The continental shelf and rifted continental margins of offshore Newfoundland revisited using constrained 3-D gravity inversion: tracking inheritance trends and rift scars

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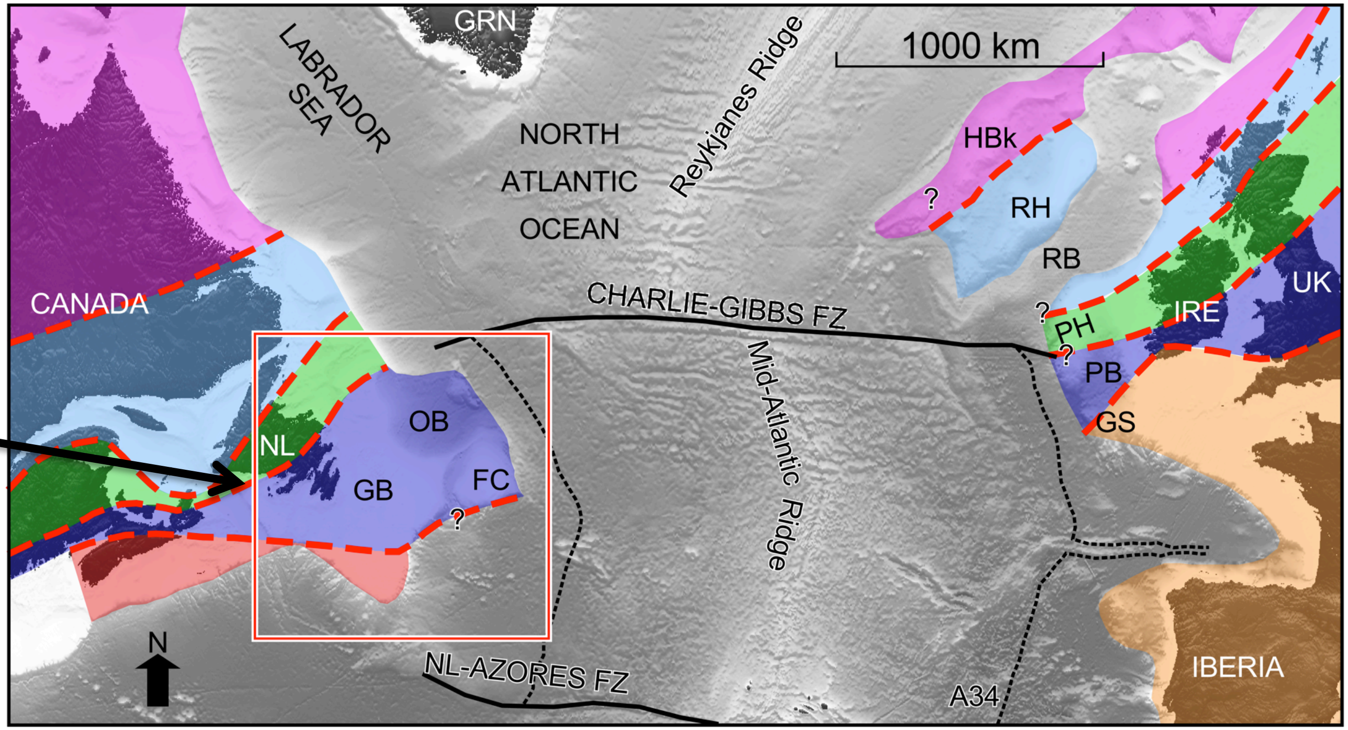
Motivation

- We want to characterize the full crustal structure of the continental shelf and rifted continental margins of offshore Newfoundland beyond existing sparse 2-D deep seismic refraction profiles.
- We use gravity data, and specifically 3-D constrained inversion, to bridge between existing seismic constraints.
- We want to invert for 3-D density distributions of the full crust and upper mantle, without having to pre-filter the observed gravity data or make constant density assumptions about the sedimentary, crustal, and upper mantle layers.

Inherited Basement Domains of the southern N. Atlantic

inversion domain



Basement Domain Affinity

- Archaean and Palaeoproterozoic
- Meso- and Neoproterozoic
- Proterozoic to Early Palaeozoic
- Avalonian (Neoproterozoic)
- Meguma (Early Palaeozoic)
- Variscan (Middle Palaeozoic)

- Fracture Zones (FZ)
- Magnetic Chron A34
- Crustal sutures

Methodology

We use two approaches:

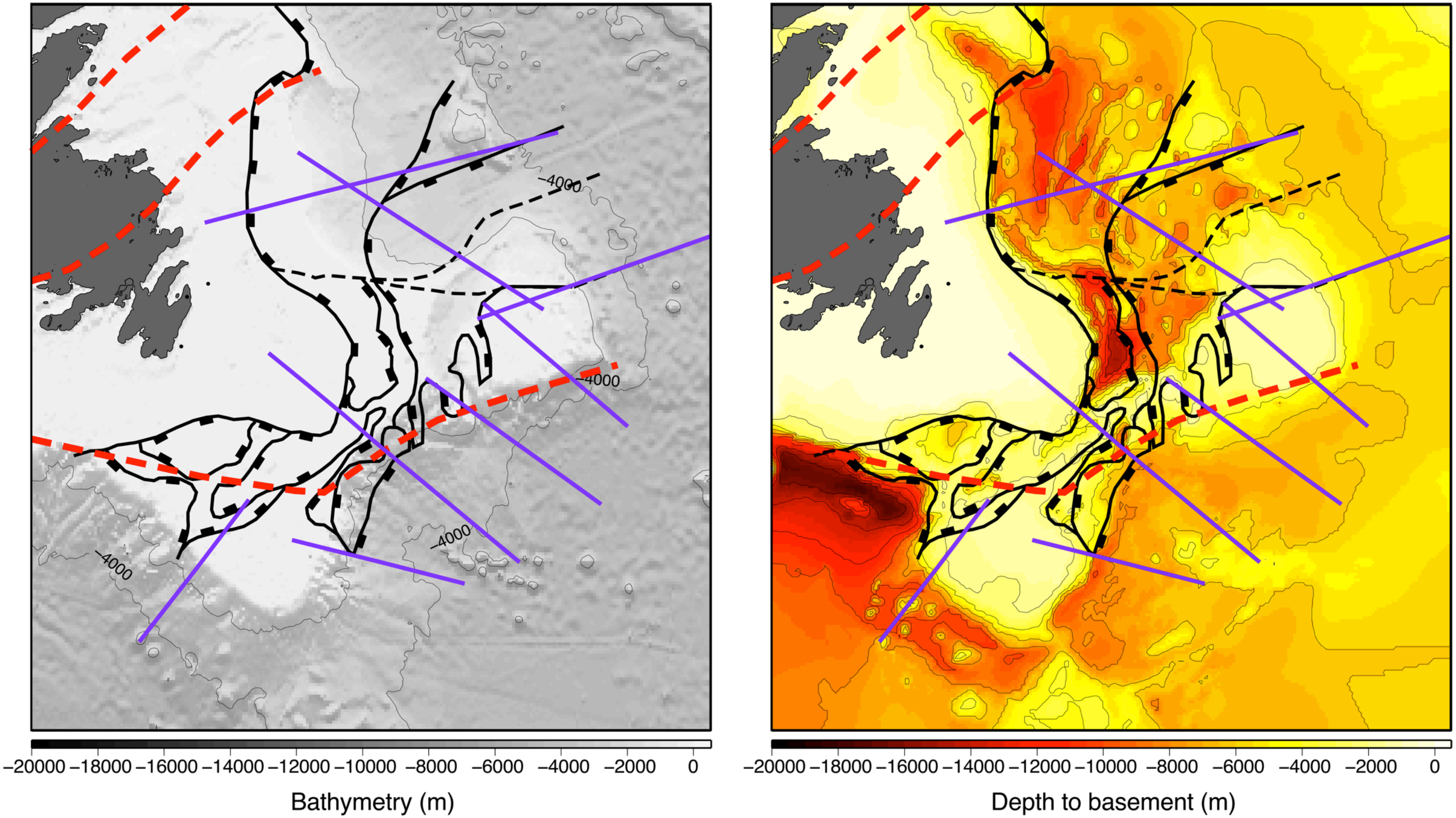
- GRAV3D minimum structure inversion (Li and Oldenburg, 1998,2000)
- Probabilistic inversion method (Geng et al., 2019)

sparse Moho constraints included directly into the probabilistic inversion

For both approaches, we use:

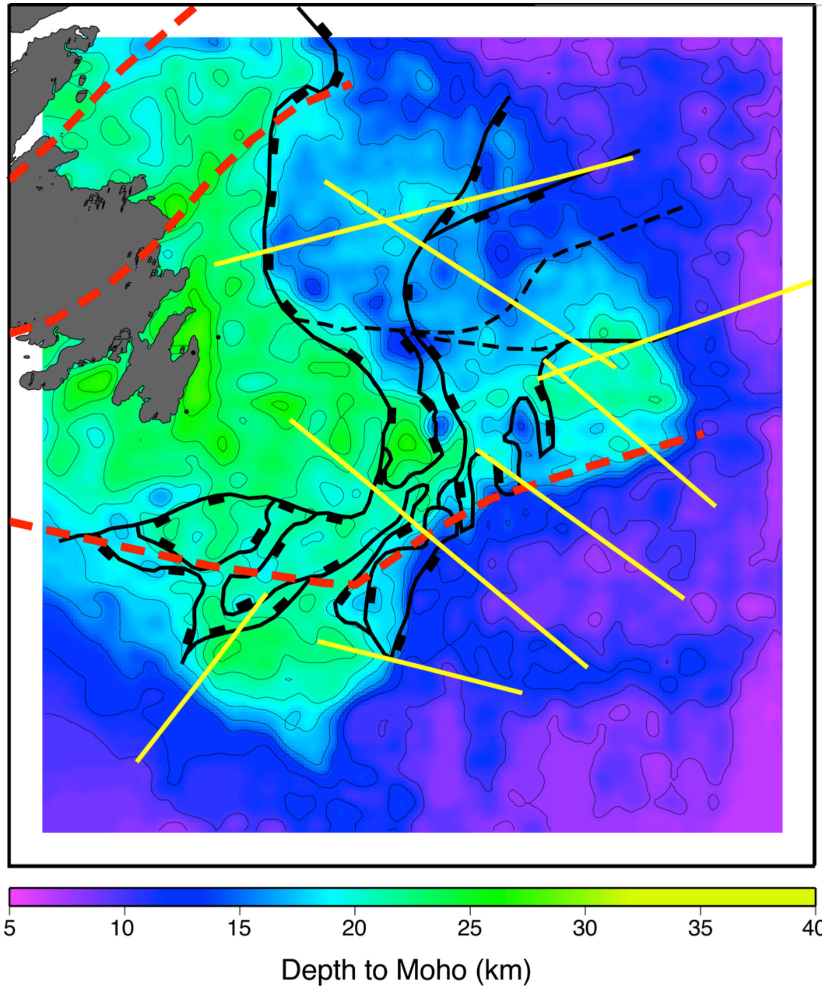
- Total inversion mesh depth of 40 km
- Inversion mesh cells of 5 km by 5 km by 500 m
- Reference density of 2950 g/cm^3
- Bathymetry and sediment thickness constraints

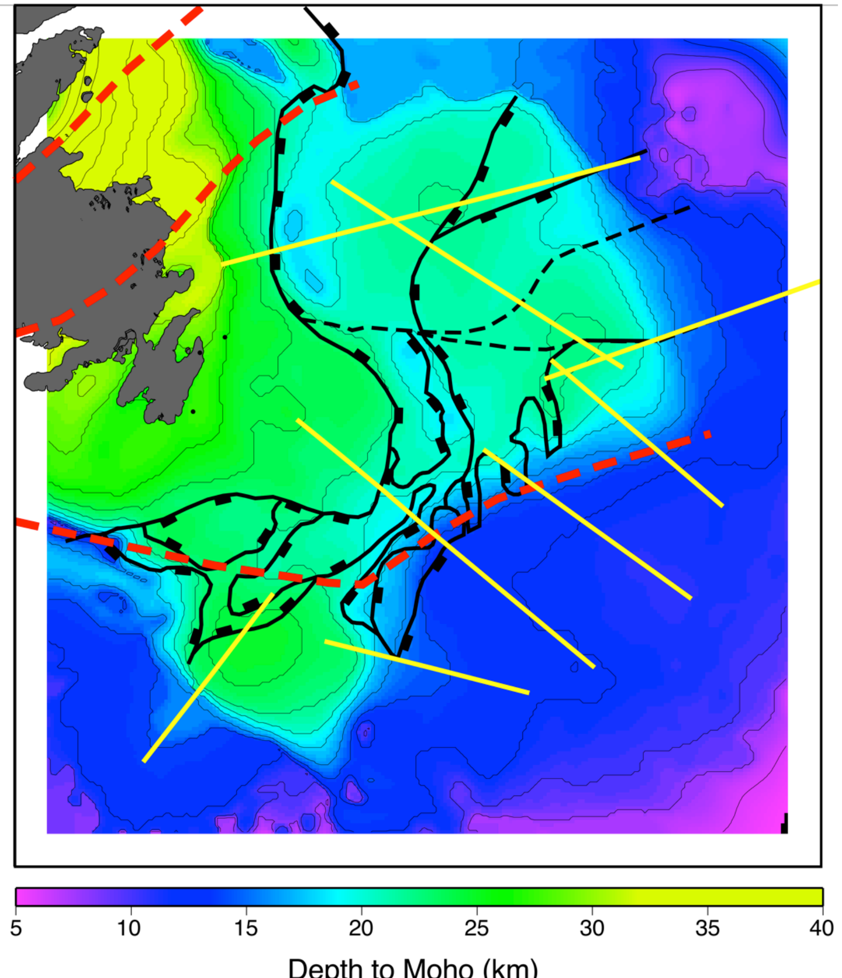
Inversion Constraints



Dashed red lines are inherited crustal sutures, black lines are faults, purple lines are crustal-scale seismic refraction lines.

Moho depth maps

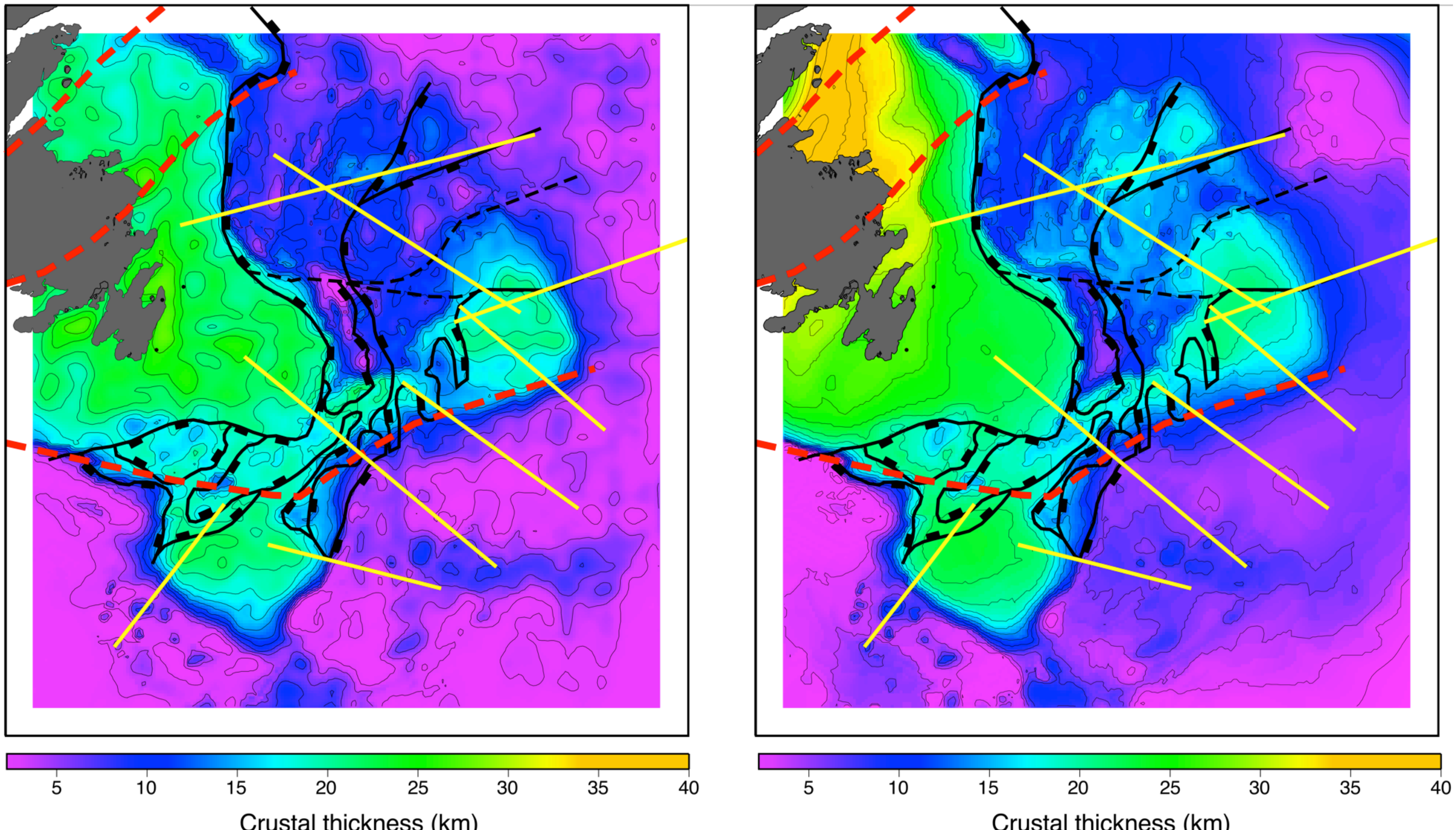




Yellow lines are crustal-scale seismic refraction lines

Crustal thickness maps

Minimum structure inversion (no Moho constraints) | **Probabilistic inversion (Moho constraints included)**



Yellow lines are crustal-scale seismic refraction lines

Conclusions

- Preliminary results from two gravity inversion approaches (minimum structure and probabilistic) show a good correlation between zones of crustal thinning and major faults/crustal sutures.

- The inclusion of Moho depth constraints directly into the probabilistic inversion does a better job of capturing both the thicker continental crust and thinner oceanic crust.

- Stronger smoothing from the probabilistic inversion fails to capture localized zones of crustal thinning. The smoothing will be reduced for future inversion tests.

References

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