A large tectonic-controlled subglacial lake with ocean drainage in Princess Elizabeth Land, East Antarctica

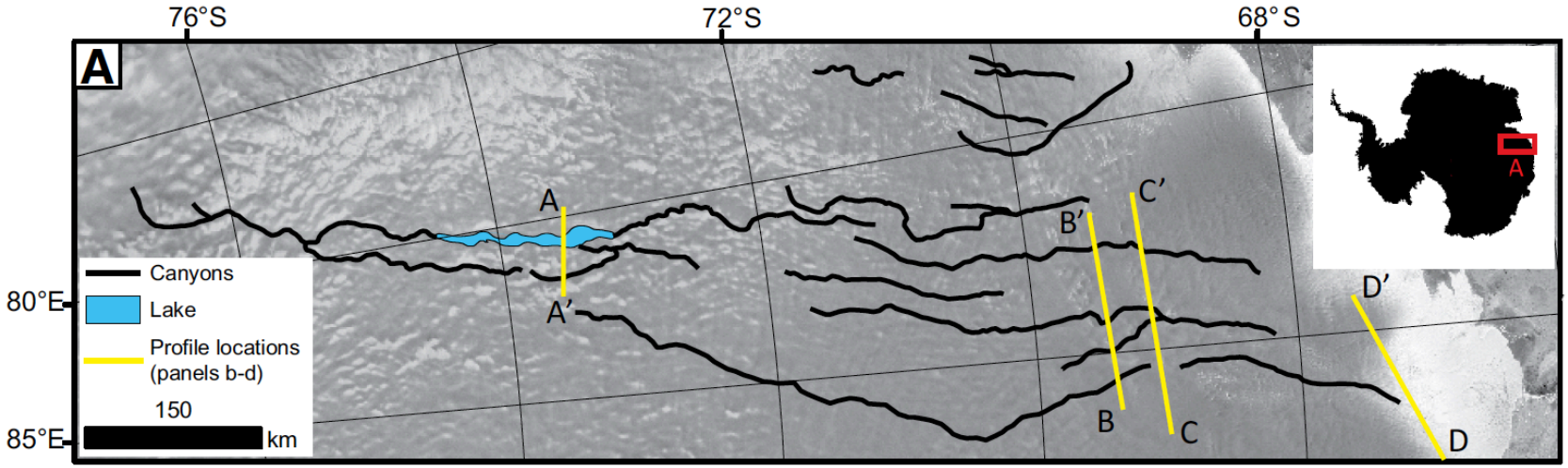
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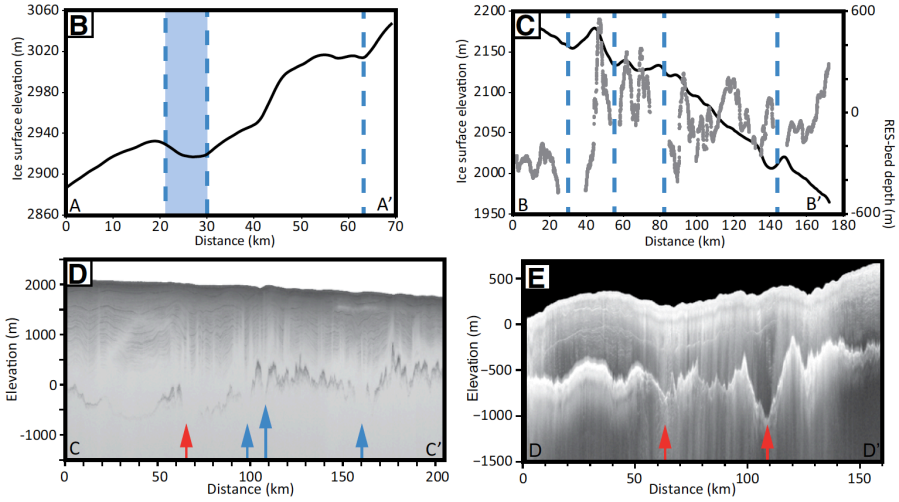
[1]University of Texas at Austin, Institute for Geophysics, USA; [2]Department of Geological Sciences, Jackson School of Geosciences, University of Texas at Austin, USA; [3]Scripps Institution of Oceanography, USA; [4]Polar Research Institute of China, China; [5]Australian Antarctic Division, Australia

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Motivation

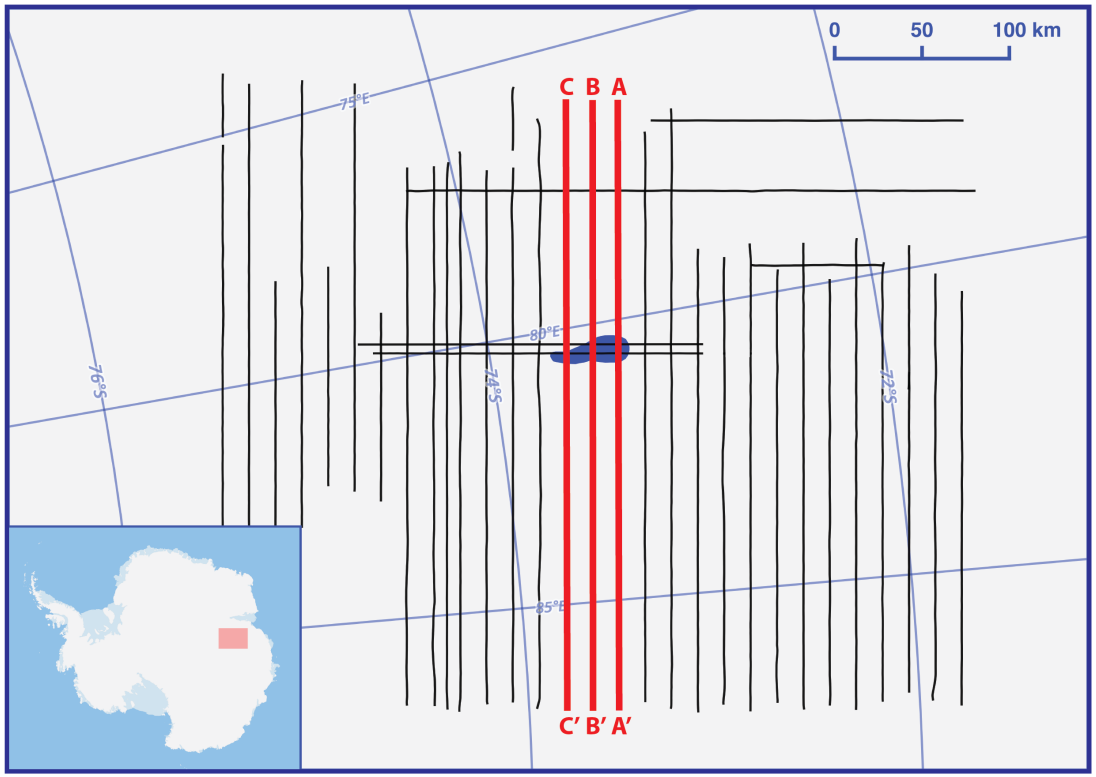




- Jamieson et al.[1] described the possible existence of an extensive subglacial canyon and lake system in Princess Elizabeth Land (PEL) based on satellite-based remote sensing.
- This canyon network was estimated to extend from the north side of the Dome A to the Leopold and Astrid Coast adjacent to the West Ice Shelf. The proposed subglacial lake was located at the upstream part of the canyon network and was estimated to be one of the largest subglacial lakes in Antarctica.
- However, until now, the existence of this proposed subglacial lake has not yet been confirmed by other, more direct observations.

Jamieson, S. S. R., et al. (2016). Geology

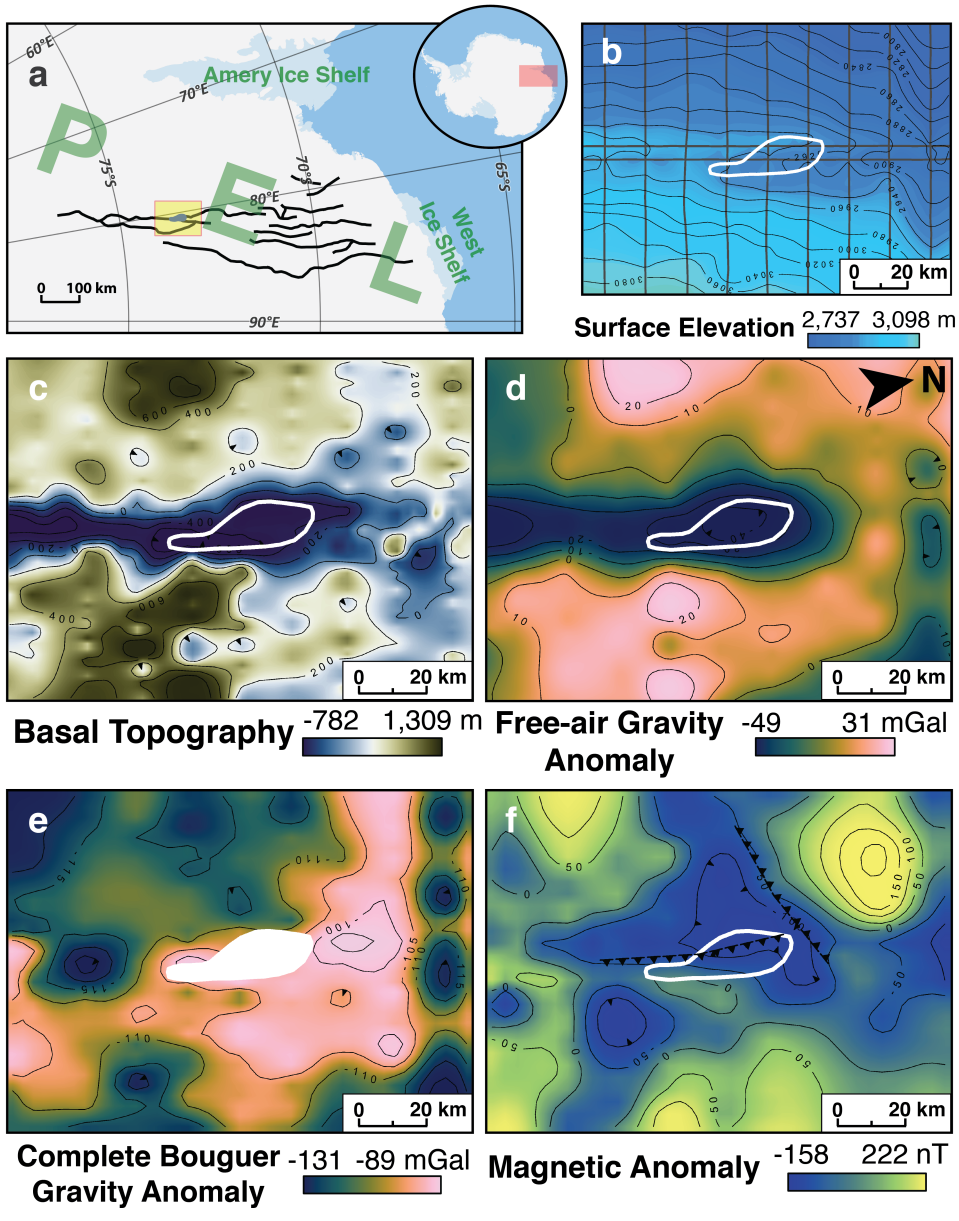
Airborne geophysics survey



Yan, S., et. al., in prep

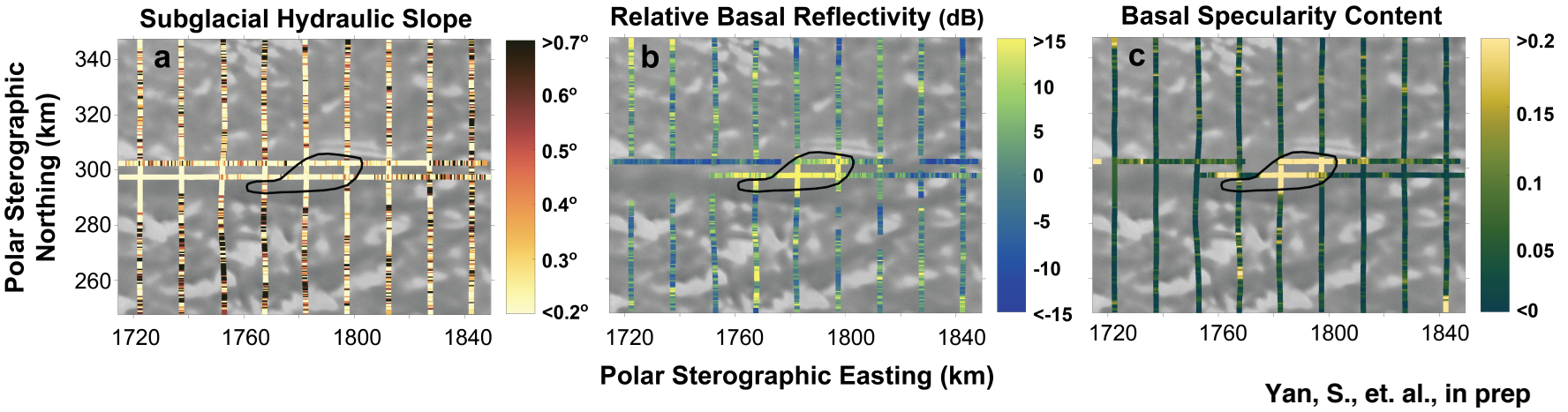
University of Texas Institute for Geophysics (UTIG), Polar Research Institute of China (PRIC), and Australian Antarctic Division (AAD) have performed several collaborative airborne geophysical surveys in East Antarctica[2]. Through this collaboration, more than 10,000 kilometers of survey profiles were collected over the proposed lake region between 2016 and 2019.

Data products



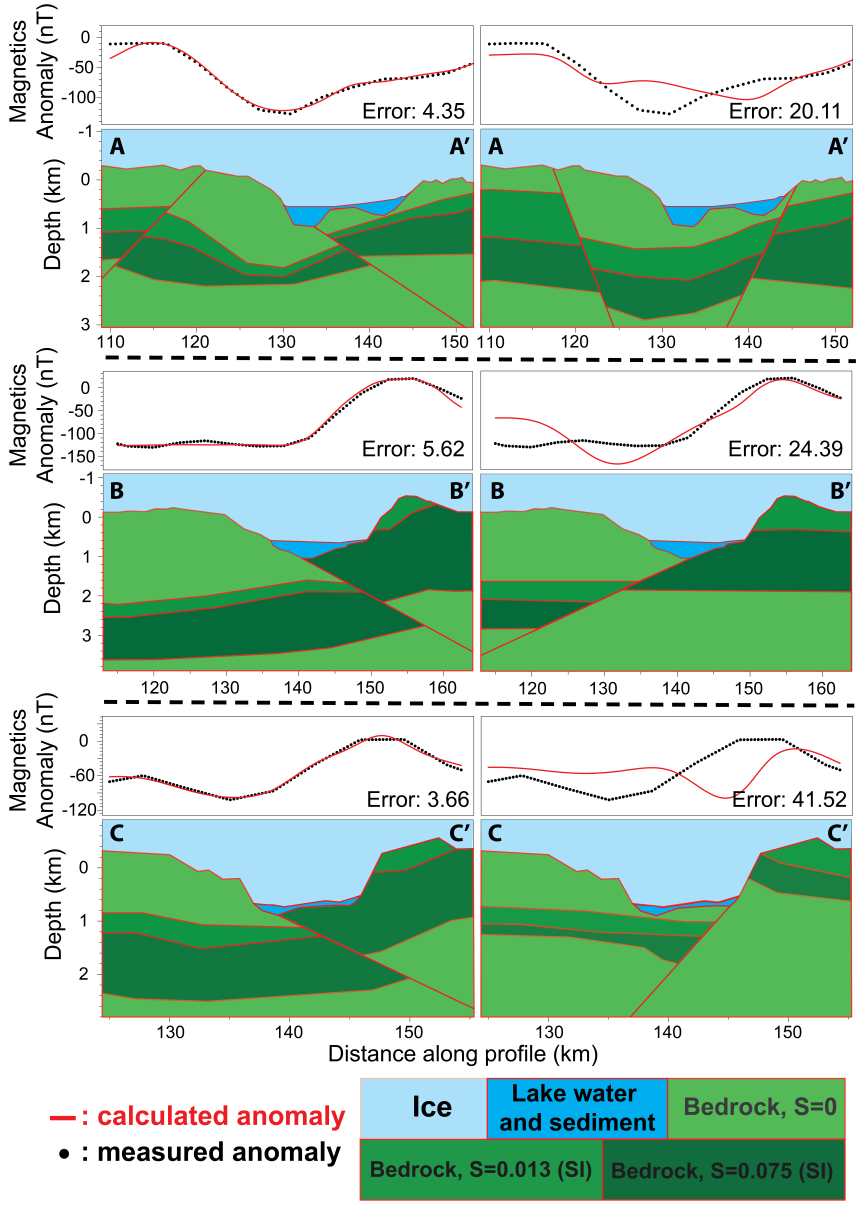
Yan, S., et. al., in prep

Data products



- Over the proposed lake area, we observed subglacial hydraulic flatness, elevated basal reflectivity and high basal specularity from airborne ice-penetrating radar (IPR) sounding. These observations meet the criteria for identifying subglacial lakes via IPR sounding[3] and therefore support the existence of this subglacial lake, hereby referred as Lake Snow Eagle (LSE).
- Adjacent spots with high relative basal reflectivity, low basal specularity and subglacial hydraulic non-flatness are also observed, which we interprete as unconsolidated water-saturated sediment[3].

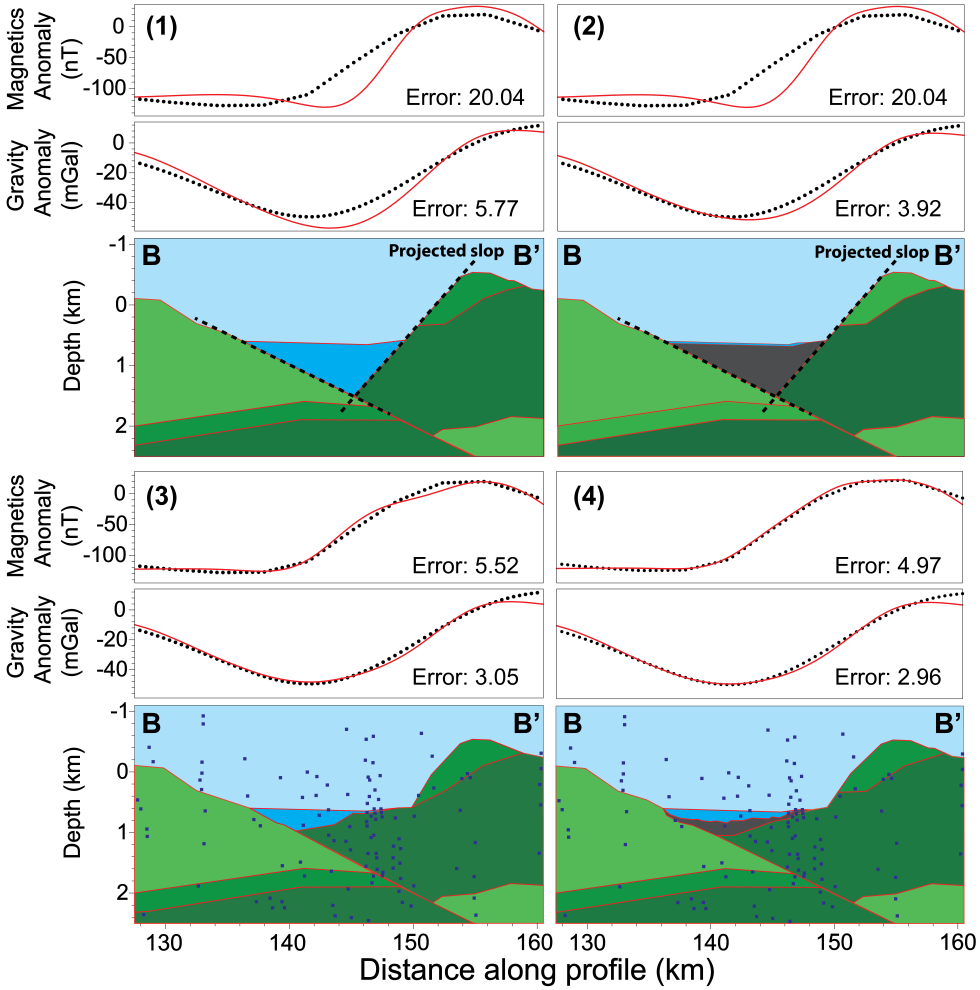
Investigating the crustal framework



- Our magnetic inversion results suggest the existence of two thrust faults, one along the north coast of LSE and another along the west coast (marked as dash lines with saw-teeth in the magnetic anomaly map).
- The orientations of these two faults correlate well with the Indo-Australo-Antarctic Suture (IAAS) zone and the Lambert Rift, respectively.
- Additionally, LSE and its host canyon appear to be in a similar orientation as the Lambert Rift, as well as Lake Vostok, Lake Sovetskaya and Lake 90 East, three of the largest subglacial lakes in Antarctica.
- These similarities in orientations indicate a possible overall tectonic signature.

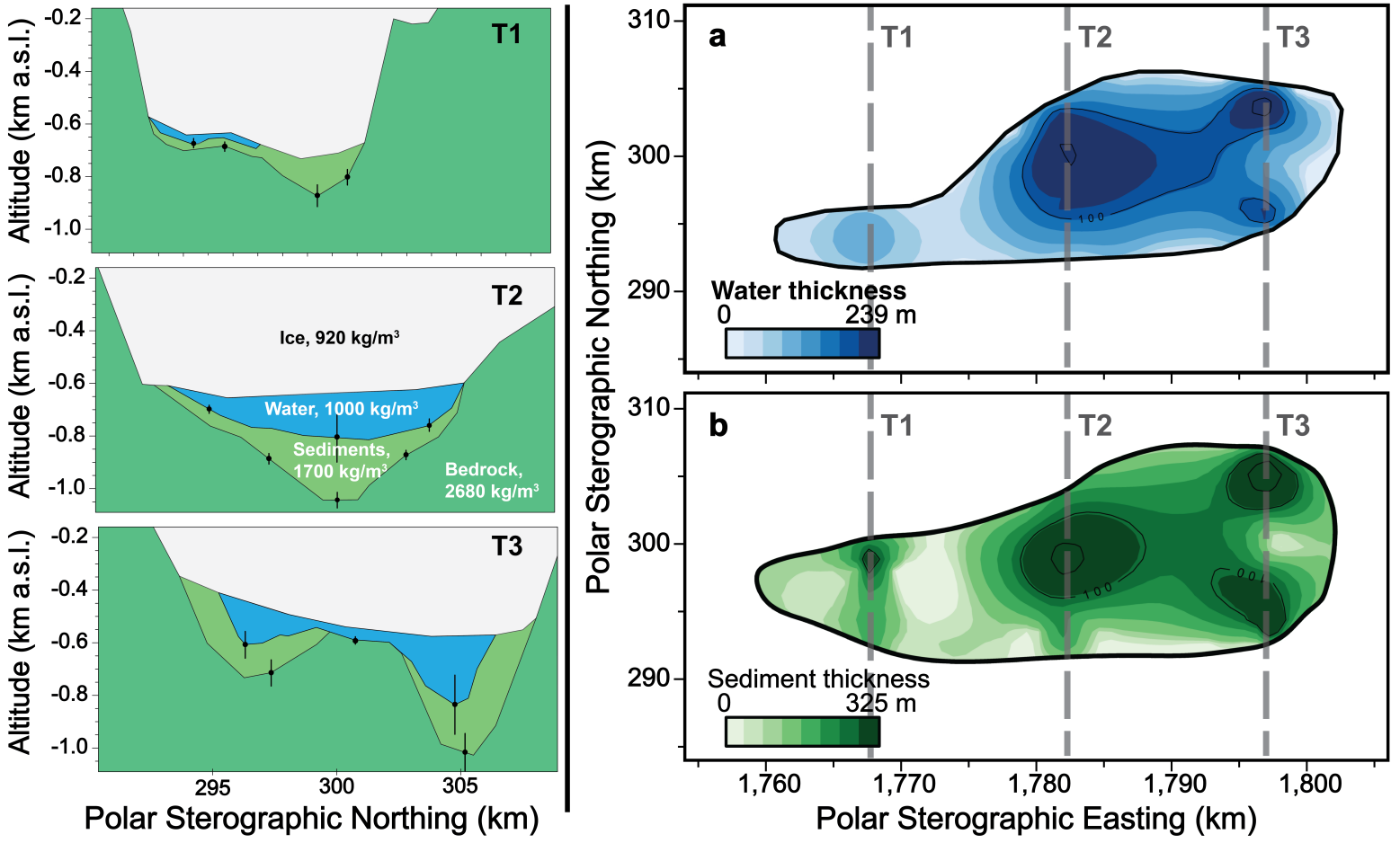
Yan, S., et. al., in prep

Testing bathymetry hypotheses



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Inversions for bathymetry



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Conclusion

- We confirm the existence of a large subglacial lake in PEL, for the first time, using recent airborne geophysics surveys.
- We estimate LSE to be about 42 km in length and 370 km^2 in area, making it one of the largest subglacial lakes in Antarctica. The estimated water volume is about 21 km^3.
- As this subglacial hydrology system is potentially connected to the coastal regions by subglacial canyon channels, it is important to note its potential role in regulating the basal melting patterns of the downstream ice shelves when subglacial discharge events occur.

Acknowledgements

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3. Carter, S. P. *et al.* Radar-based subglacial lake classification in Antarctica. *Geochemistry, Geophys. Geosystems* **8**, (2007).