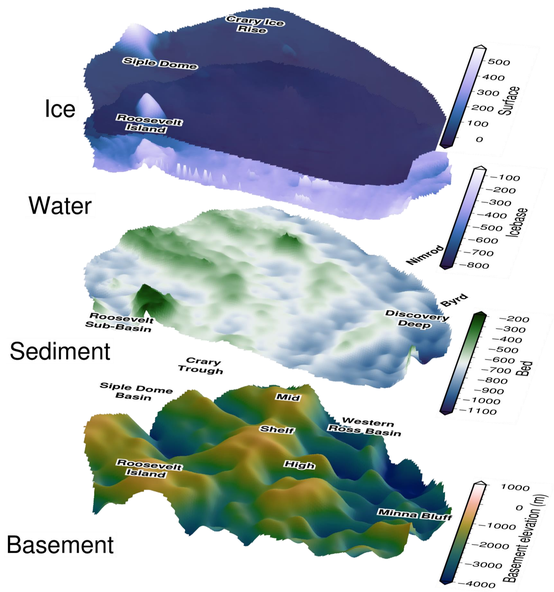
Revealing sub-ice shelf sediment basins with airborne magnetics

Matthew Tankersley[1,2], Huw Horgan[1], Christine Siddoway[3], Fabio Caratori Tontini[2,4], Kirsty Tinto[5]

[1]Antarctic Research Centre, Victoria University of Wellington, NZ [2]GNS Science, NZ
[3]Colorado College, USA [4]University of Genova, Italy [5]Lamont-Doherty Earth Observatory, USA

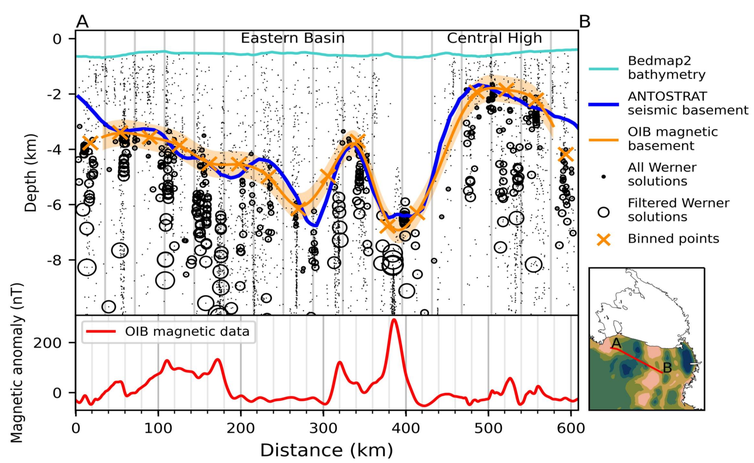
Introduction

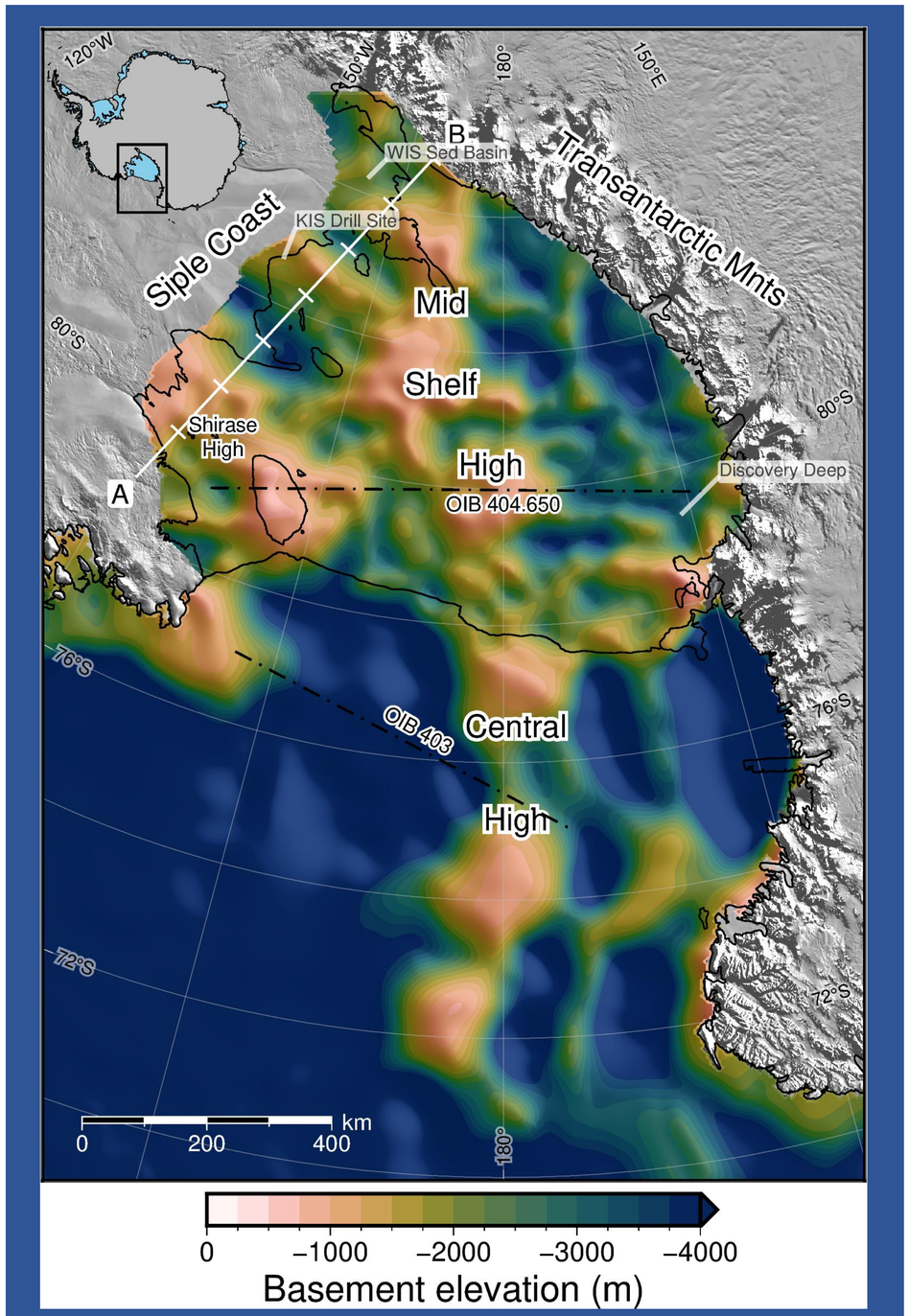
Analysis of airborne magnetics data from the ROSETTA-Ice project reveals basement rock depths and sediment distribution beneath the Ross Ice Shelf (RIS). We use the resulting basement topography to highlight sites of possible influence upon the Antarctic Ice Sheet and to further understand the tectonic history of the region.



Methods

1. **Werner deconvolution** of airborne magnetic data used to map the contact between magnetic rocks (basement) and non-magnetic overlying sediments.
2. Developed the method in the Ross Sea with Operation Ice Bridge (**OIB**[1]) aeromagnetics and **ANTOSTRAT**[2] seismic basement.
3. Used coincident OIB and ROSETTA-Ice[3] lines to determine sub-RIS basement depths.
4. Merged RIS results with regional basement depths[4].
5. Subtracted from bathymetry[5] to get **sediment thickness.**





Ross Embayment basement elevations. Data under the RIS are from this study, while offshore data (below ~78°S) are from a regional compilation[4], mostly ANTOSTRAT[3]. OIB[1] flights paths used for the tie are shown. A-B cross-section profile shown in white.

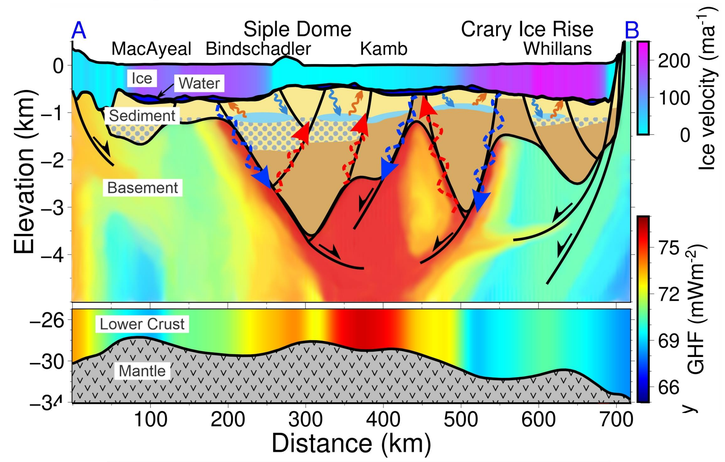
Results

- **Continuous drape of sediment**, 50-3800m thick
- **Fault-bound basins** from West Antarctic Rift System extension
- Mid-Shelf High separates **East/West Antarctic geology**
- **East Ant. is deeper;** distributed extension
- **West Ant. is shallower** with linear, narrow, deep basins

Discussion

- Narrow and deep basins along Siple Coast indicate **active rifting**
  - See Pollatsek et al. 2022 poster (this session)
- Basin bounding faults could control GHF, groundwater transport, and GIA
- Siple Coast basins likely contain **voluminous groundwater**
  - See Gustafson et al. 2022
- Broad basement highs, likely locations for **initialization of Oligocene ice**

Siple Coast cross-section (A-B)



Ice surface, ice base, and bathymetry from Bedmachine[5]. Basement from this study. Moho from Shen et al. 2018[6]. Ice is colored by velocity[7]. Lower crust, between -25km and Moho, shows GHF model[8] . Upper crust is theoretical GHF, guided by inferred fault locations

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Check out the code at GitHub:
https://github.com/mdtanker/RIS_basement_sediment

References

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