Strontium as tracer of hydrologic connectivity of thaw ponds to local hydrology in thawing subarctic landscapes

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Motivation

- Climate-change-induced warming in the Arctic has led to drastic changes in its landscape due to the thawing of permafrost
- The hydrological connectivity of Stordalen Mire, a peatland ecosystem 200km North is changing due to permafrost degradation.
- Relative to the surface, groundwater systems are enriched with strontium (Sr) and rubidium (Rb).
- Sr in particular can be used as a proxy to know the hydrological connectivity of the Mire.

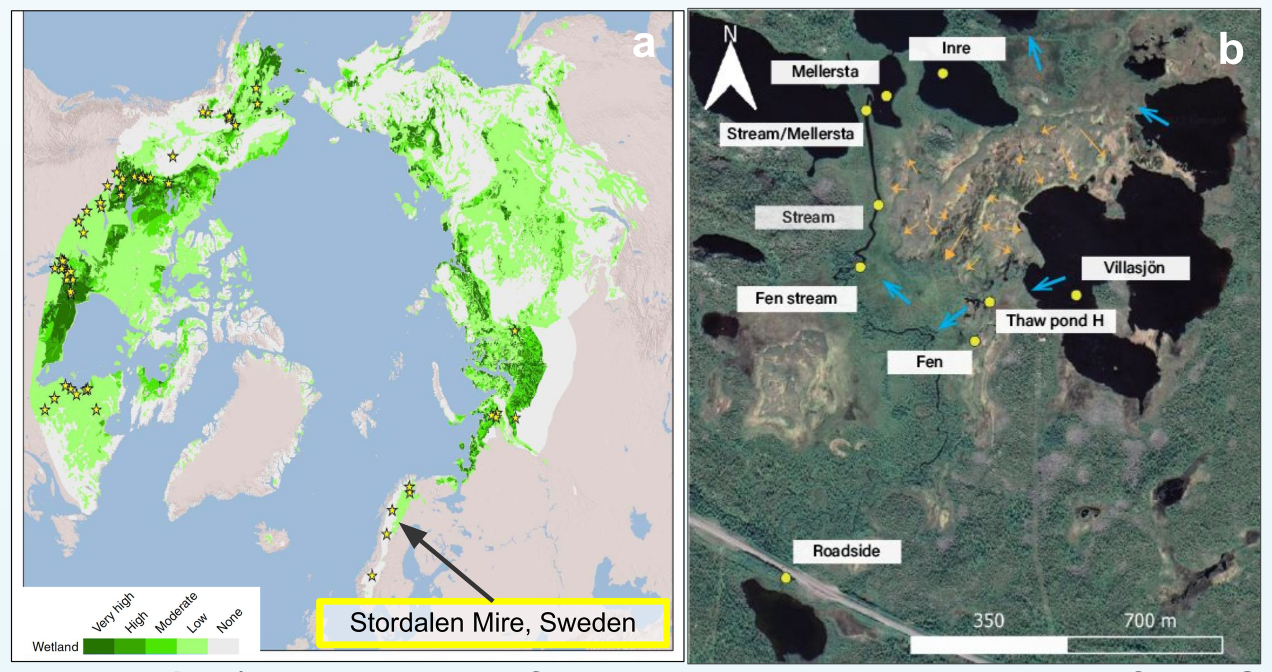

Figure 1. a) Distribution of wetlands over the pan-Arctic from Olefeldt et al., 2016 b) Map from Fahnestock, 2022 depicting water and drainage flow paths determined by Olefeldt.

Methods

- Weekly sampling of water from 20 sites including lakes, thaw ponds and stream locations in Storladen Mire, Sweden.
  - Porewater sampled one time point, in triplicate, where sampling permitted.
- In-situ parameters measured with multi-meter: water temperature, pH. %DO, conductivity, ORP, TDS and temperature.
- Abundance of Sr and Rb measured with Inductively Coupled Plasma Mass Spectrometry (ICP-MS) at UNH.

Figure 2. a) Collecting water samples in Stroladen Mire, Sweden (Photo Credit: Brayden King)b) analyzing water samples on ICP-MS at UNH (Photo Credit: Cal Distecamp)

Results

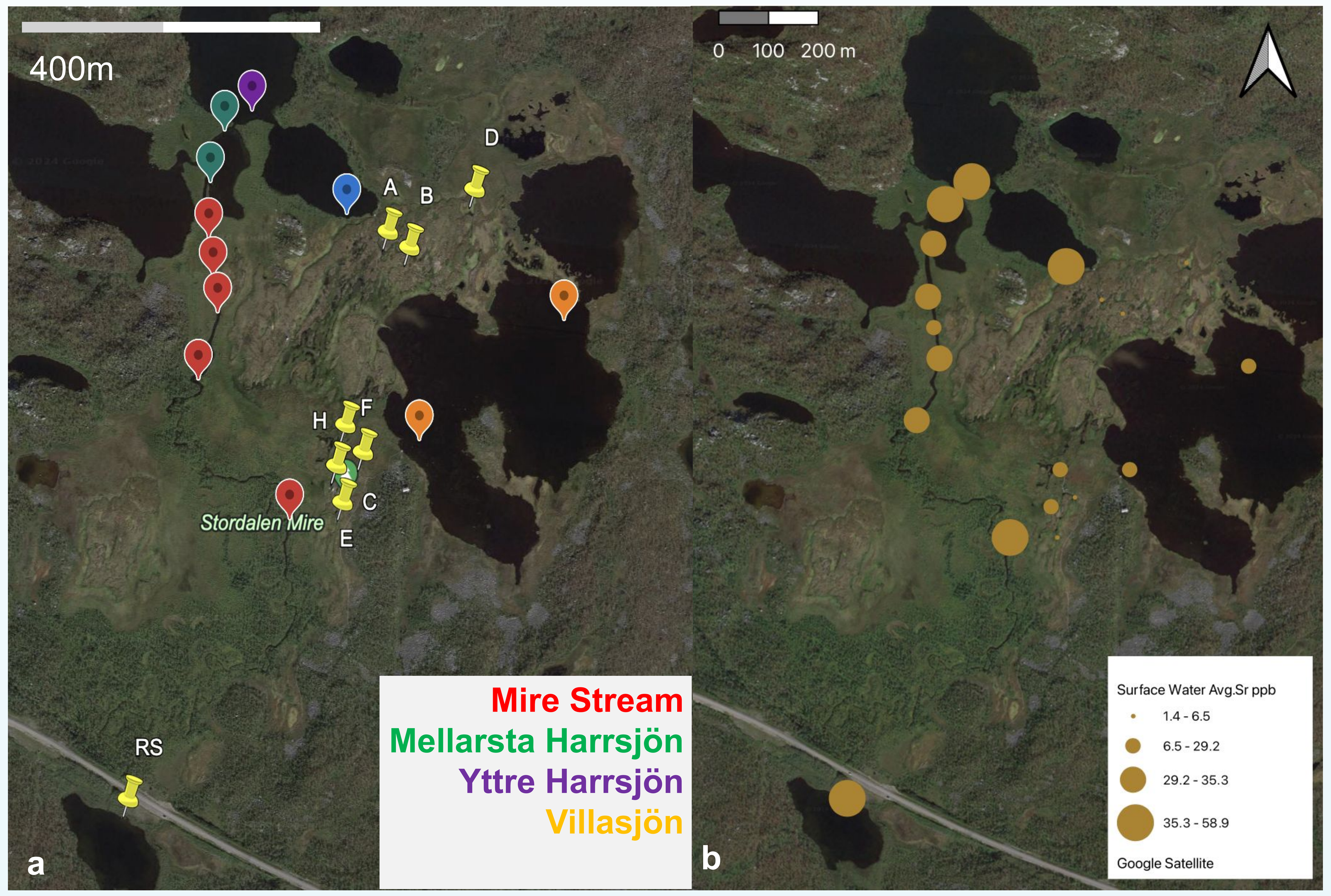

Figure 2. a) Sampling sites for the study b) Mean Sr abundance of study locations

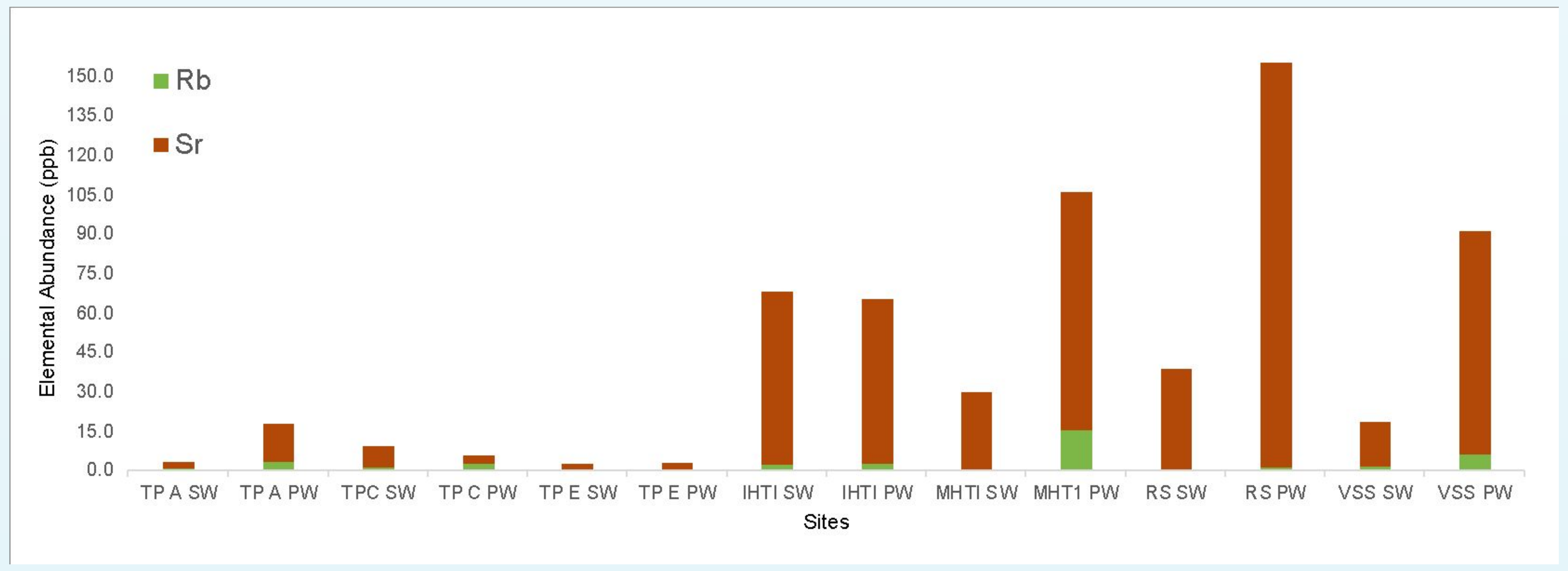

Figure 3. Sr and Rb in paired surface water and pore water samples.

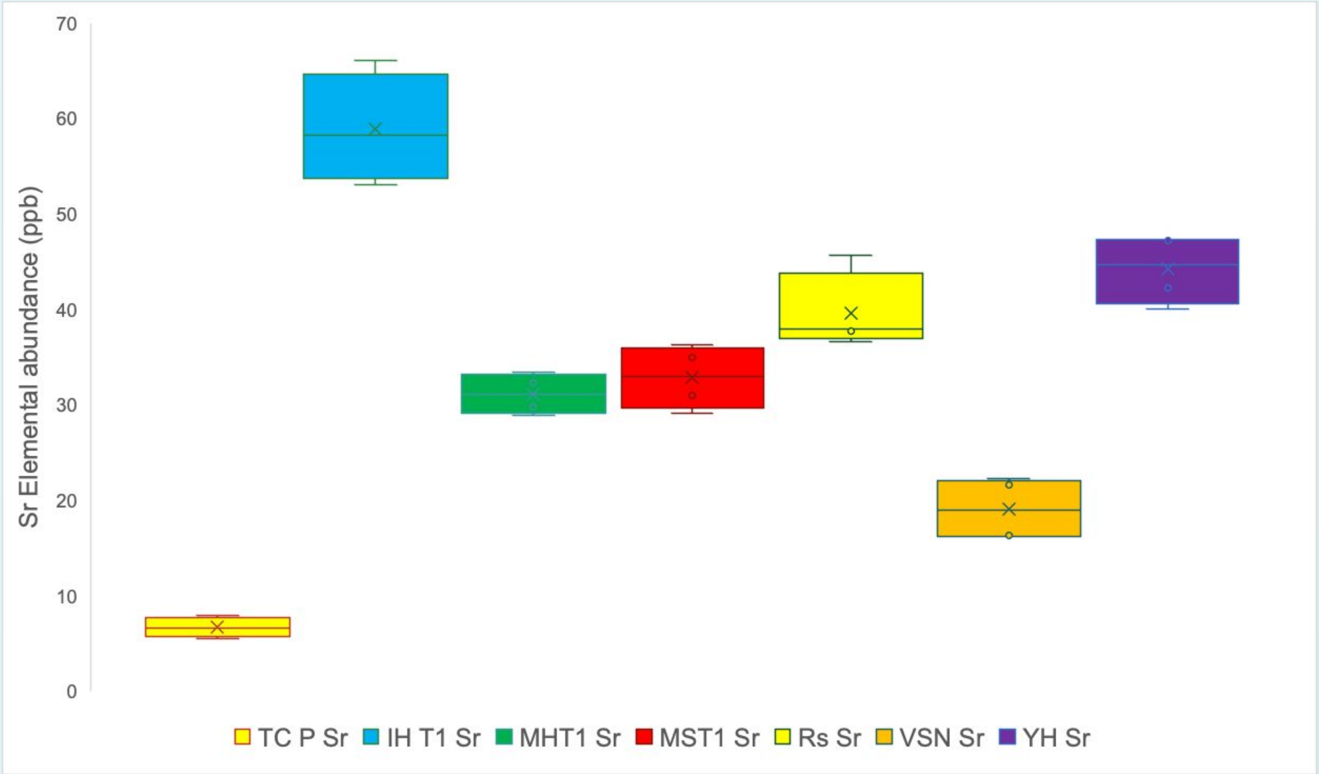

Figure 4. Sr elemental abundance variability from four-week surface water sampling

Conclusion

- Water samples showed higher abundances of Sr in porewater relative to surface water.
- Elevated Sr in lakes and stream porewater samples indicate water source is ombrotrophic and groundwater-fed.
- Elevated Sr observed in thaw ponds near fens, ecosystems characterized by hydrologic connectivity that provides nutrients to promote sedge habitat.
- Thaw ponds A, C, and E can be classified as hydrologically isolated based on the relative abundance of Sr in their porewater versus surface water.
- Temporal data showed minimal temporal variability for the four-week sampling period.

Next Steps

- Assess whether the targeted thaw ponds have changed their hydrologic connectivity, as classified by Burke et al., 2019.
- Process and analyze DOC data to explore carbon export potential and hydrologic connectivity of the landscape.

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