Updated lunar crustal thickness distribution from global geodynamic models

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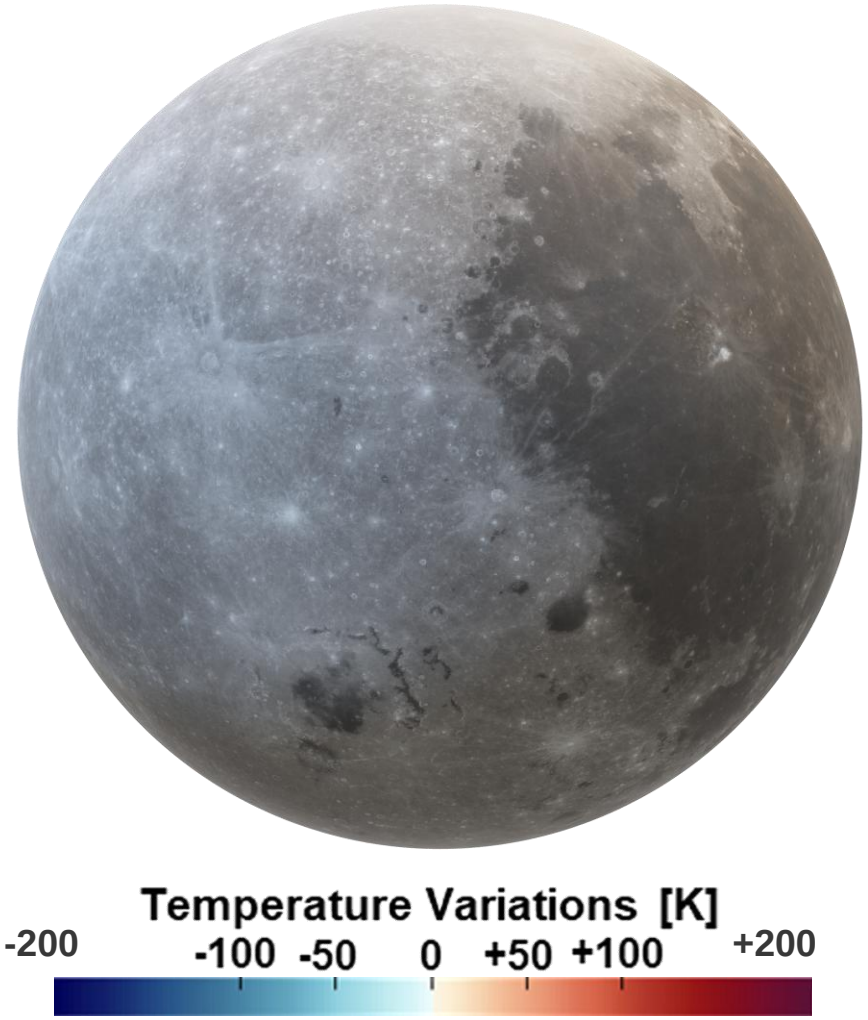
Santangelo+2025

Simulate thermal evolution for ~4.5 Ga

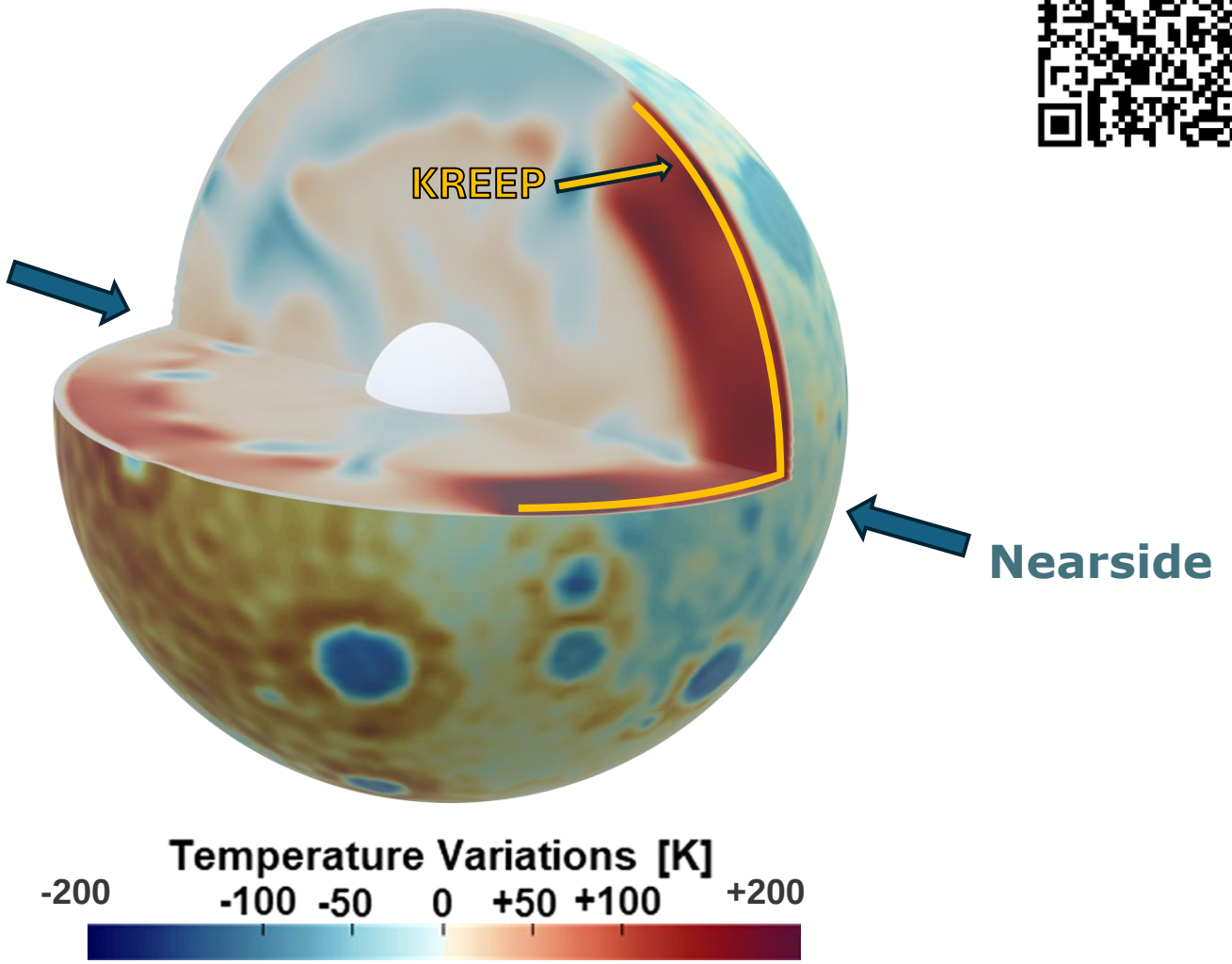
- Initial distribution of **Temperature**
- Initial distribution of **Th, U, K**
- **KREEP** unit below nearside
- Laterally **variable crust**
  [Broquet+2024]



Santangelo+2025

Simulate thermal evolution for ~4.5 Ga

- Initial distribution of **Temperature**
- Initial distribution of **Th, U, K**
- **KREEP**-rich unit below nearside
- Laterally **variable crust**
  [Broquet+2024]



KREEP: Potassium (K), Rare Earth Elements (REE), Phosphorus (P) + thorium, uranium

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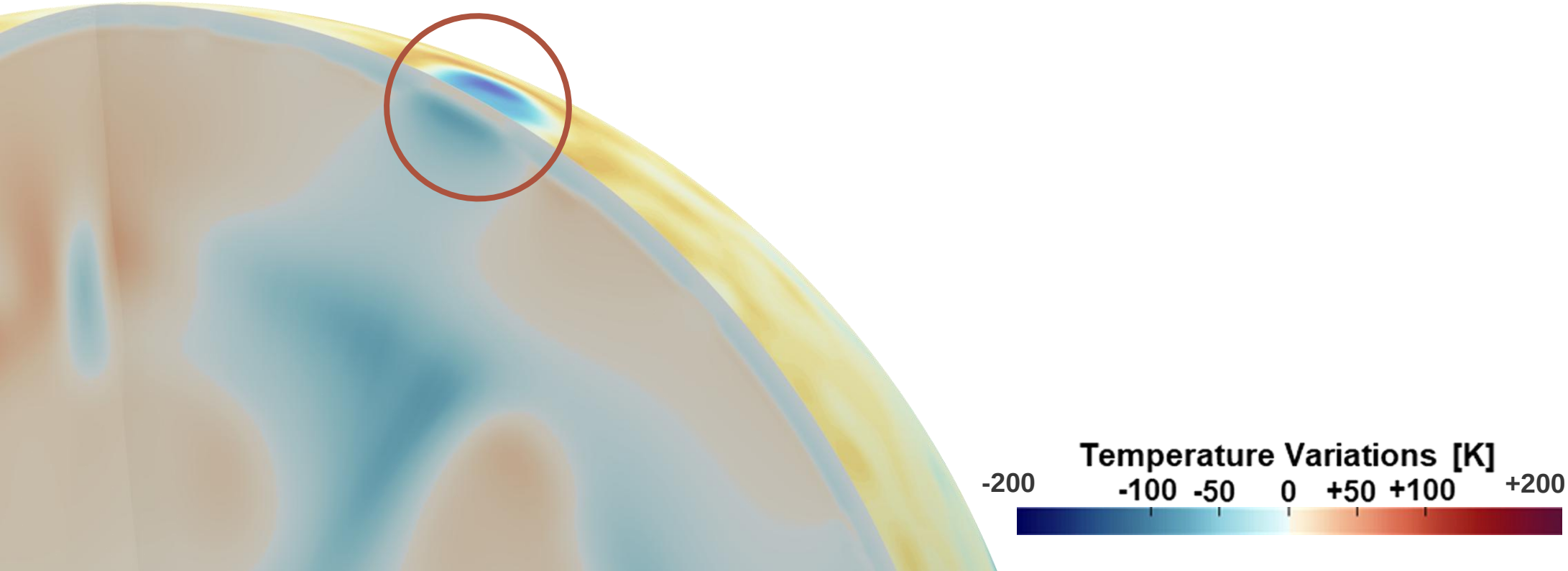

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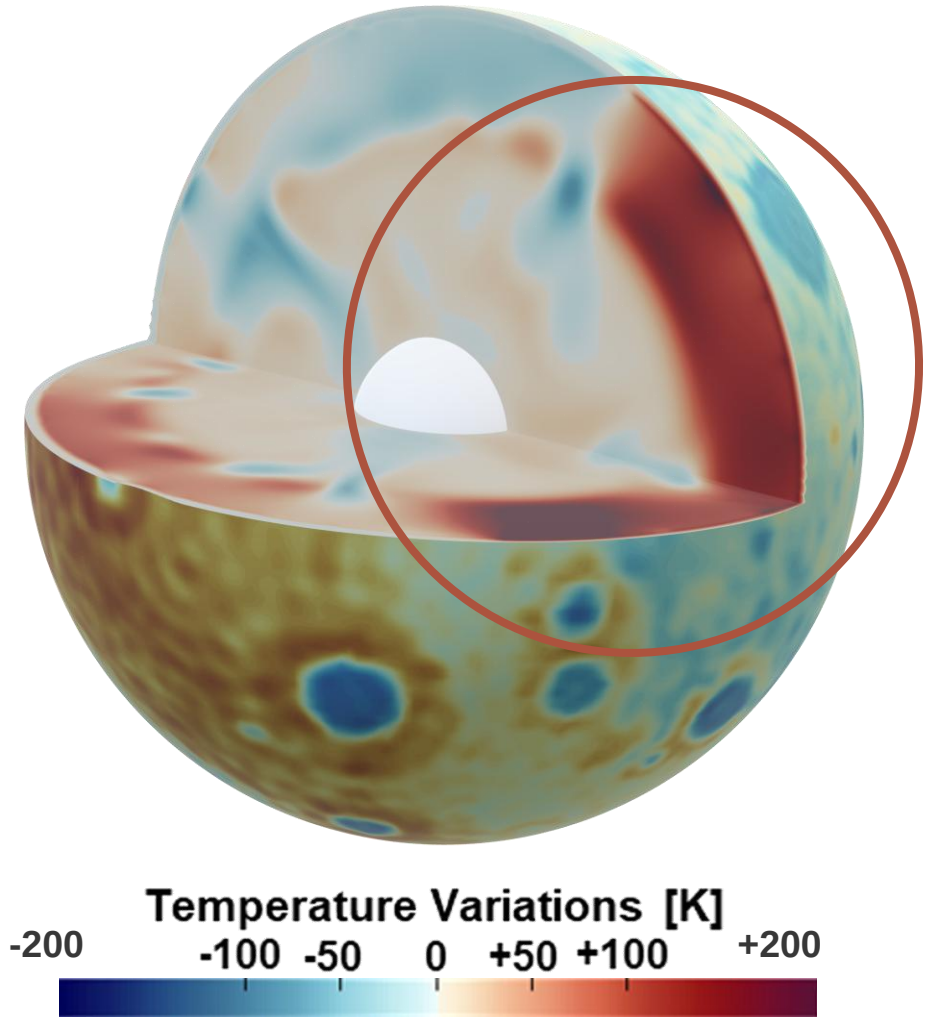

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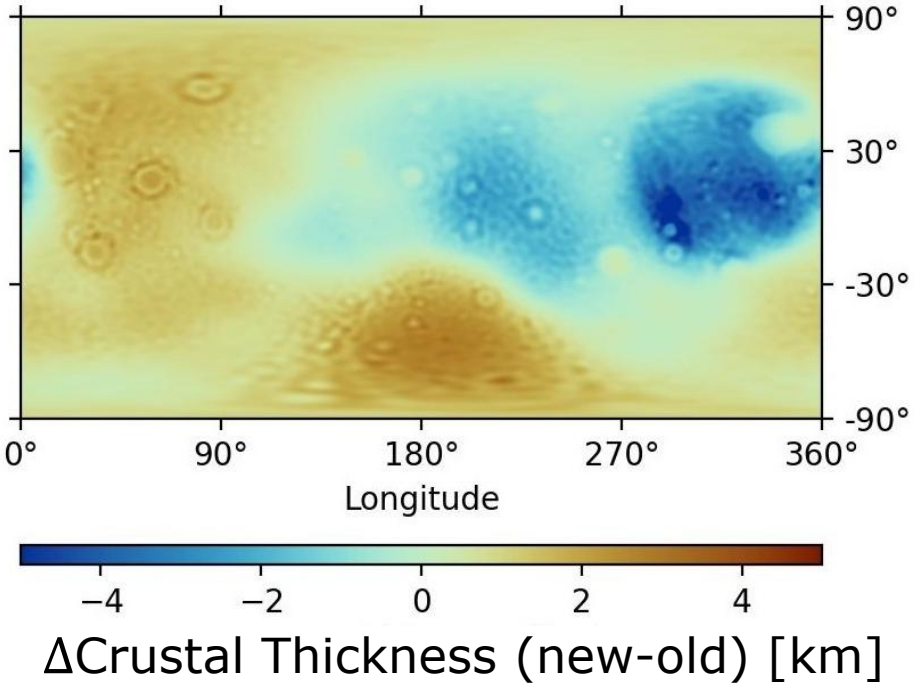
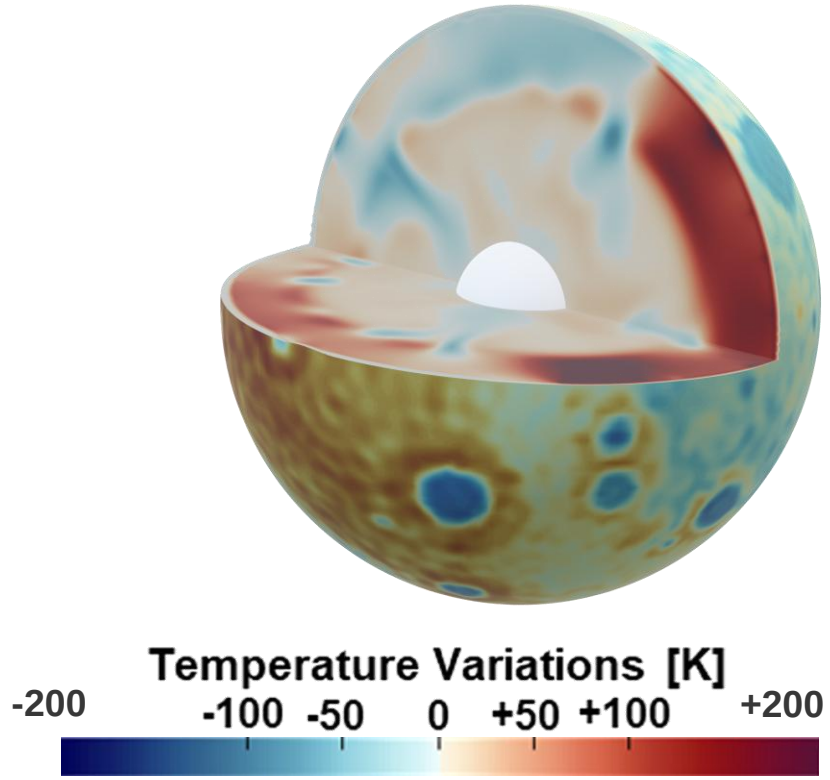
Temperature → Density variations: $\Delta\rho = \Delta T \cdot \alpha \cdot \rho_{Mantle}$





Tidal Deformations

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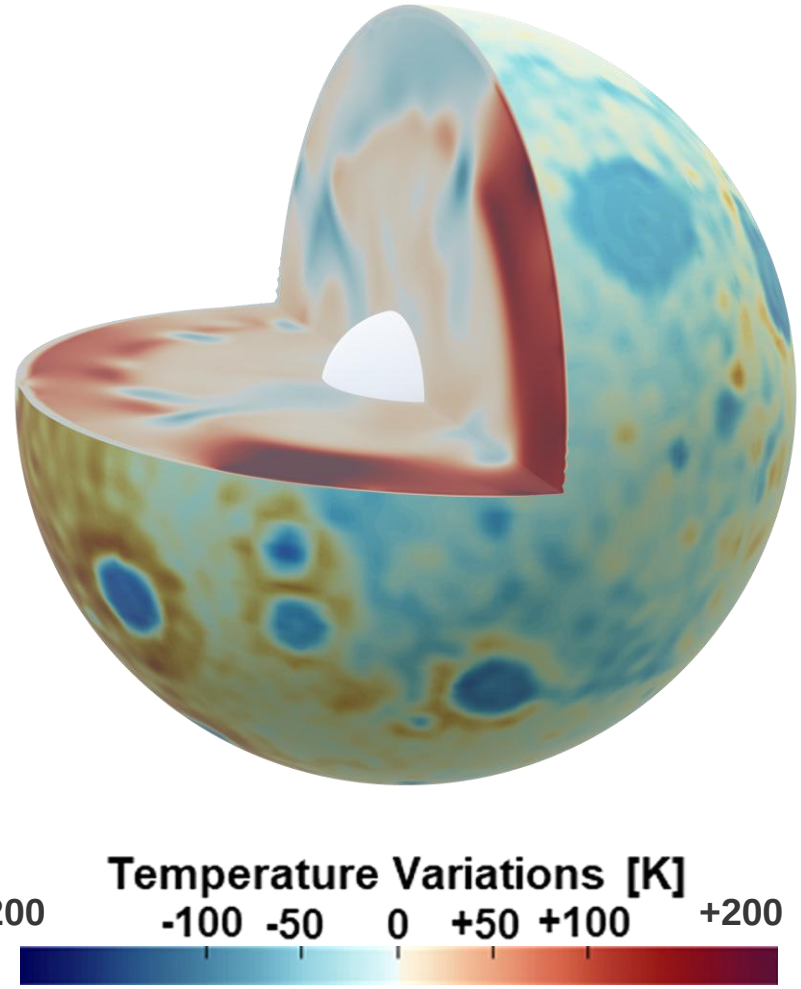
Goal

- Use **tidal deformation** measurements **as** model **constraints**
- Measured **k_2, Q** (monthly/yearly, *Goosens+2025*)
- We **test** full range of **preferred models** in *Santangelo+2025*



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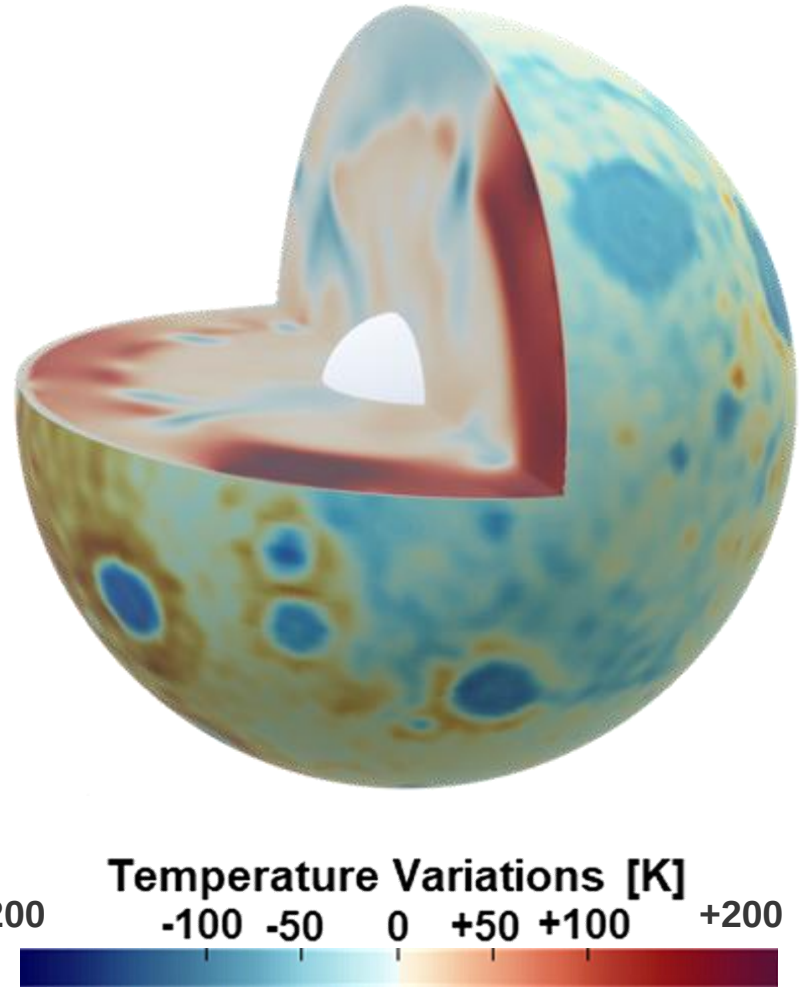

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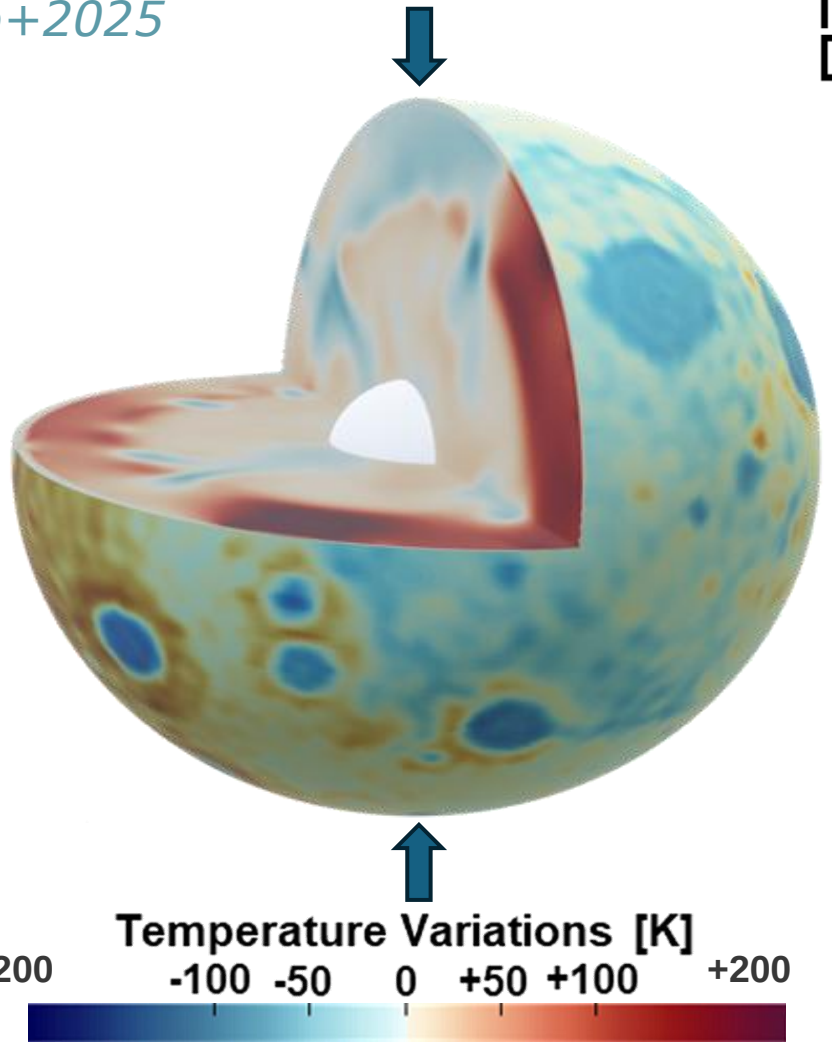

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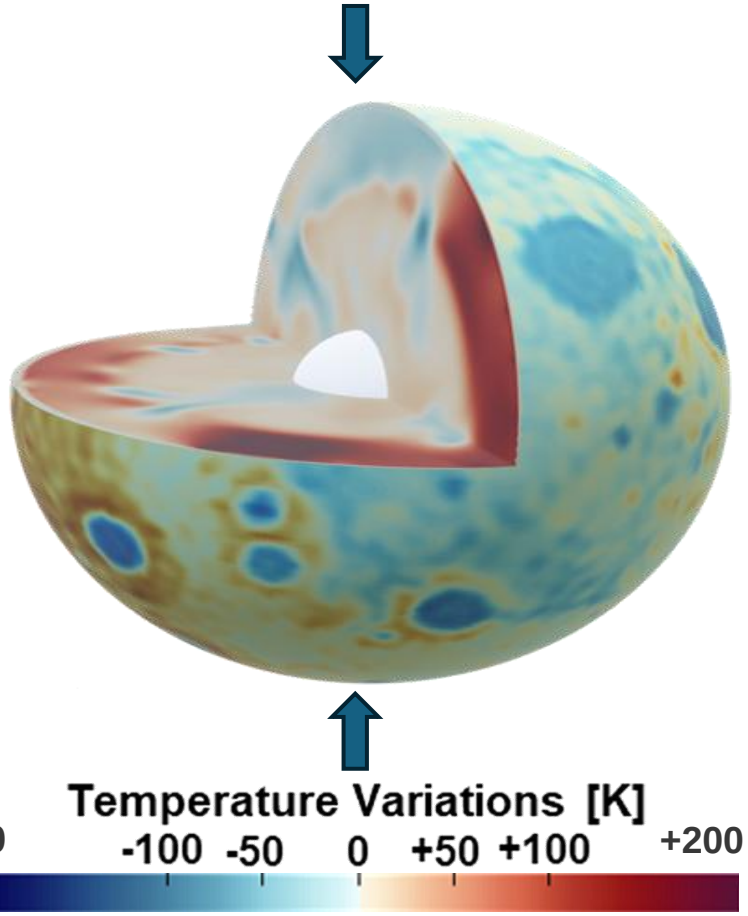
T, P → Elastic Properties (*K, μ*) → Observables (*m, MOIF, k_2, Q*)

1. Composition (bulk mantle, *Schwinger+2021*)

2. Viscoelastic Deformation Model: Sundberg-Cooper Rheology (Walterova+2023)



Tidal Deformations

- Preferred models in *Santangelo+2025* are **consistent** with **observations**
- All **observables** analysed can be **explained without** any **LVZ** at CMB

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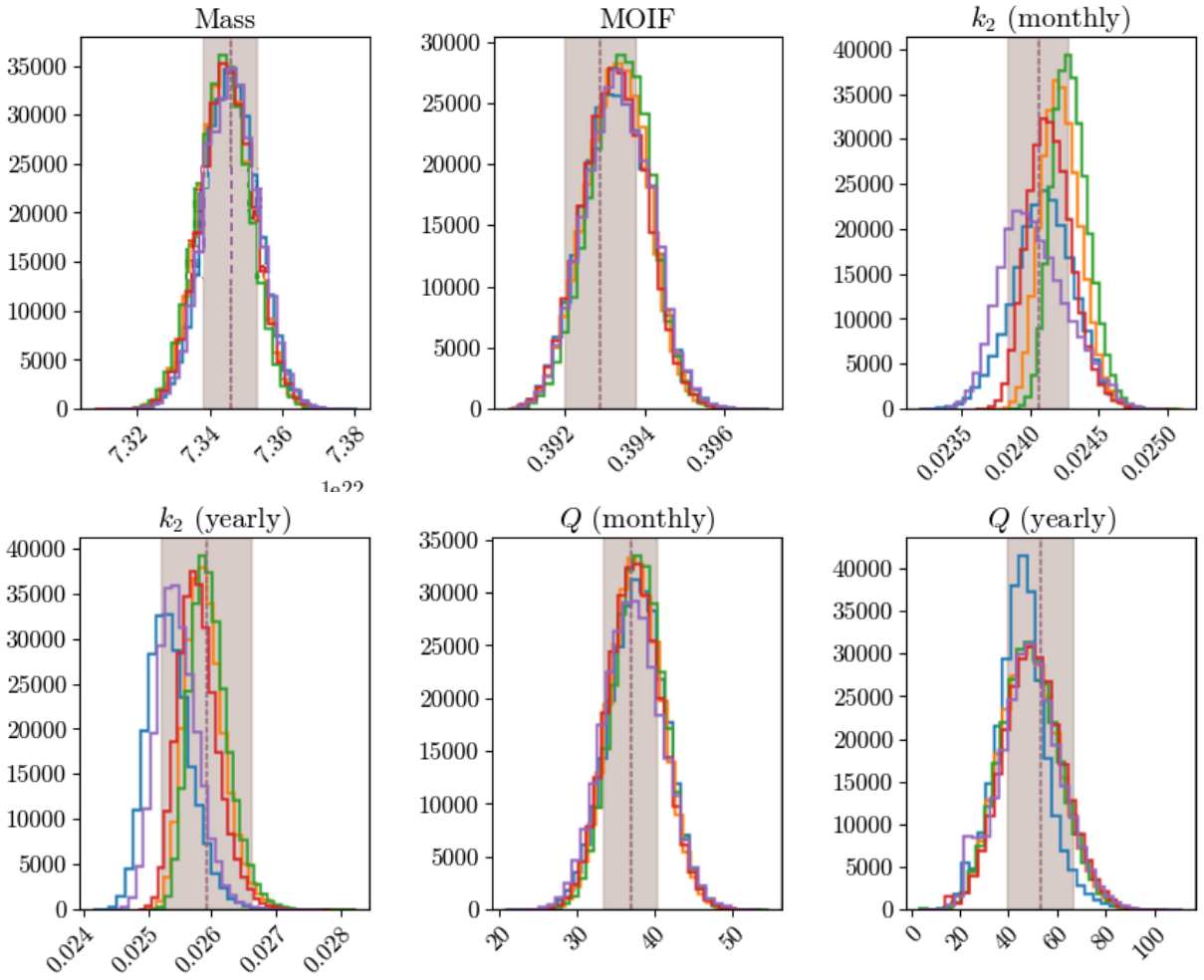
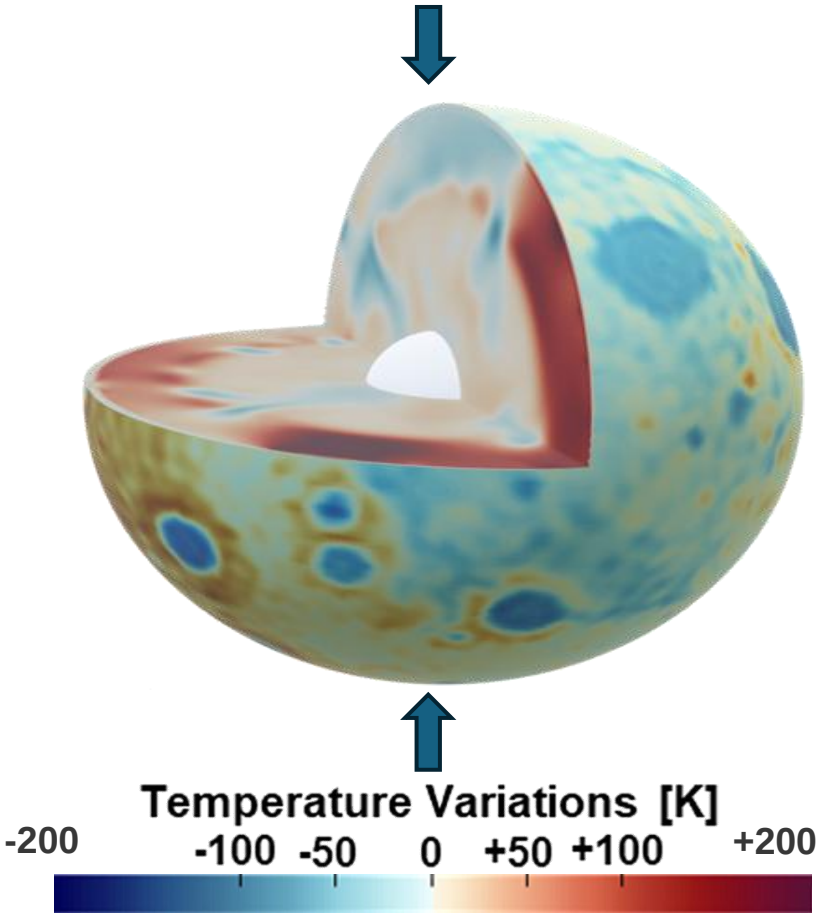
Sundberg-Cooper Rheology: $\bar{J} = f(\alpha, \zeta, \Delta, t_{rel})$

Parameter Combinations





Key Take-aways

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Outlook

- **Heat flux** and MT measurements (Mare Crisium, Schrödinger)
- **Seismic** velocity field for **3D waveform** calculation
- Extend to **3D** local **tidal deformations** (higher degrees)

Conclusions

- **State of the art** global geodynamic **model**
- Interior thermal state affects crustal thickness **up to ±6 km**
- Tidal response consistent with present-day lunar interior **without** requiring an **LVZ**