Antarctic crust heterogeneity and its influence on solid earth-cryosphere interactions

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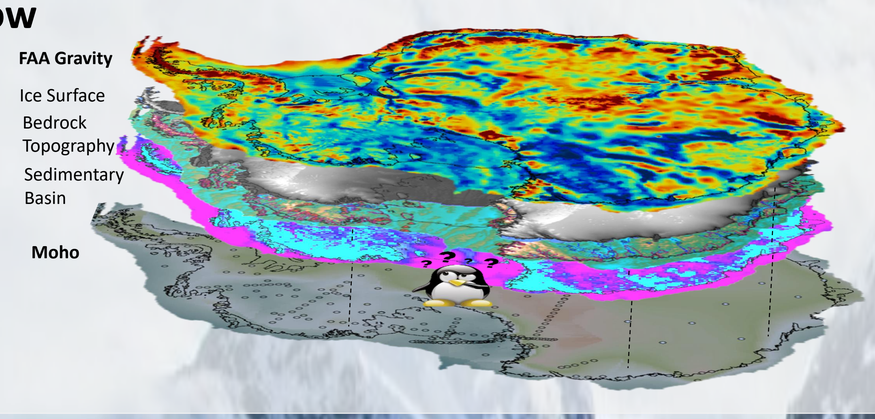
Introduction

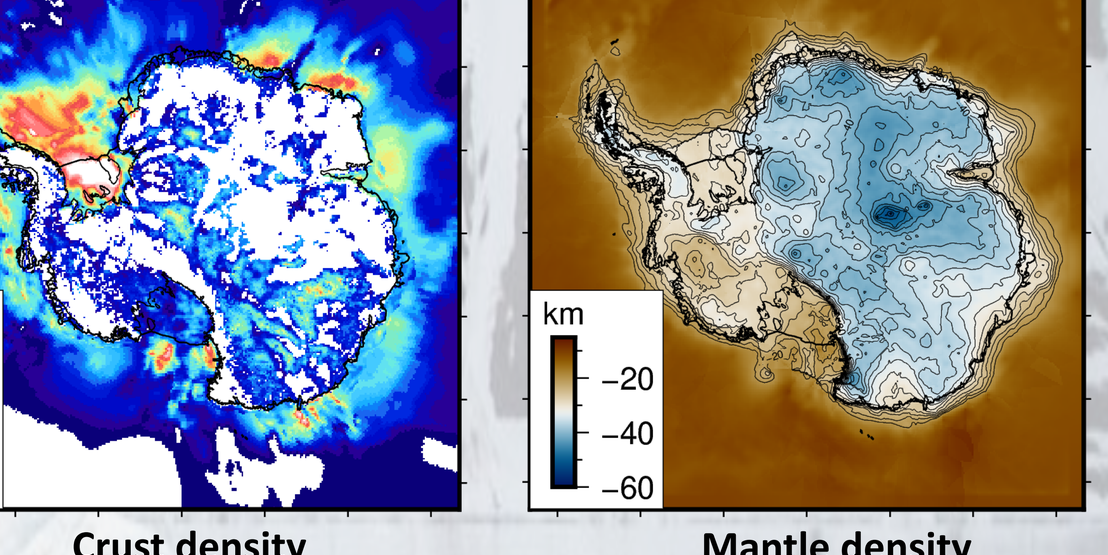
The Antarctic crustal structure is key to understanding its tectonic history, and solid earth-cryosphere interaction. The crustal heterogeneity is poorly known.

1. **Use Gravity inversion to resolve the most representative models of Antarctic crustal structure**
2. **Understand basal conditions and processes for ice-sheet flow**



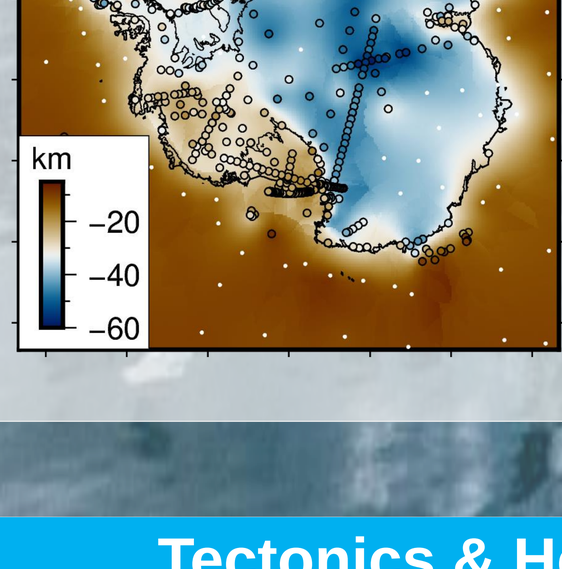
Methods

We use VPMG software (Fullagar et al., 2008) to perform the 3D gravity inversion with petrophysics and seismic Moho depth as constraints. We assemble modes by alternating **density style inversion** and **geometry style inversion.**



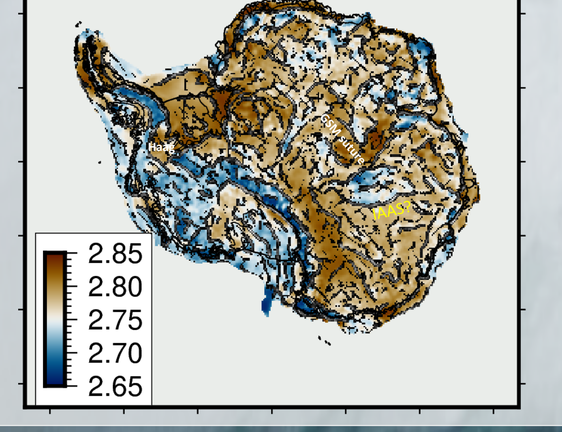
Initial Model & Mean inversion result

Free-air gravity (ANTGG+ satellite)



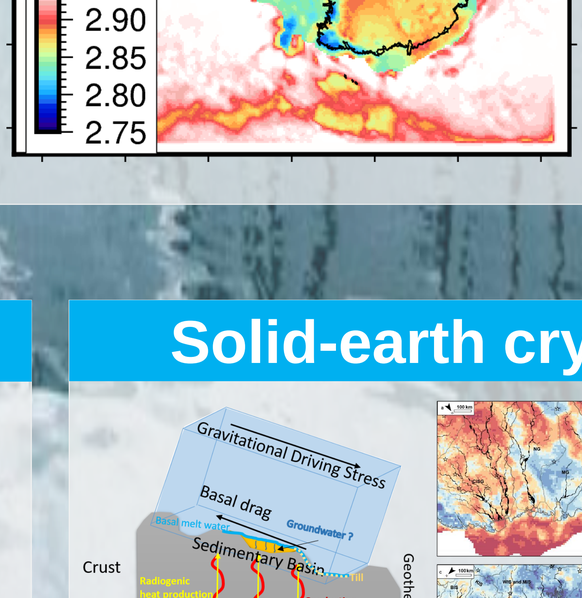
1. **Thick SSB in EANT; Thin SSB in WANT.**
2. **Crust thickness and density: less dense WANT (~25 km); dense crust in EANT (~35 km).**
3. **Crust thickness variation in WANT indicate multistage rifting.**

Initial Moho Surface

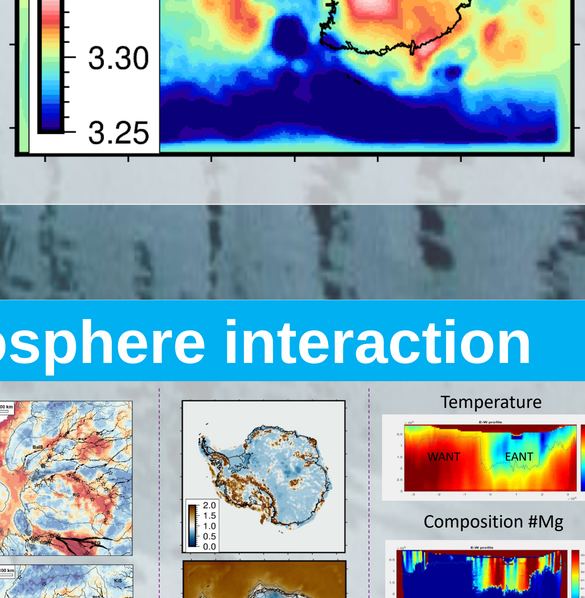


4. **Thick and dense crust (and mantle) in WSB might explain thick SSB preservation.**
5. **Mantle density is not well constrained. Ring shape low density in WANT corresponds well with low Vs structure in the uppermost mantle (Shen et al., 2018).**

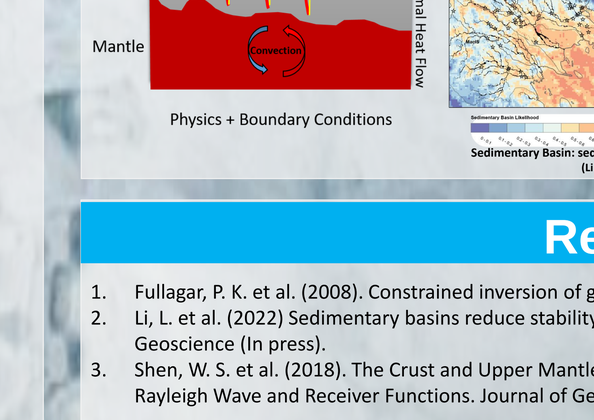
Sedimentary Basin Thickness



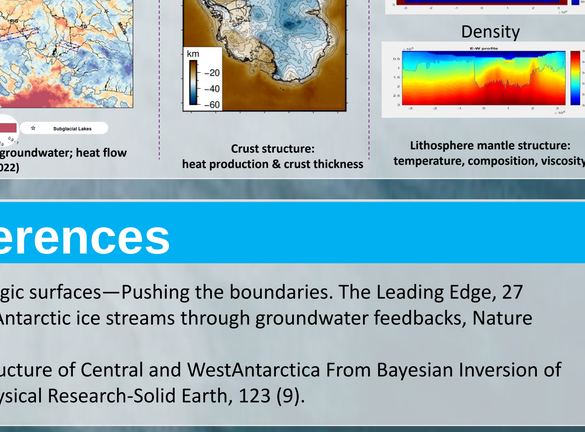
Moho Depth



Crust density



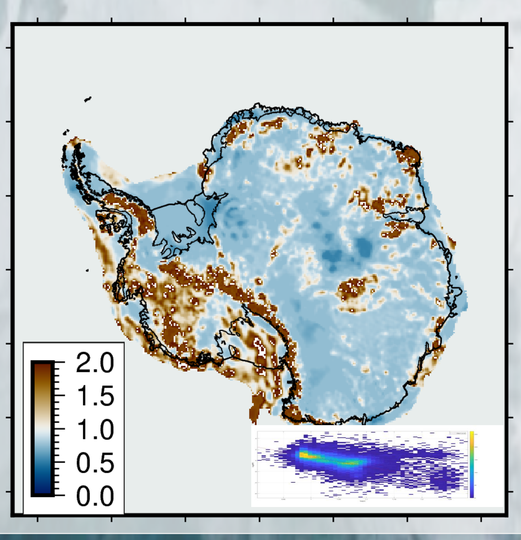
Mantle density



Tectonics & Heat Production

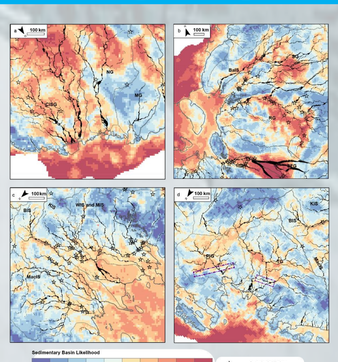
Upper Crust density + Multiscale lineament

Upper Crust heat production



Solid-earth cryosphere interaction

Physics + Boundary Conditions



Sedimentary Basin: sediment; groundwater; heat flow (Li et al., 2022)

Crust structure: heat production & crust thickness

Lithosphere mantle structure: temperature, composition, viscosity

References

1. Fullagar, P. K. et al. (2008). Constrained inversion of geologic surfaces—Pushing the boundaries. The Leading Edge, 27
2. Li, L. et al. (2022) Sedimentary basins reduce stability of Antarctic ice streams through groundwater feedbacks, Nature Geoscience (In press).
3. Shen, W. S. et al. (2018). The Crust and Upper Mantle Structure of Central and WestAntarctica From Bayesian Inversion of Rayleigh Wave and Receiver Functions. Journal of Geophysical Research-Solid Earth, 123 (9).