

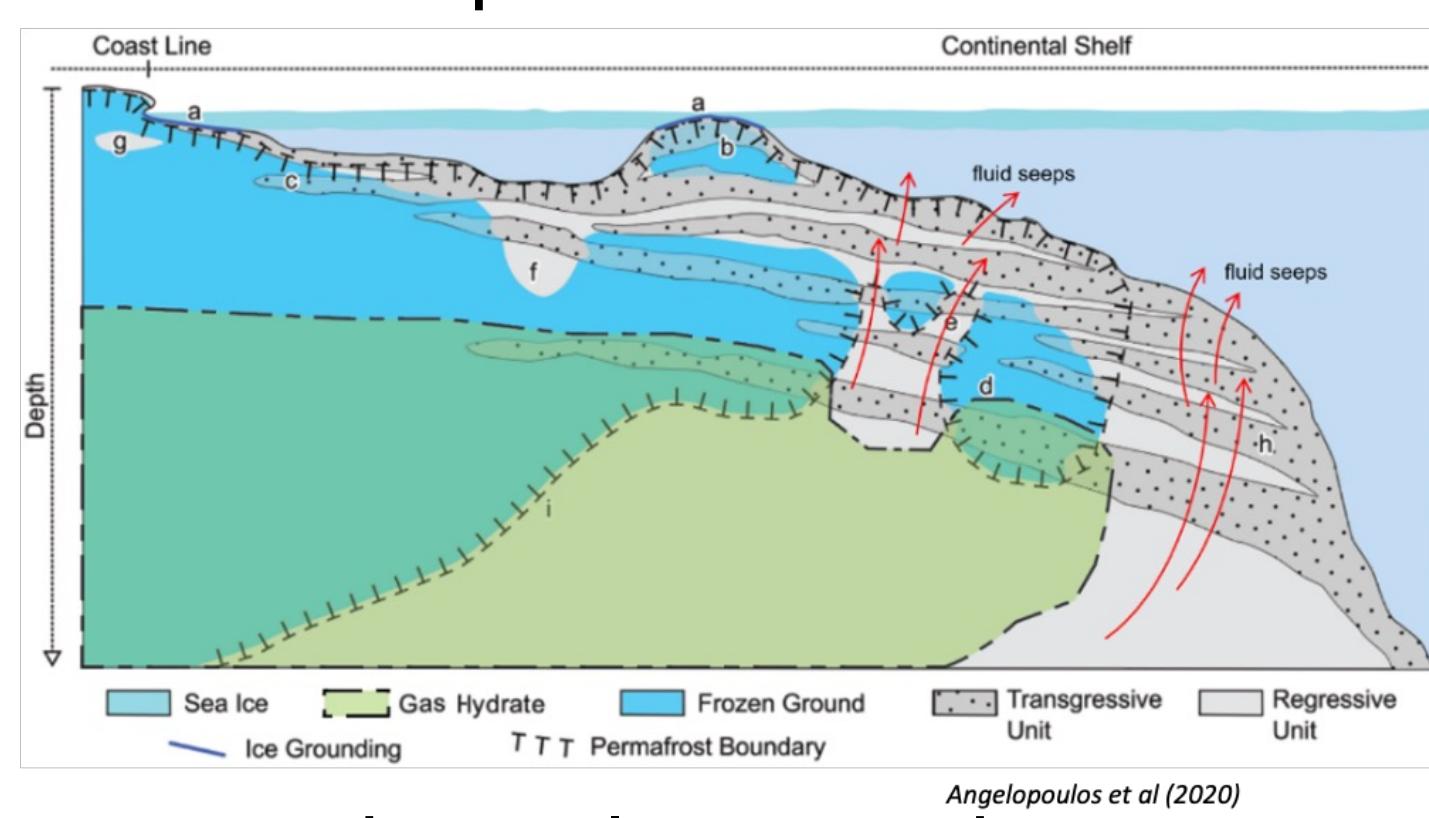
USING DISTRIBUTED FIBER OPTIC SENSING TO CHARACTERIZE SEAFLOOR PERMAFROST AND THE NEARSHORE ARCTIC OCEAN (PEMDATS)

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PROBLEM

- Assess the potential to use Distributed Fiber Optic Sensing (DFOS) to characterize submarine permafrost, associated gas hydrate deposits, and seafloor seeps



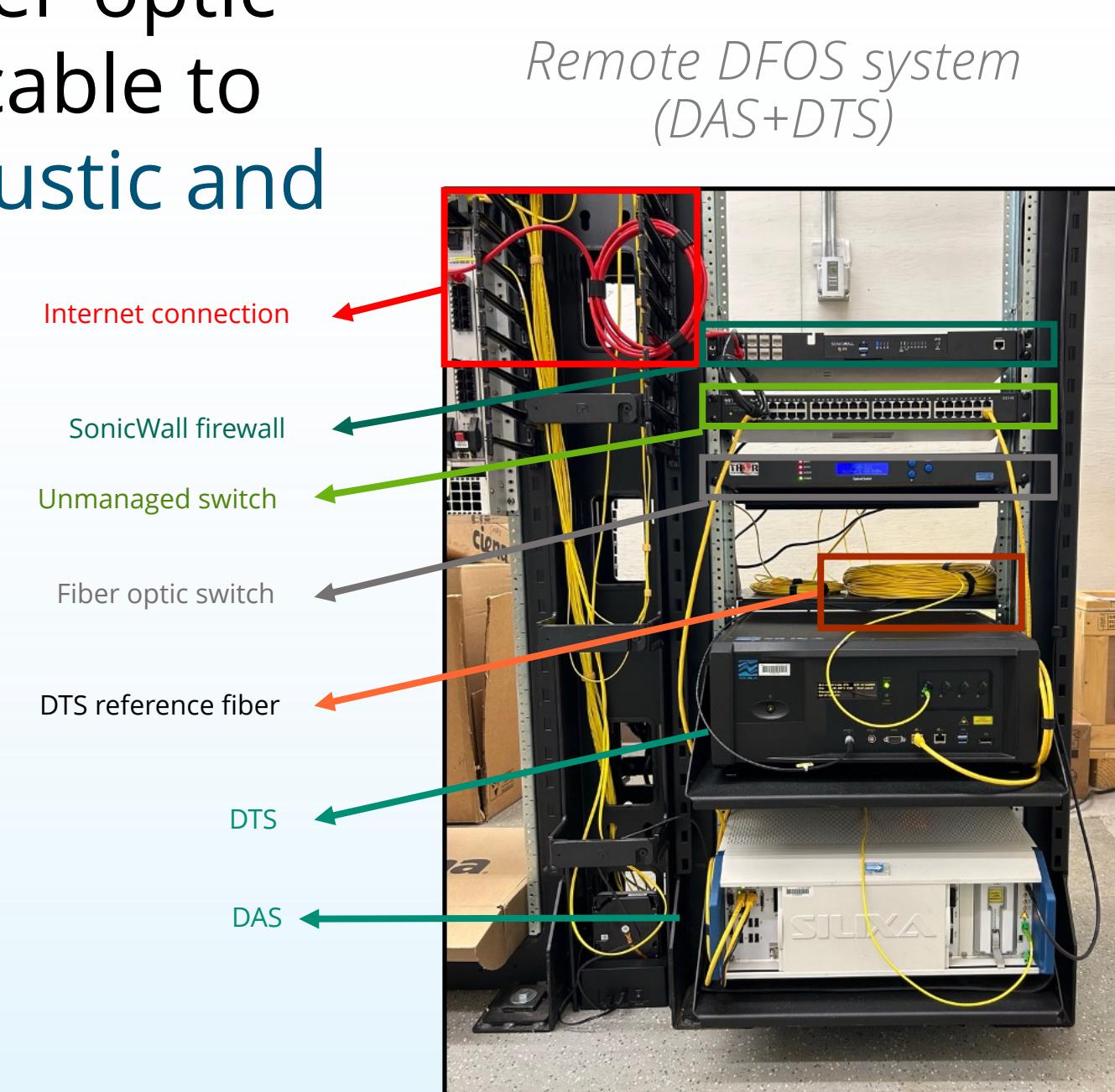
- Supports Sandia's Climate Change Security Initiative and strengthens Sandia's long-standing presence in Arctic research

APPROACH

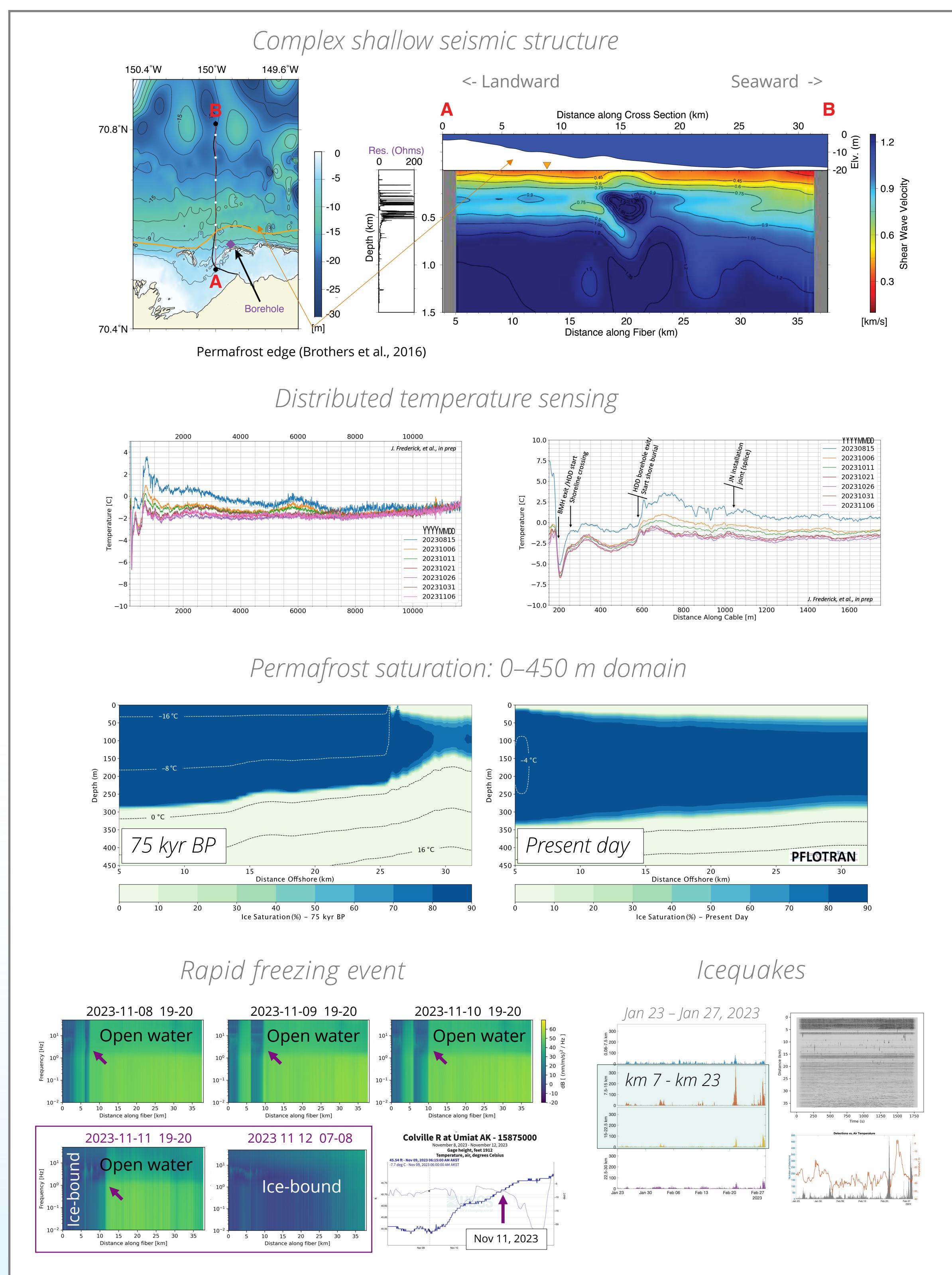
Where: Beaufort Sea (from Oliktok Point 37 km seaward)

How: Use seafloor fiber-optic telecommunications cable to record **co-located acoustic and temperature data**

- Seismic and thermodynamic modeling
- Map nearshore temperature and acoustic structure



DISTRIBUTED FIBER OPTIC SENSING
Efficient and cost-effective multi-modal monitoring system for seafloor permafrost and nearshore Arctic Ocean



IMPACT

- Preliminary seismic model shows permafrost extending down to ~400-500 m below sea level and further offshore than previously imaged.
- Thermodynamic modeling is consistent with seismic data.
- We also imaged rapid freezing events, characterized icequakes, fostered potential collaboration with US Naval Research Laboratory, published peer-reviewed article, and reached 9.9 M people with media coverage.

Results of this work will lead to an improved understanding of seafloor permafrost and nearshore Arctic Ocean processes.

FUTURE DIRECTIONS

- Improve ambient noise seismic model
- Correlate seismic model with data from University of Texas at Austin
- Improve thermodynamic model
- Constrain thermodynamic model with seismic and University of Washington data for anaerobic oxidation of methane
- Research potential drivers for seafloor temperature variations
- Characterize permafrost and gas release with local/teleseismic events

References

- Angelopoulos, M., Overduin, P.P., Miesner, F., Grigoriev, M.N., Vasiliev, A.A. (2020), Recent advances in the study of Arctic submarine permafrost, *Permafrost and Periglacial Processes*, doi:10.1002/ppb.2061.
- Brothers, L.L., Herman, B.M., Hart, P.E., Ruppel, C.D. (2016), Subsea ice-bearing permafrost on the U.S. Beaufort Margin: 1. Minimum seaward extent defined from multichannel seismic reflection data, *Geochem. Geophys. Geosyst.*, 17, doi:10.1002/2016GC006584.