South Australia – Antarctica Conjugate Rifted Margins: Mapping Crustal Thickness & Lithosphere Thinning Using Satellite Gravity Inversion

Summary

Phase 1 – Maps: no sediments used
Phase 2 – Maps and cross-sections: sediments used

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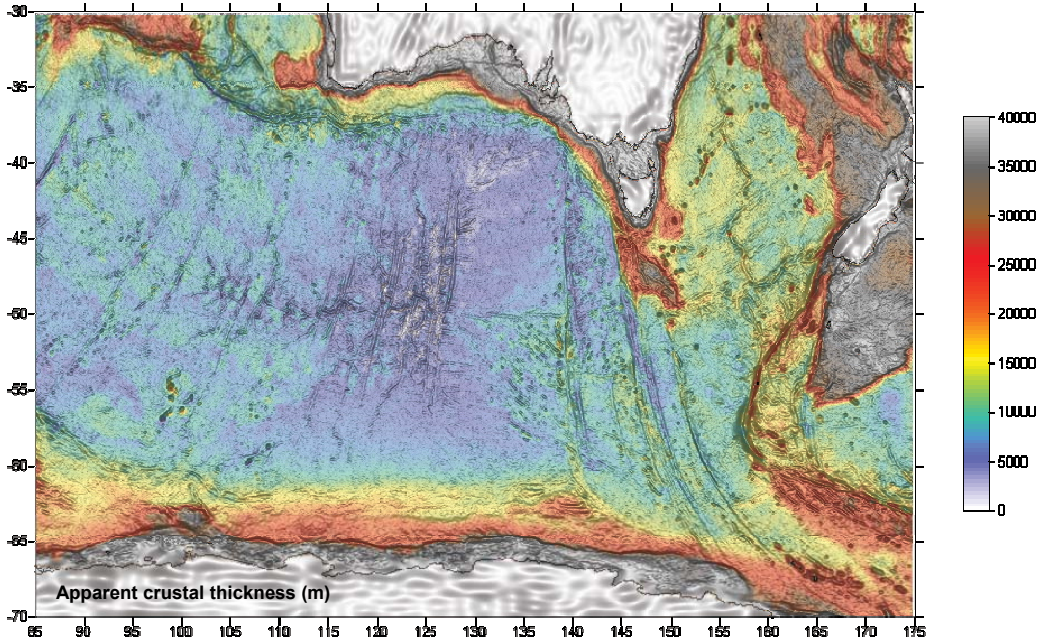
This report contains the results of research carried out by the author under contract to Geoscience Australia. Several grids resulting from this work are available for free download from Geoscience Australia web site (see last slide for more details).



S. Australia – Antarctica Conjugate Rifted Margins: Mapping Crustal Thickness & Lithosphere Thinning Using Satellite Gravity Inversion

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Gravity inversion including sediments (Phase 2)
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Sensitivity to oldest oceanic isochrons used to pre-determine oceanic lithosphere
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•Cross-sections

Summary

S. Australia – Antarctica Conjugate Rifted Margins: Gravity Inversion

Introduction

Crustal thickness, continental lithosphere thinning factor and residual continental crustal thickness have been determined for the South Australian and Antarctic conjugate rifted margins and adjacent oceanic regions using gravity inversion incorporating a lithosphere thermal gravity anomaly correction using the method of Greenhalgh & Kusznir (2007) and Chappell & Kusznir (2008). Satellite derived gravity anomaly data (Smith & Sandwell 1997), bathymetry data (Gebco 2003), sediment thickness data provided by Geoscience Australia and ocean isochron data (Mueller et al. 2003) have been used to derive the mantle residual gravity anomaly which is then inverted in the 3D spectral domain to give Moho depth. The region of investigation is contained within the coordinate limits 30° - 70°S and 85° – 175°E. Gravity inversion has been carried out for both thick and thin sediment thickness map grids provided by Geoscience Australia.

The results of the gravity inversion are shown in the form of: (i) maps of crustal basement thickness, continental lithosphere thinning factor and residual continental crustal thickness; and (ii) crustal cross-sections showing predicted Moho depth, and thicknesses of residual continental crust, volcanic addition and sediment for the South Australian and conjugate Antarctic continental margins. 32 regional 2D cross-sections have been constructed; 16 for each conjugate margin.

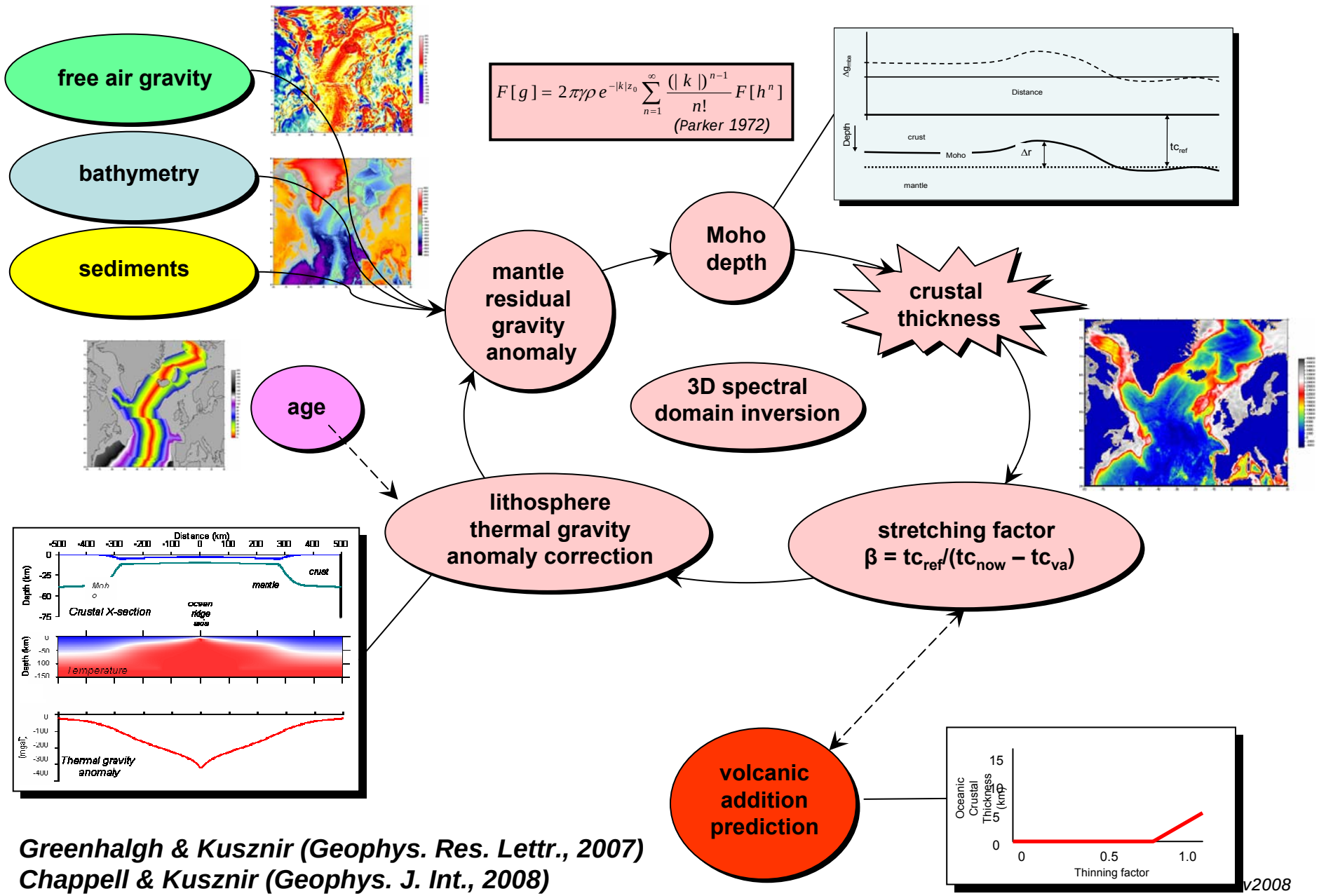
Thinning factor estimates determined from crustal thinning from gravity inversion require a volcanic addition correction. Parameterisations of volcanic addition as a function of lithosphere thinning factor ($1-1/\beta$) appropriate to magma-poor, normal and volcanic margins have been used in the gravity inversion. The sensitivity of predicted crustal thickness and lithosphere thinning factor from the gravity inversion to volcanic addition is shown in map form. Cross sections and maps have been determined using volcanic addition models appropriate to both “magma poor” and “normal” rifted continental margins.

Sensitivity tests of the gravity inversion results to reference crustal thickness have been carried out. Calibration against seismic refraction observations of Moho depth suggest that the reference crustal thickness is between 40 - 42.5 km on the S. Australian margin and between 37.5 – 40 km on the Antarctic conjugate margin.

Gravity inversion tests have also been carried out to examine the sensitivity of predicted crustal thickness and lithosphere thinning factor to breakup age and the age of the oldest oceanic isochrons used to condition the lithosphere thermal model. The preferred age of continental breakup used in the gravity inversion is 84 Ma. The preferred age of the oldest oceanic isochron used to condition the oceanic component of the lithosphere thermal model is 44 Ma and is chosen to avoid using the oldest isochrons against the ocean-continent transition which contain errors in both age and location, and which may prejudice the determination of ocean-continent transition using gravity inversion.

Sensitivity tests for sediment density and crustal basement density have also been carried out.

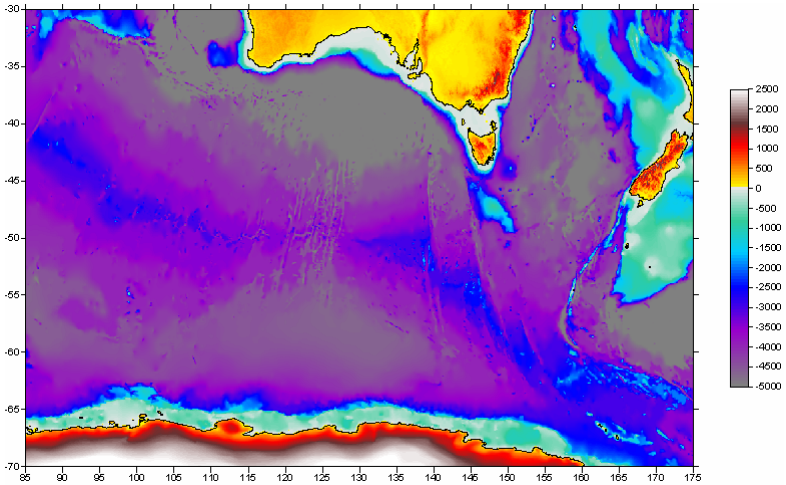
Rifted Margin Crustal Thickness & Thinning Factor from Gravity Inversion



Greenhalgh & Kusznir (Geophys. Res. Lettr., 2007)
Chappell & Kusznir (Geophys. J. Int., 2008)

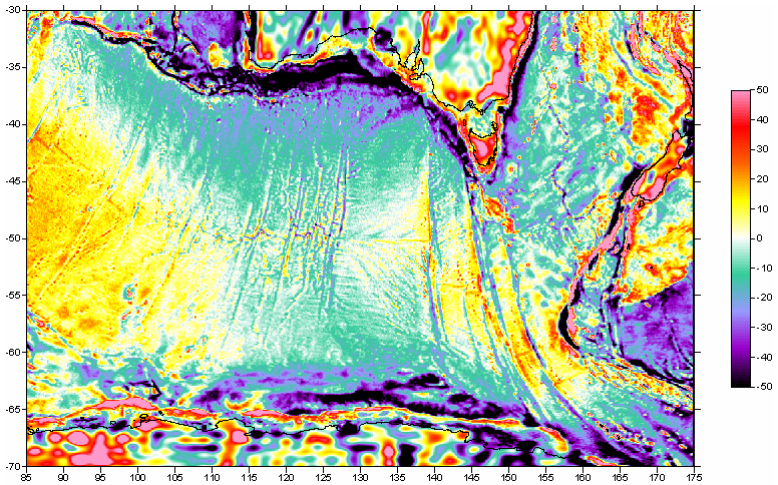
Gravity Inversion – Input Data

Bathymetry & Topography (m)



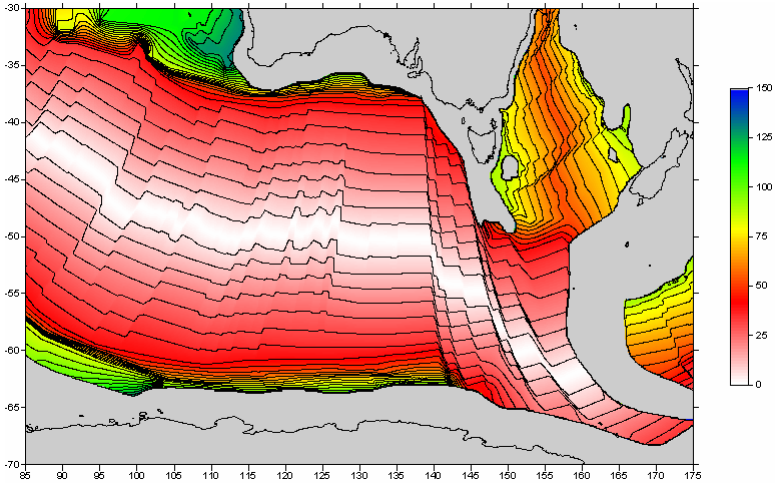
Gebco (2003)

Free Air Gravity Anomaly (mgal)



(Sandwell & Smith 1997)

Ocean Age (Ma)



Mueller et al. (1997)

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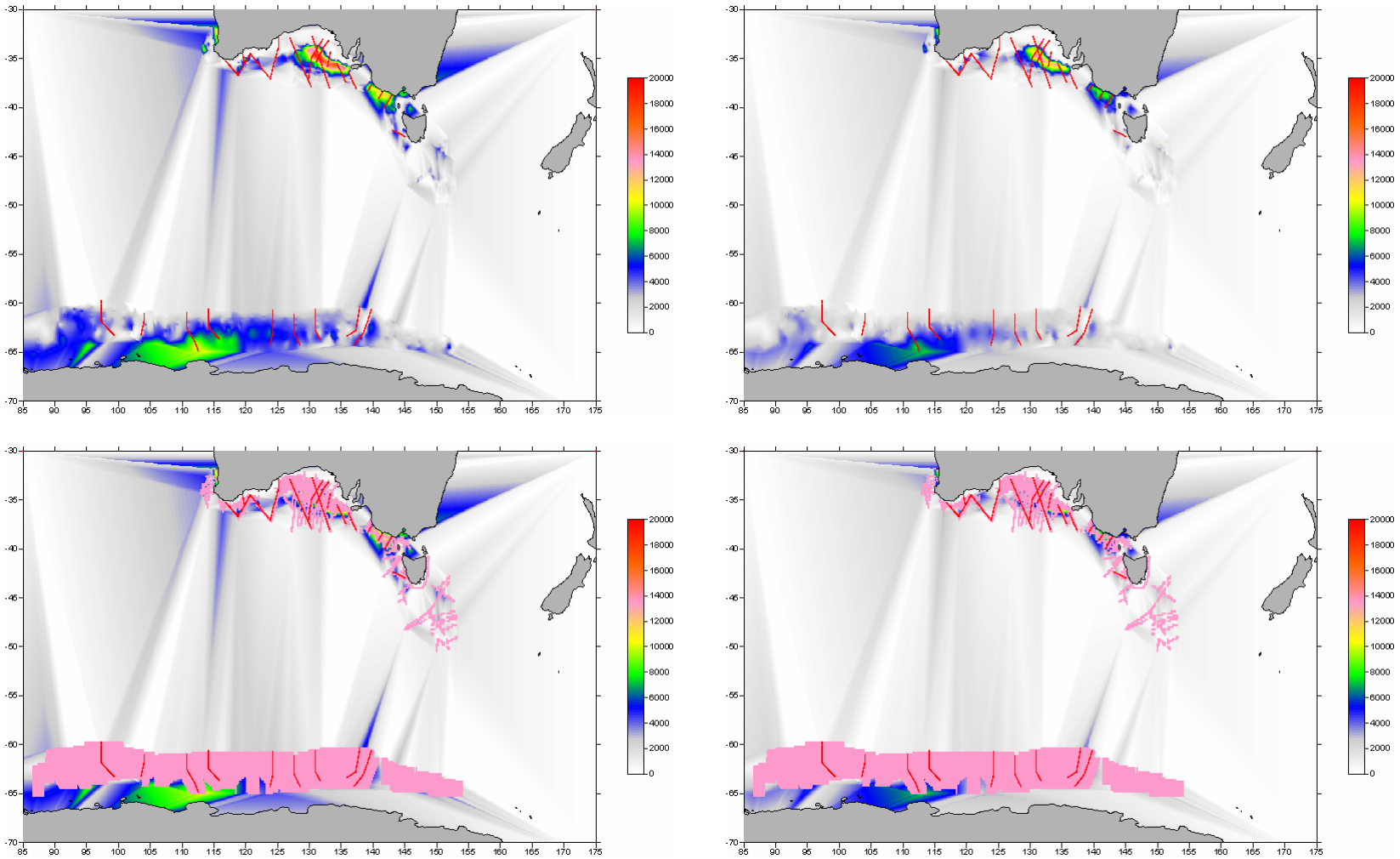
GA Sediment Thickness (m)

Thick estimate

Thin estimate



GA seismic grid coverage & velocity calibration lines superimposed

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S. Australia – Antarctica Conjugate Rifted Margins: Gravity Inversion

Inversion Parameters

- Low-cut Butterworth filter below λ = 100 km

- Lithosphere thermal gravity correction

- Breakup age = 84 Ma and sensitivities

- Oldest ocean isochrons = 44 Ma and sensitivities

- Thinning factor used to predict volcanic addition (oceanic crust and magmatic underplating)
    - "Magma poor" γ_{crit} = 0.7, ct_{ocean} = 0 km
    - Volcanic margin γ_{crit} = 0.5, ct_{ocean} = 10 km
    - "Normal" margin γ_{crit} = 0.7, ct_{ocean} = 7 km

- Reference crustal thickness (Ct_{ref})= 40 km and sensitivities

- Crustal density = 2850 km/m^3 and sensitivities

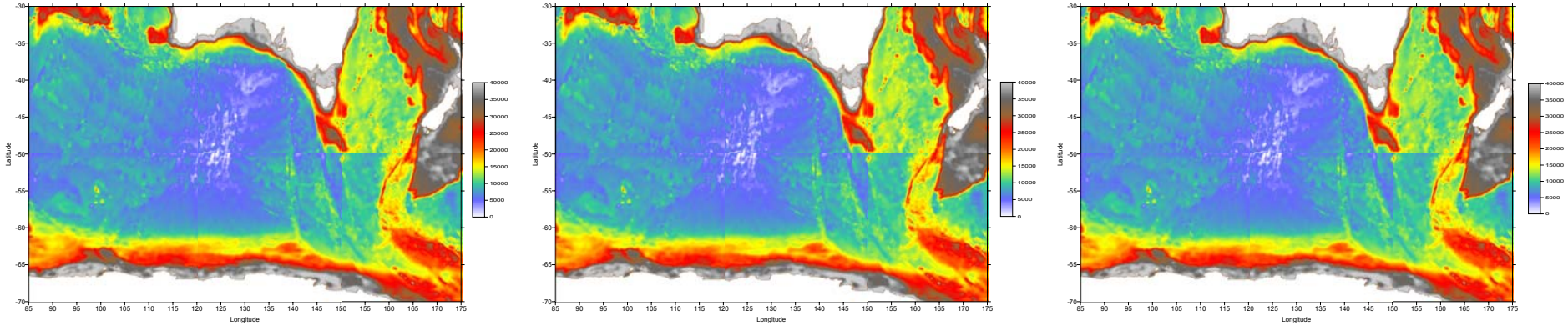
- Sediment gravity anomaly correction and sensitivities

S. Australia - Antarctica Rifted Margins - Gravity Inversion

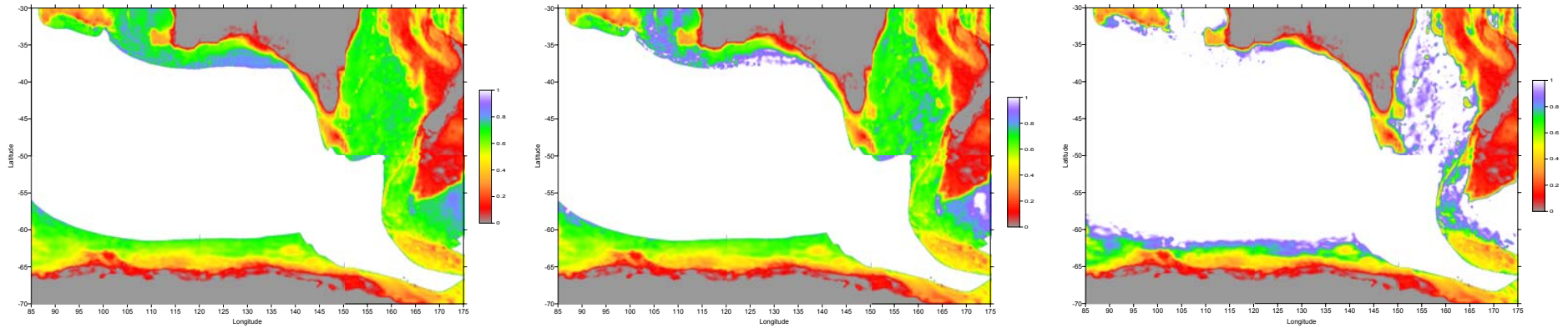
Sensitivity to Volcanic Addition

No sediments

Crustal thickness (m)



Continental Lithosphere Thinning Factor (1 – 1/β)



"Magma poor" margin
(ocean crust thickness = 0 km, γcrit = 0.7)

"Normal" volcanic addition margin
(ocean crust thickness = 7 km, γcrit = 0.7)

Volcanic margin
(ocean crust thickness = 10 km, γcrit = 0.5)

- Breakup age = 84 Ma
- Oldest isochron used = 44 Ma
- Lithosphere thermal correction on
- Reference crustal thickness = 40 km
- No sediments

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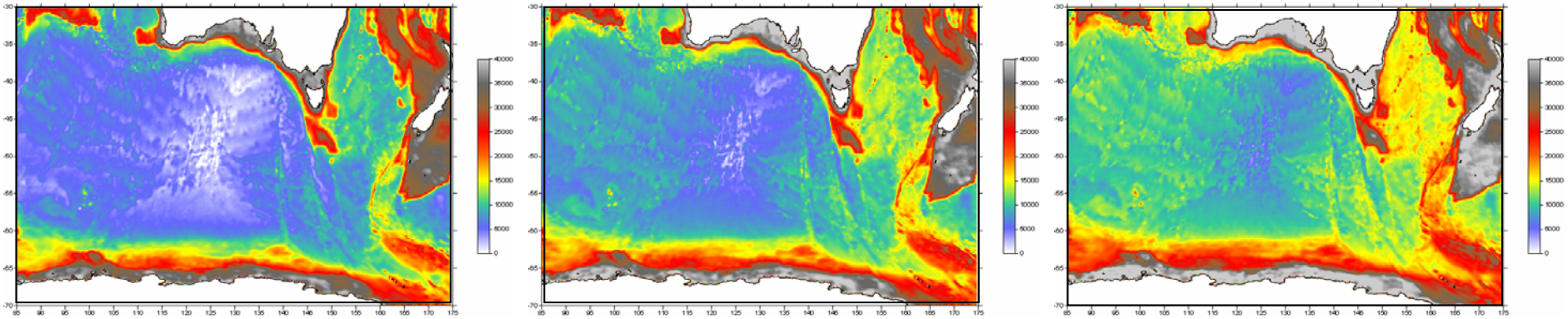
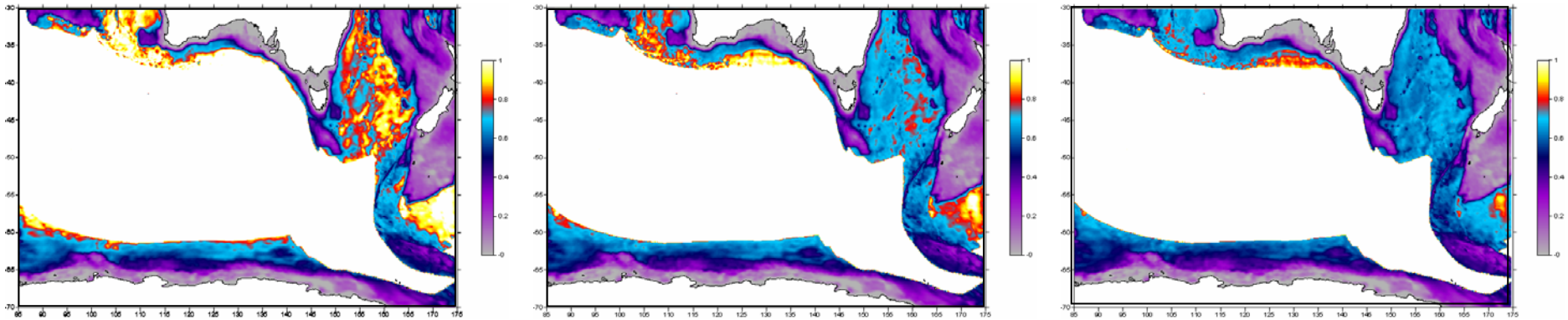
Sensitivity to Reference Crustal Thickness

No sediments

Crustal thickness (m)



Continental Lithosphere Thinning Factor (1 – 1/β)



Ref. crust thick = 37.5 km | Ref. crust thick = 40.0 km | Ref. crust thick = 42.5 km

- "Normal" volcanic addition margin (ocean crust thickness = 7 km, γ_{crit} = 0.7)
- Breakup age = 84 Ma
- Oldest isochron used = 44 Ma
- Lithosphere thermal correction on
- No sediments

Preferred value = 40.0 km

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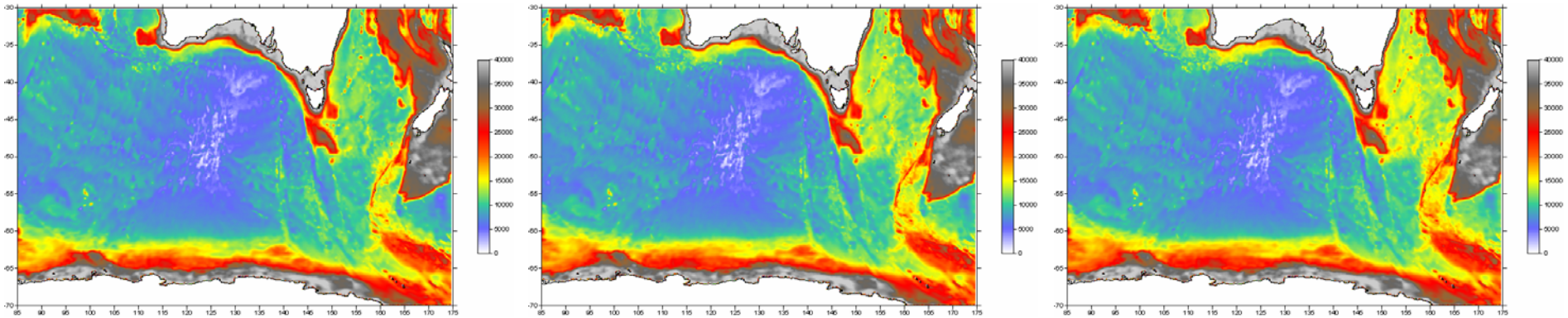
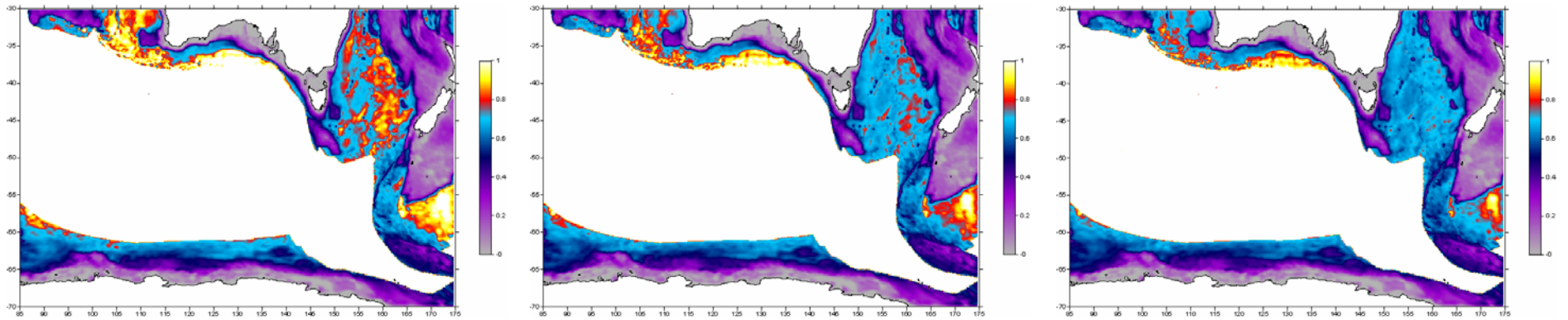
Sensitivity to Breakup Age

No sediments

Crustal thickness (m)



Continental Lithosphere Thinning Factor (1 – 1/β)



Breakup Age = 64 Ma | Breakup Age = 84 Ma | Breakup Age = 104 Ma

- "Normal" volcanic addition margin (ocean crust thickness = 7 km, γ_{crit} = 0.7)
- Oldest isochron used = 44 Ma
- Lithosphere thermal correction on
- Reference crustal thickness = 40 km
- No sediments

Preferred value = 84 Ma

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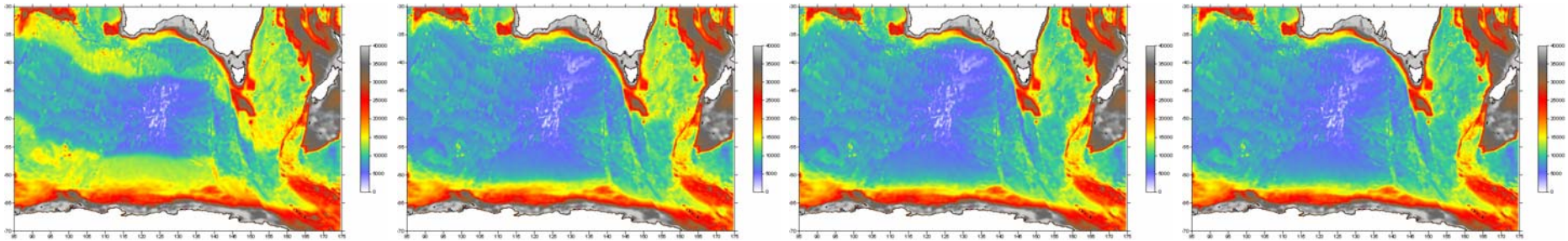
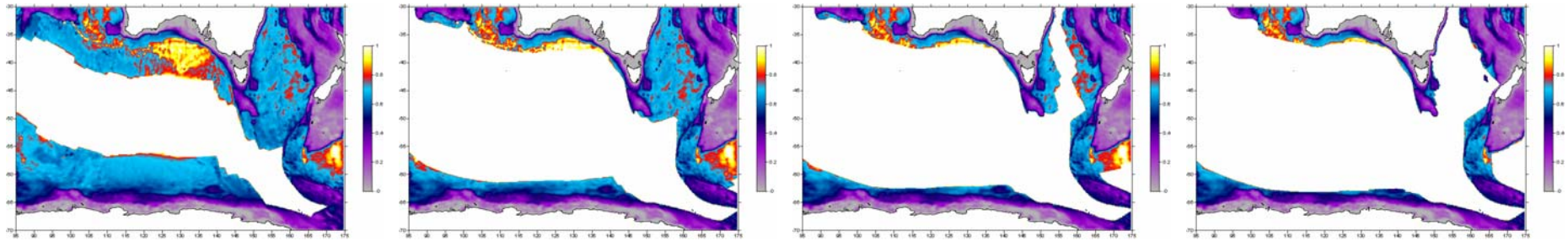
Sensitivity to oldest oceanic isochrons used to pre-determine oceanic lithosphere

Crustal thickness (m)



Continental Lithosphere Thinning Factor (1 – 1/β)



Oldest Isochron = 24 Ma | Oldest Isochron = 44 Ma | Oldest Isochron = 64 Ma | Oldest Isochron = 84 Ma

No sediments

- "Normal" volcanic addition margin (ocean crust thickness = 7 km, γ_{crit} = 0.7)
- Breakup age = 84 Ma
- Lithosphere thermal correction on
- Reference crustal thickness = 40 km
- No sediments

Preferred value = 44 Ma

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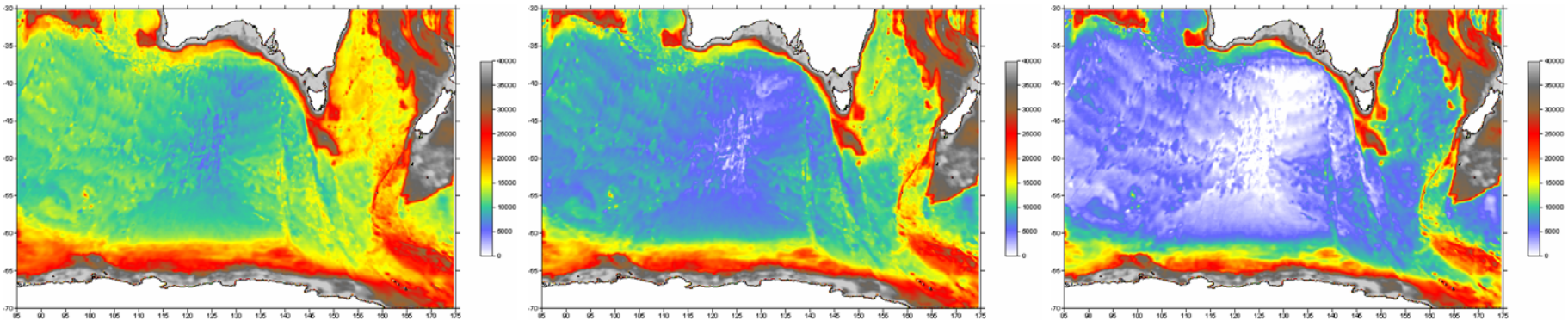
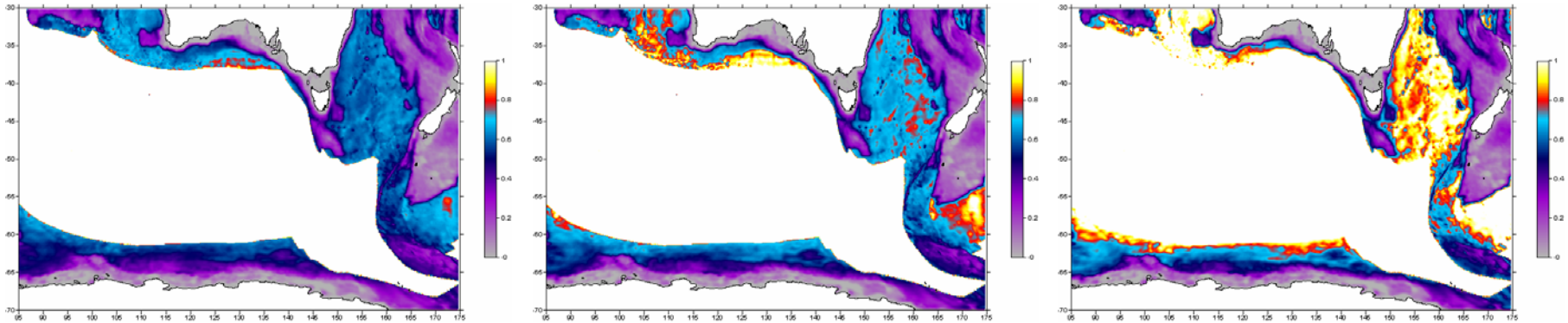
Sensitivity to crustal basement density

No sediments

Crustal thickness (m)



Continental Lithosphere Thinning Factor (1 – 1/β)



Density = 2800 kg/m^3 | Density = 2850 kg/m^3 | Density = 2900 kg/m^3

- "Normal" volcanic addition margin (ocean crust thickness = 7 km, γ_{crit} = 0.7)
- Breakup age = 84 Ma
- Oldest isochron used = 44 Ma
- Reference crustal thickness = 40 km
- Lithosphere thermal correction on
- No sediments

Preferred value = 2850 kg/m^3

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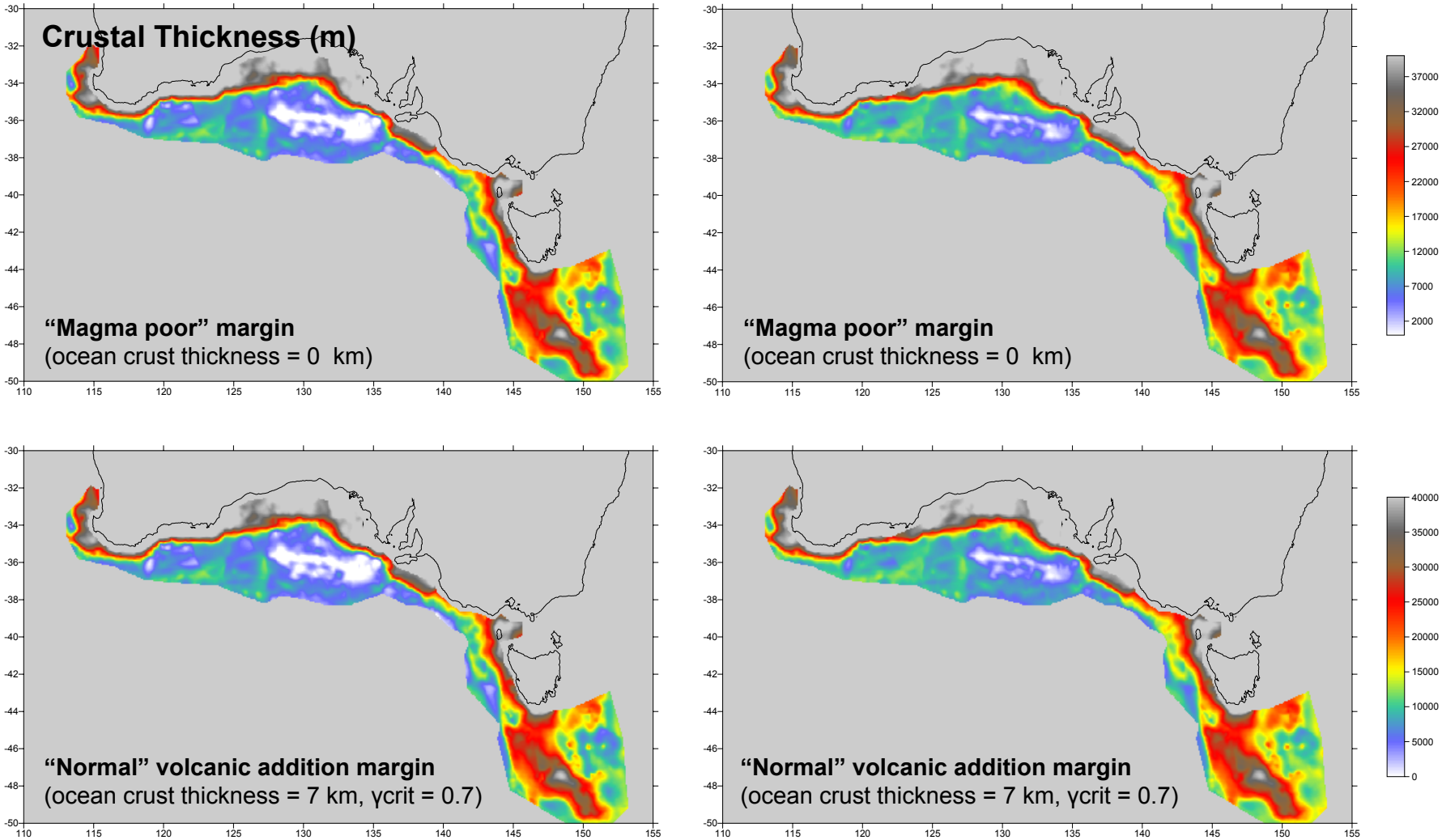
Sensitivity to volcanic addition

With sediments

Sediment thickness: thick estimate

Sediment thickness: thin estimate



- Breakup age = 84 Ma
- Oldest isochron used = 44 Ma
- Lithosphere thermal correction on
- Reference crustal thickness = 42.5 km
- Compaction control of sediment density

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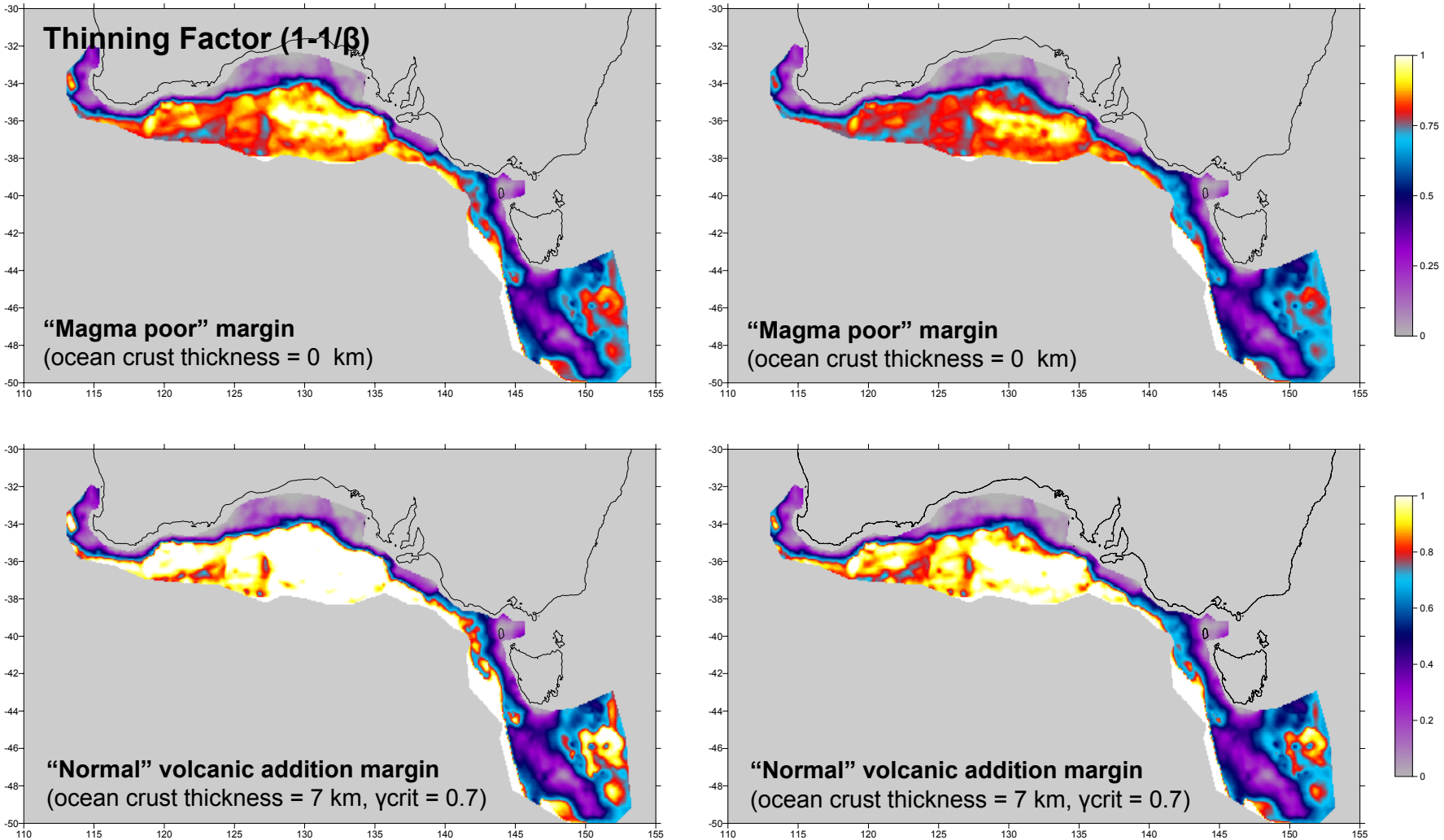
S. Australia - Antarctica Rifted Margins - Gravity Inversion

Sensitivity to volcanic addition

With sediments

Sediment thickness: thick estimate

Sediment thickness: thin estimate



- Breakup age = 84 Ma
- Oldest isochron used = 44 Ma
- Lithosphere thermal correction on
- Reference crustal thickness = 42.5 km
- Compaction control of sediment density

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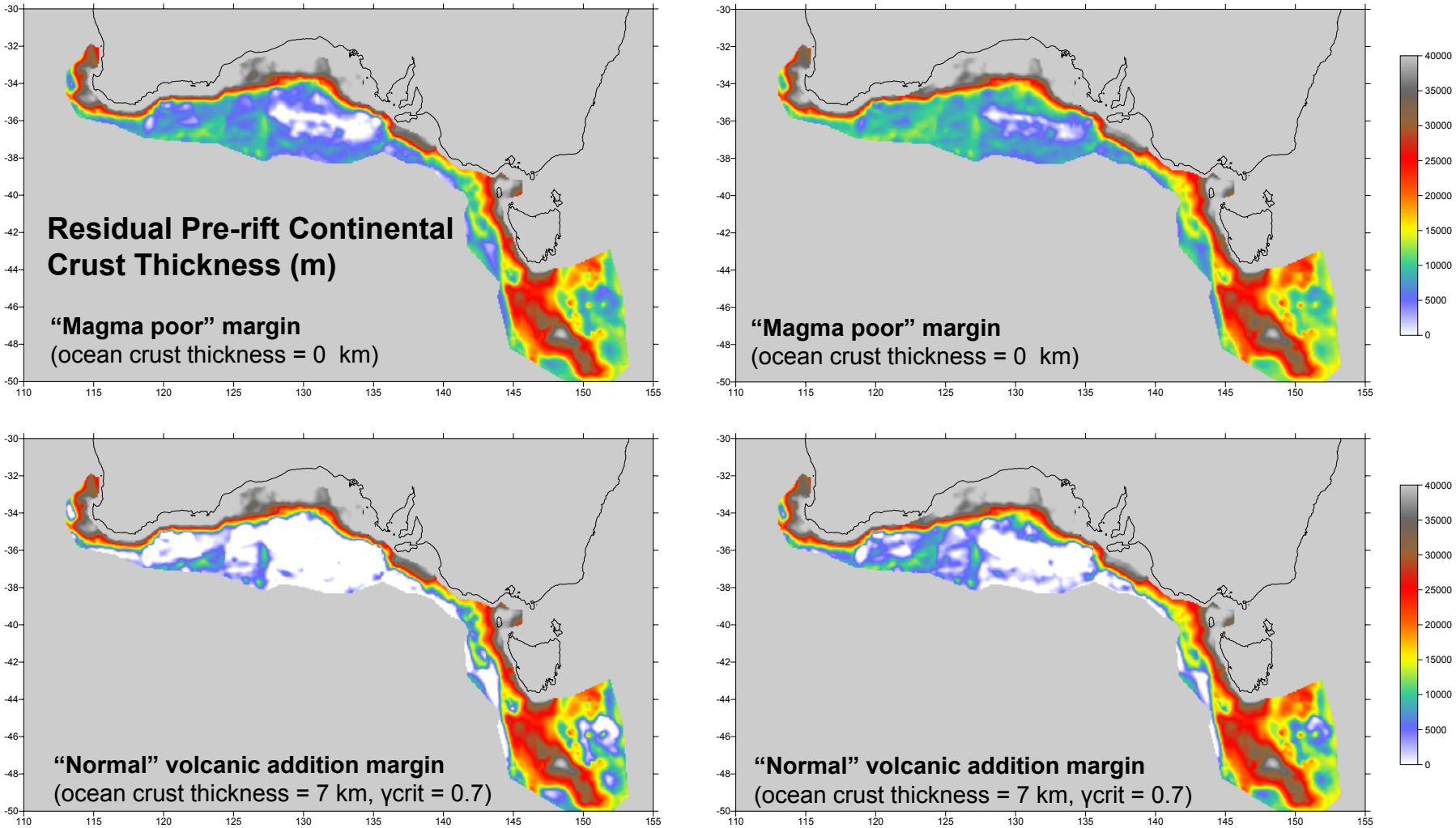
Sensitivity to volcanic addition

With sediments

Sediment thickness: thick estimate

Sediment thickness: thin estimate



- Breakup age = 84 Ma
- Oldest isochron used = 44 Ma
- Lithosphere thermal correction on
- Reference crustal thickness = 42.5 km
- Compaction control of sediment density

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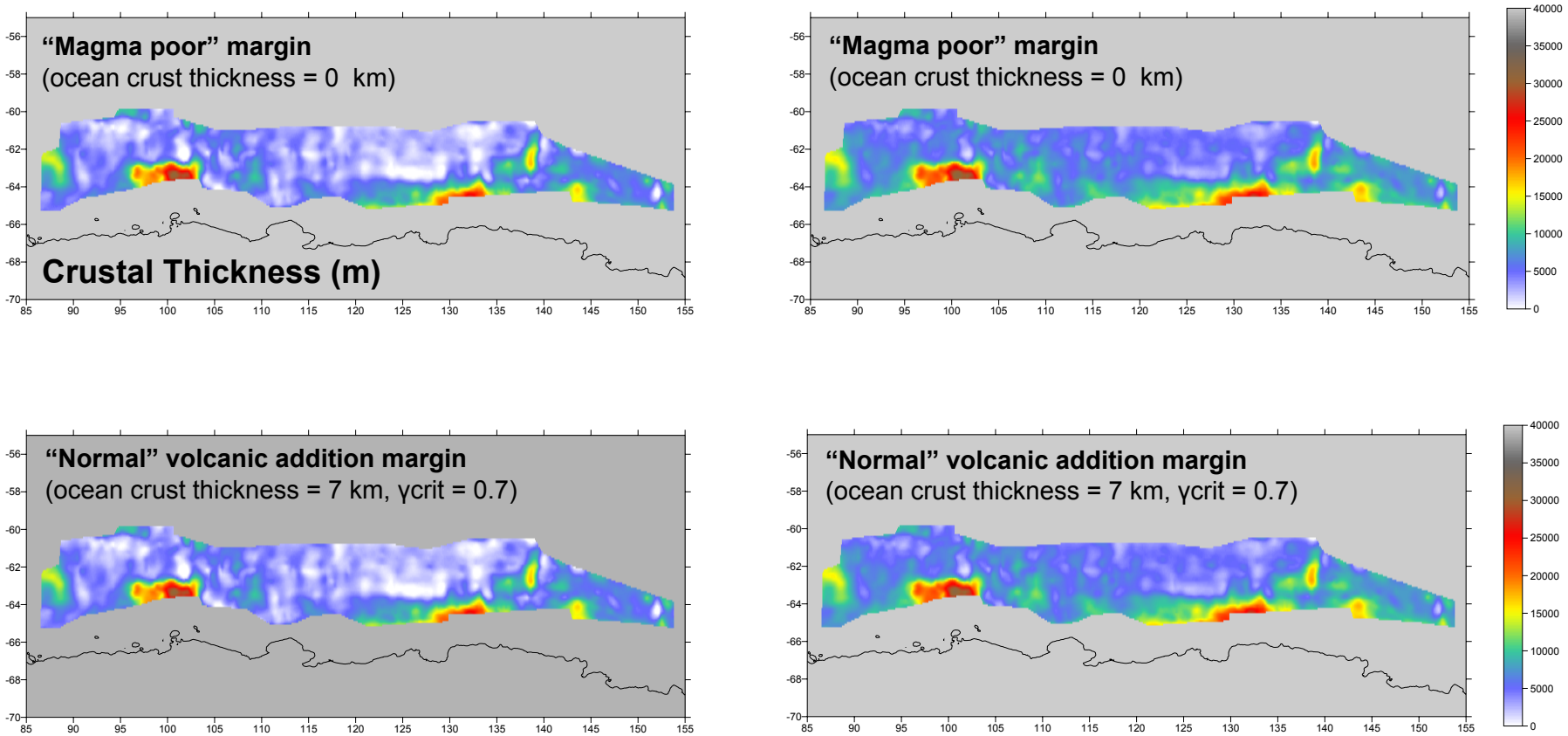
Sensitivity to volcanic addition

With sediments

Sediment thickness: thick estimate

Sediment thickness: thin estimate



- Breakup age = 84 Ma
- Oldest isochron used = 44 Ma
- Lithosphere thermal correction on
- Reference crustal thickness = 37.5 km
- Compaction control of sediment density

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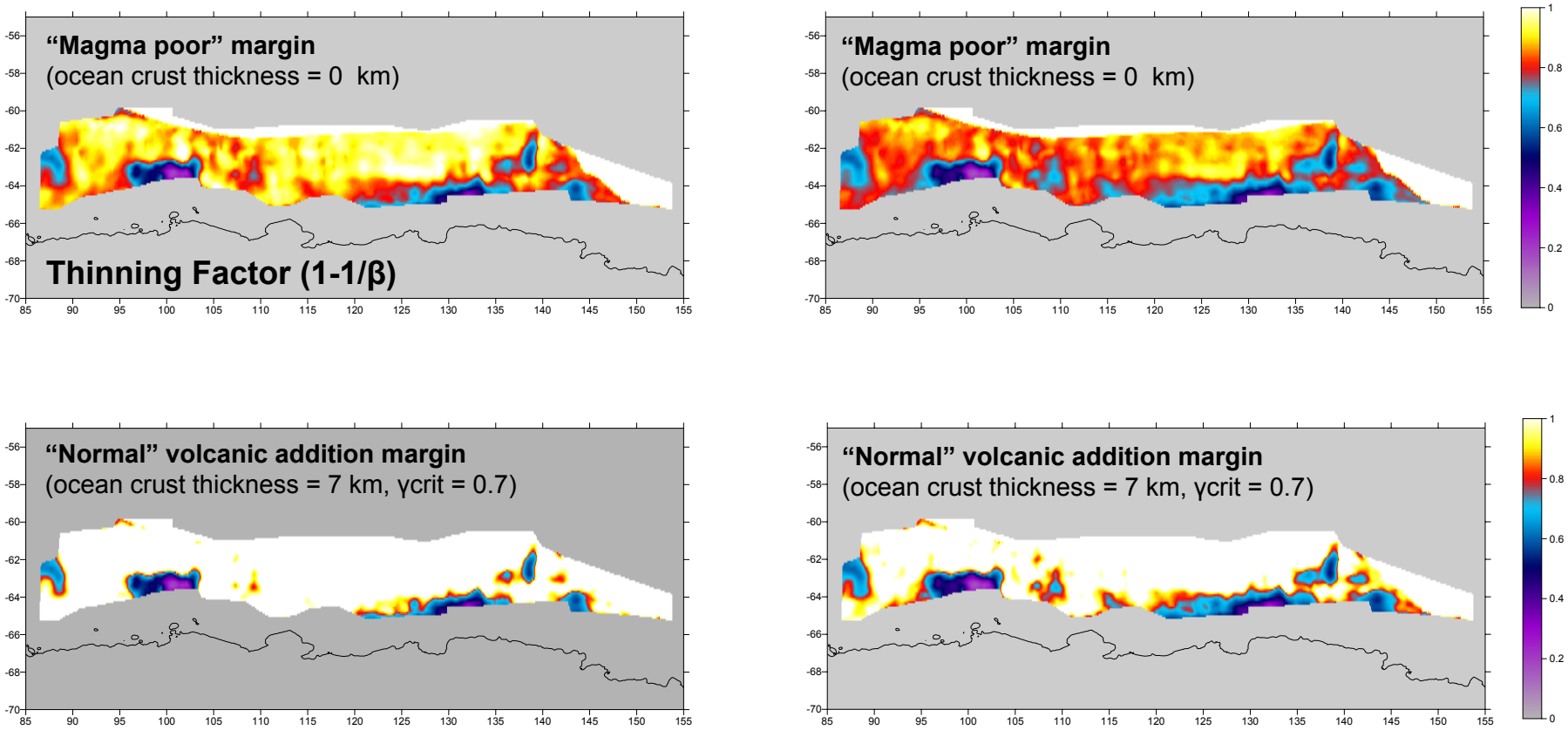
Sensitivity to volcanic addition

With sediments

Sediment thickness: thick estimate

Sediment thickness: thin estimate



- Breakup age = 84 Ma
- Oldest isochron used = 44 Ma
- Lithosphere thermal correction on
- Reference crustal thickness = 37.5 km
- Compaction control of sediment density

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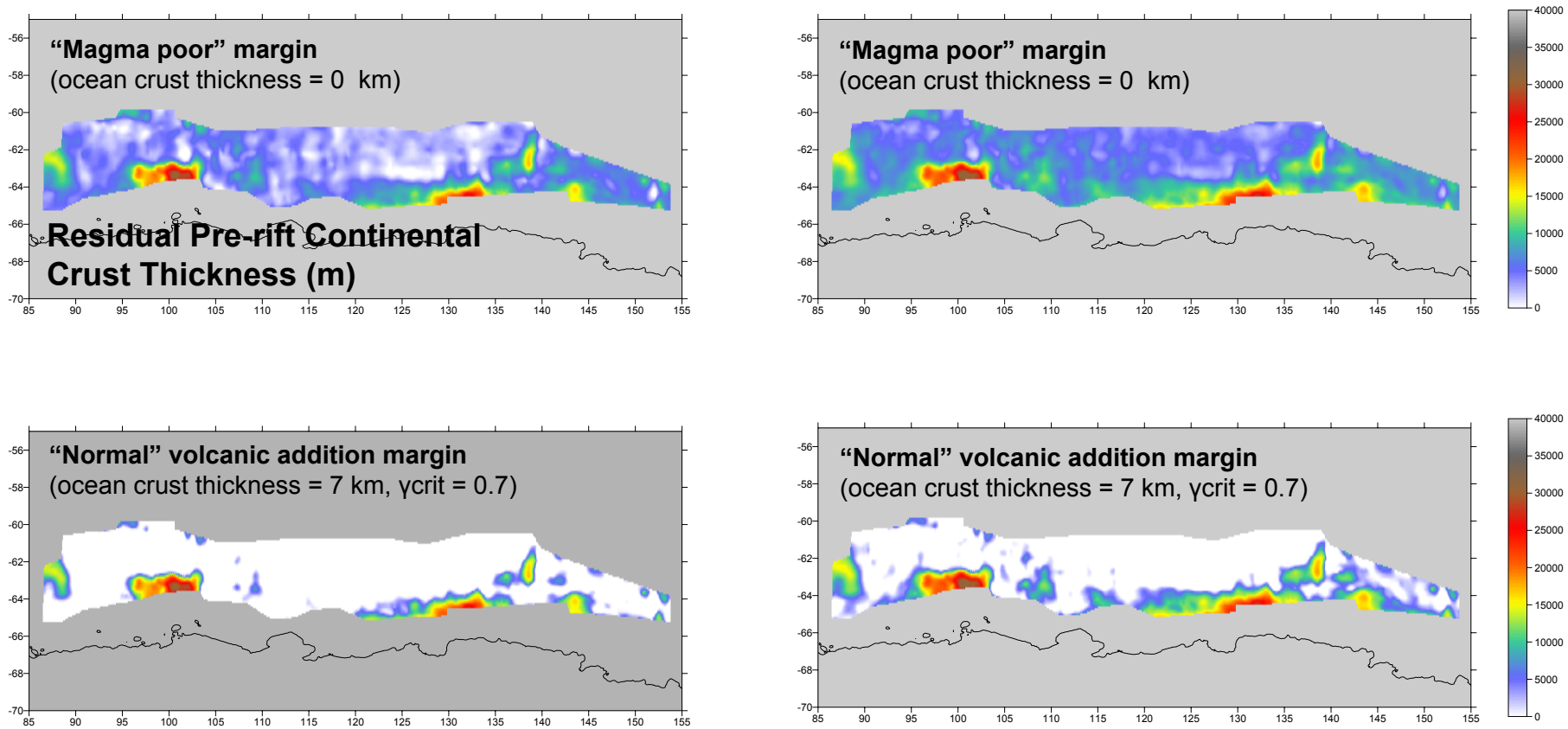
S. Australia - Antarctica Rifted Margins - Gravity Inversion

Sensitivity to volcanic addition

With sediments

Sediment thickness: thick estimate

Sediment thickness: thin estimate



- Breakup age = 84 Ma
- Oldest isochron used = 44 Ma
- Lithosphere thermal correction on
- Reference crustal thickness = 37.5 km
- Compaction control of sediment density

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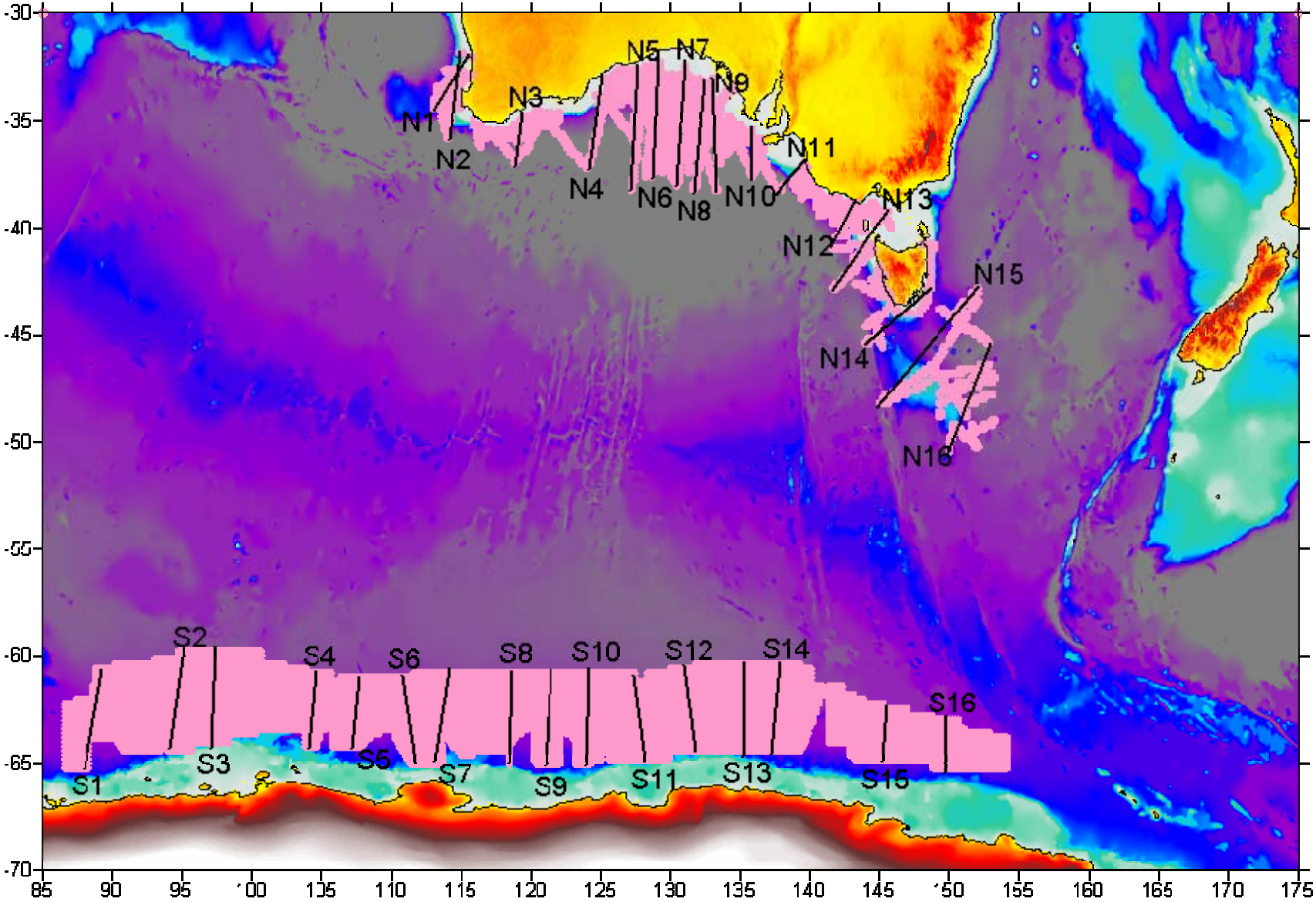
S. Australia - Antarctica Rifted Margins - Gravity Inversion



Extracted 2D cross-sections (black) from gravity inversion superimposed on seismic grid coverage (pink)

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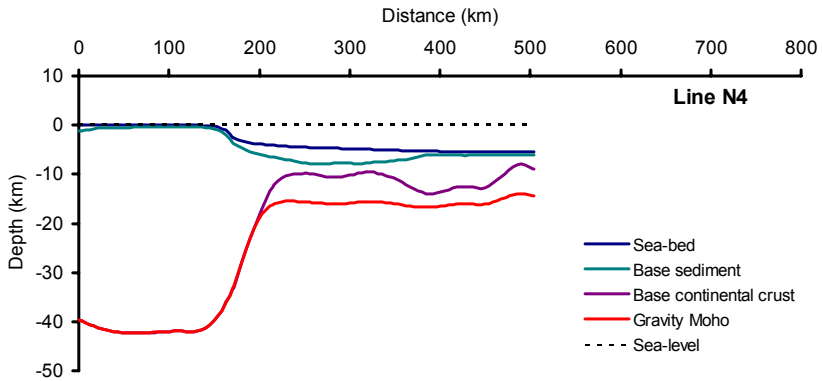
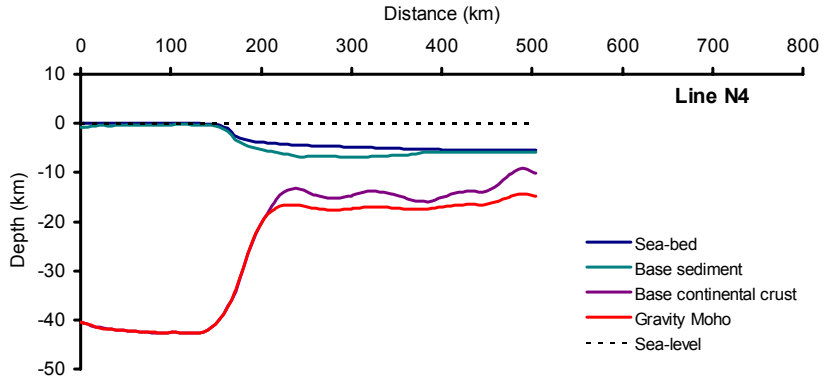
S. Australia - Antarctica Rifted Margins - Gravity Inversion

Sensitivity to volcanic addition

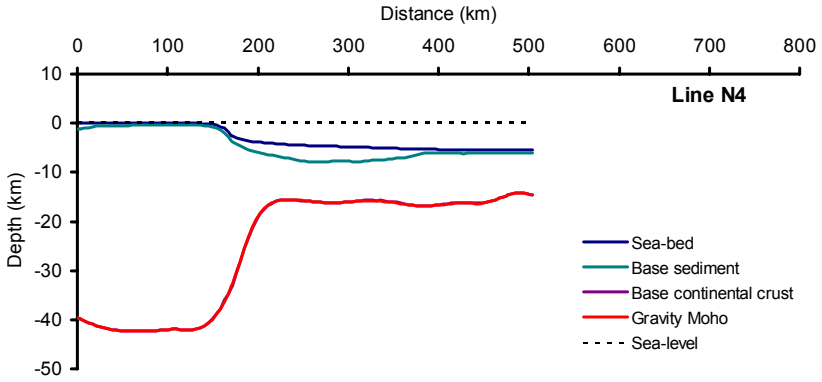
Sediment thickness: thick estimate

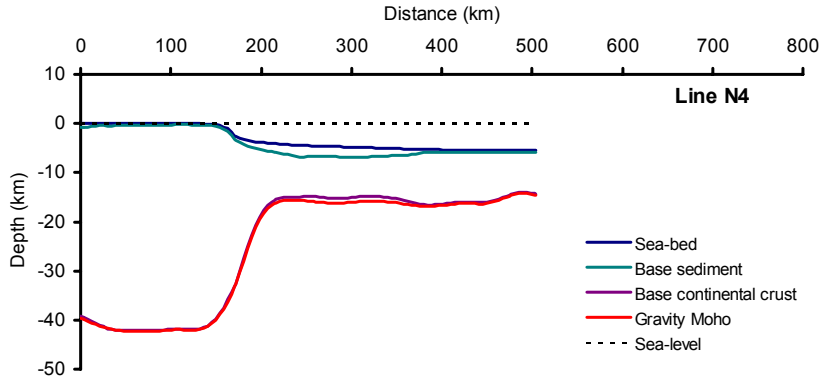


Sediment thickness: thin estimate



"Normal" volcanic addition margin (ocean crust thickness = 7 km, γcrit = 0.7)



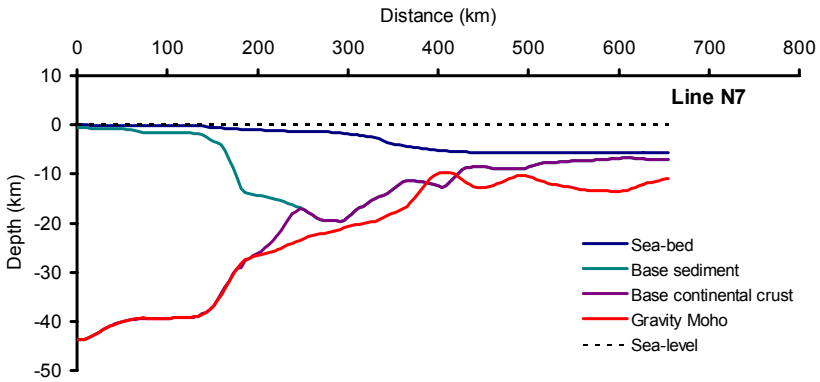


"Magma" poor margin (ocean crust thickness = 0 km)

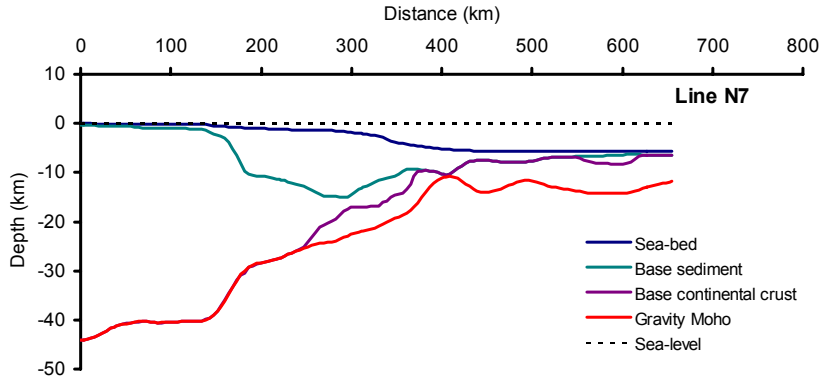
S. Australia - Antarctica Rifted Margins - Gravity Inversion

Sensitivity to volcanic addition

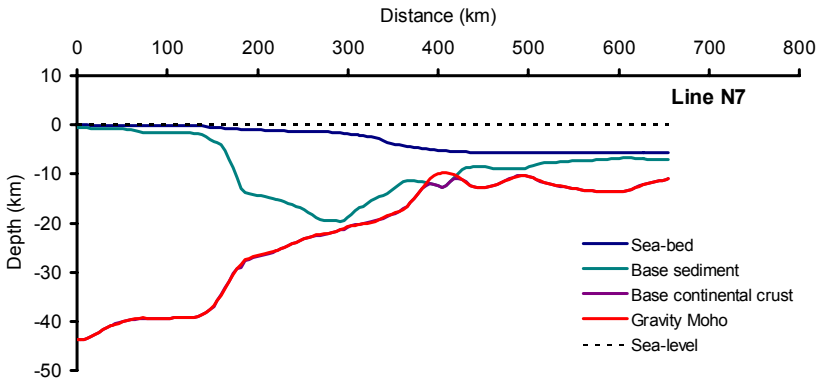
Sediment thickness: thick estimate

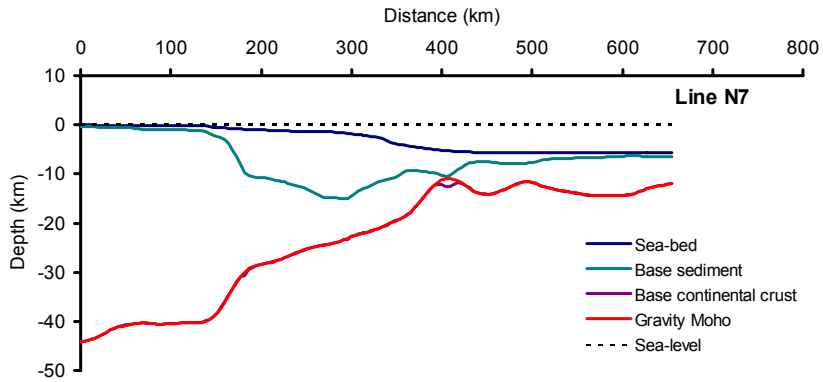


Sediment thickness: thin estimate



"Normal" volcanic addition margin (ocean crust thickness = 7 km, γcrit = 0.7)





"Magma" poor margin (ocean crust thickness = 0 km)

- Breakup age = 84 Ma
- Oldest isochron used = 44 Ma
- Lithosphere thermal correction on
- Reference crustal thickness = 42.5 km
- Compaction control of sediment density

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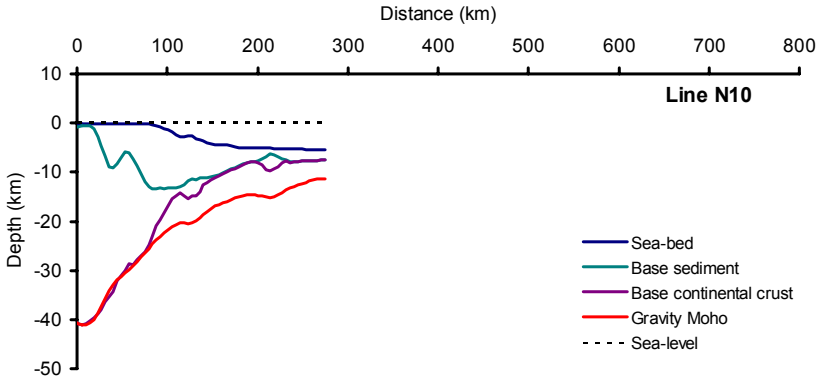
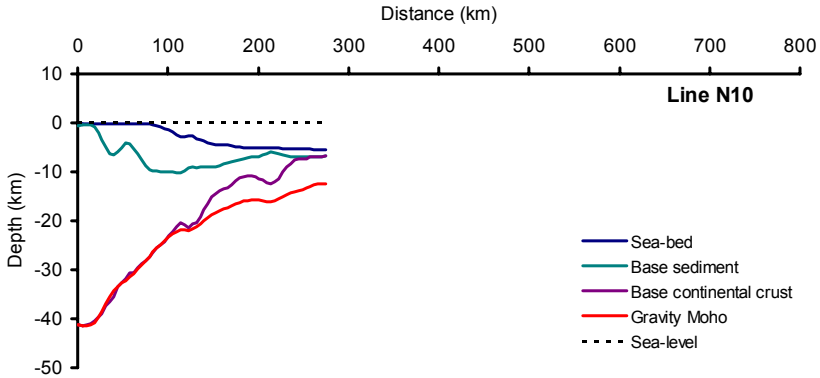
Sensitivity to volcanic addition

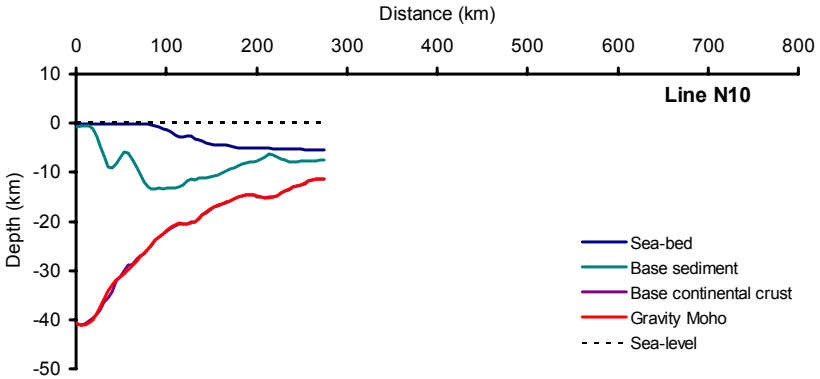
Sediment thickness: thick estimate

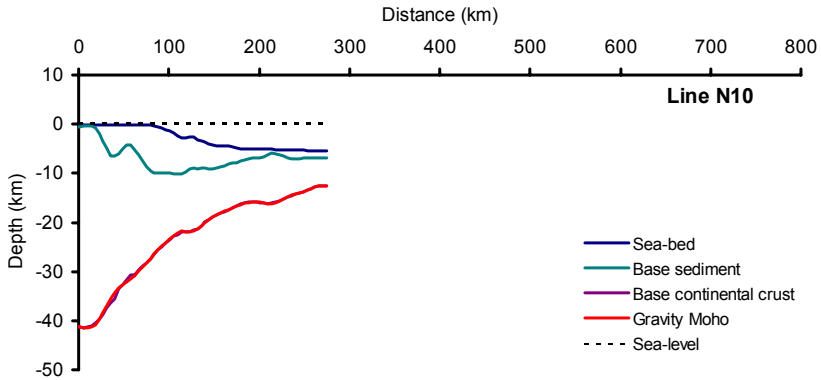


Sediment thickness: thin estimate



"Normal" volcanic addition margin (ocean crust thickness = 7 km, γcrit = 0.7)





"Magma" poor margin (ocean crust thickness = 0 km)

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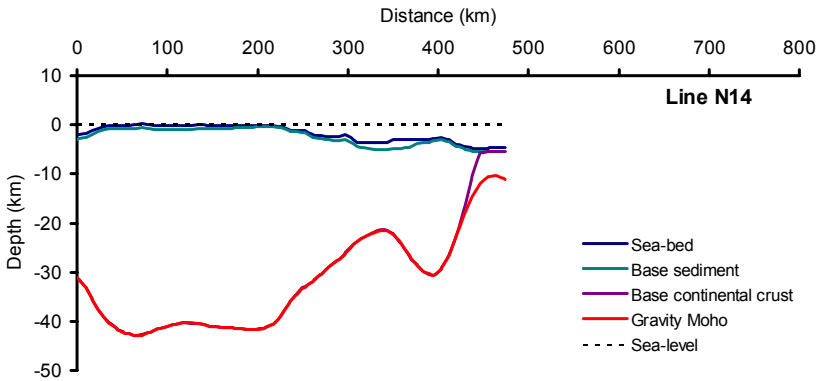
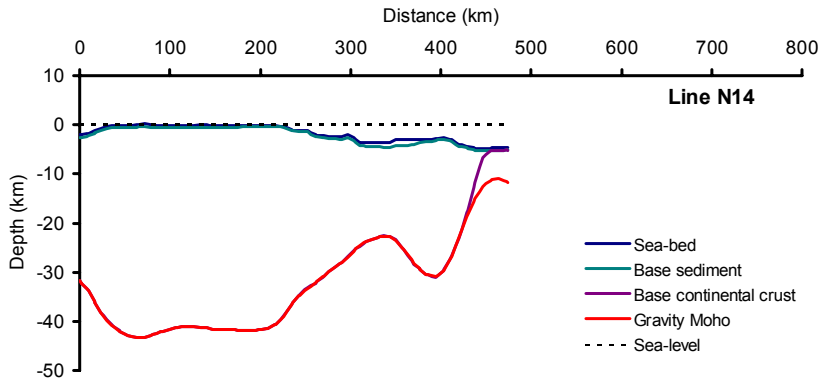
S. Australia - Antarctica Rifted Margins - Gravity Inversion

Sensitivity to volcanic addition

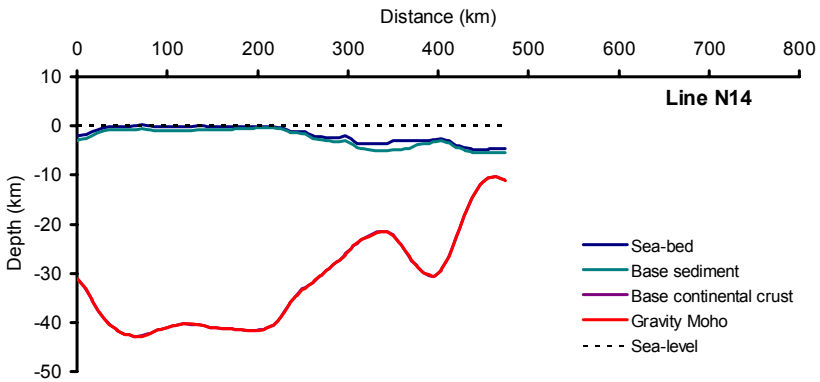
Sediment thickness: thick estimate

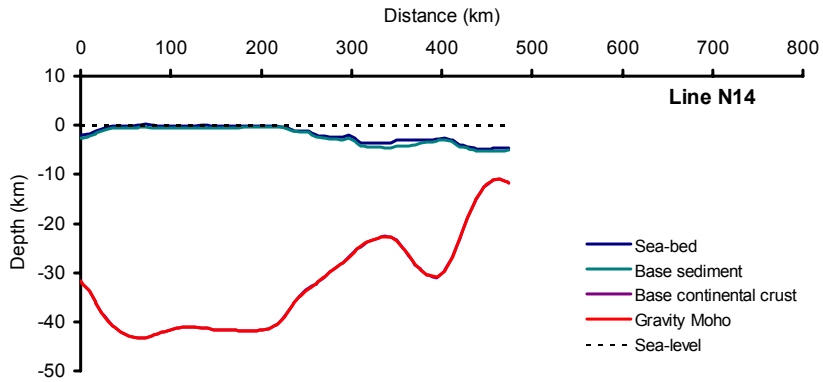


Sediment thickness: thin estimate



"Normal" volcanic addition margin (ocean crust thickness = 7 km, γcrit = 0.7)





"Magma" poor margin (ocean crust thickness = 0 km)

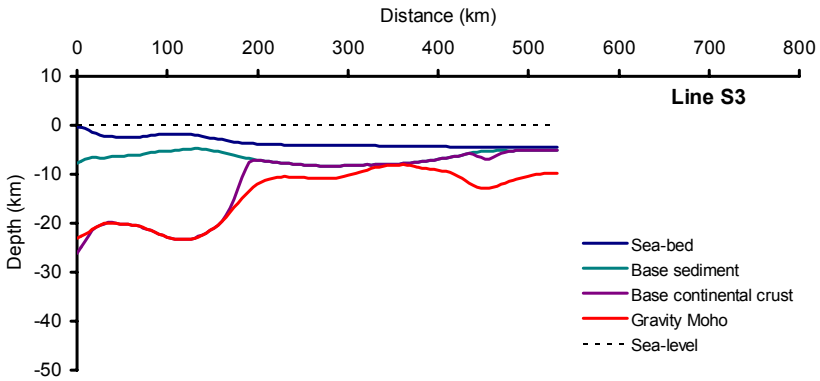
- Breakup age = 84 Ma
- Oldest isochron used = 44 Ma
- Lithosphere thermal correction on
- Reference crustal thickness = 42.5 km
- Compaction control of sediment density

NJK/Nov2008

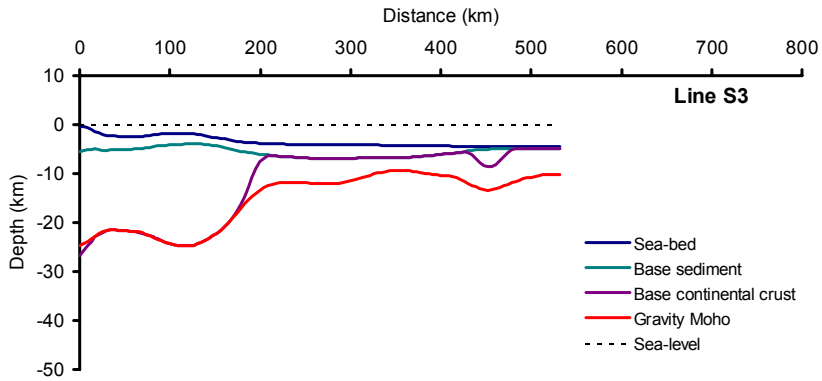
S. Australia - Antarctica Rifted Margins - Gravity Inversion

Sensitivity to volcanic addition

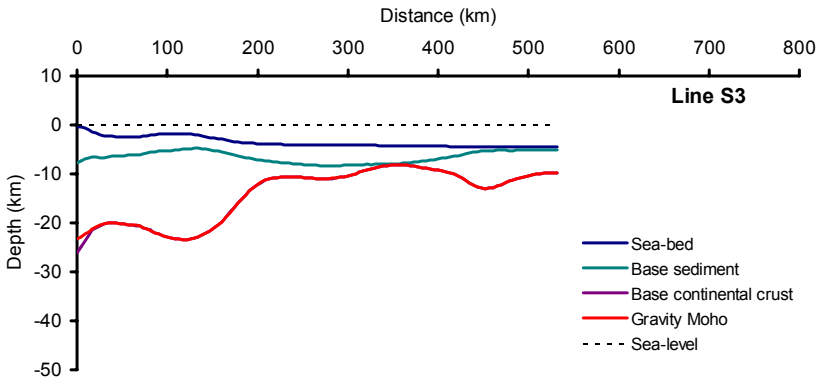
Sediment thickness: thick estimate

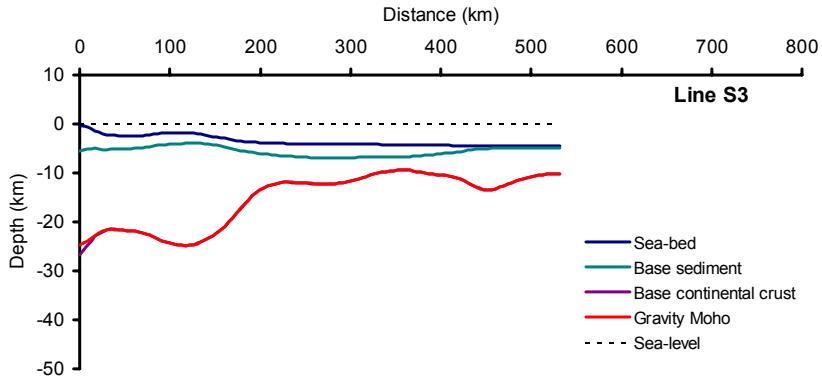


Sediment thickness: thin estimate



"Normal" volcanic addition margin (ocean crust thickness = 7 km, γcrit = 0.7)





"Magma" poor margin (ocean crust thickness = 0 km)

- Breakup age = 84 Ma
- Oldest isochron used = 44 Ma
- Lithosphere thermal correction on
- Reference crustal thickness = 37.5 km
- Compaction control of sediment density

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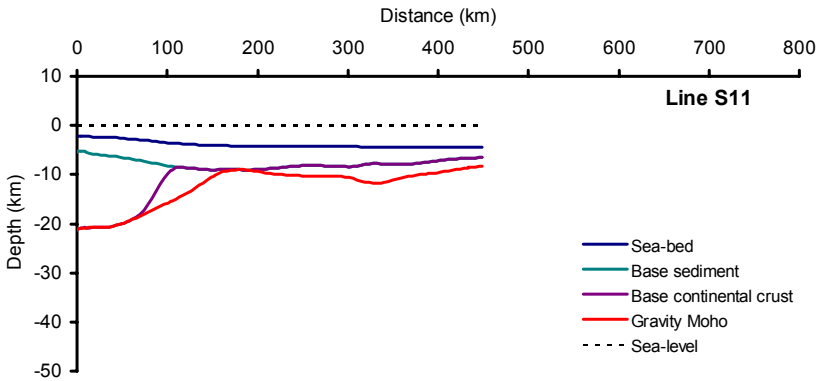
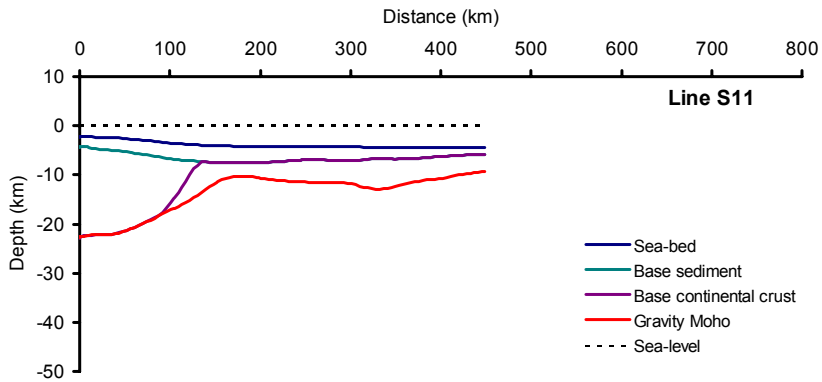
S. Australia - Antarctica Rifted Margins - Gravity Inversion

Sensitivity to volcanic addition

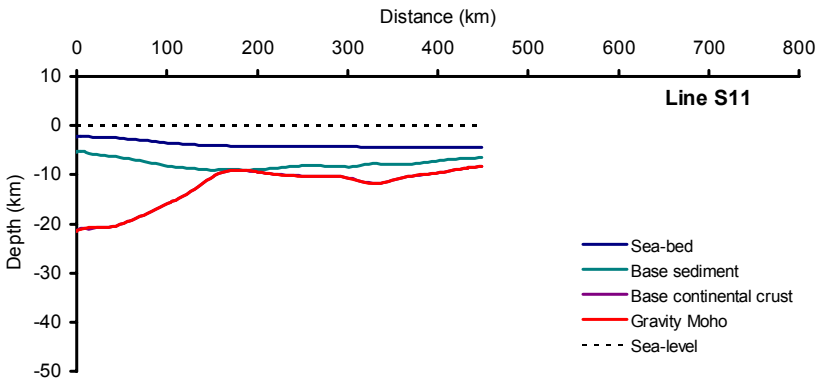
Sediment thickness: thick estimate

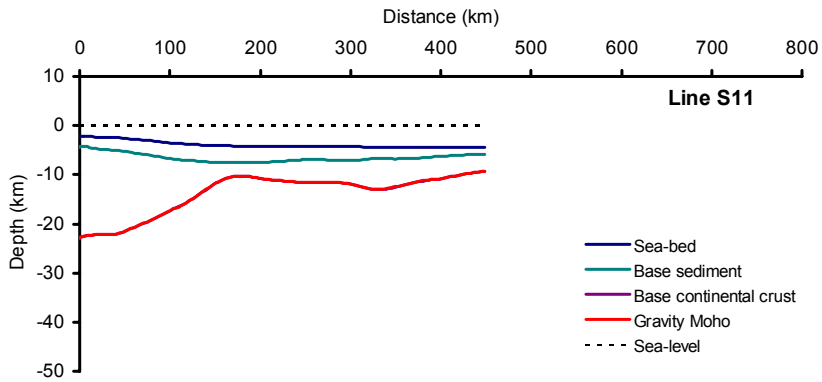


Sediment thickness: thin estimate



"Normal" volcanic addition margin (ocean crust thickness = 7 km, γcrit = 0.7)





"Magma" poor margin (ocean crust thickness = 0 km)

- Breakup age = 84 Ma
- Oldest isochron used = 44 Ma
- Lithosphere thermal correction on
- Reference crustal thickness = 37.5 km
- Compaction control of sediment density

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S. Australia - Antarctica Rifted Margins - Gravity Inversion

Sensitivity to reference crustal thickness

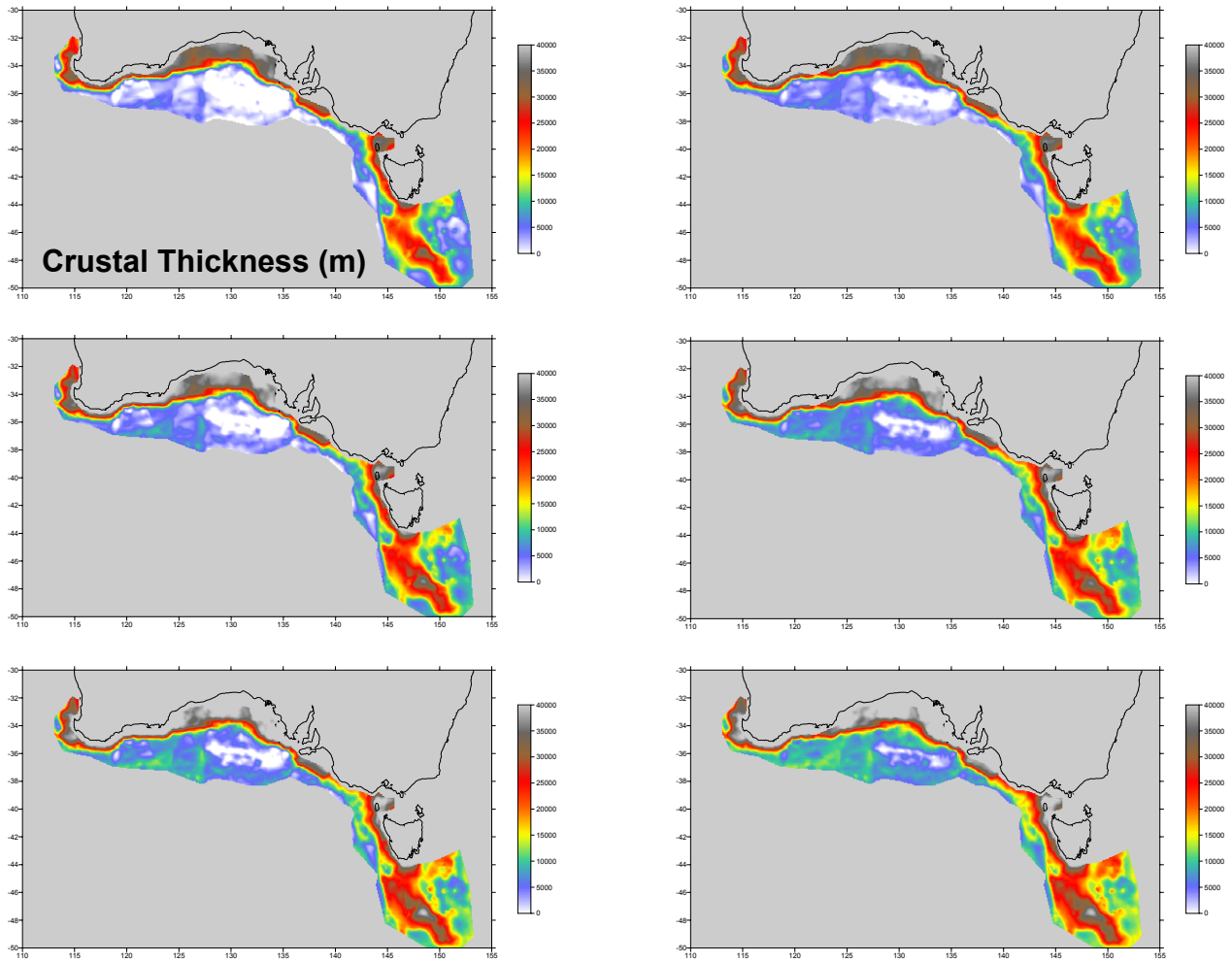
Sediment thickness: thick estimate

Sediment thickness: thin estimate

Ct_{ref} = 37.5 km

Ct_{ref} = 40 km

Ct_{ref} = 42.5 km



- "Normal" volcanic addition margin (ocean crust thickness = 7 km, γ_{crit} = 0.7)
- Breakup age = 84 Ma
- Oldest isochron used = 44 Ma
- Lithosphere thermal correction on

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S. Australia - Antarctica Rifted Margins - Gravity Inversion

Sensitivity to reference crustal thickness

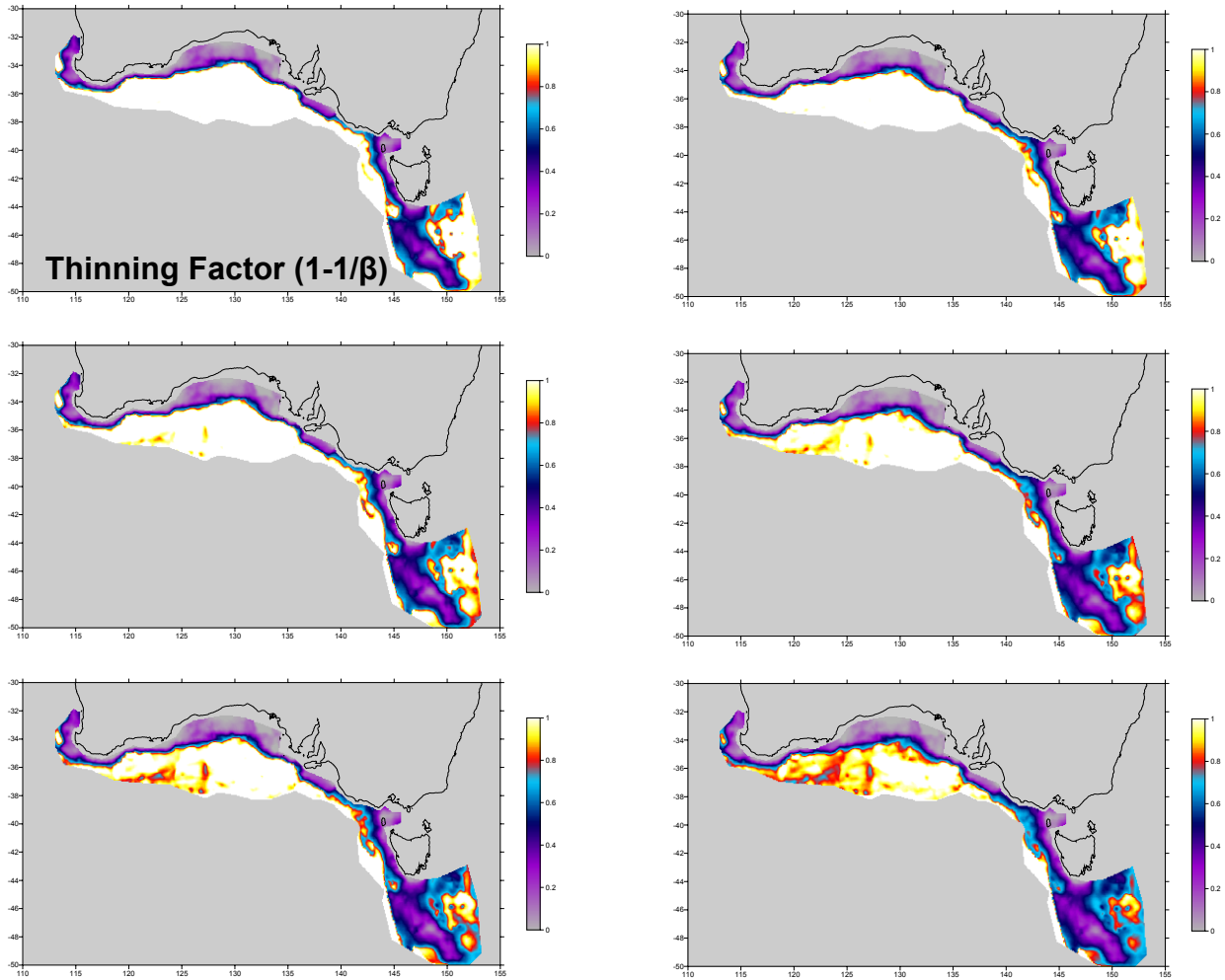
Sediment thickness: thick estimate

Sediment thickness: thin estimate

Ct_{ref} = 37.5 km

Ct_{ref} = 40 km

Ct_{ref} = 42.5 km



- "Normal" volcanic addition margin (ocean crust thickness = 7 km, γ_{crit} = 0.7)
- Breakup age = 84 Ma
- Oldest isochron used = 44 Ma
- Lithosphere thermal correction on

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S. Australia - Antarctica Rifted Margins - Gravity Inversion

Sensitivity to reference crustal thickness

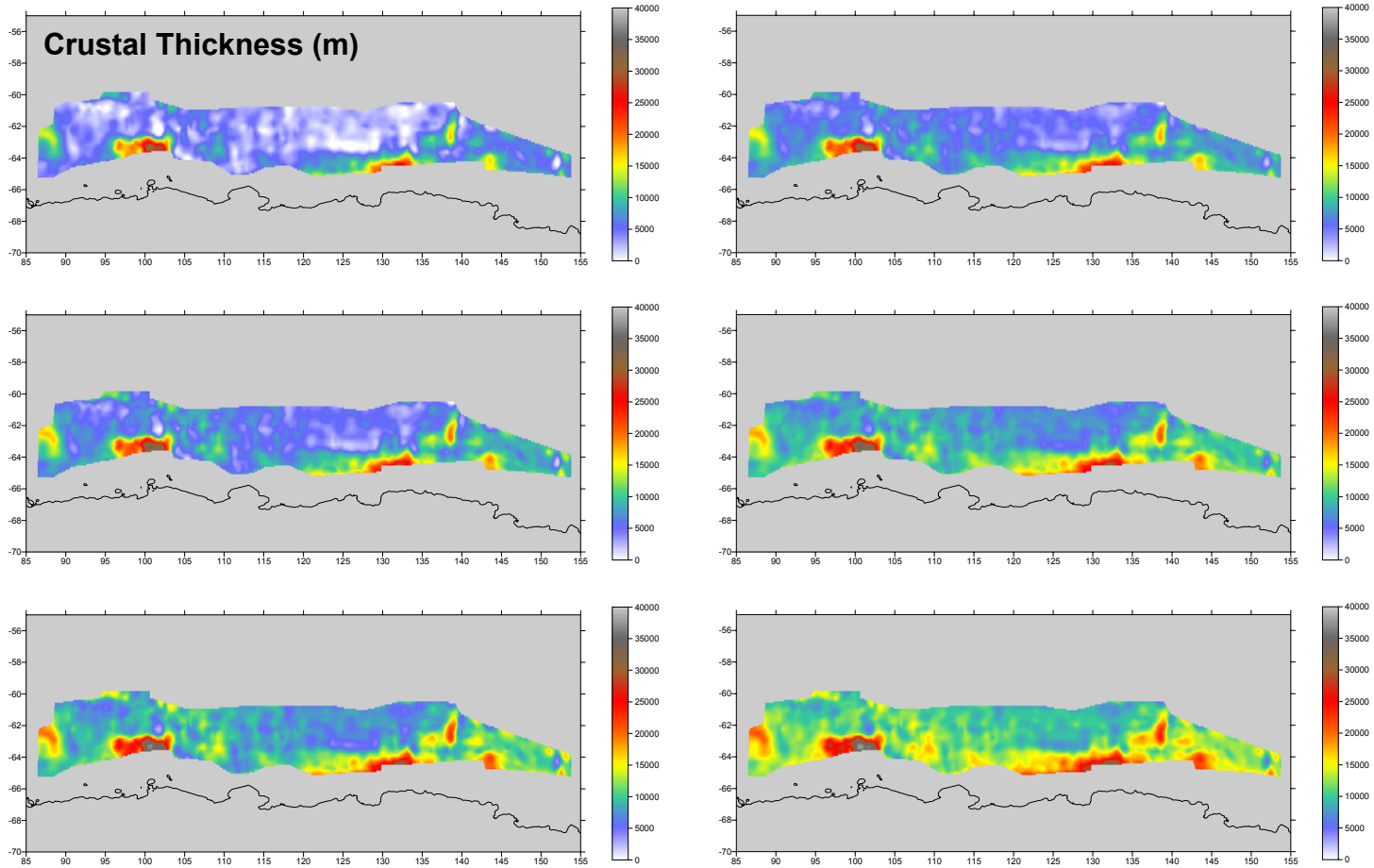
Sediment thickness: thick estimate

Sediment thickness: thin estimate

Ct_{ref} = 37.5 km

Ct_{ref} = 40 km

Ct_{ref} = 42.5 km



- "Normal" volcanic addition margin (ocean crust thickness = 7 km, γ_{crit} = 0.7)
- Breakup age = 84 Ma
- Oldest isochron used = 44 Ma
- Lithosphere thermal correction on

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S. Australia - Antarctica Rifted Margins - Gravity Inversion

Sensitivity to reference crustal thickness

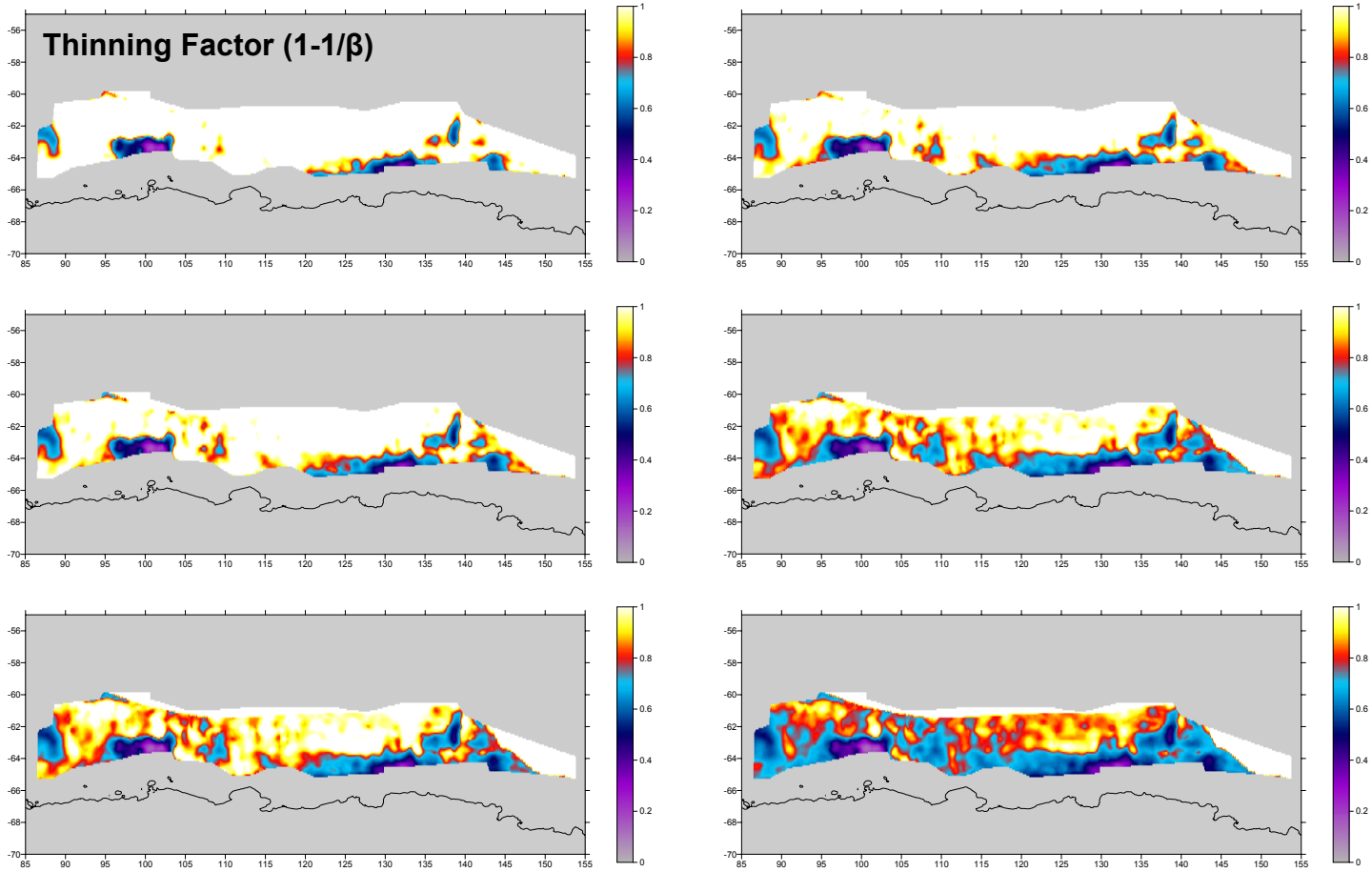
Sediment thickness: thick estimate

Sediment thickness: thin estimate

Ct_{ref} = 37.5 km

Ct_{ref} = 40 km

Ct_{ref} = 42.5 km



- "Normal" volcanic addition margin (ocean crust thickness = 7 km, γ_{crit} = 0.7)
- Breakup age = 84 Ma
- Oldest isochron used = 44 Ma
- Lithosphere thermal correction on

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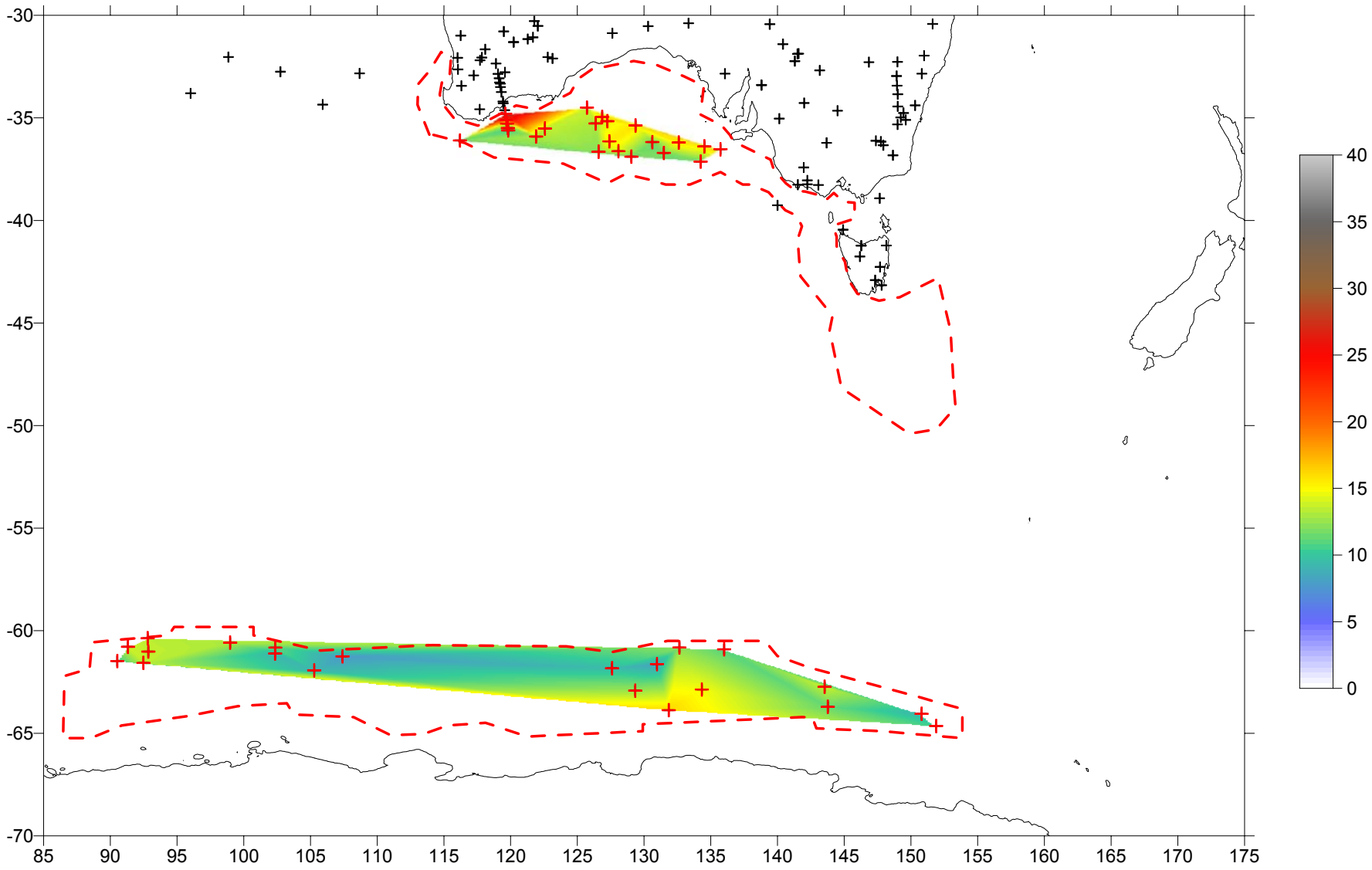
GA Refraction Moho Depths (km)



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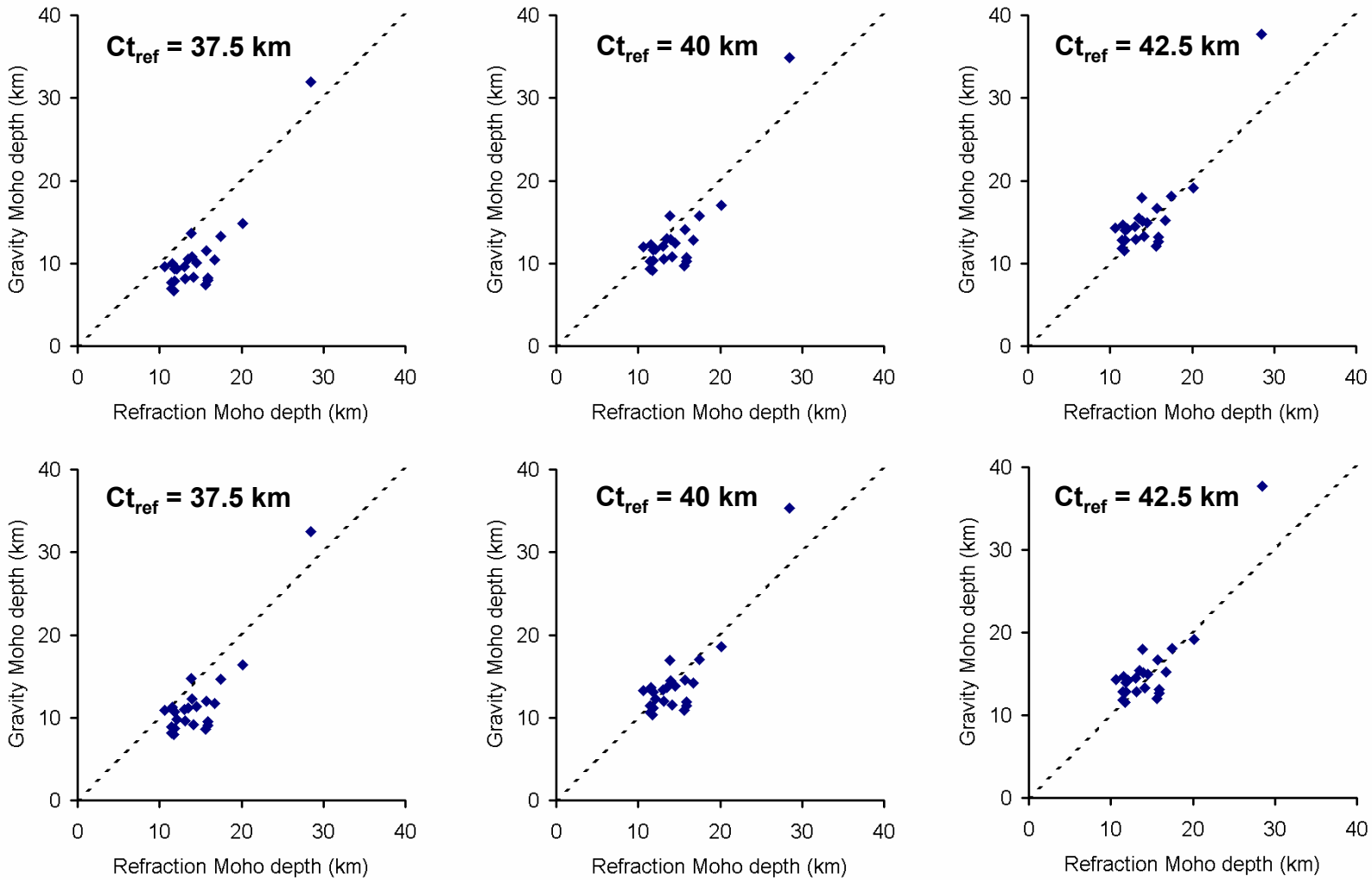
S. Australia - Antarctica Rifted Margins - Gravity Inversion

Sensitivity to reference crustal thickness

S. Australian Margin

Sediment thickness: thick estimate

Sediment thickness: thin estimate



- "Normal" volcanic addition margin (ocean crust thickness = 7 km, γ_{crit} = 0.7)
- Breakup age = 84 Ma
- Oldest isochron used = 44 Ma
- Lithosphere thermal correction on

Preferred value = 40 - 42.5 km

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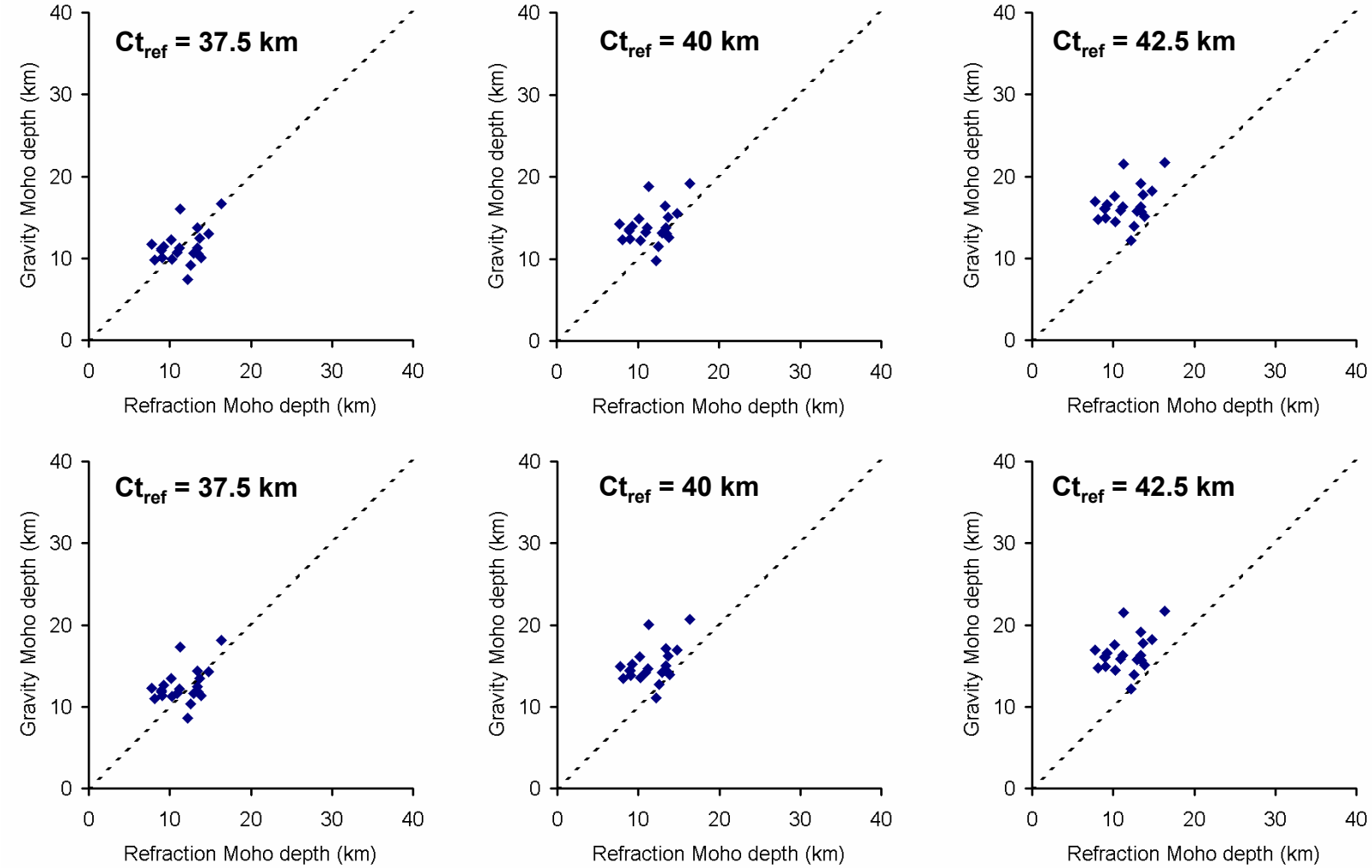
S. Australia - Antarctica Rifted Margins - Gravity Inversion

Sensitivity to reference crustal thickness

Antarctic Margin

Sediment thickness: thick estimate

Sediment thickness: thin estimate



- "Normal" volcanic addition margin (ocean crust thickness = 7 km, γ_{crit} = 0.7)
- Breakup age = 84 Ma
- Oldest isochron used = 44 Ma
- Lithosphere thermal correction on

Preferred value = 37.5 - 40 km

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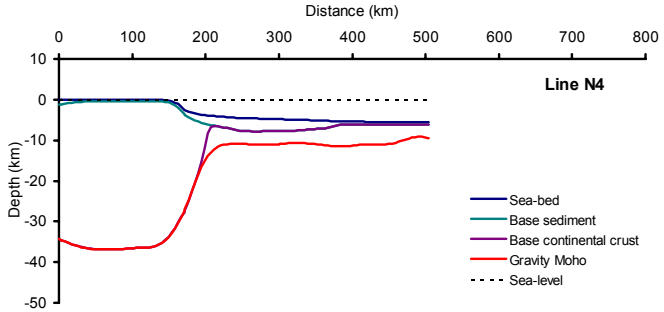
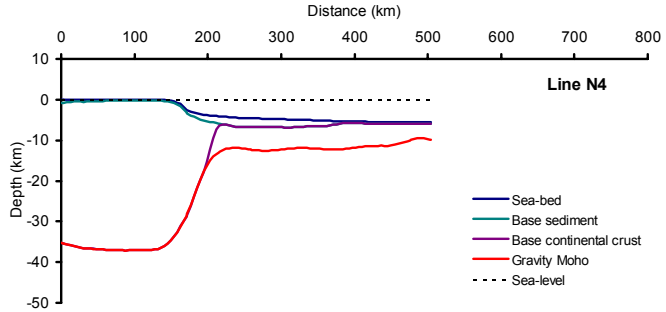
S. Australia - Antarctica Rifted Margins - Gravity Inversion

Sensitivity to reference crustal thickness

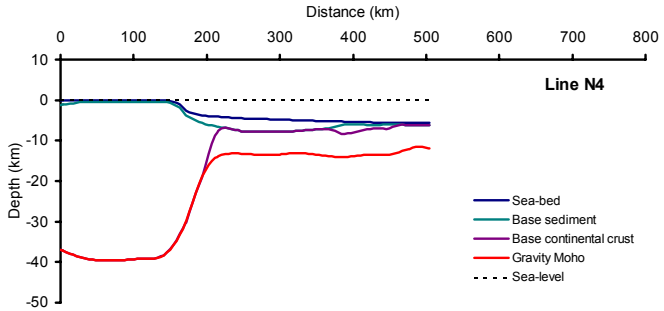
Sediment thickness: thick estimate | **Sediment thickness: thin estimate**

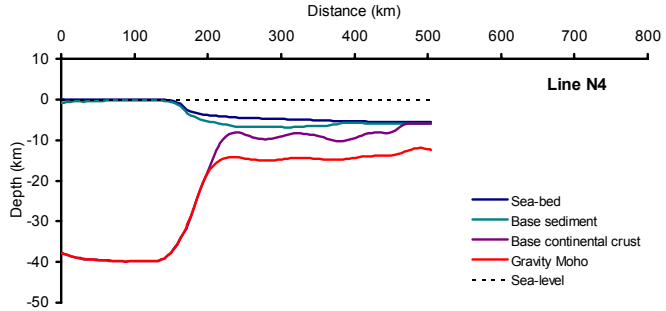
Ct_{ref} = 37.5 km



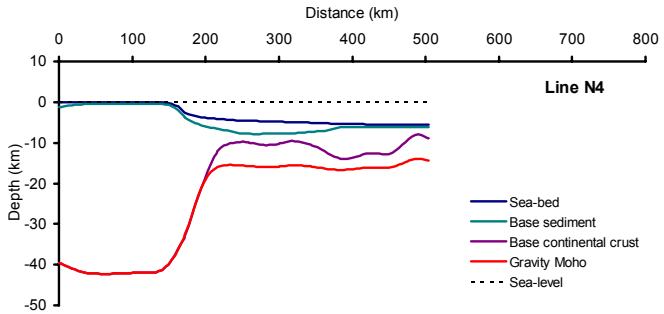


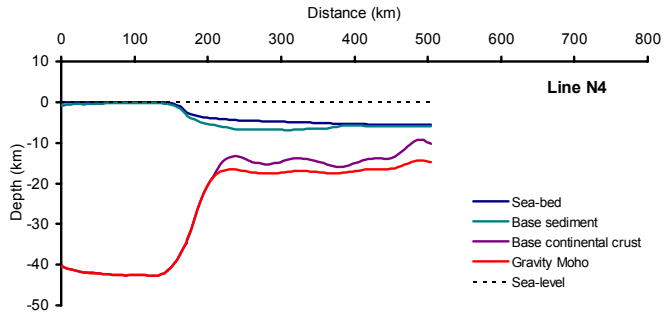
Ct_{ref} = 40 km





Ct_{ref} = 42.5 km





- "Normal" volcanic addition margin (ocean crust thickness = 7 km, γ_{crit} = 0.7)
- Breakup age = 84 Ma
- Oldest isochron used = 44 Ma
- Lithosphere thermal correction on

Preferred value = 40 - 42.5 km

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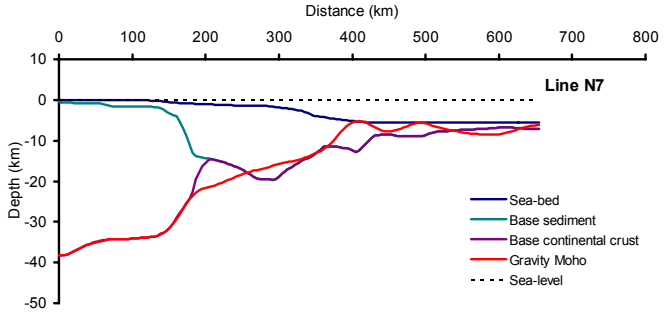
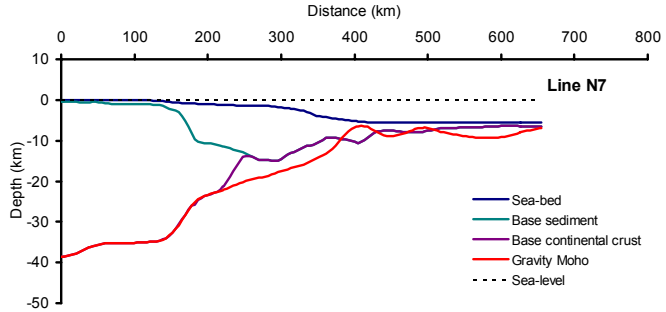
S. Australia - Antarctica Rifted Margins - Gravity Inversion

Sensitivity to reference crustal thickness

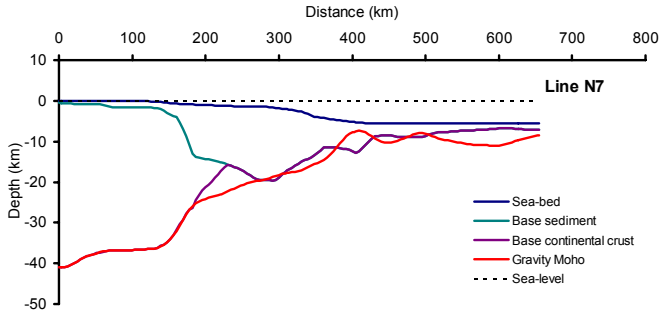
Sediment thickness: thick estimate | **Sediment thickness: thin estimate**

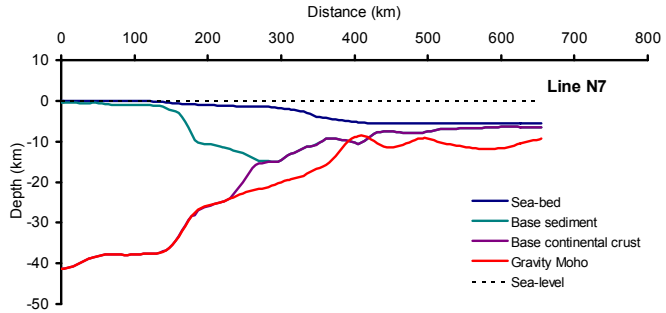
Ct_{ref} = 37.5 km



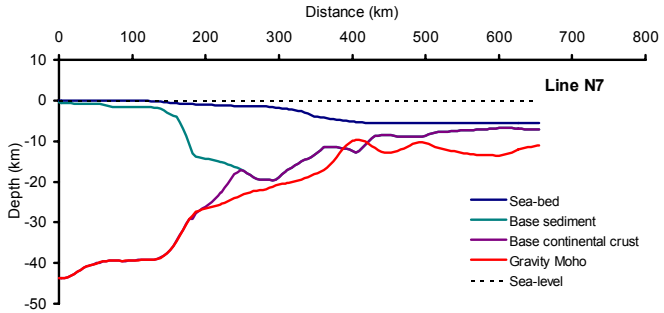


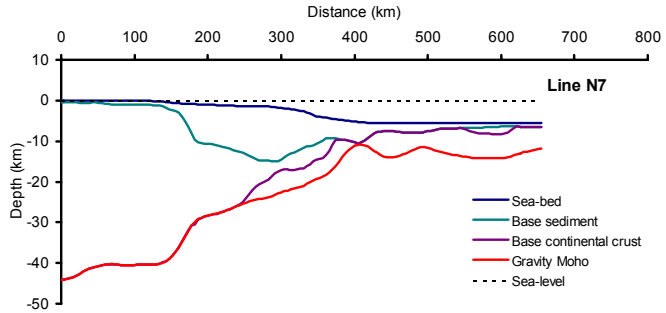
Ct_{ref} = 40 km





Ct_{ref} = 42.5 km





- "Normal" volcanic addition margin (ocean crust thickness = 7 km, γ_{crit} = 0.7)
- Breakup age = 84 Ma
- Oldest isochron used = 44 Ma
- Lithosphere thermal correction on

Preferred value = 40 - 42.5 km

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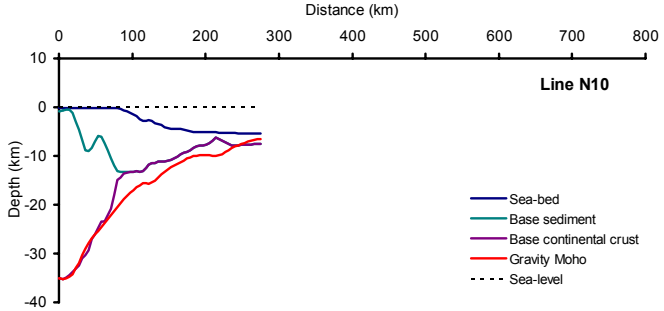
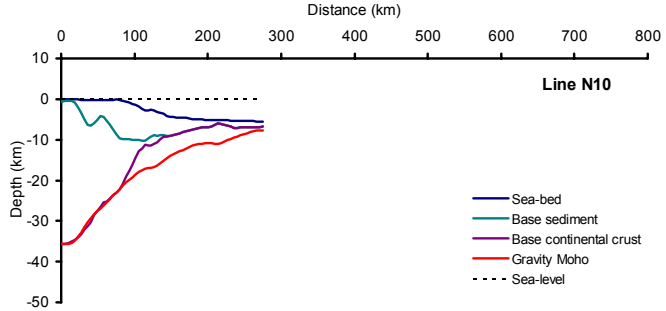
S. Australia - Antarctica Rifted Margins - Gravity Inversion

Sensitivity to reference crustal thickness

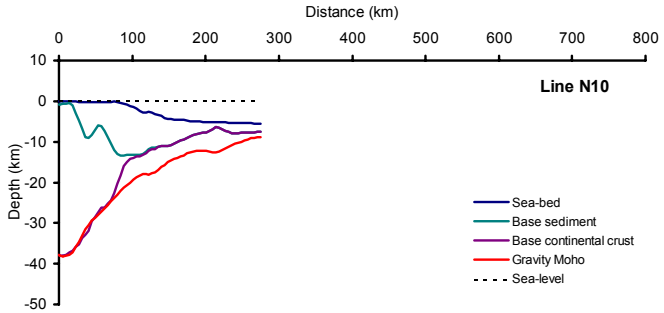
Sediment thickness: thick estimate | **Sediment thickness: thin estimate**

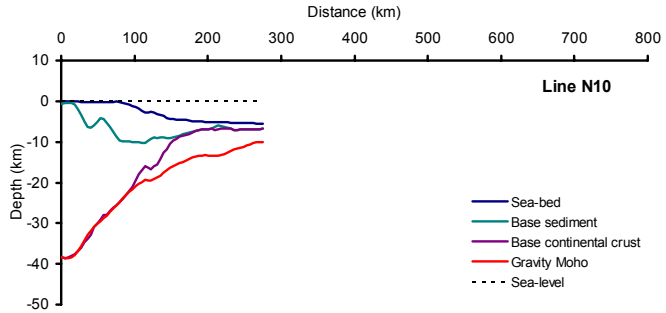
Ct_{ref} = 37.5 km



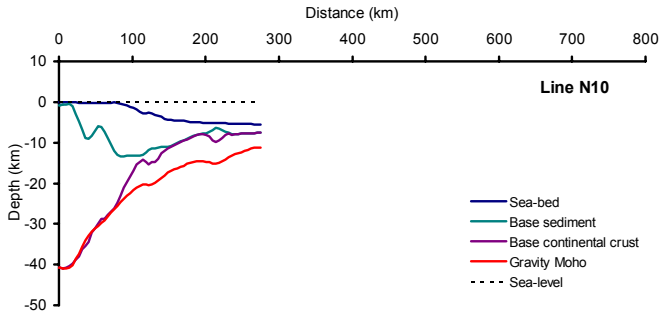


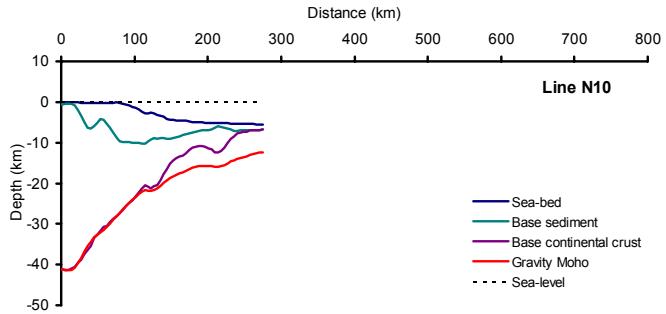
Ct_{ref} = 40 km





Ct_{ref} = 42.5 km





- "Normal" volcanic addition margin (ocean crust thickness = 7 km, γ_{crit} = 0.7)
- Breakup age = 84 Ma
- Oldest isochron used = 44 Ma
- Lithosphere thermal correction on

Preferred value = 40 - 42.5 km

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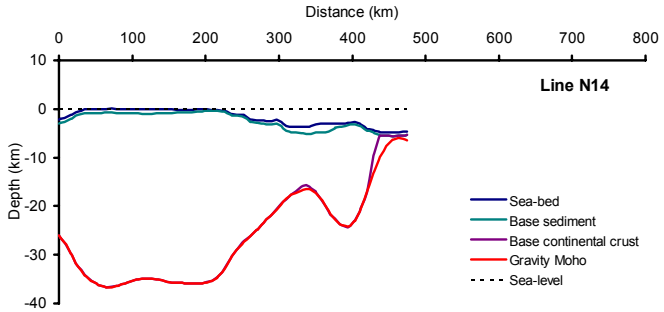
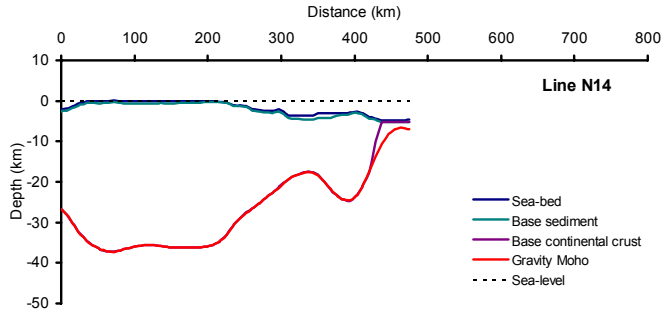
S. Australia - Antarctica Rifted Margins - Gravity Inversion

Sensitivity to reference crustal thickness

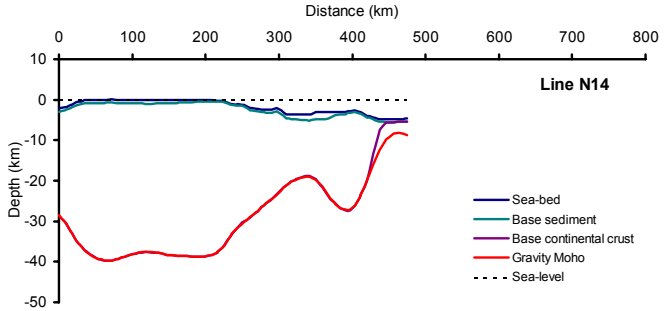
Sediment thickness: thick estimate | **Sediment thickness: thin estimate**

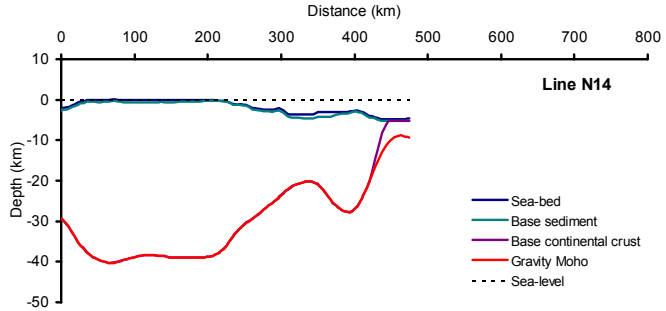
Ct_{ref} = 37.5 km



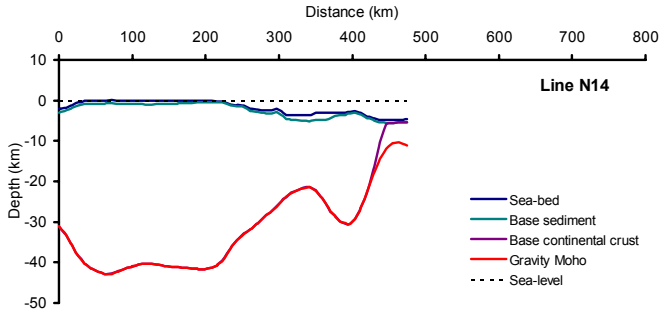


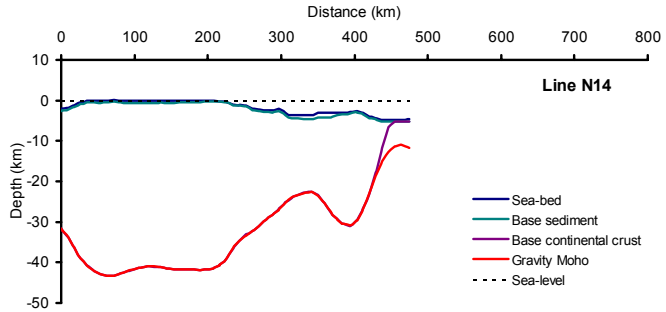
Ct_{ref} = 40 km





Ct_{ref} = 42.5 km





- "Normal" volcanic addition margin (ocean crust thickness = 7 km, γ_{crit} = 0.7)
- Breakup age = 84 Ma
- Oldest isochron used = 44 Ma
- Lithosphere thermal correction on

Preferred value = 40 - 42.5 km

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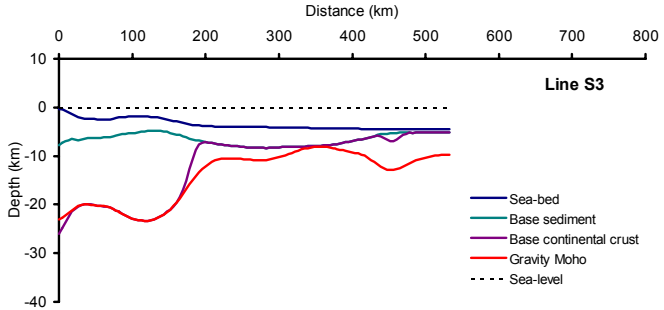
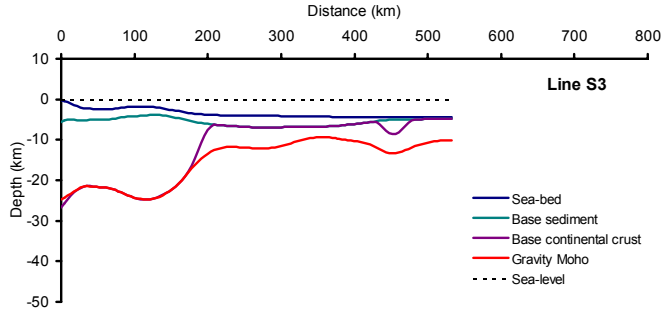
S. Australia - Antarctica Rifted Margins - Gravity Inversion

Sensitivity to reference crustal thickness

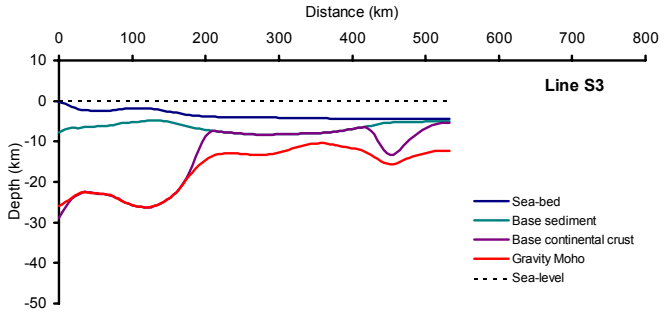
Sediment thickness: thick estimate | **Sediment thickness: thin estimate**

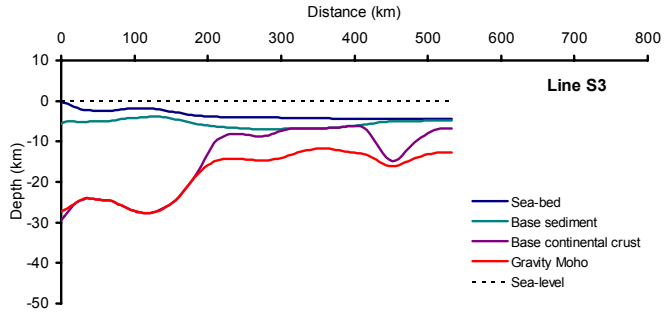
Ct_{ref} = 37.5 km



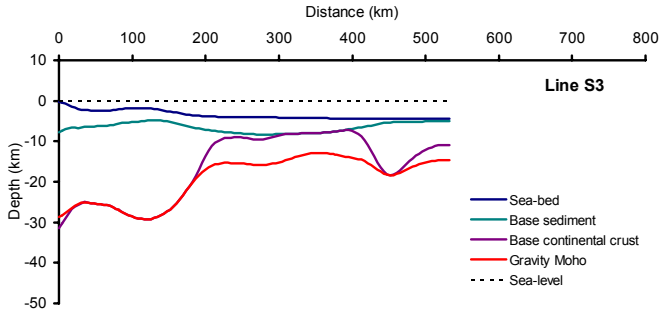


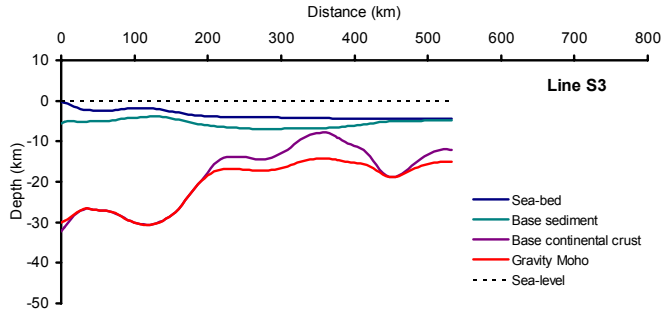
Ct_{ref} = 40 km





Ct_{ref} = 42.5 km





- "Normal" volcanic addition margin (ocean crust thickness = 7 km, γ_{crit} = 0.7)
- Breakup age = 84 Ma
- Oldest isochron used = 44 Ma
- Lithosphere thermal correction on

Preferred value = 37.5 – 40 km

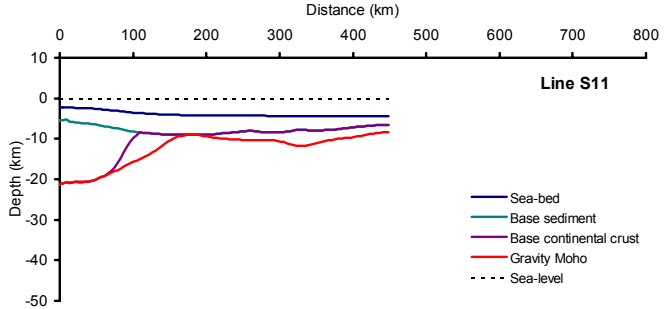
NJK/Nov2008

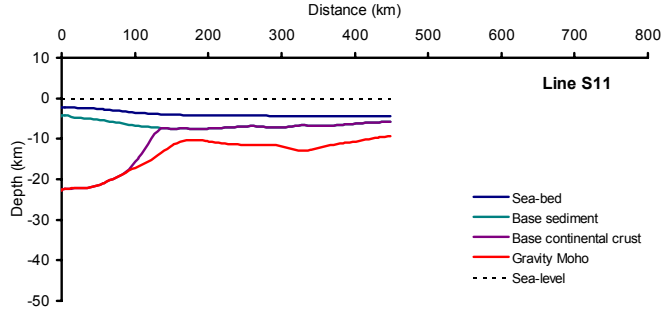
S. Australia - Antarctica Rifted Margins - Gravity Inversion

Sensitivity to reference crustal thickness

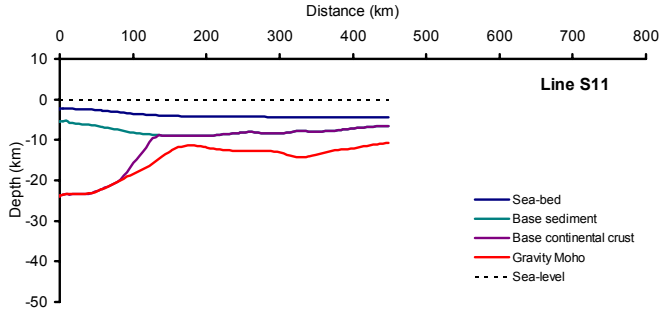
Sediment thickness: thick estimate | **Sediment thickness: thin estimate**

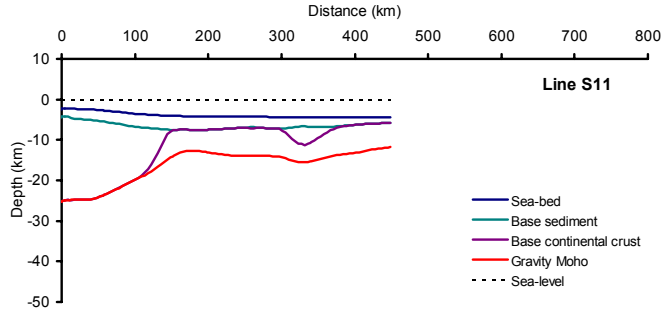
Ct_{ref} = 37.5 km



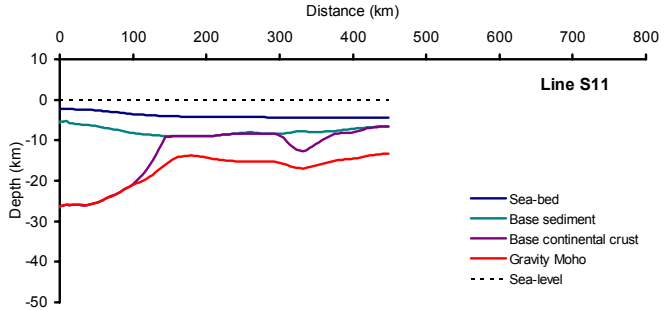


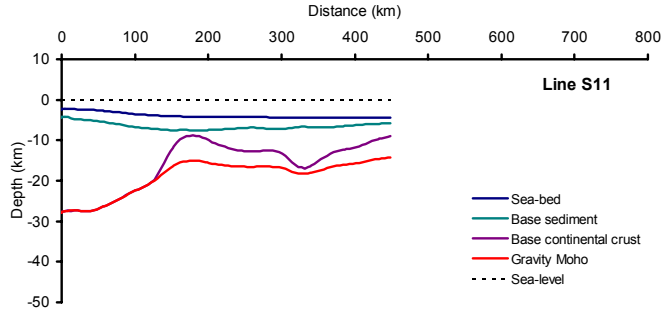
Ct_{ref} = 40 km





Ct_{ref} = 42.5 km





- "Normal" volcanic addition margin (ocean crust thickness = 7 km, γ_{crit} = 0.7)
- Breakup age = 84 Ma
- Oldest isochron used = 44 Ma
- Lithosphere thermal correction on

Preferred value = 37.5 – 40 km

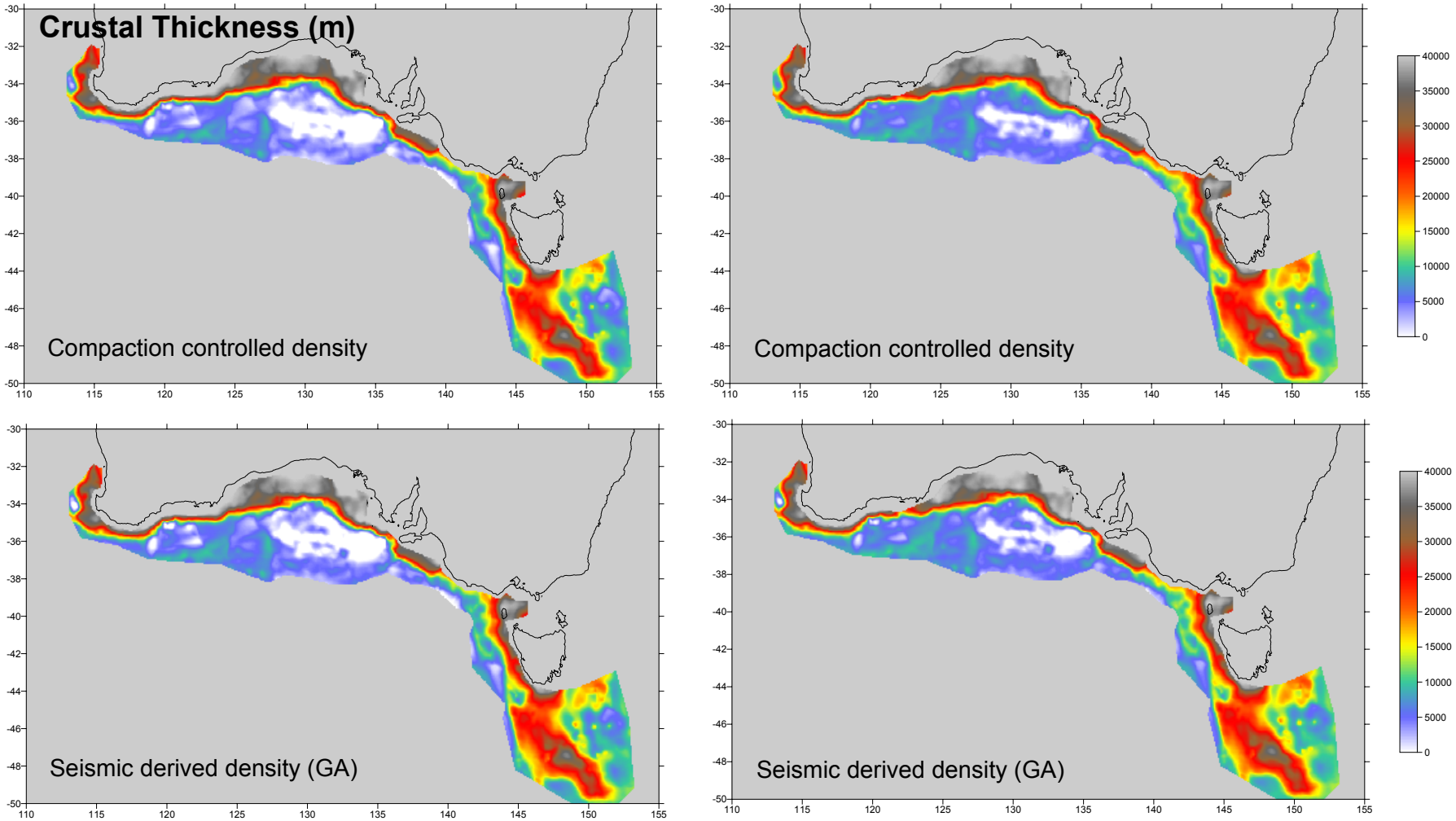
NJK/Nov2008

S. Australia - Antarctica Rifted Margins - Gravity Inversion

Sensitivity to sediment density

Sediment thickness: thick estimate

Sediment thickness: thin estimate



- "Normal" volcanic addition margin (ocean crust thickness = 7 km, γ_{crit} = 0.7)
- Breakup age = 84 Ma
- Oldest isochron used = 44 Ma
- Lithosphere thermal correction on
- Reference crustal thickness = 40 km

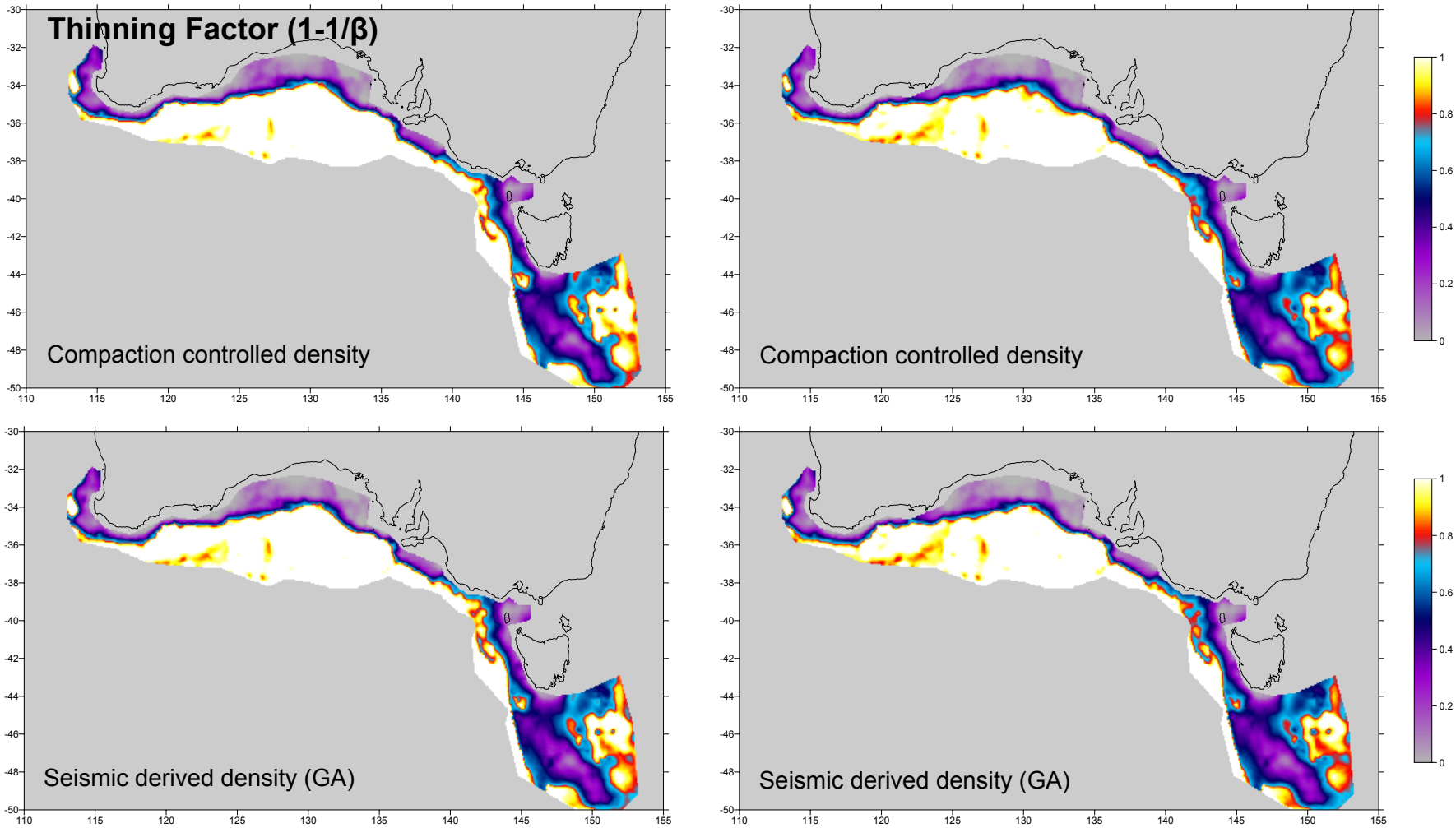
NJK/Nov2008

S. Australia - Antarctica Rifted Margins - Gravity Inversion

Sensitivity to sediment density

Sediment thickness: thick estimate

Sediment thickness: thin estimate



- "Normal" volcanic addition margin (ocean crust thickness = 7 km, γ_{crit} = 0.7)
- Breakup age = 84 Ma
- Oldest isochron used = 44 Ma
- Lithosphere thermal correction on
- Reference crustal thickness = 40 km

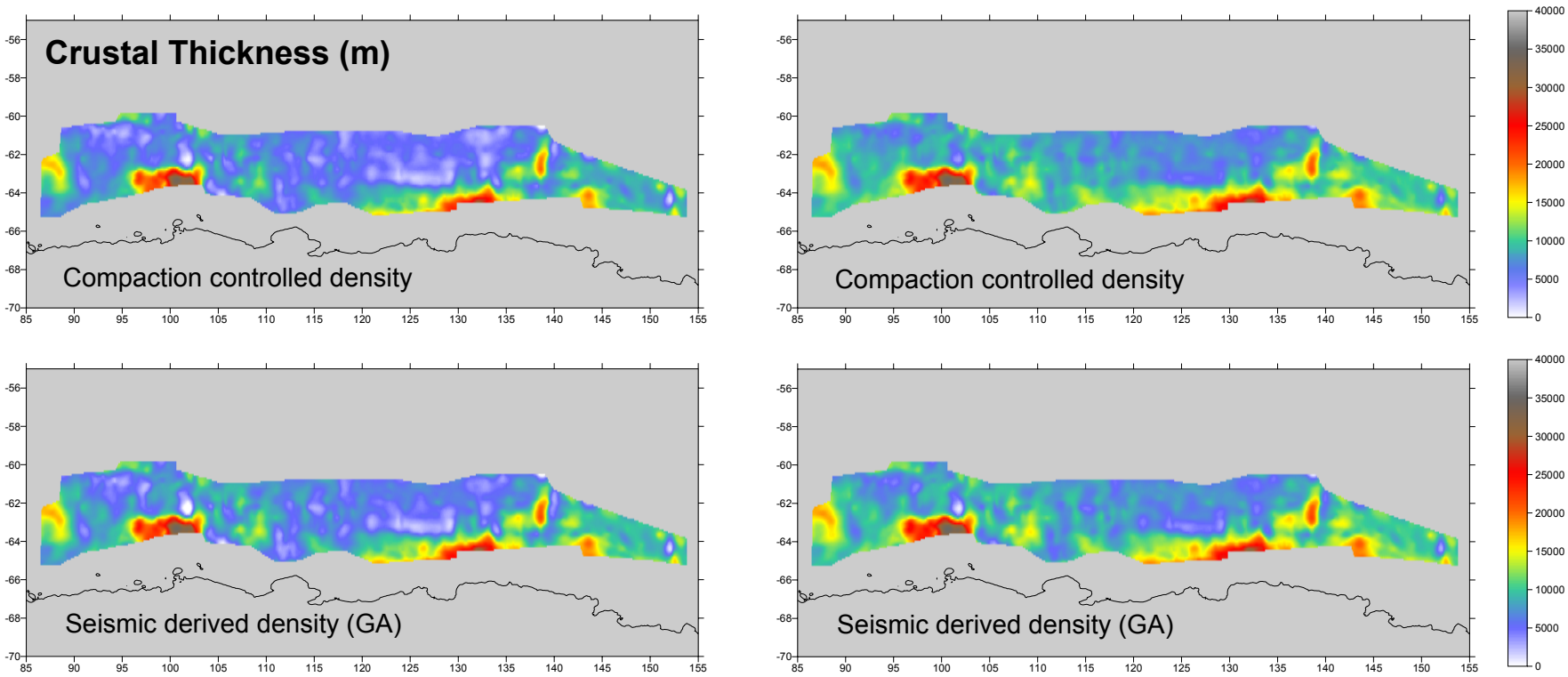
NJK/Nov2008

S. Australia - Antarctica Rifted Margins - Gravity Inversion

Sensitivity to sediment density

Sediment thickness: thick estimate

Sediment thickness: thin estimate



- "Normal" volcanic addition margin (ocean crust thickness = 7 km, γ_{crit} = 0.7)
- Breakup age = 84 Ma
- Oldest isochron used = 44 Ma
- Lithosphere thermal correction on
- Reference crustal thickness = 40 km

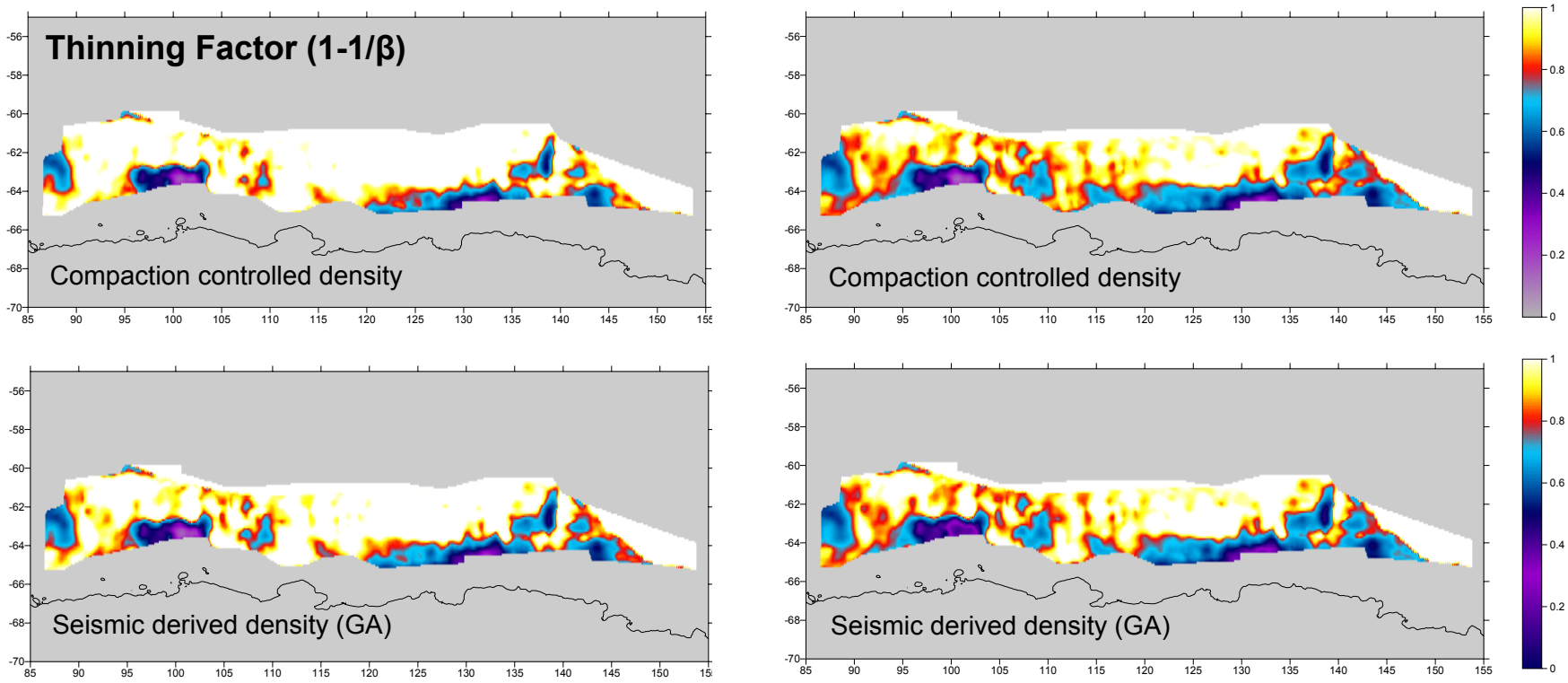
NJK/Nov2008

S. Australia - Antarctica Rifted Margins - Gravity Inversion

Sensitivity to sediment density

Sediment thickness: thick estimate

Sediment thickness: thin estimate



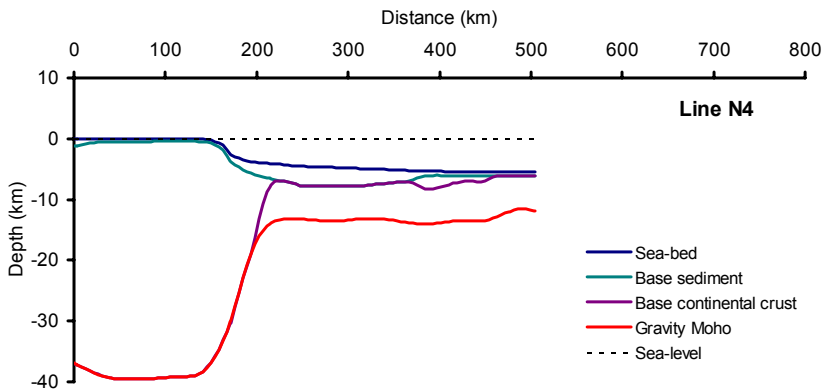
- "Normal" volcanic addition margin (ocean crust thickness = 7 km, γ_{crit} = 0.7)
- Breakup age = 84 Ma
- Oldest isochron used = 44 Ma
- Lithosphere thermal correction on
- Reference crustal thickness = 40 km

NJK/Nov2008

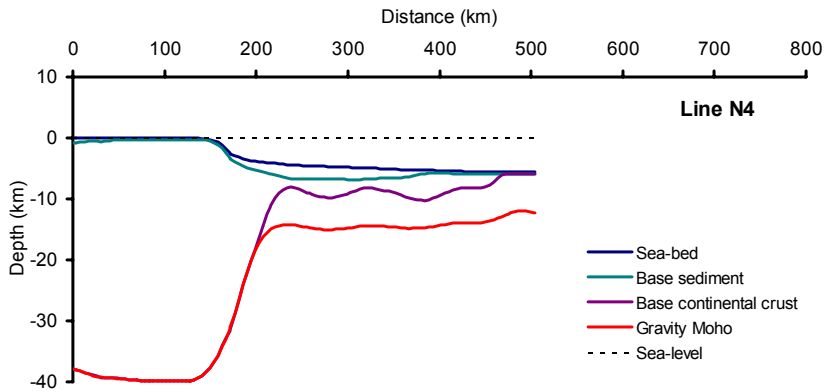
S. Australia - Antarctica Rifted Margins - Gravity Inversion

Sensitivity to sediment density

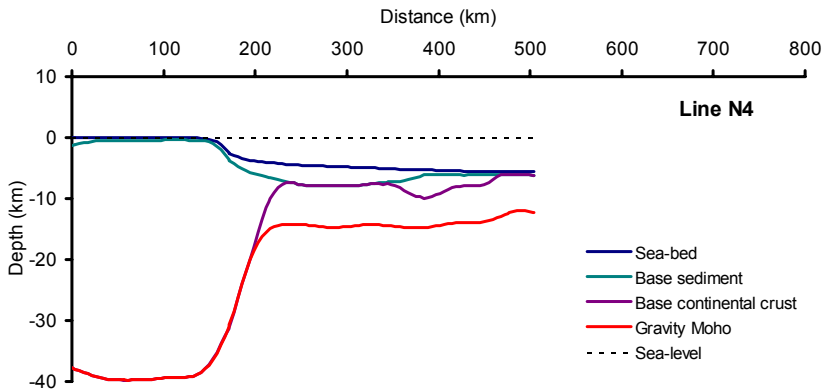
Sediment thickness: thick estimate

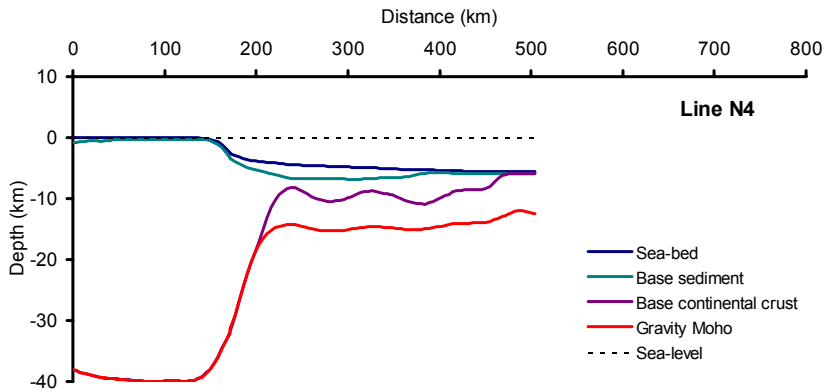


Sediment thickness: thin estimate



Compaction controlled





Seismic derived (GA)

- "Normal" volcanic addition margin (ocean crust thickness = 7 km, γ_{crit} = 0.7)
- Breakup age = 84 Ma
- Oldest isochron used = 44 Ma
- Lithosphere thermal correction on
- Reference crustal thickness = 40 km

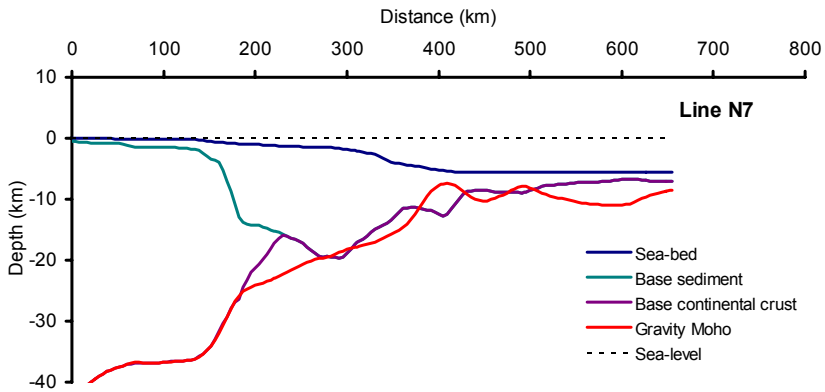
Preferred value = compaction controlled density

NJK/Nov2008

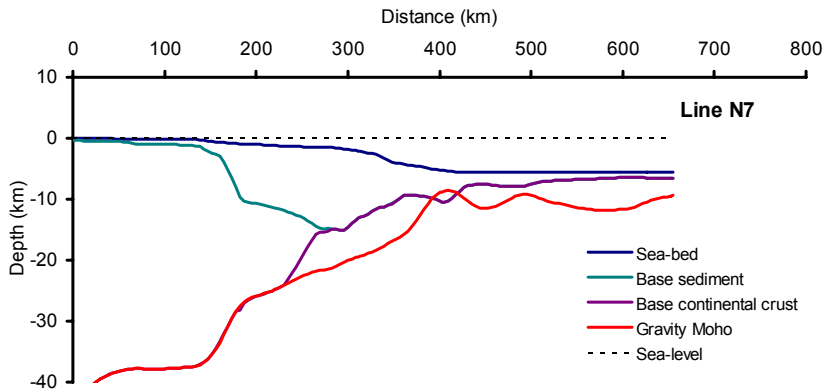
S. Australia - Antarctica Rifted Margins - Gravity Inversion

Sensitivity to sediment density

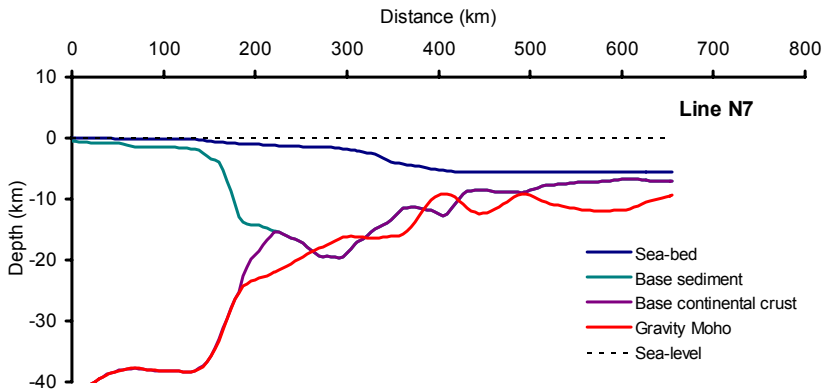
Sediment thickness: thick estimate

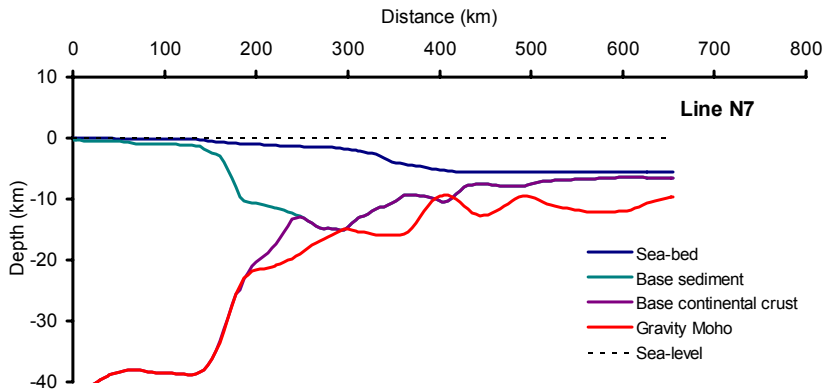


Sediment thickness: thin estimate



Compaction controlled





Seismic derived (GA)

- "Normal" volcanic addition margin (ocean crust thickness = 7 km, γ_{crit} = 0.7)
- Breakup age = 84 Ma
- Oldest isochron used = 44 Ma
- Lithosphere thermal correction on
- Reference crustal thickness = 40 km

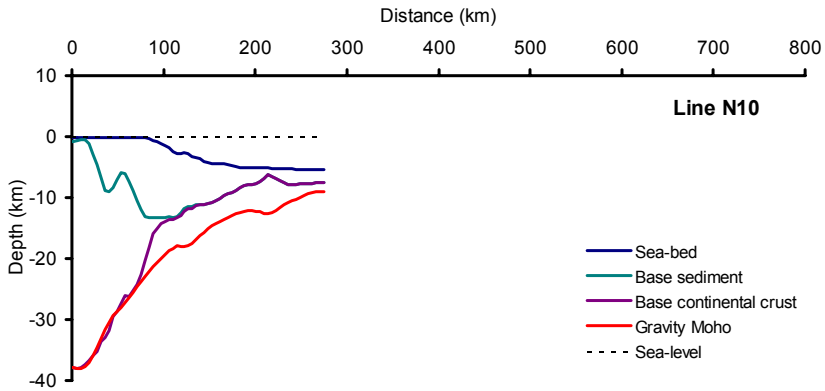
Preferred value = compaction controlled density

NJK/Nov2008

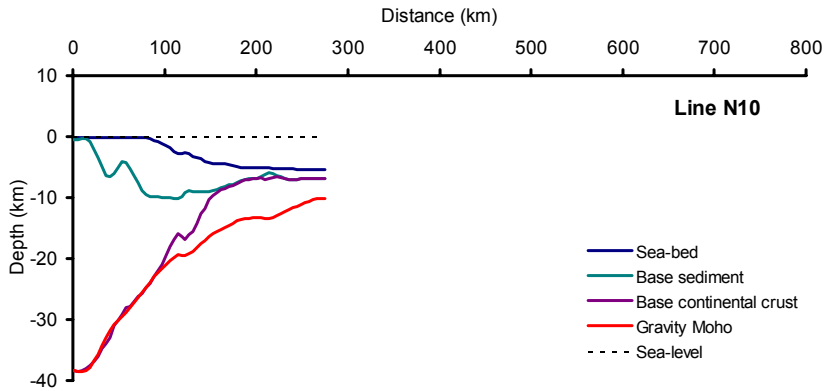
S. Australia - Antarctica Rifted Margins - Gravity Inversion

Sensitivity to sediment density

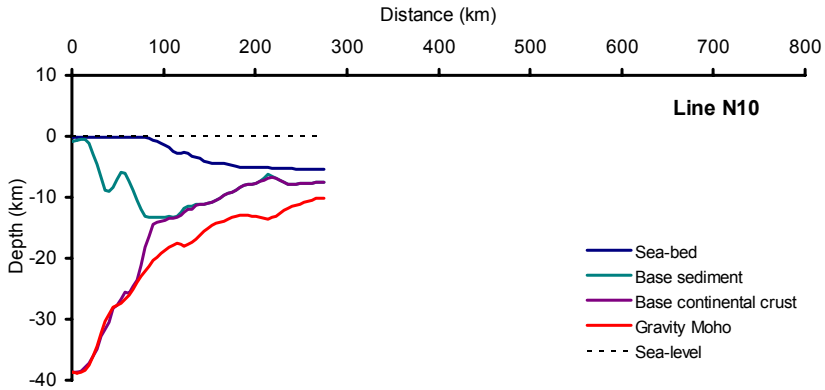
Sediment thickness: thick estimate

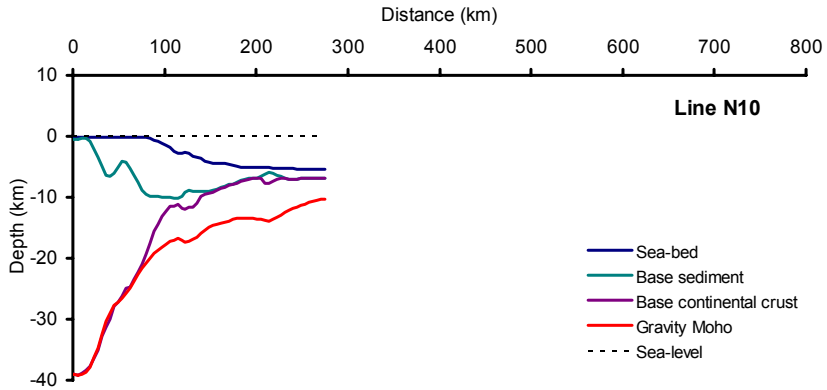


Sediment thickness: thin estimate



Compaction controlled





Seismic derived (GA)

- "Normal" volcanic addition margin (ocean crust thickness = 7 km, γ_{crit} = 0.7)
- Breakup age = 84 Ma
- Oldest isochron used = 44 Ma
- Lithosphere thermal correction on
- Reference crustal thickness = 40 km

Preferred value = compaction controlled density

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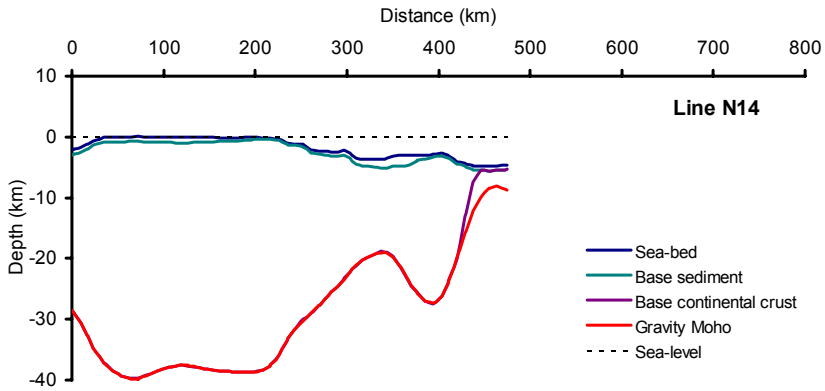
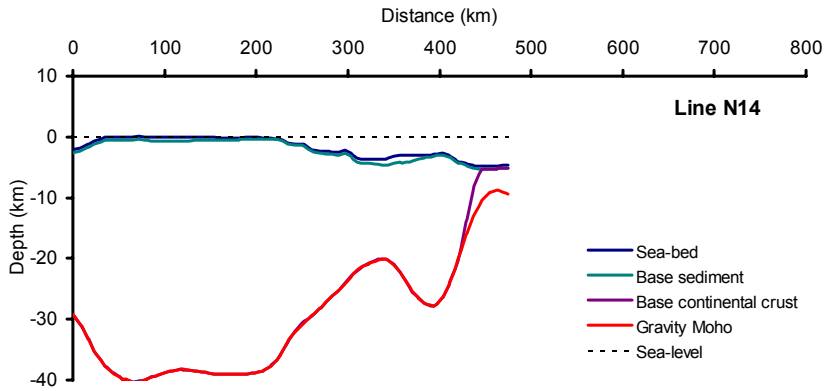
S. Australia - Antarctica Rifted Margins - Gravity Inversion

Sensitivity to sediment density

Sediment thickness: thick estimate



Sediment thickness: thin estimate



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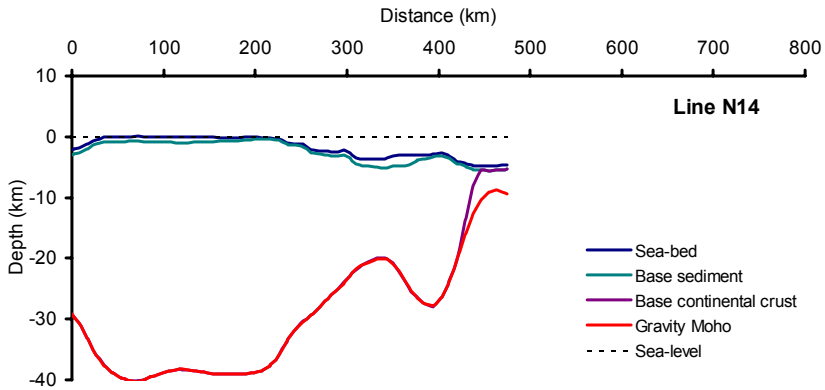

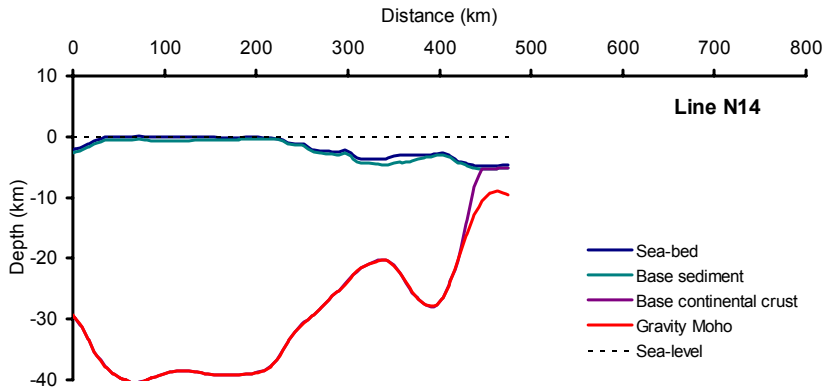

Seismic derived (GA)

- "Normal" volcanic addition margin (ocean crust thickness = 7 km, γ_{crit} = 0.7)
- Breakup age = 84 Ma
- Oldest isochron used = 44 Ma
- Lithosphere thermal correction on
- Reference crustal thickness = 40 km

Preferred value = compaction controlled density

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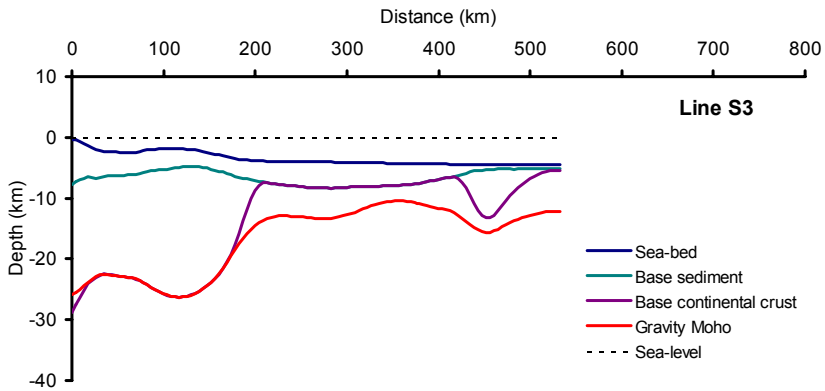
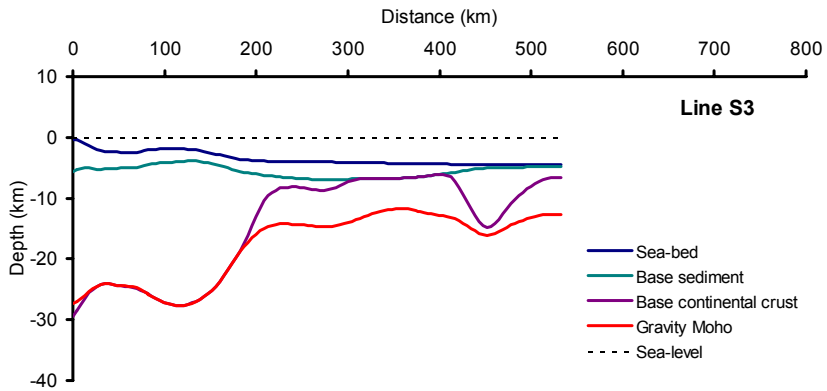
S. Australia - Antarctica Rifted Margins - Gravity Inversion

Sensitivity to sediment density

Sediment thickness: thick estimate



Sediment thickness: thin estimate



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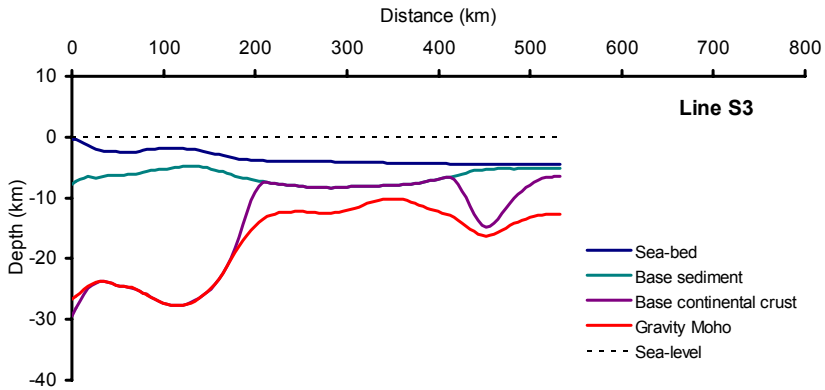

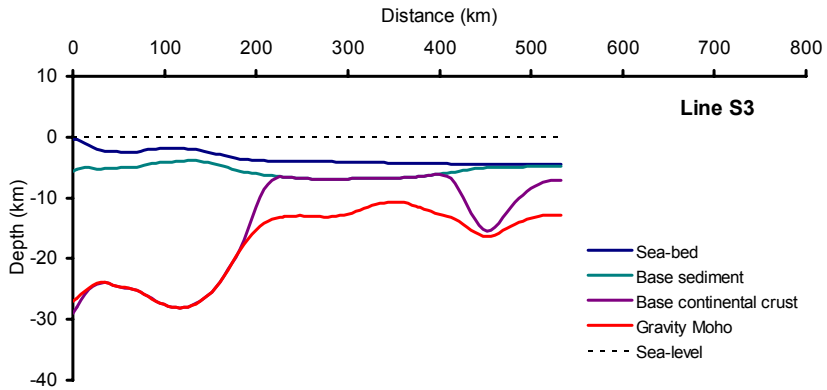

Seismic derived (GA)

- "Normal" volcanic addition margin (ocean crust thickness = 7 km, γ_{crit} = 0.7)
- Breakup age = 84 Ma
- Oldest isochron used = 44 Ma
- Lithosphere thermal correction on
- Reference crustal thickness = 40 km

Preferred value = compaction controlled density

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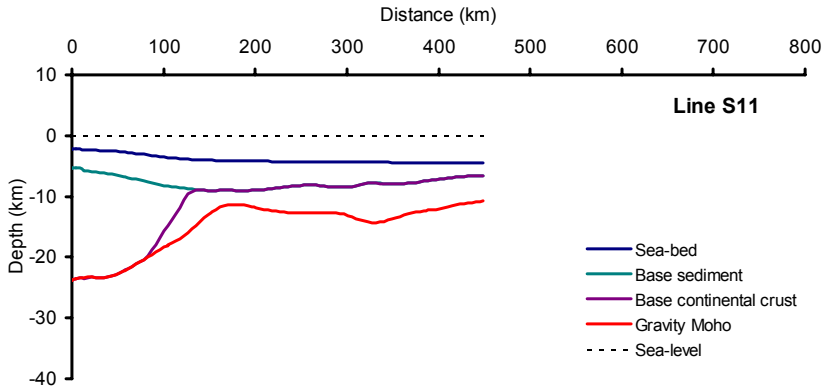
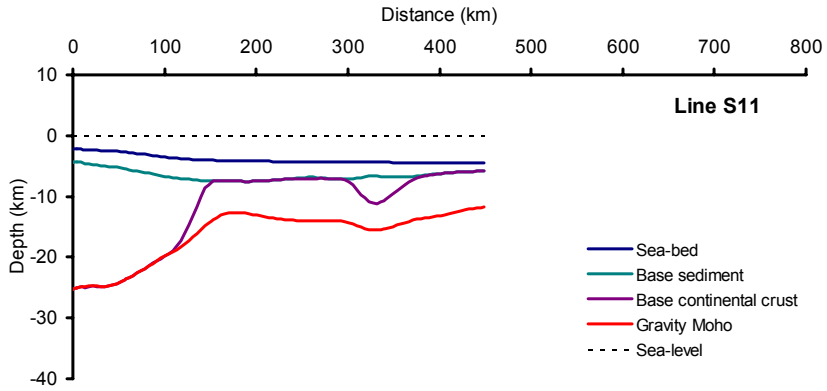
S. Australia - Antarctica Rifted Margins - Gravity Inversion

Sensitivity to sediment density

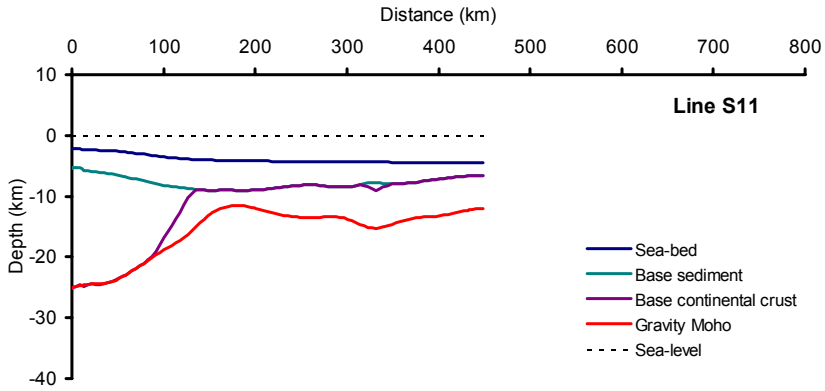
Sediment thickness: thick estimate

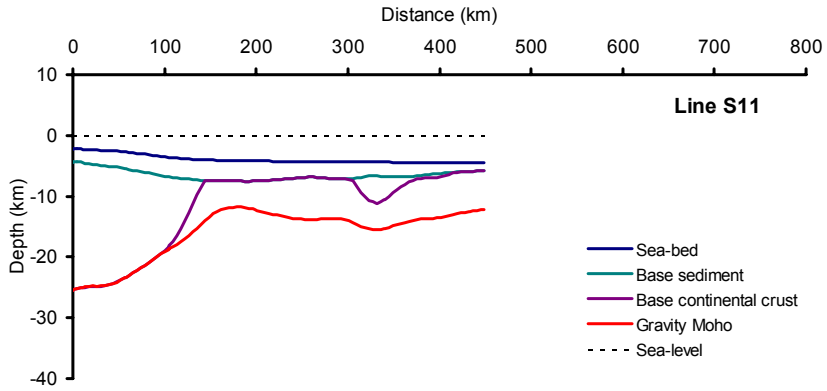


Sediment thickness: thin estimate



Compaction controlled





Seismic derived (GA)

- "Normal" volcanic addition margin (ocean crust thickness = 7 km, γ_{crit} = 0.7)
- Breakup age = 84 Ma
- Oldest isochron used = 44 Ma
- Lithosphere thermal correction on
- Reference crustal thickness = 40 km

Preferred value = compaction controlled density

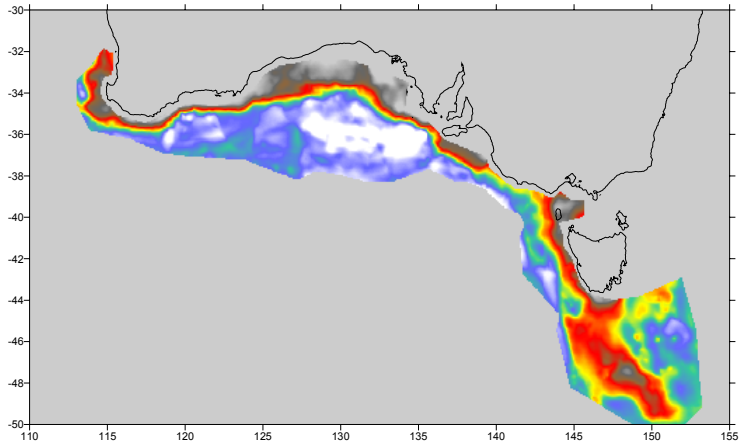
NJK/Nov2008

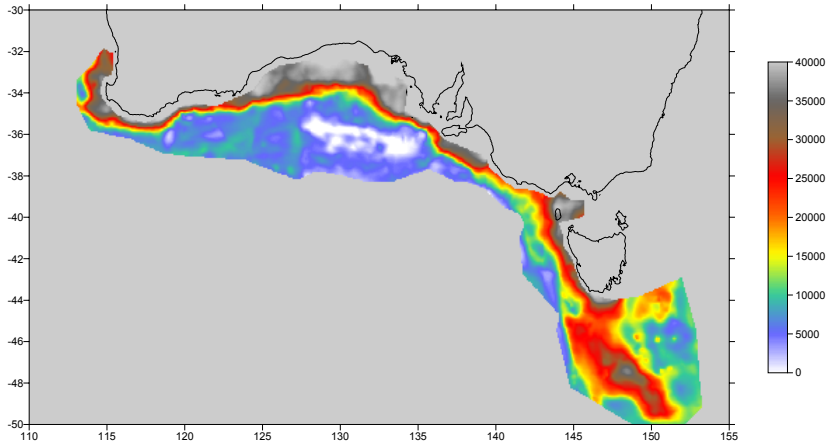
S. Australia - Antarctica Rifted Margins - Gravity Inversion

Sensitivity to oldest isochron used

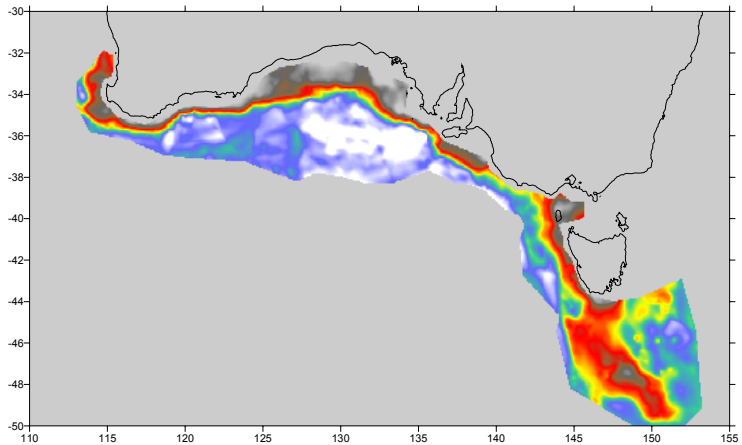
Sediment thickness: thick estimate | **Sediment thickness: thin estimate**

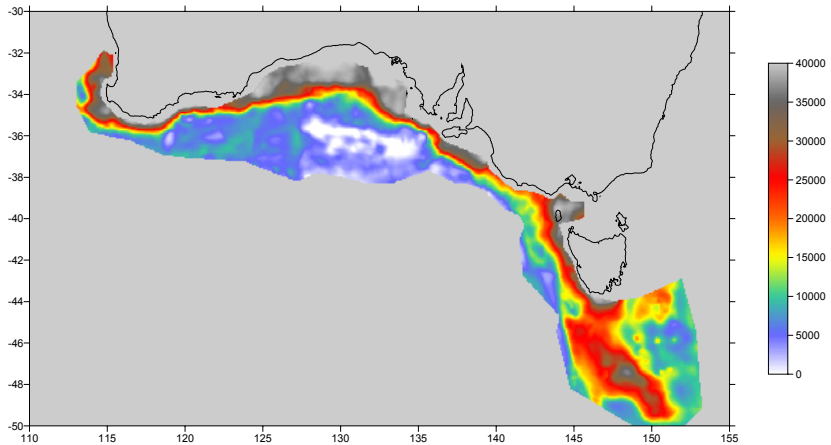
44 Ma





64 Ma





- "Normal" volcanic addition margin (ocean crust thickness = 7 km, γ_{crit} = 0.7)
- Breakup age = 84 Ma
- Lithosphere thermal correction on
- Reference crustal thickness = 40 km
- Compaction controlled density

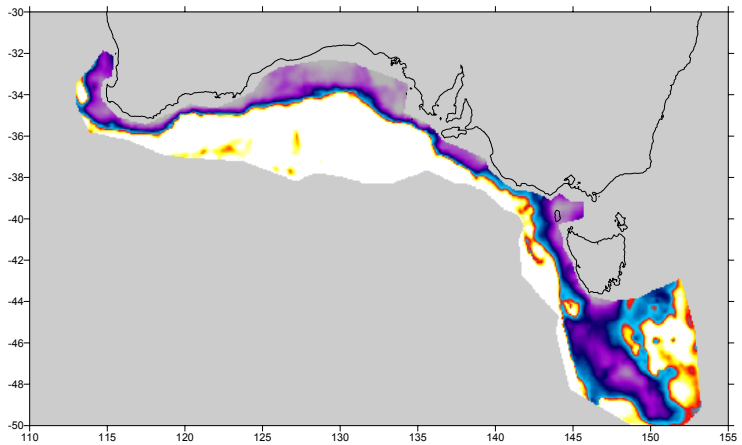
NJK/Nov2008

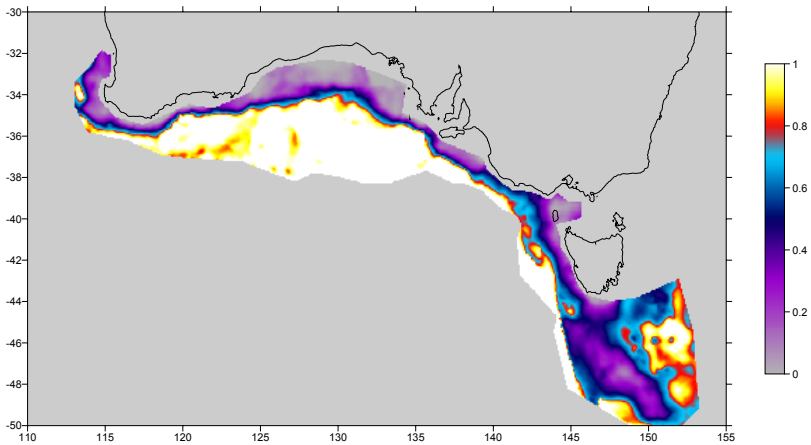
S. Australia - Antarctica Rifted Margins - Gravity Inversion

Sensitivity to oldest isochron used

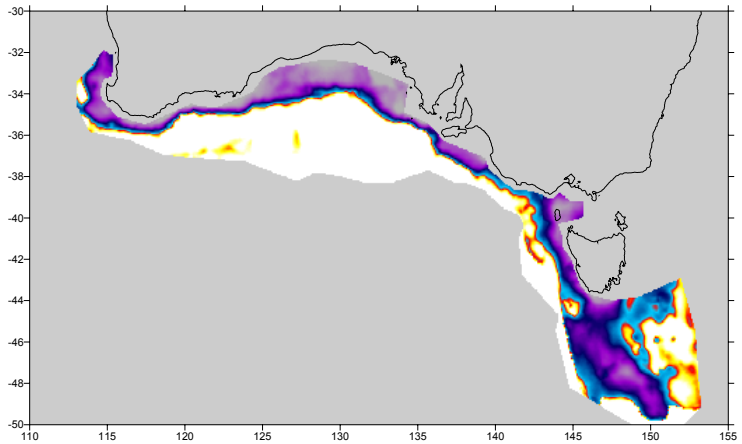
Sediment thickness: thick estimate | **Sediment thickness: thin estimate**

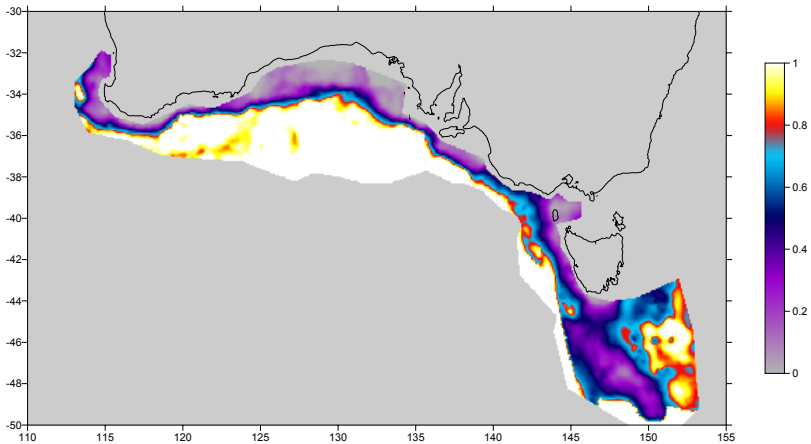
44 Ma





64 Ma





- "Normal" volcanic addition margin (ocean crust thickness = 7 km, γ_{crit} = 0.7)
- Breakup age = 84 Ma
- Lithosphere thermal correction on
- Reference crustal thickness = 40 km
- Compaction controlled density

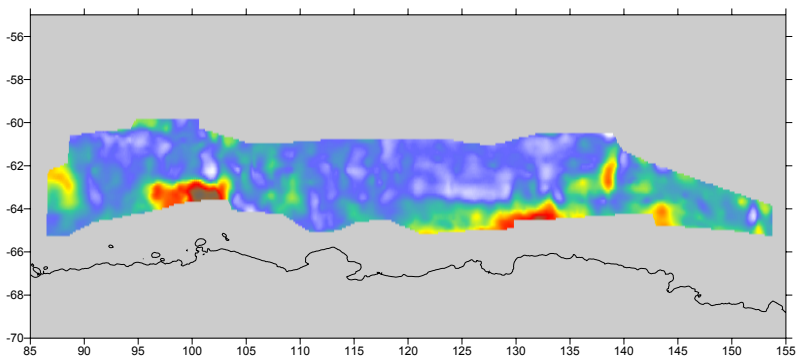
NJK/Nov2008

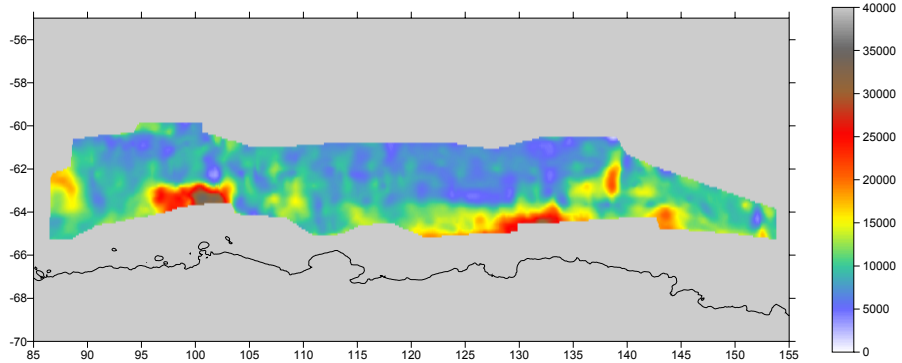
S. Australia - Antarctica Rifted Margins - Gravity Inversion

Sensitivity to oldest isochron used

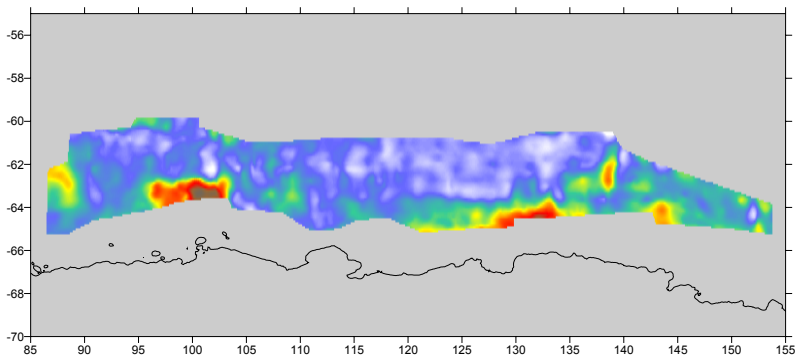
Sediment thickness: thick estimate | **Sediment thickness: thin estimate**

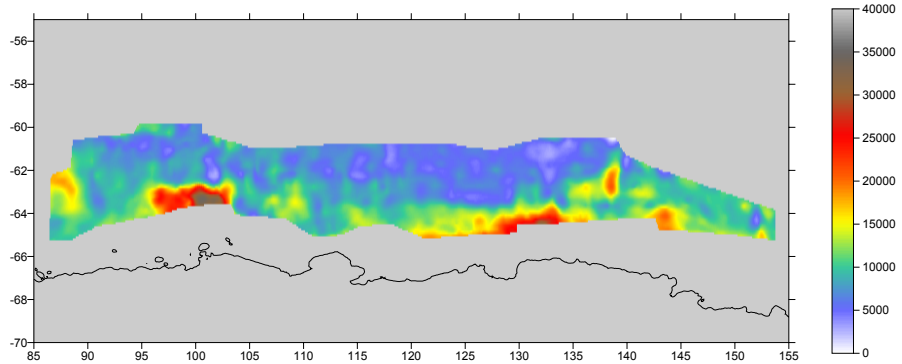
44 Ma





64 Ma





- "Normal" volcanic addition margin (ocean crust thickness = 7 km, γ_{crit} = 0.7)
- Breakup age = 84 Ma
- Lithosphere thermal correction on
- Reference crustal thickness = 40 km
- Compaction controlled density

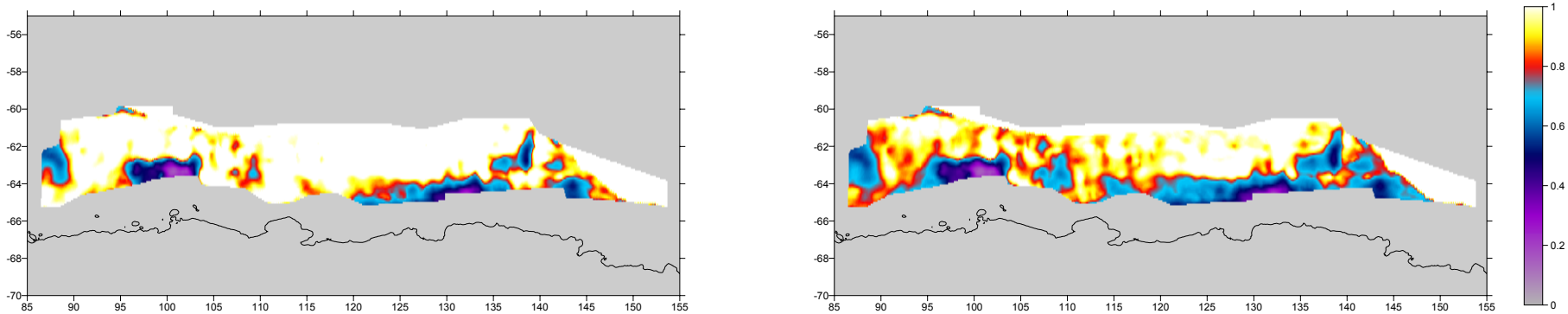
NJK/Nov2008

S. Australia - Antarctica Rifted Margins - Gravity Inversion

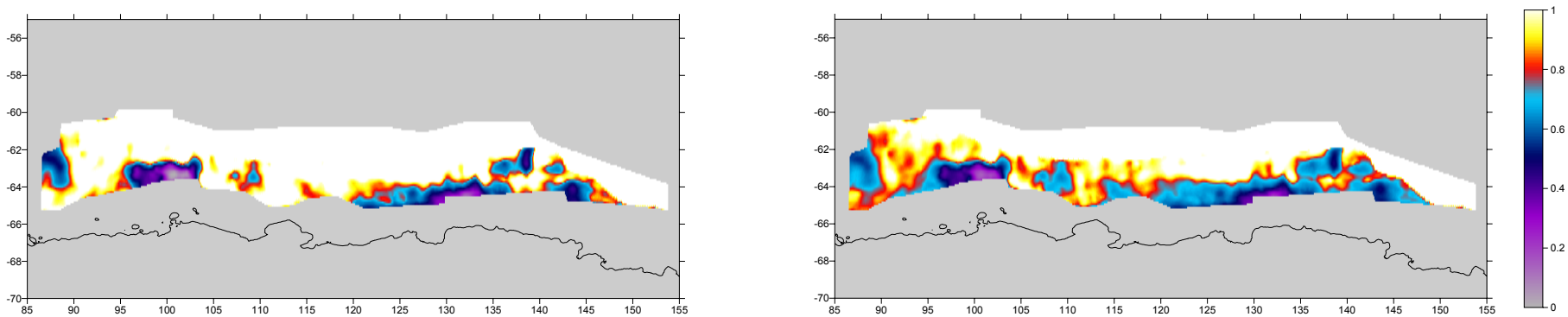
Sensitivity to oldest isochron used

Sediment thickness: thick estimate | **Sediment thickness: thin estimate**

44 Ma



64 Ma



- "Normal" volcanic addition margin (ocean crust thickness = 7 km, γ_{crit} = 0.7)
- Breakup age = 84 Ma
- Lithosphere thermal correction on
- Reference crustal thickness = 40 km
- Compaction controlled density

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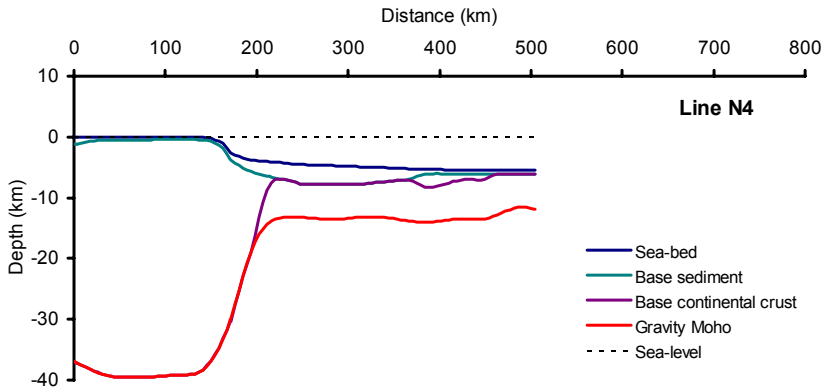
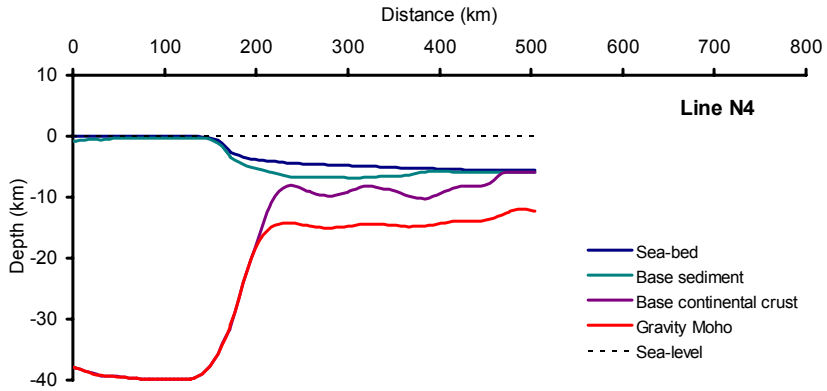
S. Australia - Antarctica Rifted Margins - Gravity Inversion

Sensitivity to oldest isochron used

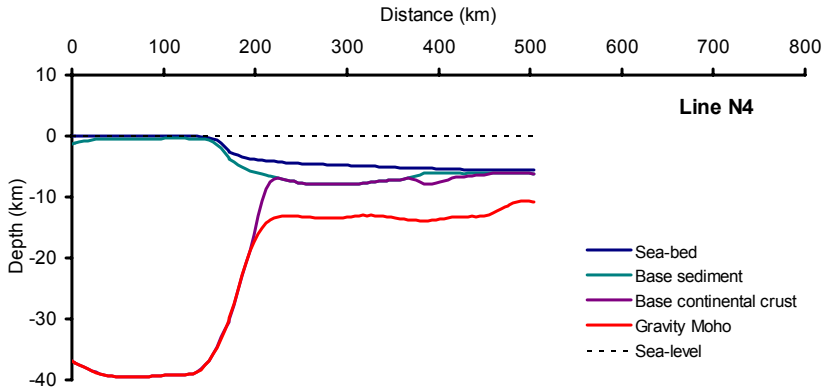
Sediment thickness: thick estimate

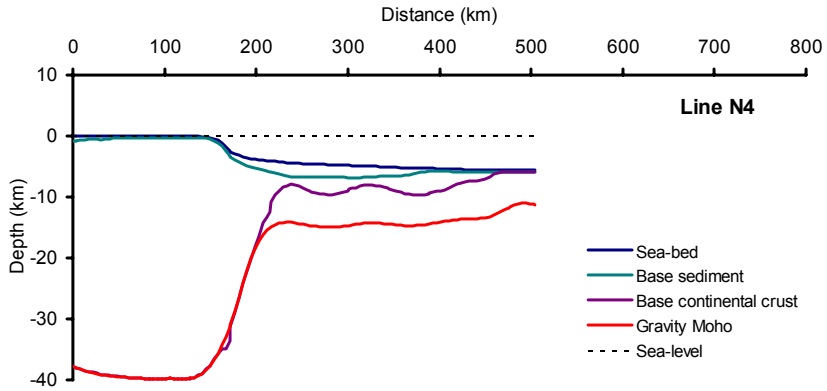


Sediment thickness: thin estimate



44 Ma





64 Ma

- "Normal" volcanic addition margin (ocean crust thickness = 7 km, γ_{crit} = 0.7)
- Breakup age = 84 Ma
- Lithosphere thermal correction on
- Reference crustal thickness = 40 km
- Compaction controlled density

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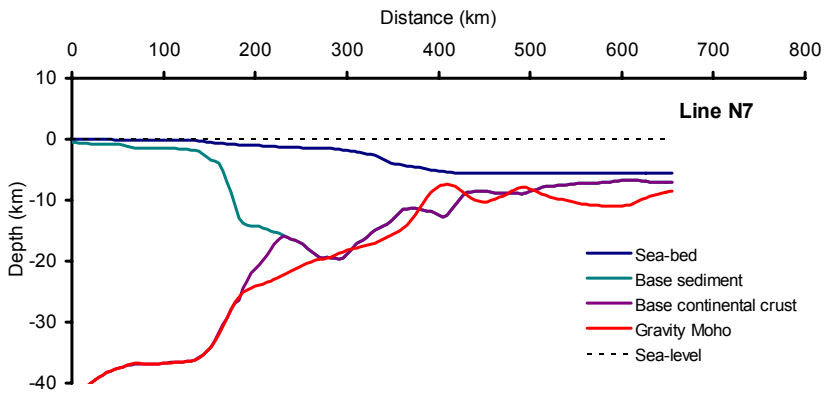
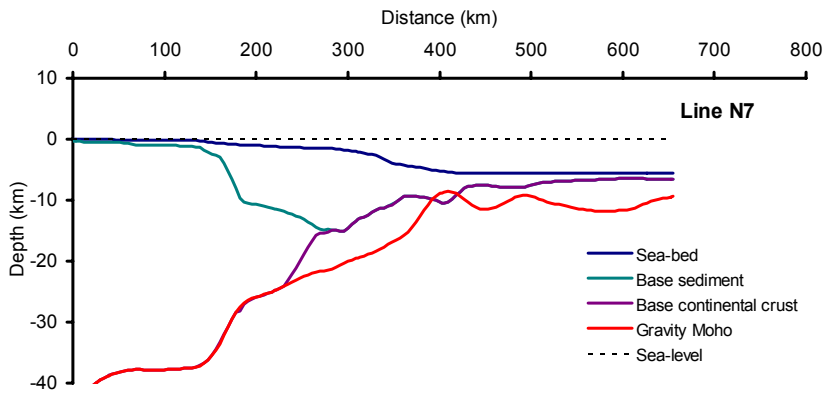
S. Australia - Antarctica Rifted Margins - Gravity Inversion

Sensitivity to oldest isochron used

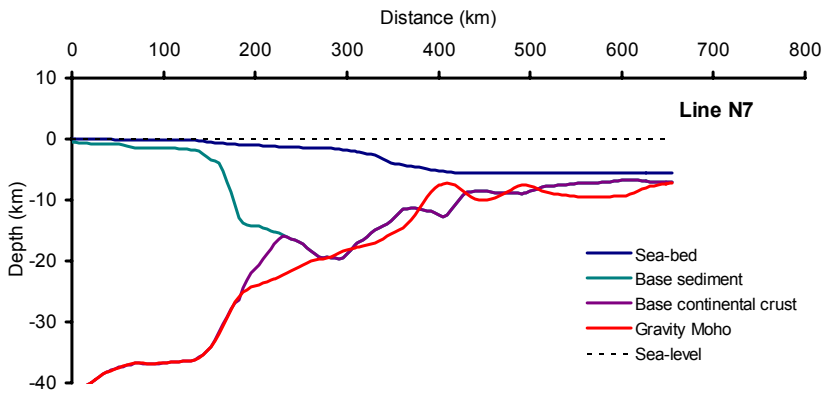
Sediment thickness: thick estimate

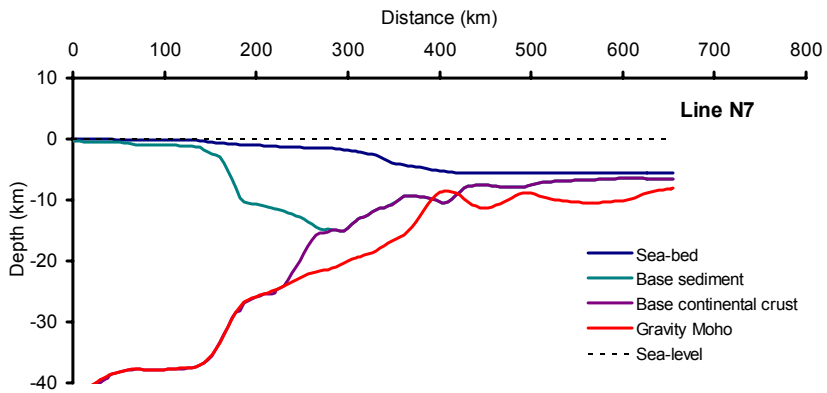


Sediment thickness: thin estimate



44 Ma





64 Ma

- "Normal" volcanic addition margin (ocean crust thickness = 7 km, γ_{crit} = 0.7)
- Breakup age = 84 Ma
- Lithosphere thermal correction on
- Reference crustal thickness = 40 km
- Compaction controlled density

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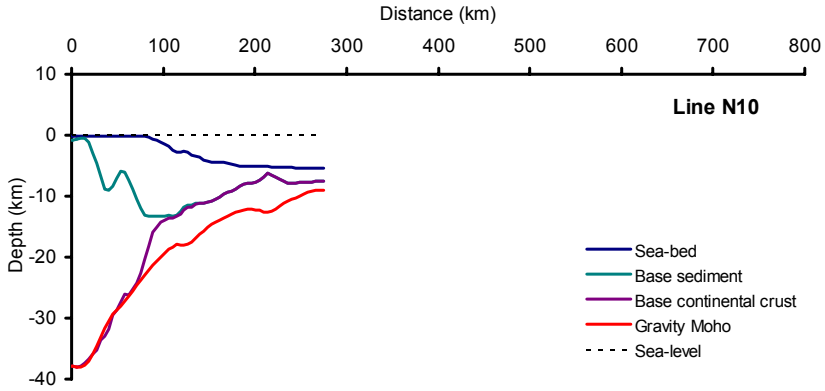
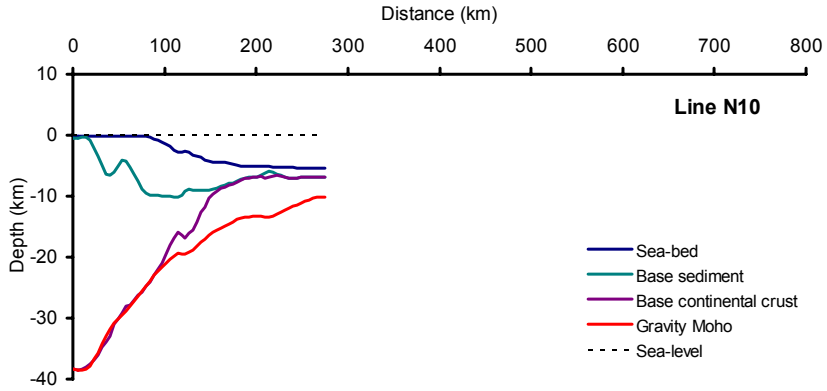
S. Australia - Antarctica Rifted Margins - Gravity Inversion

Sensitivity to oldest isochron used

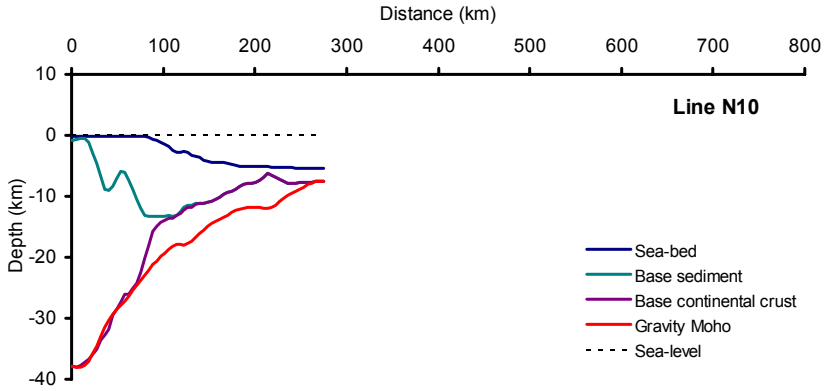
Sediment thickness: thick estimate

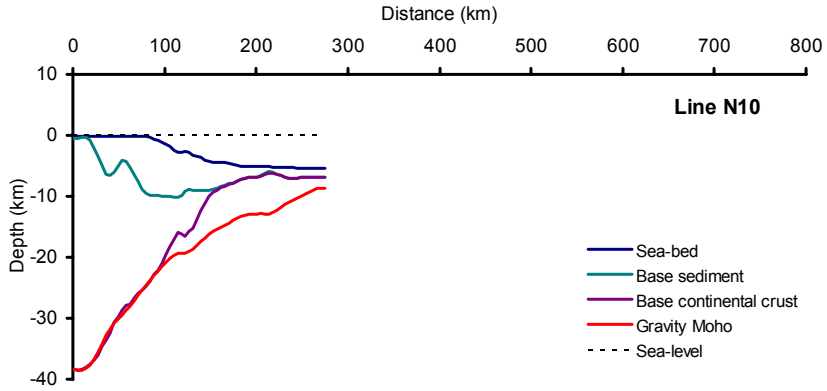


Sediment thickness: thin estimate



44 Ma





64 Ma

- "Normal" volcanic addition margin (ocean crust thickness = 7 km, γ_{crit} = 0.7)
- Breakup age = 84 Ma
- Lithosphere thermal correction on
- Reference crustal thickness = 40 km
- Compaction controlled density

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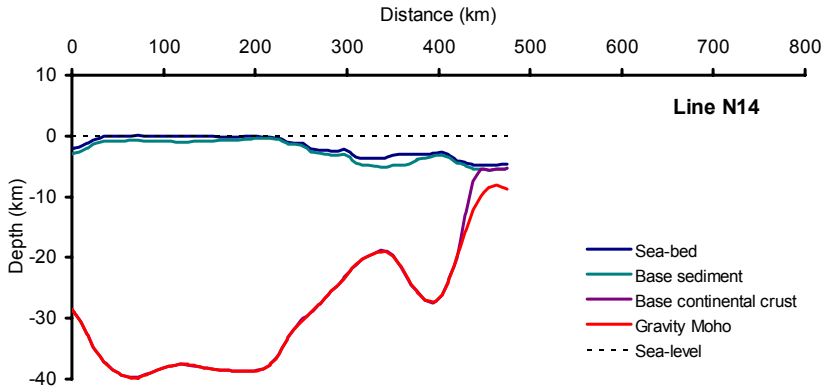
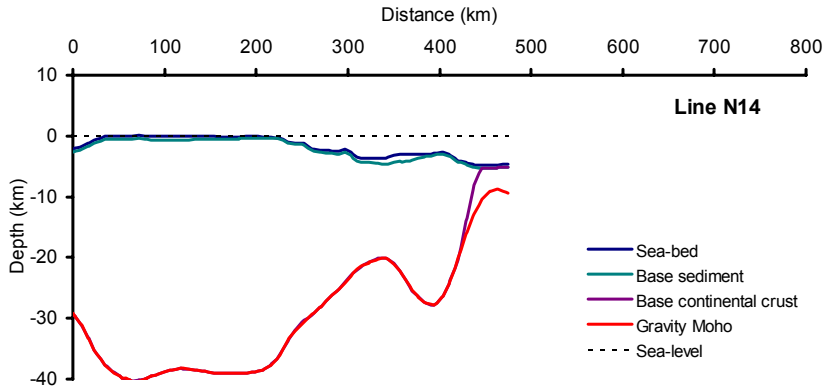
S. Australia - Antarctica Rifted Margins - Gravity Inversion

Sensitivity to oldest isochron used

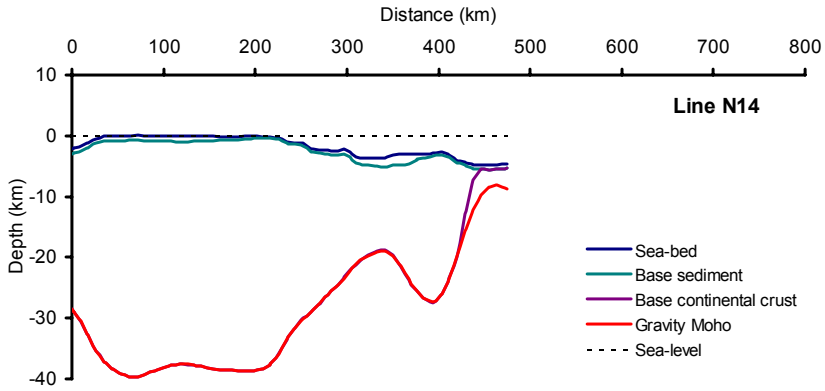
Sediment thickness: thick estimate

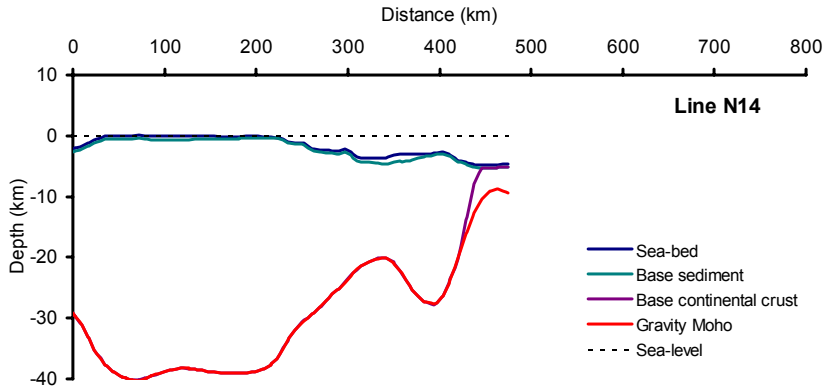


Sediment thickness: thin estimate



44 Ma





64 Ma

- "Normal" volcanic addition margin (ocean crust thickness = 7 km, γ_{crit} = 0.7)
- Breakup age = 84 Ma
- Lithosphere thermal correction on
- Reference crustal thickness = 40 km
- Compaction controlled density

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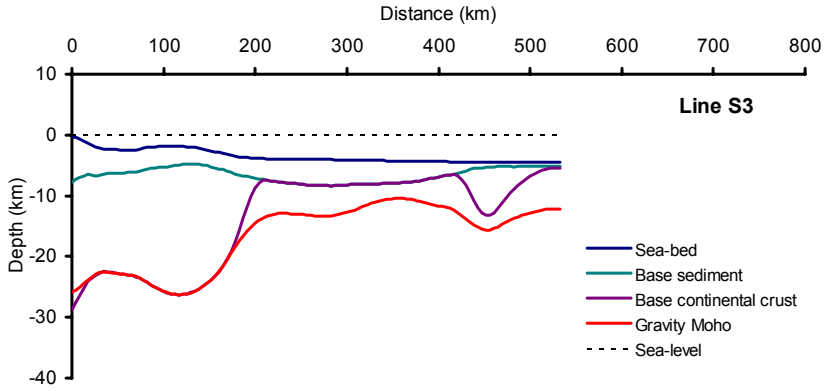
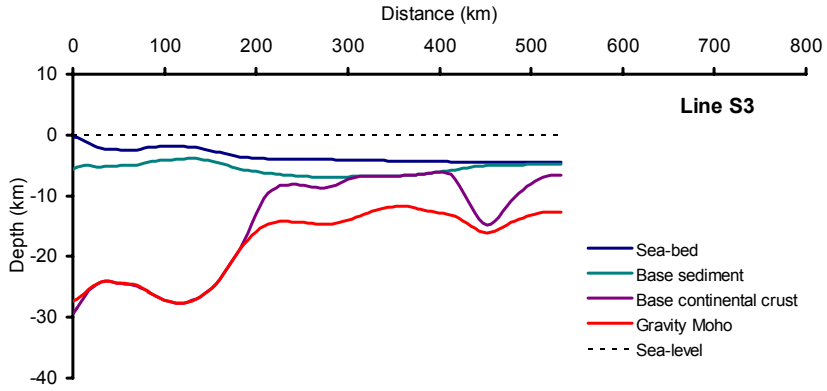
S. Australia - Antarctica Rifted Margins - Gravity Inversion

Sensitivity to oldest isochron used

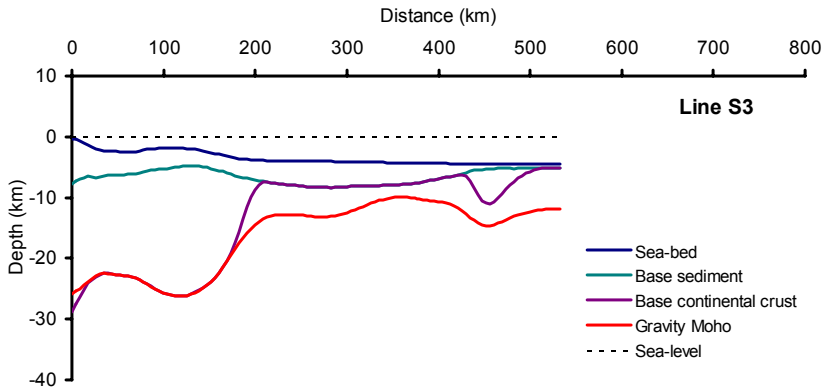
Sediment thickness: thick estimate

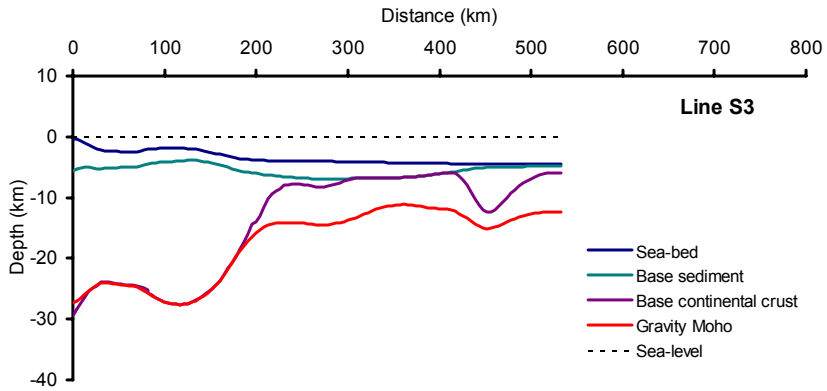


Sediment thickness: thin estimate



44 Ma





64 Ma

- "Normal" volcanic addition margin (ocean crust thickness = 7 km, γ_{crit} = 0.7)
- Breakup age = 84 Ma
- Lithosphere thermal correction on
- Reference crustal thickness = 40 km
- Compaction controlled density

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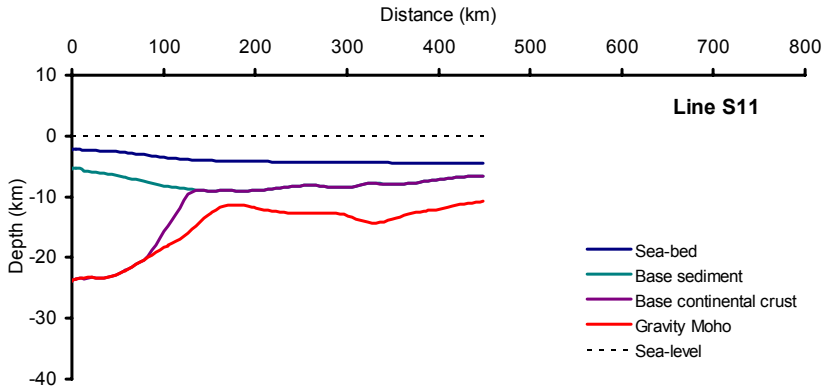
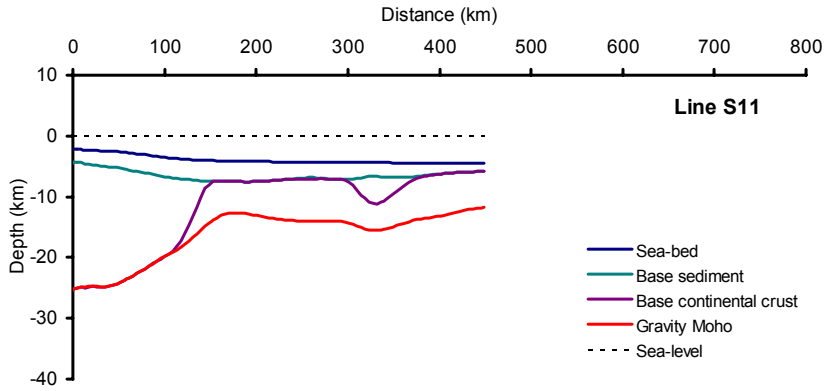
S. Australia - Antarctica Rifted Margins - Gravity Inversion

Sensitivity to oldest isochron used

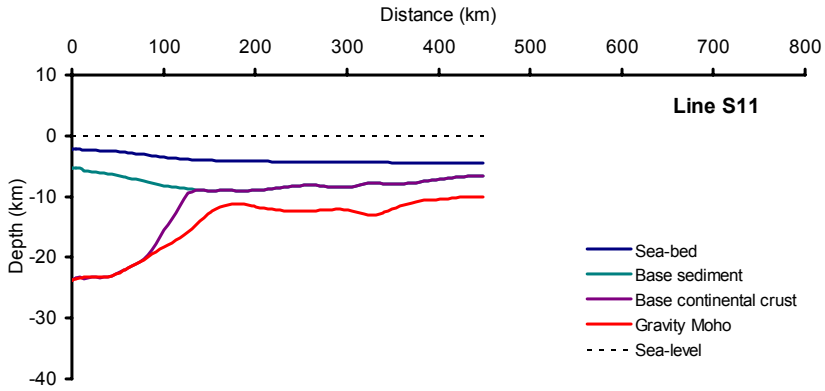
Sediment thickness: thick estimate

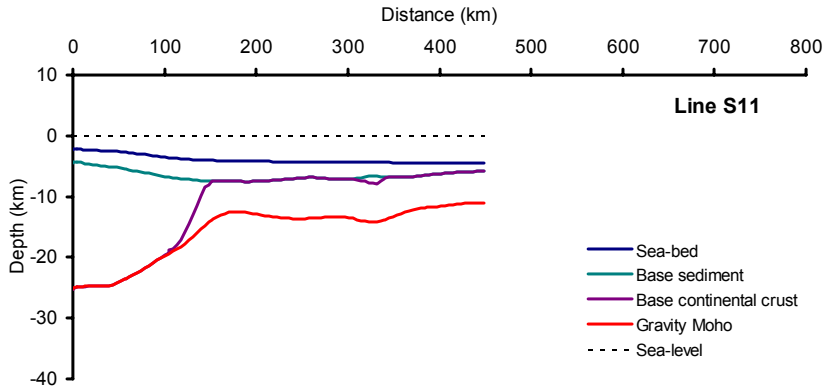


Sediment thickness: thin estimate



44 Ma





64 Ma

- "Normal" volcanic addition margin (ocean crust thickness = 7 km, γ_{crit} = 0.7)
- Breakup age = 84 Ma
- Lithosphere thermal correction on
- Reference crustal thickness = 40 km
- Compaction controlled density

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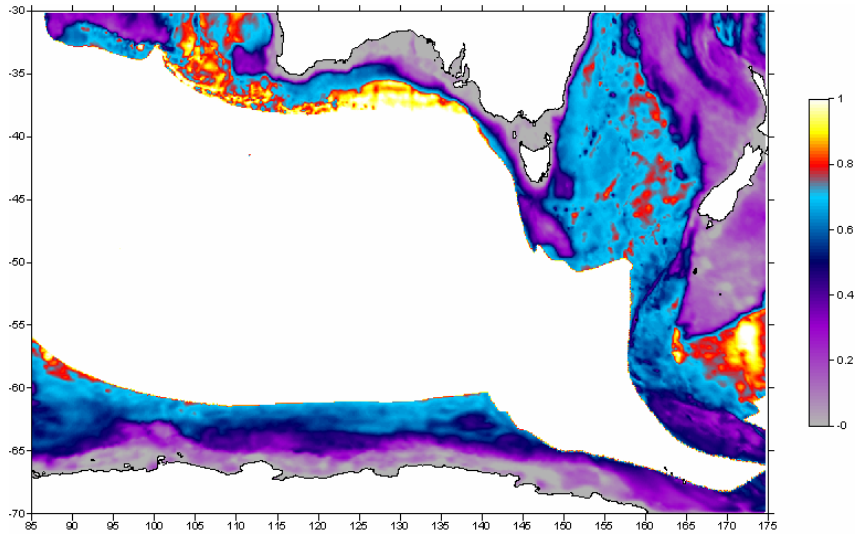
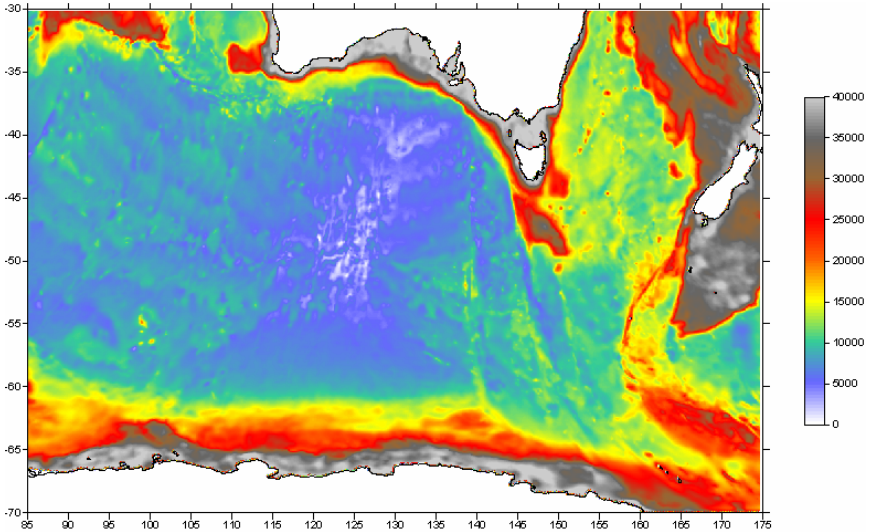
S. Australia - Antarctica Rifted Margins - Gravity Inversion

Summary 1

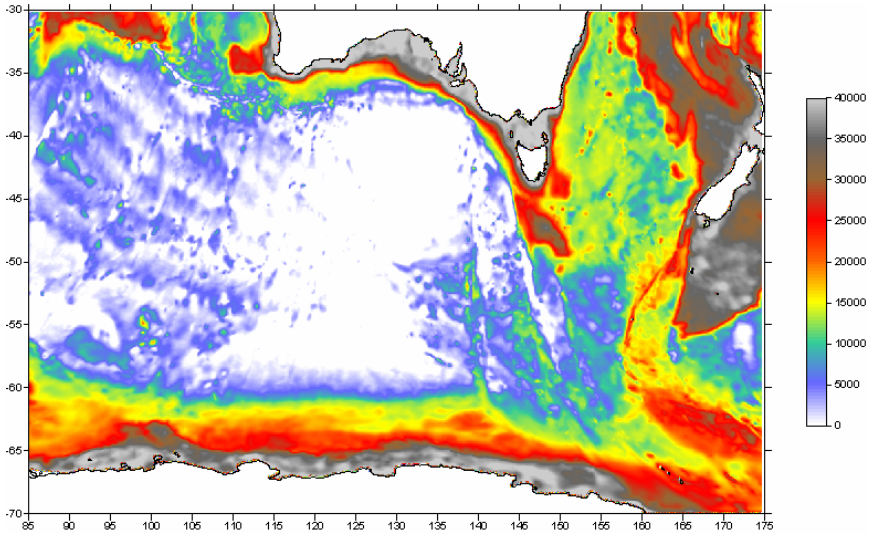
Continental Lithosphere Thinning Factor (1 – 1/β)



Crustal thickness (m)



Residual Continental Crust (m)



No sediments

- "Normal volcanic addition margin (ocean crust thickness = 7 km, γ_{crit} = 0.7)
- Breakup age = 84 Ma
- Oldest isochron used = 44 Ma
- Lithosphere thermal correction on
- Reference crustal thickness = 40 km
- No sediments

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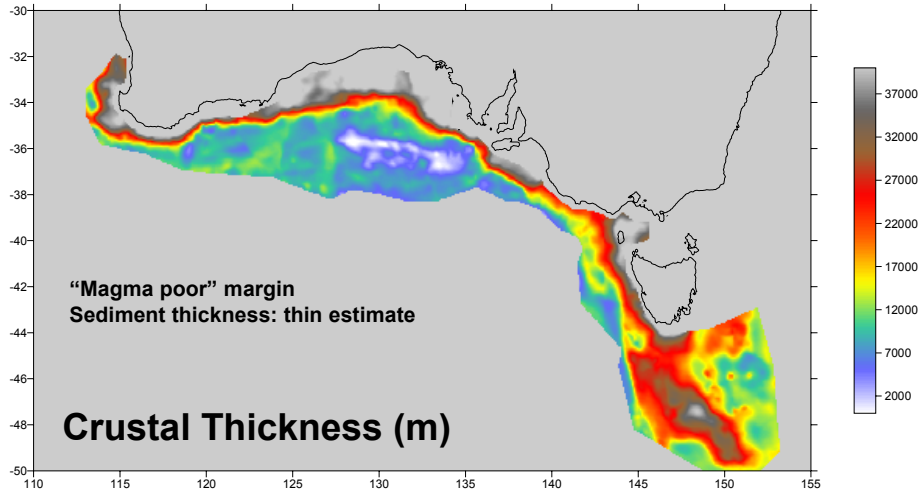
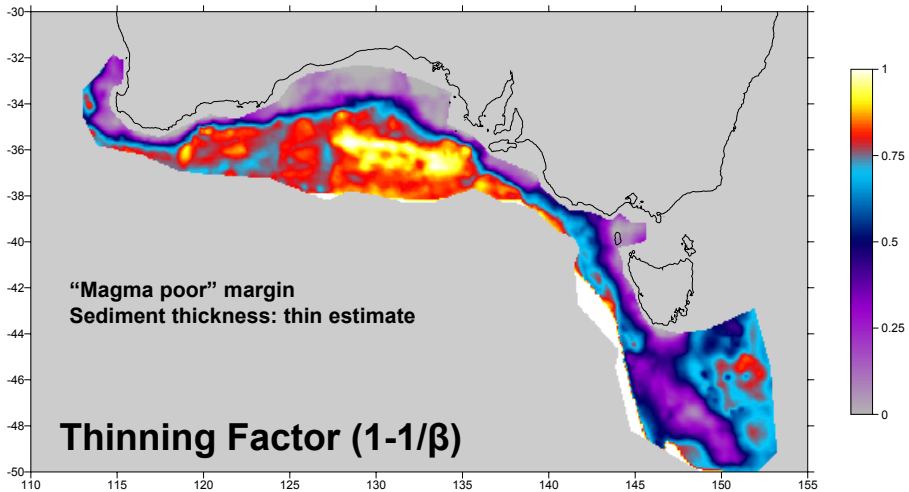
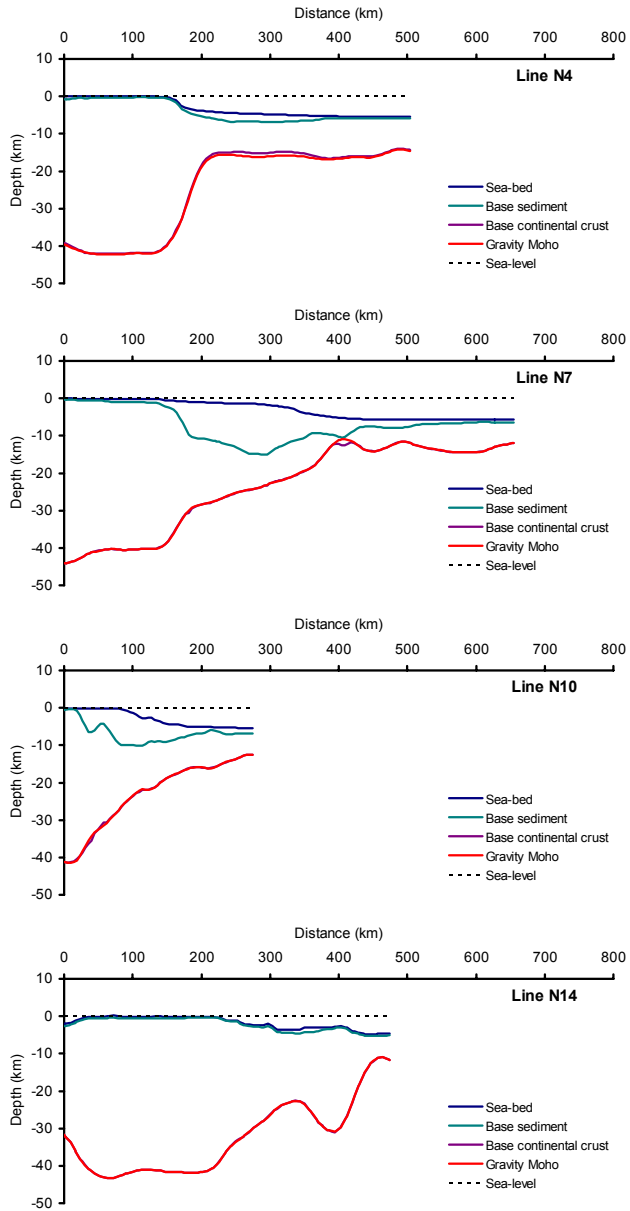
S. Australia - Antarctica Rifted Margins - Gravity Inversion

Summary 2







- "Magma" poor margin (ocean crust thickness = 0 km)
- Breakup age = 84 Ma, Oldest isochron used = 44 Ma
- Lithosphere thermal correction on
- Reference crustal thickness = 42.5 km
- Compaction controlled density
- Thin sediment thickness estimate

With sediments

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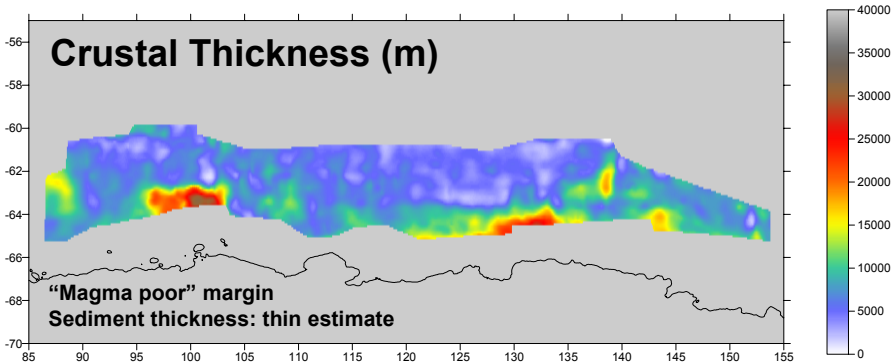
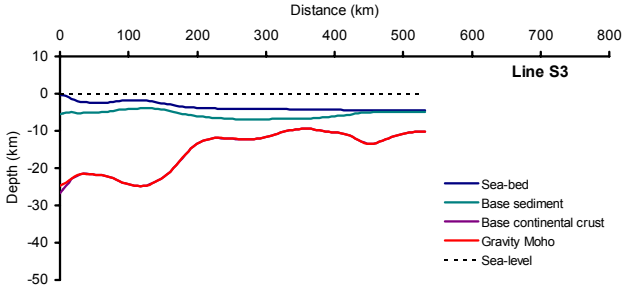
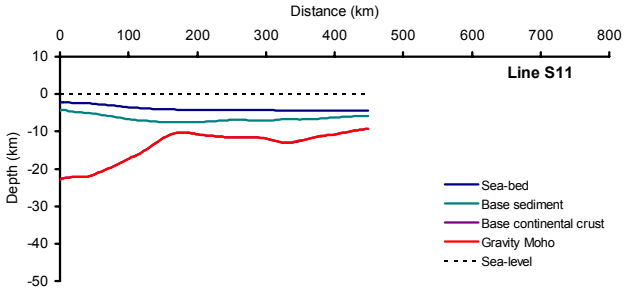
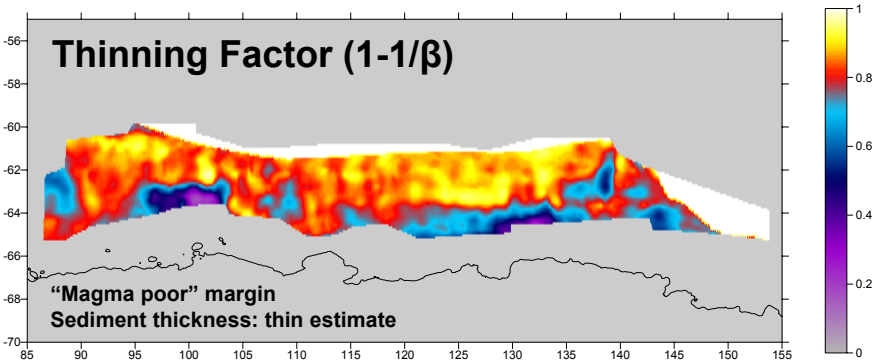
S. Australia - Antarctica Rifted Margins - Gravity Inversion

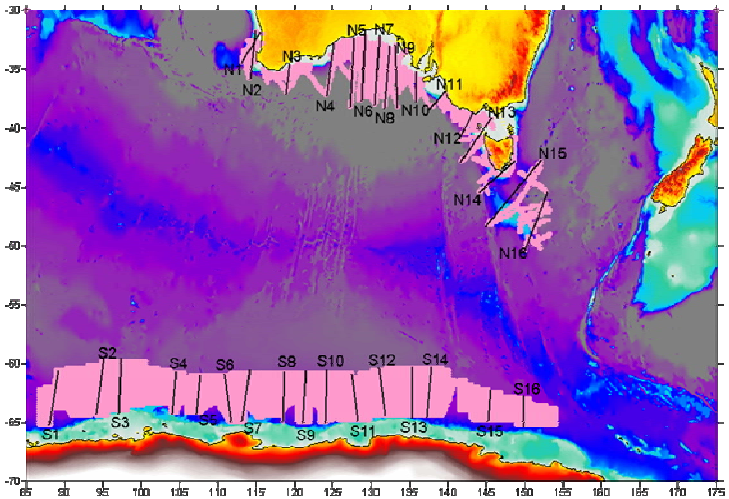
Summary 3











- "Magma" poor margin (ocean crust thickness = 0 km)
- Breakup age = 84 Ma, Oldest isochron used = 44 Ma
- Lithosphere thermal correction on
- Reference crustal thickness = 37.5 km
- Compaction controlled density
- Thin sediment thickness estimate

With sediments

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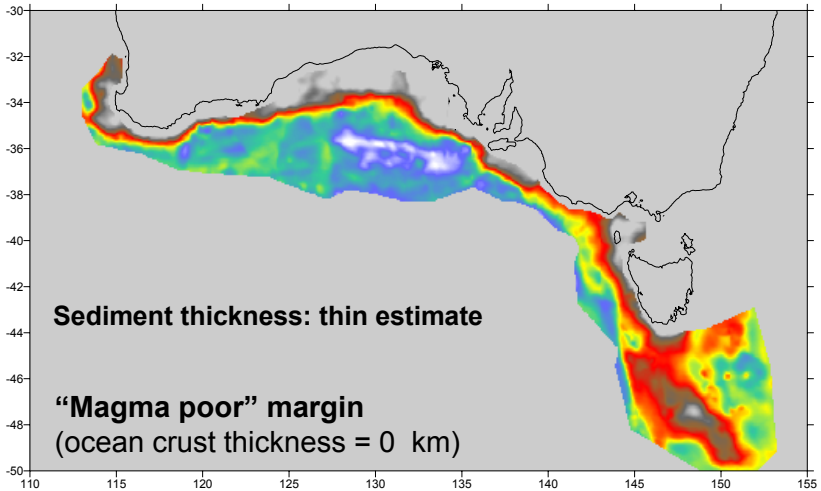
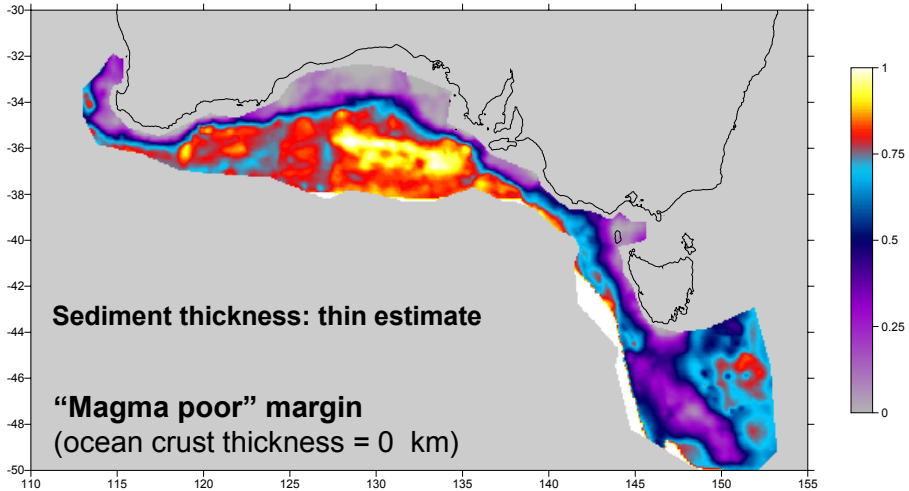
S. Australia - Antarctica Rifted Margins - Gravity Inversion

Summary 4

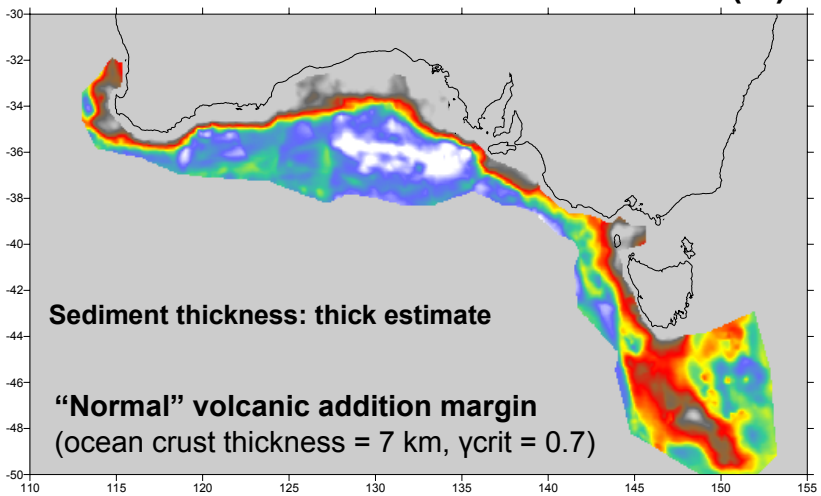
Crustal Thickness (m)



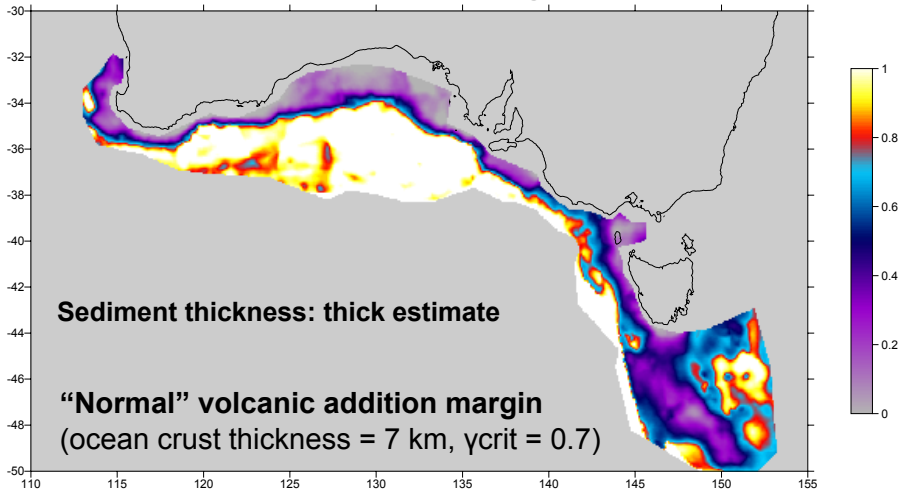
Thinning Factor (1-1/β)



Crustal Thickness (m)



Thinning Factor (1-1/β)



- Breakup age = 84 Ma
- Oldest isochron used = 44 Ma
- Lithosphere thermal correction on
- Reference crustal thickness = 42.5 km
- Compaction control of sediment density

With sediments

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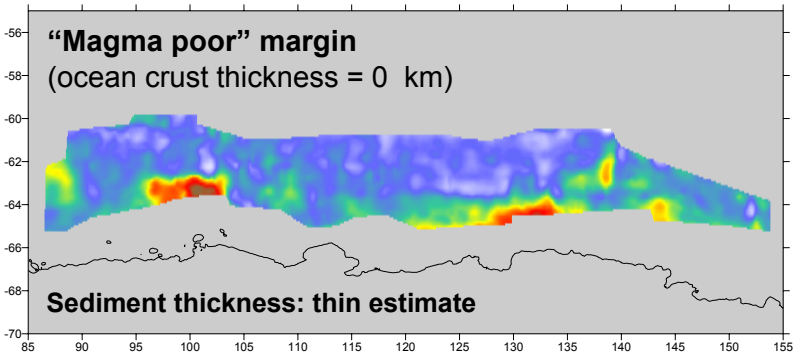
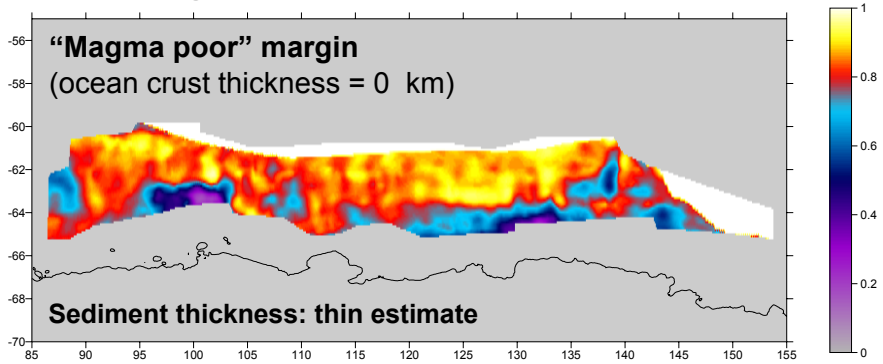
S. Australia - Antarctica Rifted Margins - Gravity Inversion

Summary 5

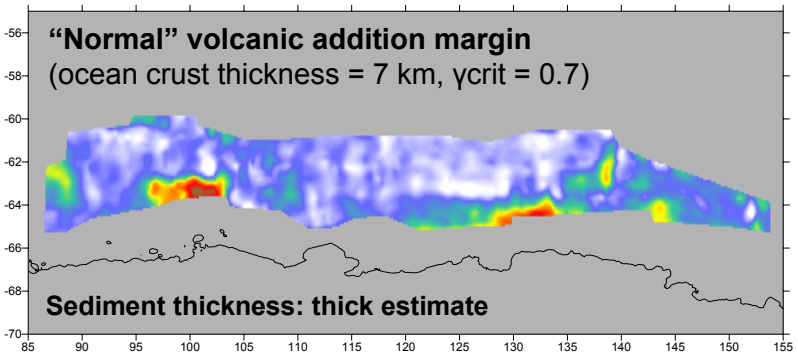
Crustal Thickness (m)



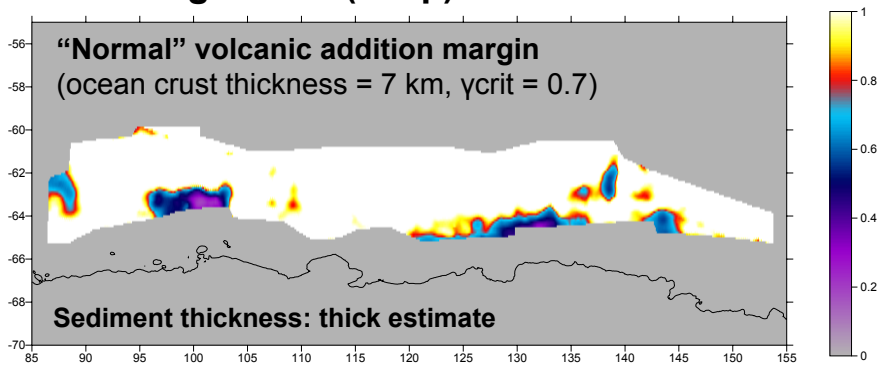
Thinning Factor (1-1/β)



Crustal Thickness (m)



Thinning Factor (1-1/β)



- Breakup age = 84 Ma
- Oldest isochron used = 44 Ma
- Lithosphere thermal correction on
- Reference crustal thickness = 37.5 km
- Compaction control of sediment density

With sediments

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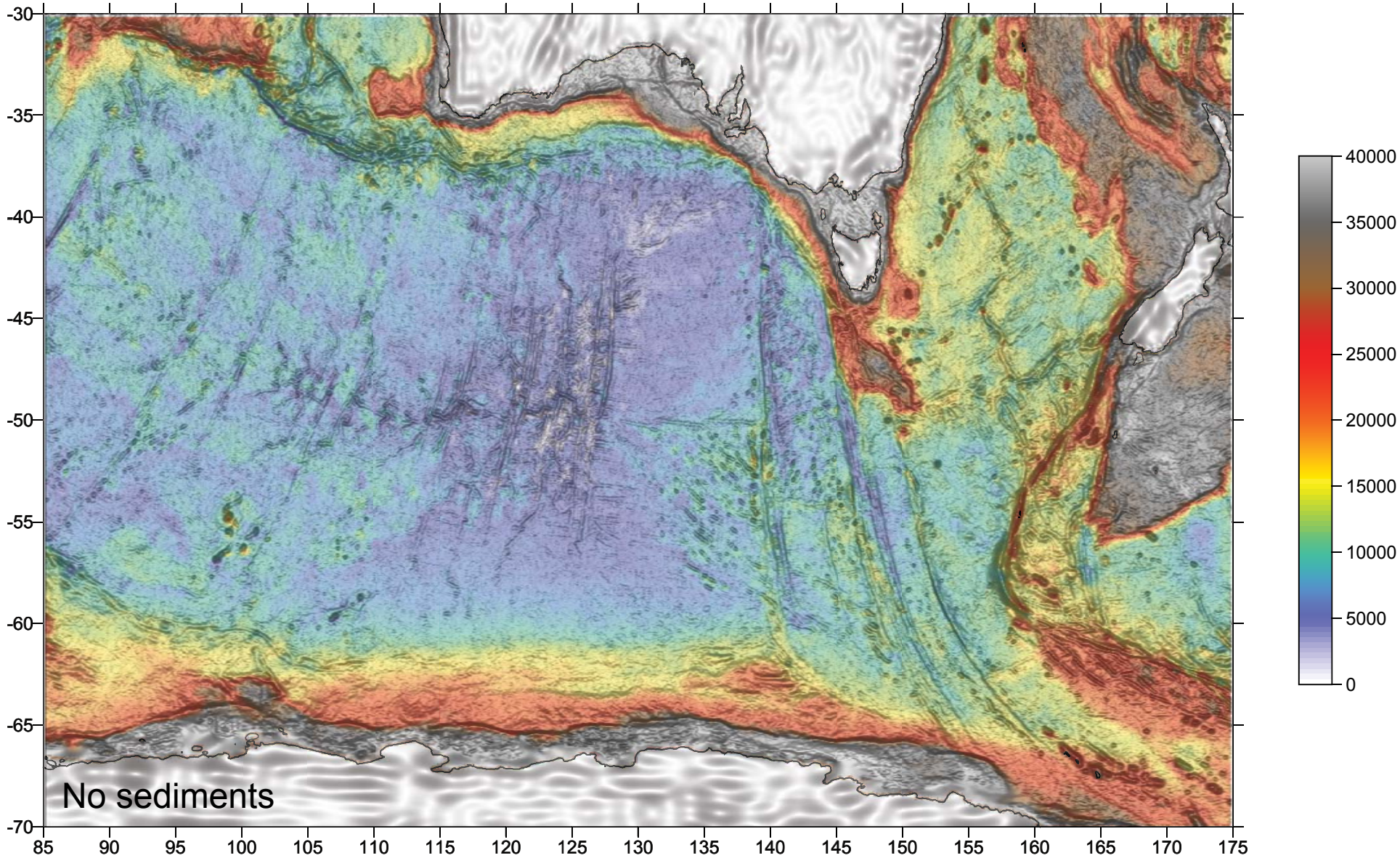
S. Australia - Antarctica Rifted Margins - Gravity Inversion



Crustal thickness (m) with superimposed shaded relief free air gravity

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The following 32 grids (including crustal thickness, Moho depth, thinning factor and residual continental crust grids) resulting from this work are available for free download from Geoscience Australia web site as ascii files (16 for Australian and 16 for Antarctic Margin):

	Australian South Margin	Antarctic Margin
1	42_5_norm_thick_84_44_cr_thick.asc	37_5_norm_thick_84_44_cr_thick.asc
2	42_5_norm_thick_84_44_m_depth.asc	37_5_norm_thick_84_44_m_depth.asc
3	42_5_norm_thick_84_44_thin_fac.asc	37_5_norm_thick_84_44_thin_fac.asc
4	42_5_norm_thick_84_44_res_cont_cr.asc	37_5_norm_thick_84_44_res_cont_cr.asc
5	42_5_norm_thin_84_44_cr_thick.asc	37_5_norm_thin_84_44_cr_thick.asc
6	42_5_norm_thin_84_44_m_depth.asc	37_5_norm_thin_84_44_m_depth.asc
7	42_5_norm_thin_84_44_thin_fac.asc	37_5_norm_thin_84_44_thin_fac.asc
8	42_5_norm_thin_84_44_res_cont_cr.asc	37_5_norm_thin_84_44_res_cont_cr.asc
9	42_5_poor_thick_84_44_cr_thick.asc	37_5_poor_thick_84_44_cr_thick.asc
10	42_5_poor_thick_84_44_m_depth.asc	37_5_poor_thick_84_44_m_depth.asc
11	42_5_poor_thick_84_44_thin_fac.asc	37_5_poor_thick_84_44_thin_fac.asc
12	42_5_poor_thick_84_44_res_cont_cr.asc	37_5_poor_thick_84_44_res_cont_cr.asc
13	42_5_poor_thin_84_44_cr_thick.asc	37_5_poor_thin_84_44_cr_thick.asc
14	42_5_poor_thin_84_44_m_depth.asc	37_5_poor_thin_84_44_m_depth.asc
15	42_5_poor_thin_84_44_thin_fac.asc	37_5_poor_thin_84_44_thin_fac.asc
16	42_5_poor_thin_84_44_res_cont_cr.asc	37_5_poor_thin_84_44_res_cont_cr.asc

They are included into a single archive (.zip) file of total size 21 Mbytes. The file 'readme.txt' is also included in the archive to assist in understanding of the grids, and their possible utilisation. This report is also included in the archive file in the Adobe Acrobat format (.pdf).