map of Georgina-Arunta provides context to seismic lines
- 3D map underpinned by many varied uses of potential-field data
  - Worming of data provides clues to geometries
  - Further geophysical processing assists interpretations away from seismic lines
  - Forward modelling confirms, refines and aids seismic interpretation