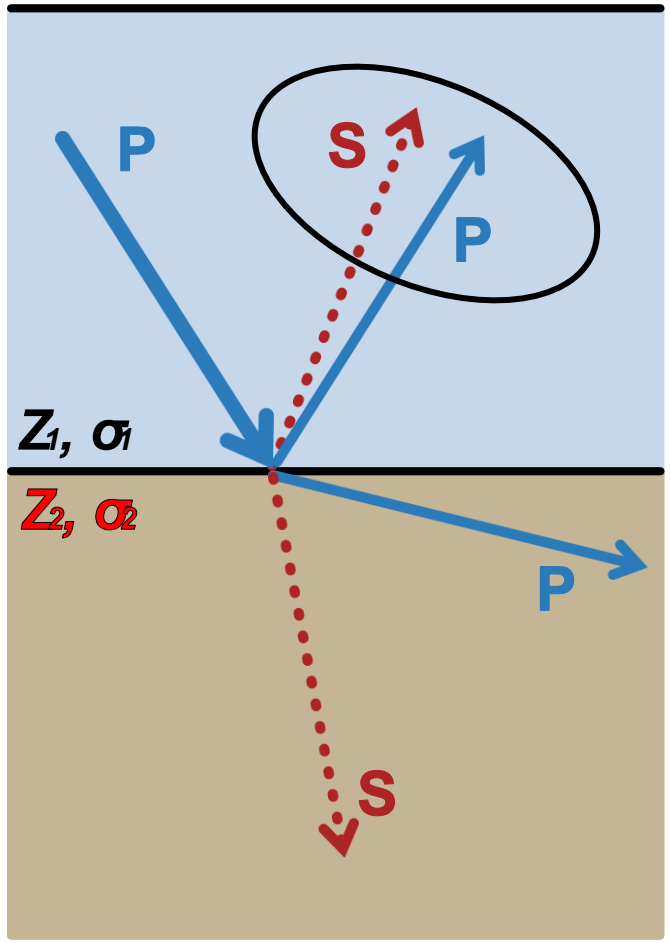
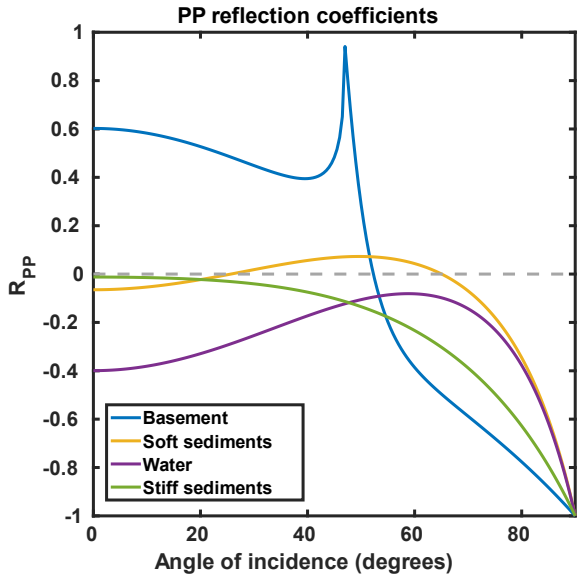
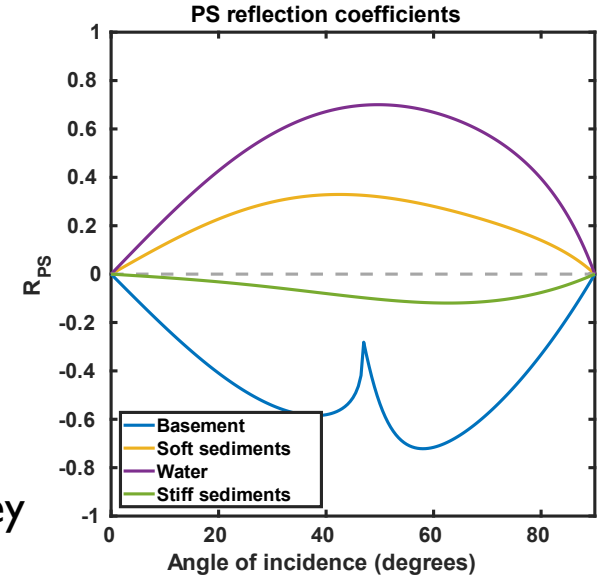
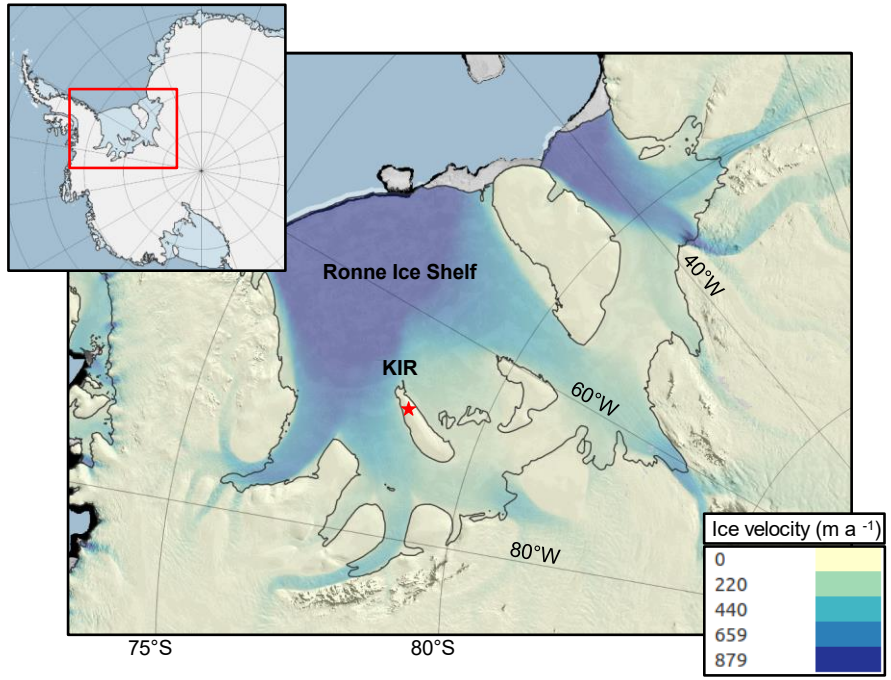
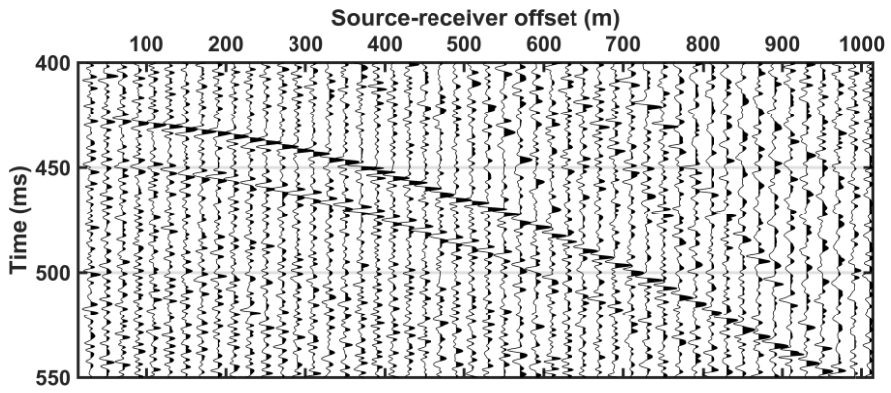
Improving identification of glacier bed properties with converted wave seismics











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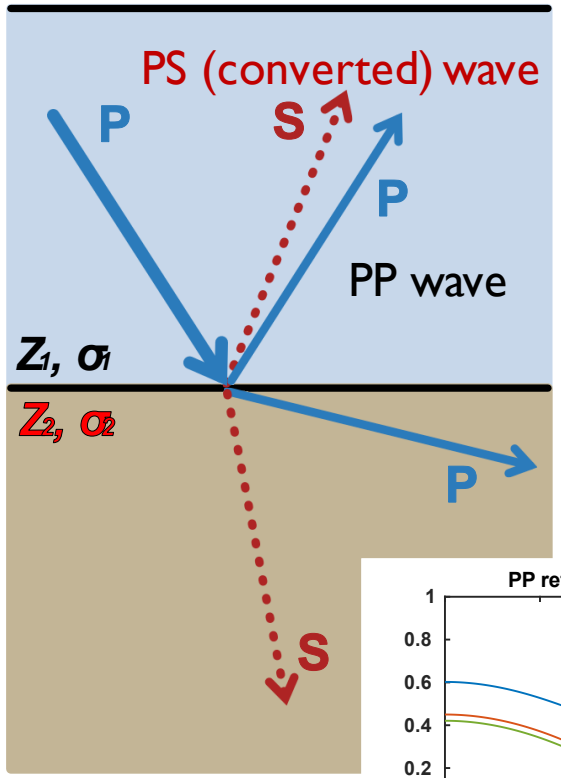
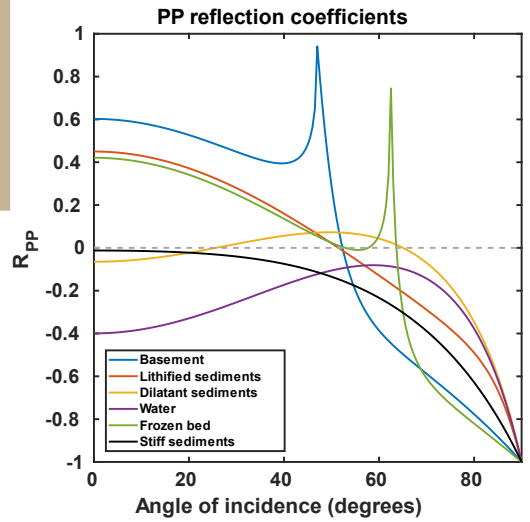
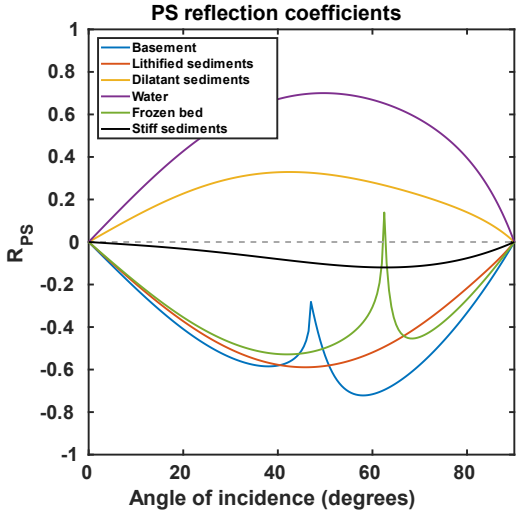
Concept



- Identifying glacier bed materials is important for understanding flow mechanisms and studying ice sheet history
- Amplitude-versus-angle (AVA) methods provide a means of doing this
- Downgoing compressional (P) wave energy is partitioned at the glacier bed into compressional- and shear-wave energy (P and S waves) - angle dependent
- Described by the Zoeppritz equations, controlled by acoustic impedance Z and Poisson's ratio σ





The problem: PP-wave AVA inversions are highly non-unique.

Can inverting Rpp *and* Rps improve constraint of Z and σ?

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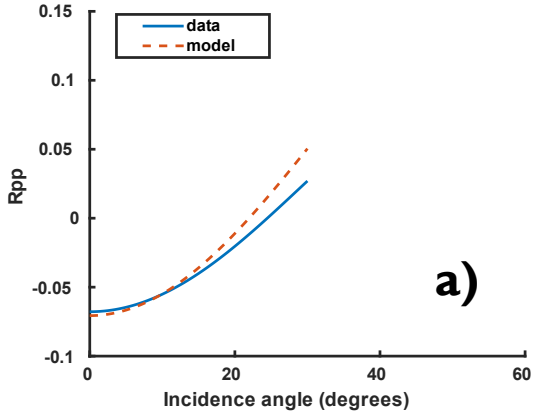
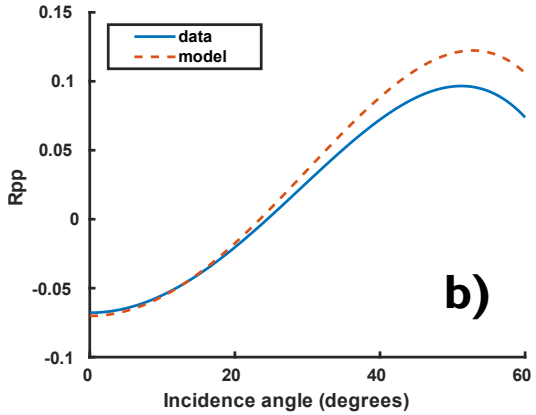
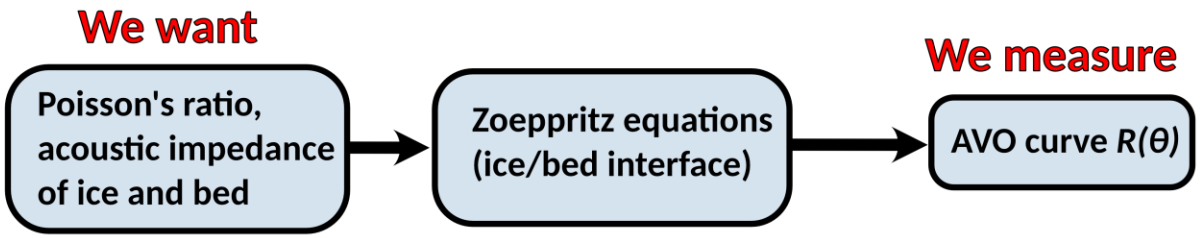
Synthetic tests







- We generate synthetic AVA curves for bed materials with known properties (water, soft till, stiff till, lithified till, permafrost, bedrock)
- Jointly invert the AVA curves for the PP-wave and the PS-conversion to find acoustic impedance and Poisson's ratio
- Compare the performance of PP inversion and joint inversion when given AVA curves cut off at **a)** 30 and **b)** 60 degrees - realistic limits of data acquisition
- Model space is explored using a Markov-chain Monte Carlo method. We run ensembles of inversions to establish uncertainties on results.

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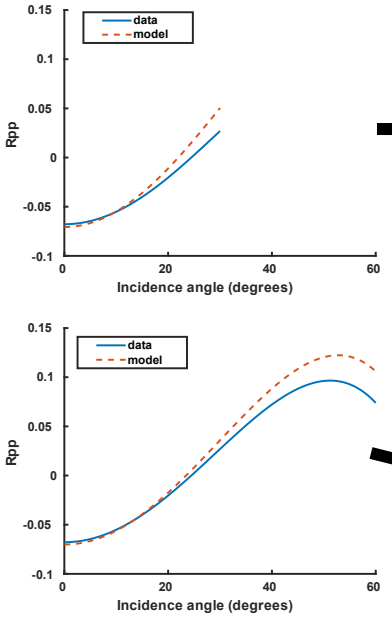
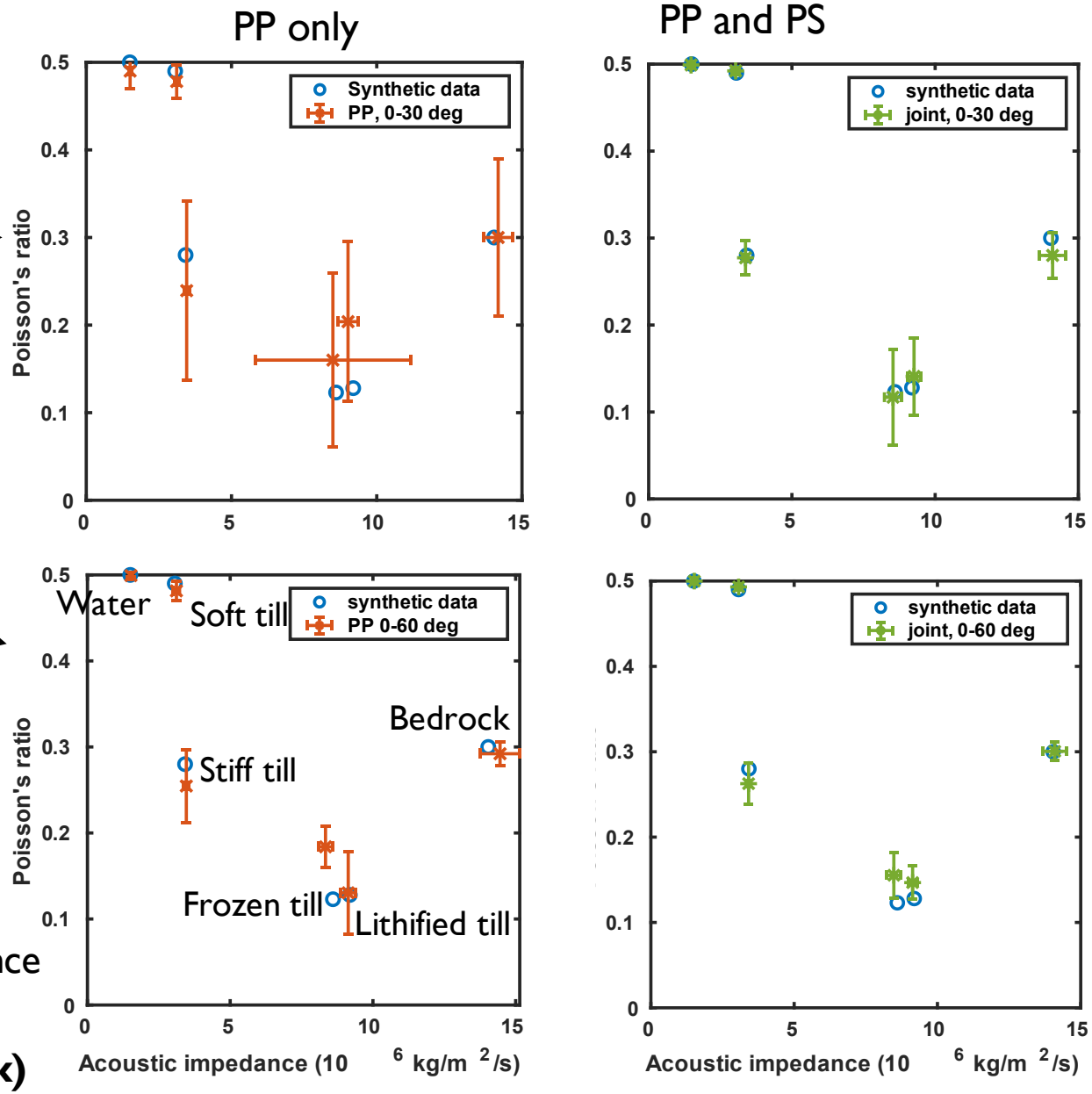
Synthetic results



0-30° incidence

0-60° incidence



- Joint inversion improves constraint of bed properties
- The advantage of including PS is greatest with restricted angle ranges
- Joint inversion over 0-30° incidence constrains acoustic impedance and Poisson's ratio similarly to PP inversion over 0-60°

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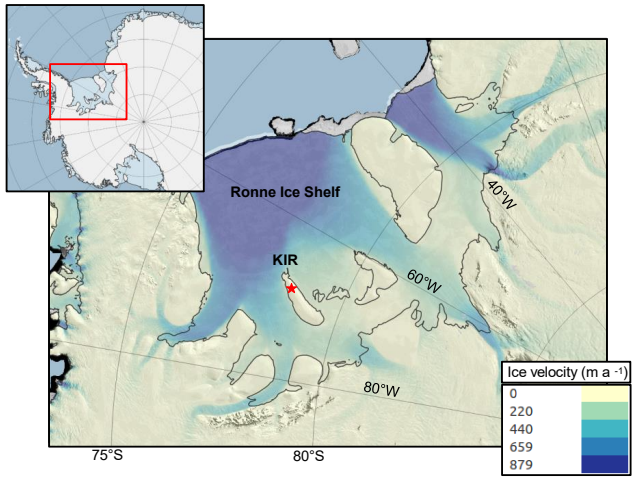
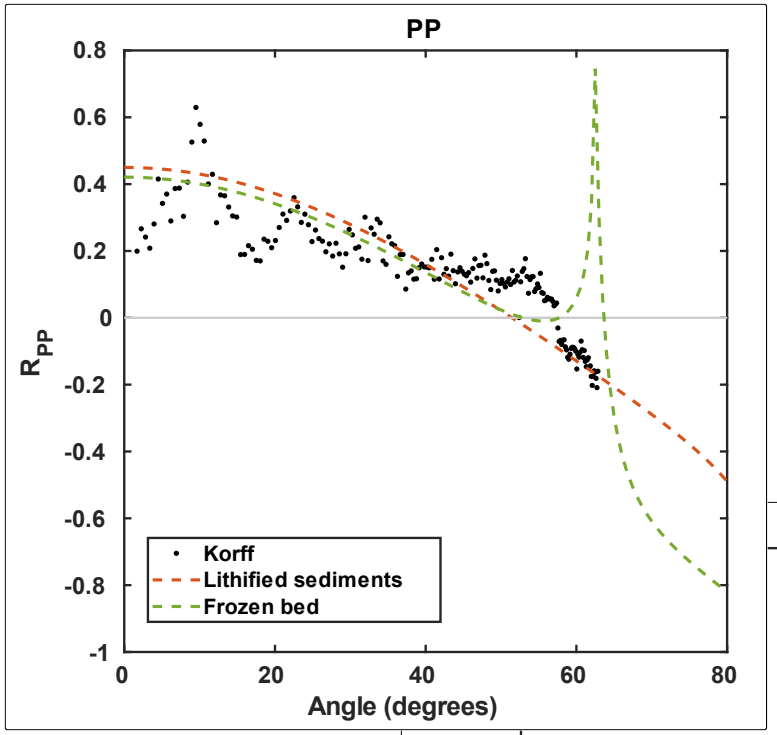
Korff Ice Rise

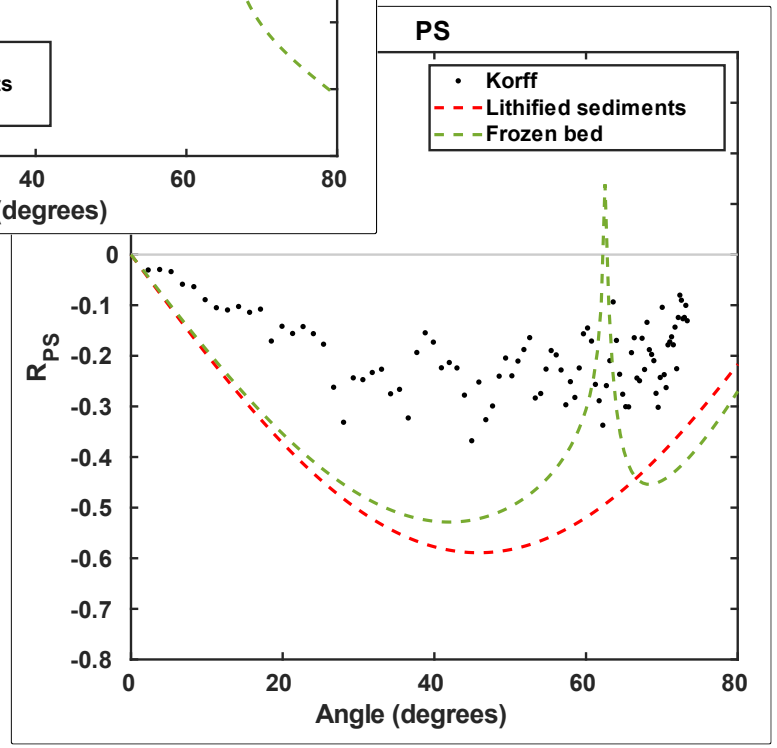
- In the past, the Grounding line of the Weddell sea region was further advanced than it is today. How did we get here?
  - a) Monotonic retreat to current position
  - b) Rapid retreat followed by readvance

- If we can determine whether the bed at Korff is frozen, this may provide clues about the date of grounding

- Preliminary results!







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