

Mercury in permafrost landscapes in the Norwegian Subarctic – current status and potential for increased release and methylation by permafrost thaw

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Introduction Arctic soils are estimated to store a significant amount of the worlds Hg¹. With increasing warming climate and permafrost thaw, the fate of the Hg sequestered in the Arctic soils are of great concern². Here we map current Hg concentrations in Subarctic soil and water and investigate potential release from thawing permafrost.

Material and Methods

Soil and water samples were collected at three different sites in the Norwegian Subarctic. All soil samples were analyzed for C, macro- and micronutrients, and Hg. Water samples were analyzed for HgT and MeHg. Soil samples were incubated as stirred slurries to assess potential release of Hg from permafrost peat cores into water, while monitoring CO₂ and CH₄ gas production, and DOC production/consumption. The effect of redox conditions (oxic/anoxic), nutrients (N, P), readily accessible C, electron acceptors (SO₄²⁻) and native DOC were also tested.

Results

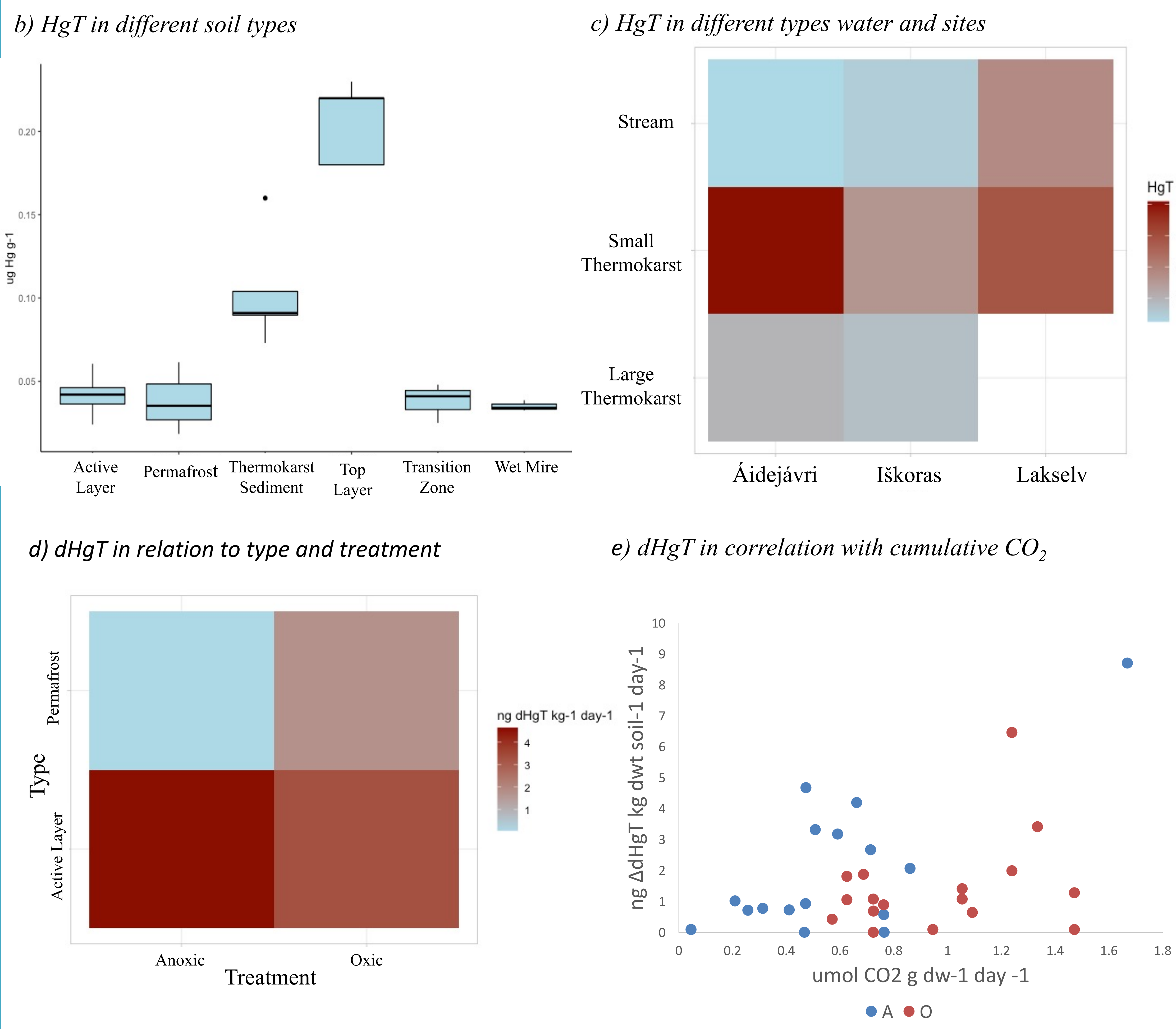
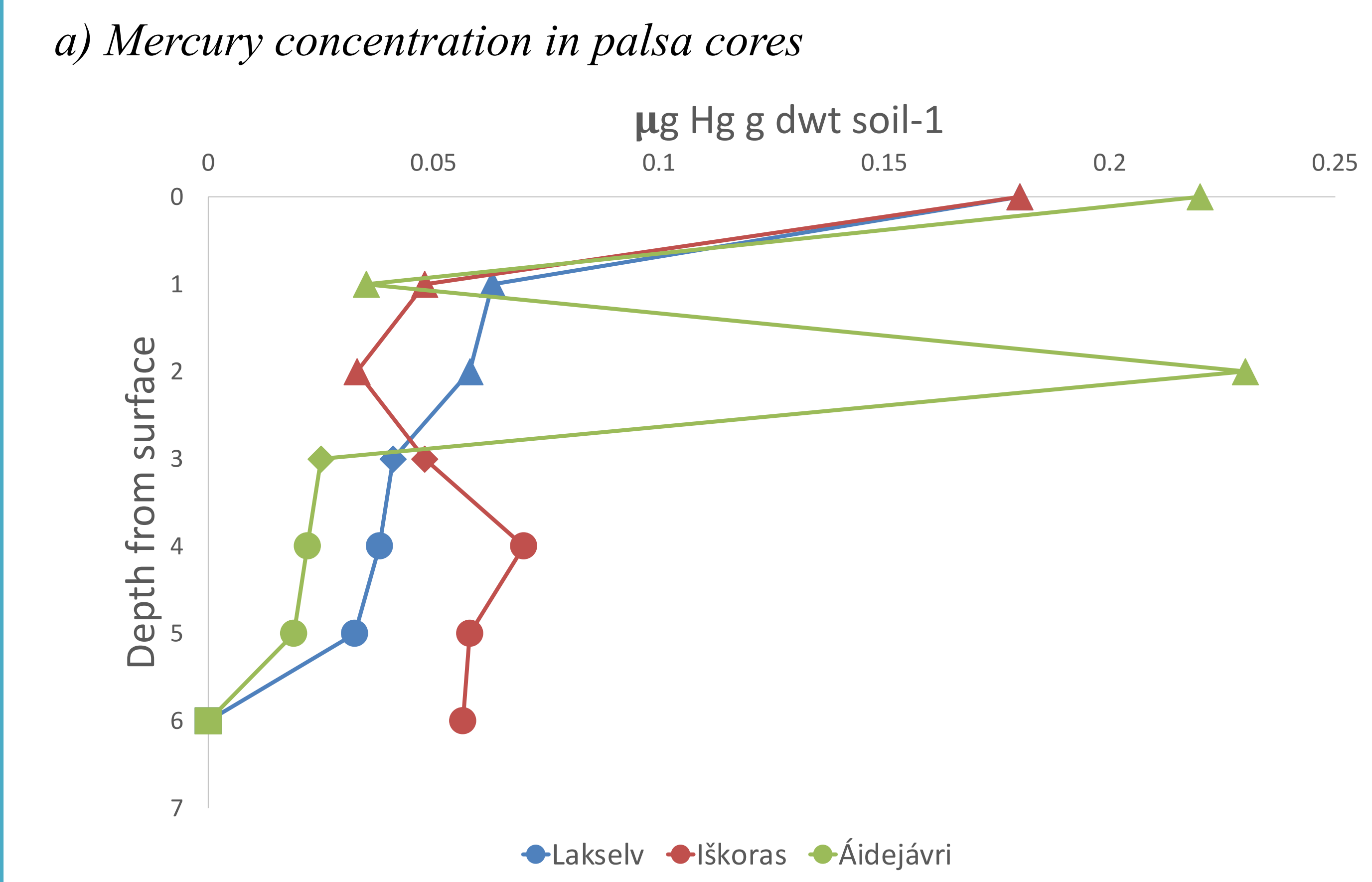


Fig. 1: Mapping of Hg concentratiton and possible release in Subarctic soil. a) Hg concentration in soil profiles, b) Hg concentration in different types of Subarctic soils, c) HgT concentrations in Subarctic waters, d) dHgT in relation to type of sample and treatment e) Correlation with rates of dHgT and CO2 emission from incubated permafrost soil

Conclusion

There are significant differences in Hg concentrations between sites and environmental features. Top layer of palsas and thermokarst sediments have the highest concentration in soil and small thermokarst ponds have the highest concentration in water. Incubations show that the active layer releases more Hg into the water than permafrost soil. In addition, anoxic incubations generally release more Hg into the water phase than oxic incubations. There is a weak correlation between carbon degradation and release of Hg.

Key takeaway

Anoxically incubated active layer releases the most Hg into water, making formation of thermokarst ponds a potentially significant source of Hg into Arctic aquatic systems.

References

¹Schuster, P. F., Schaefer, K. M., Aiken, G. R., Antweiler, R. C., Dewild, J. F., Gryziec, J. D., . . . Zhang, T. (2018). Permafrost Stores a Globally Significant Amount of Mercury. *Geophysical Research Letters*, 45(3), 1463-1471. doi:<https://doi.org/10.1002/2017GL075571>

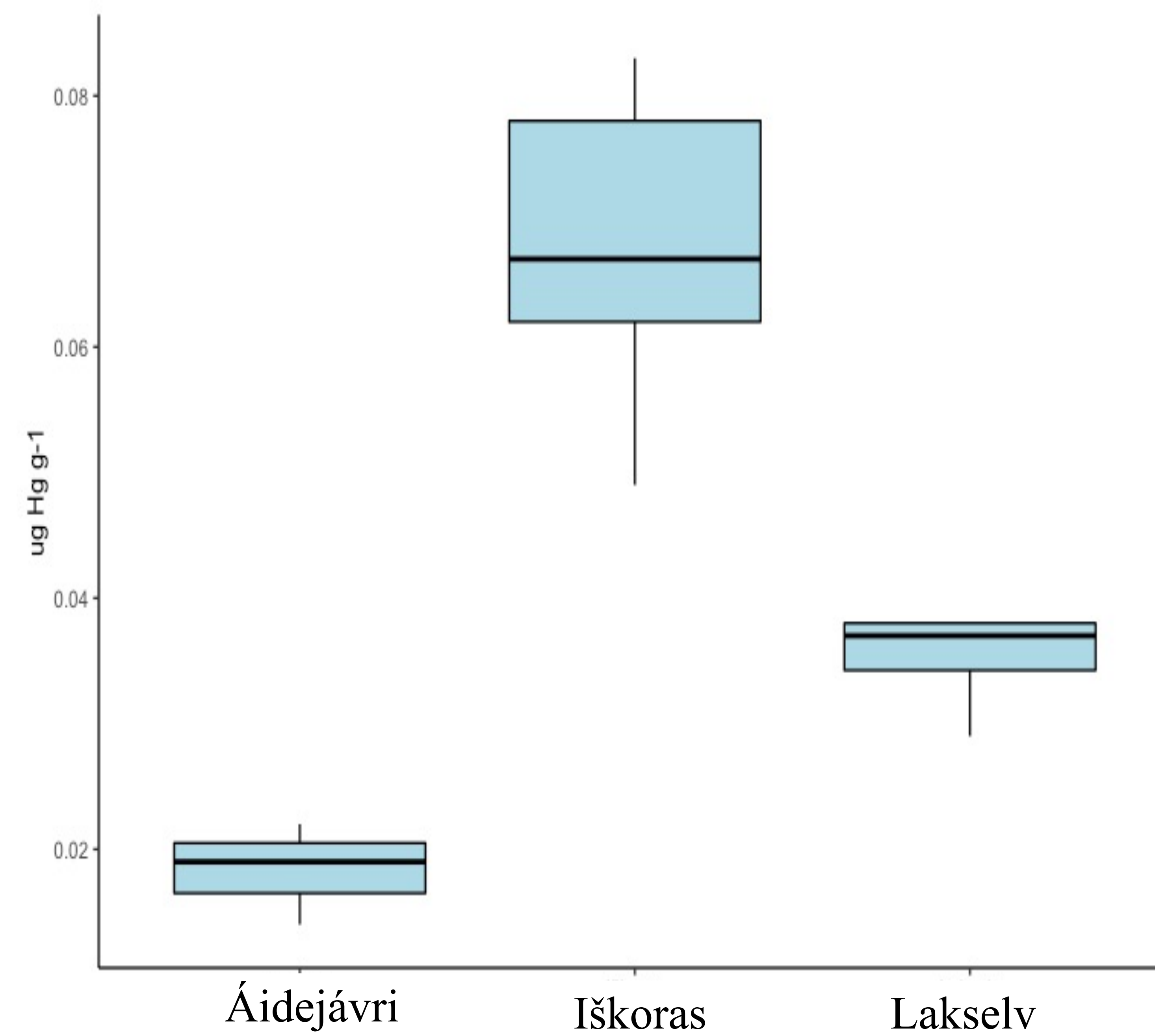
²Rydbberg, J., Klaminder, J., Rosén, P., & Bindler, R. (2010). Climate driven release of carbon and mercury from permafrost mires increases mercury loading to sub-arctic lakes. *Science of The Total Environment*, 408, 4778-4783. doi:10.1016/j.scitotenv.2010.06.056

Supplementary material

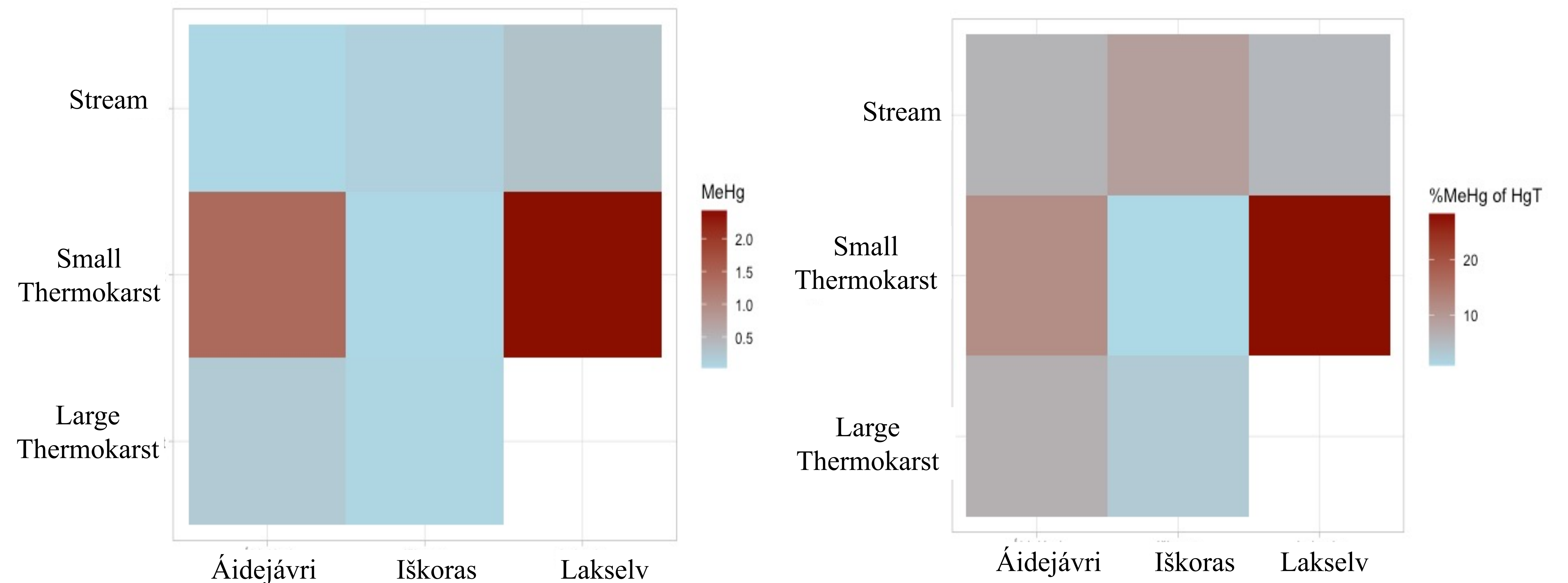
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Hg concentration in permafrost



Methylmercury in ambient water



Accumulation of dHgT, DOC, and CO₂ with depth

