Response of Redox-Active Organic Matter Reduction to Long-Term Climate Change Manipulations in a Boreal Peatland

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Introduction

- Peatlands serve as sinks and sources of methane (CH_4) and carbon dioxide (CO_2)
- Redox-active organic matter (RAOM) reduction is an understudied, anaerobic respiration pathway in peatlands that suppresses CH_4 production (Fig. 1)

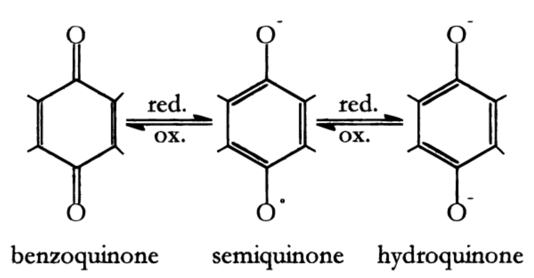

Fig 1. An example of a quinone reduction reaction, the redox-active component of RAOM of interest in this study.

- Global climate change may alter respiration pathways and subsequent carbon (C) storage in peatlands

<u>Research Question:</u>
What are the long-term effects of whole ecosystem warming and elevated atmospheric CO_2 on RAOM reduction?

Methods

<u>Study Site</u>

- SPRUCE (Spruce and Peatland Responses Under a Changing Environment)
- 10 years of whole ecosystem warming (WEW) and elevated CO_2 (eCO_2) (Fig. 2)

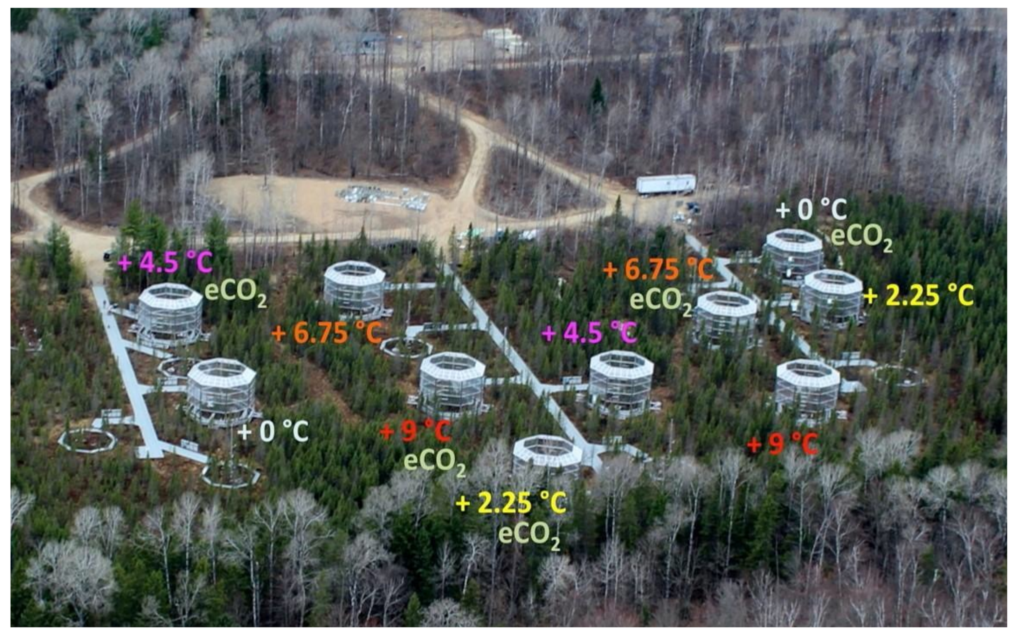

Fig 2. Experimental design of the SPRUCE site. Photo Credit: Oak Ridge National Lab.

<u>Experiment 1: Direct Effects of WEW and eCO2 on RAOM</u>

- Common substrate and field peat incubated in each experimental unit for 1 month (Fig. 3)

<u>Experiment 2: Manipulation-Induced Changes in RAOM Pools</u>

- Incubated peat at 10-20 cm and 175-200 cm at 18°C for 42 days
- Peat was both biologically and chemically reduced to compare RAOM pools

Fig 3. Example of peat packets (left) being prepared for incubation at the SPRUCE site (right).

Direct Effects of Whole Ecosystem Warming and Elevated CO_2 on RAOM Reduction

- Warming led to increased RAOM reduction in common substrate peat, while neither peat types showed effects of eCO_2
- Differences between the two peat types could be driven by time of collection or changes in peat chemistry

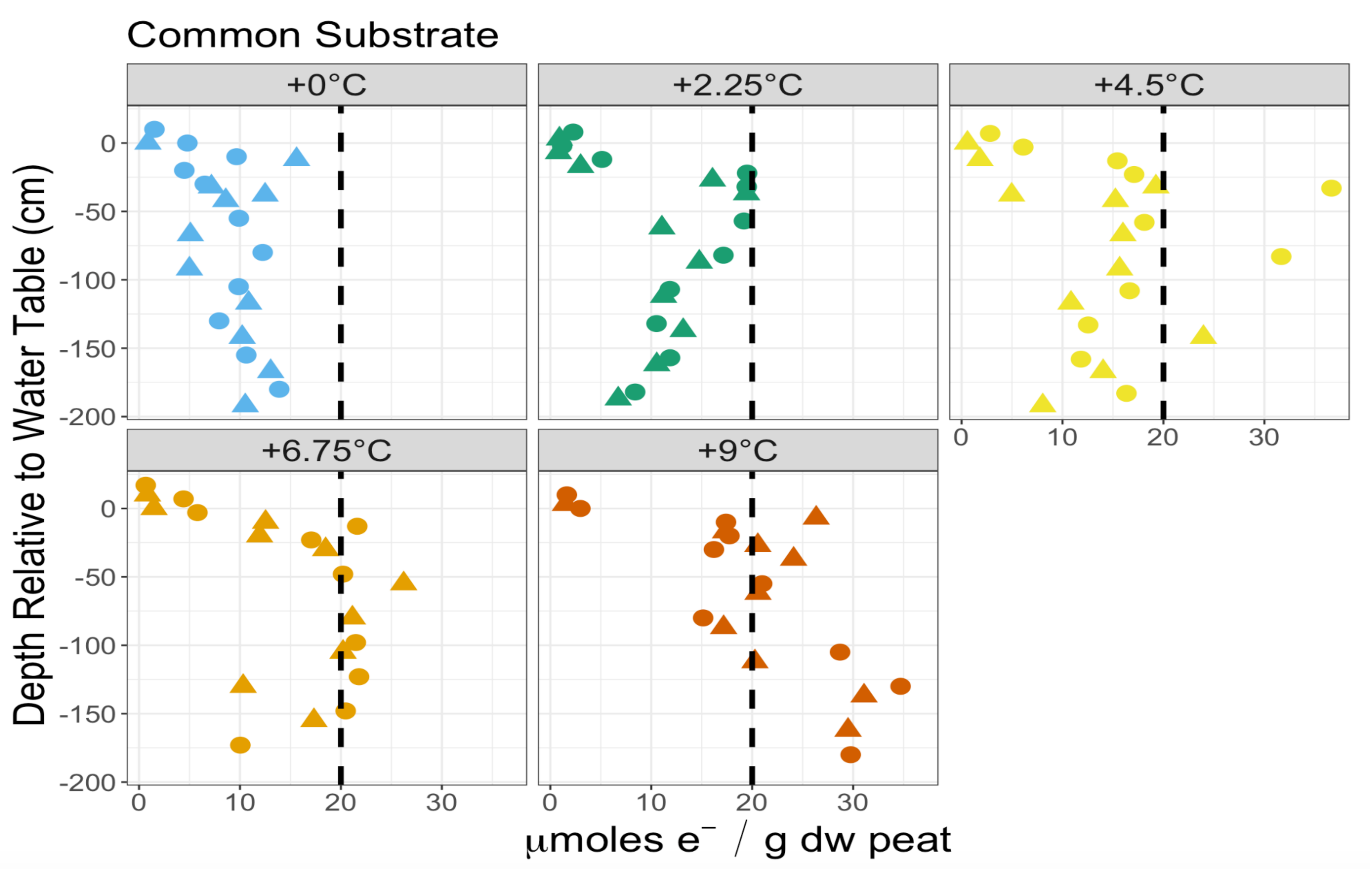

Fig 4. RAOM reduction in common substrate peat reported as electron shuttling capacity (x axis, an indirect assay to measure RAOM reduction). The dotted black line serves as a reference point to compare facets.

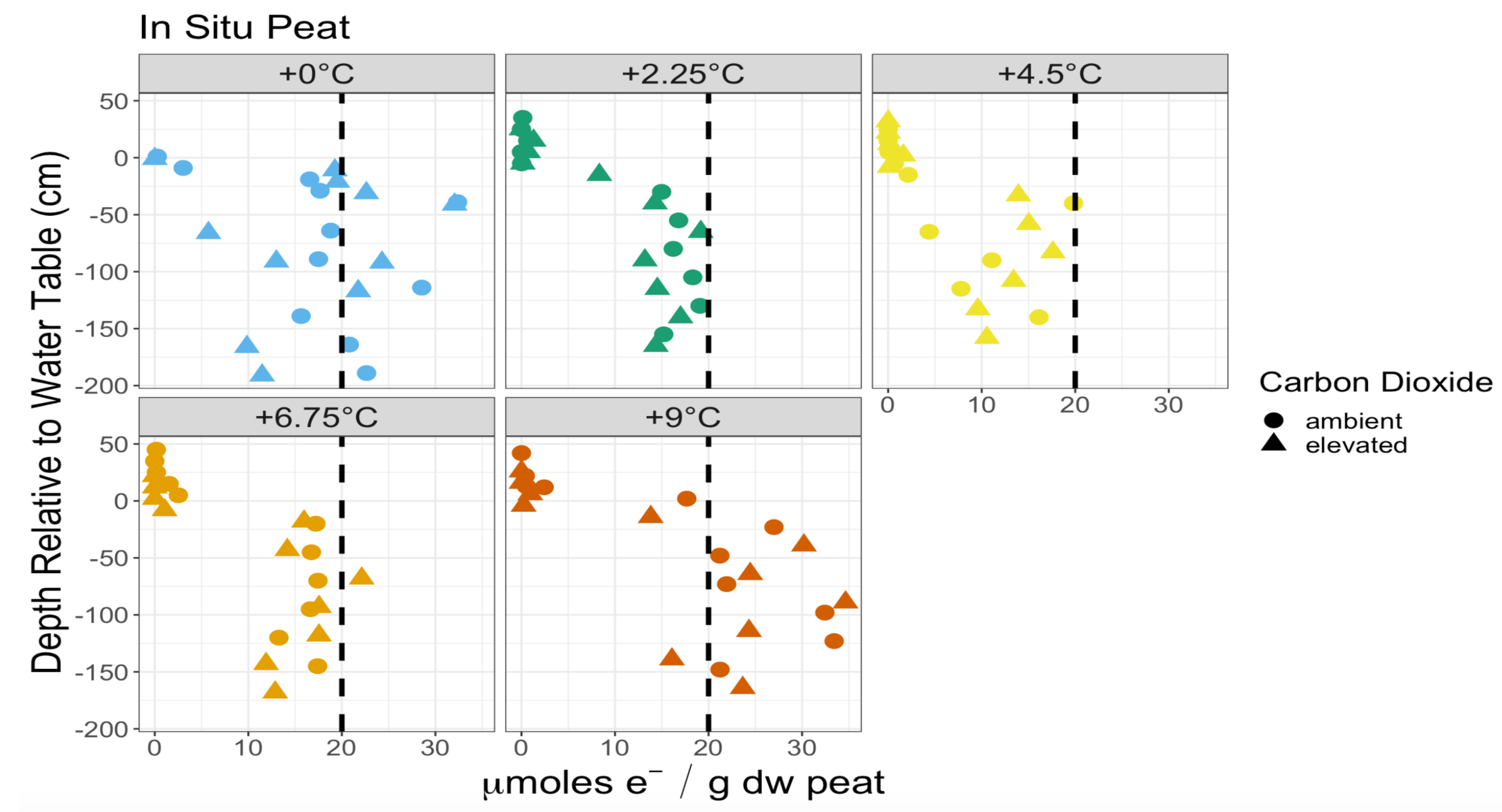

Fig. 5. RAOM reduction in in situ peat, or peat from each experimental unit at SPRUCE. Note that peat harvested was fully oxidized before being returned to its corresponding depth and incubated for 1 month.

Manipulation-Induced Changes in RAOM Pools

- 10-20 cm has fastest rates of RAOM reduction
- 10 years of warming have not changed the sizes of the RAOM pools

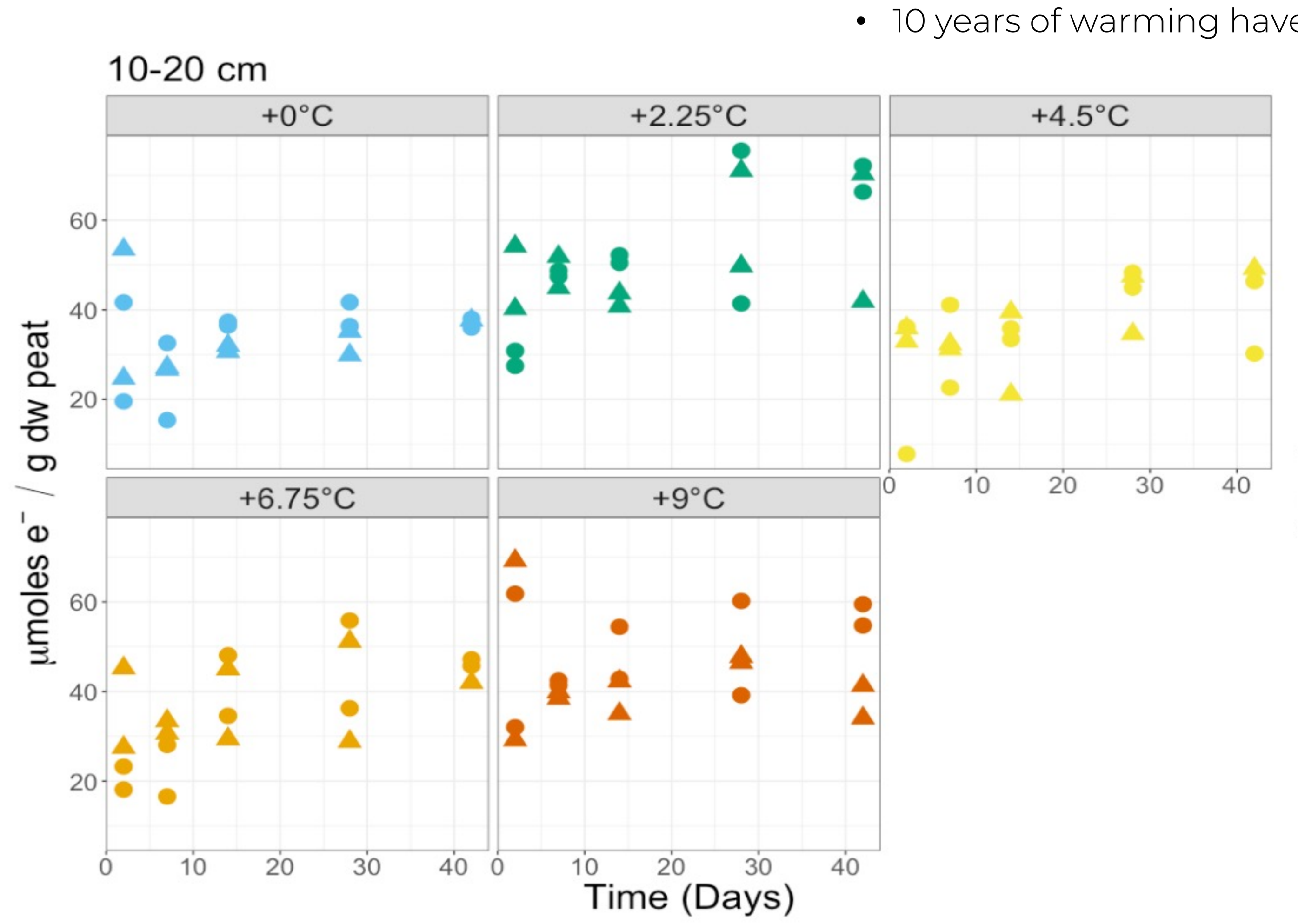

Fig 6. RAOM reduction of peat at 10-20 cm from each experimental unit incubated at a common temperature (18 deg C) for 42 days. Peat was fully oxidized before reduction to represent the potential for RAOM reduction.

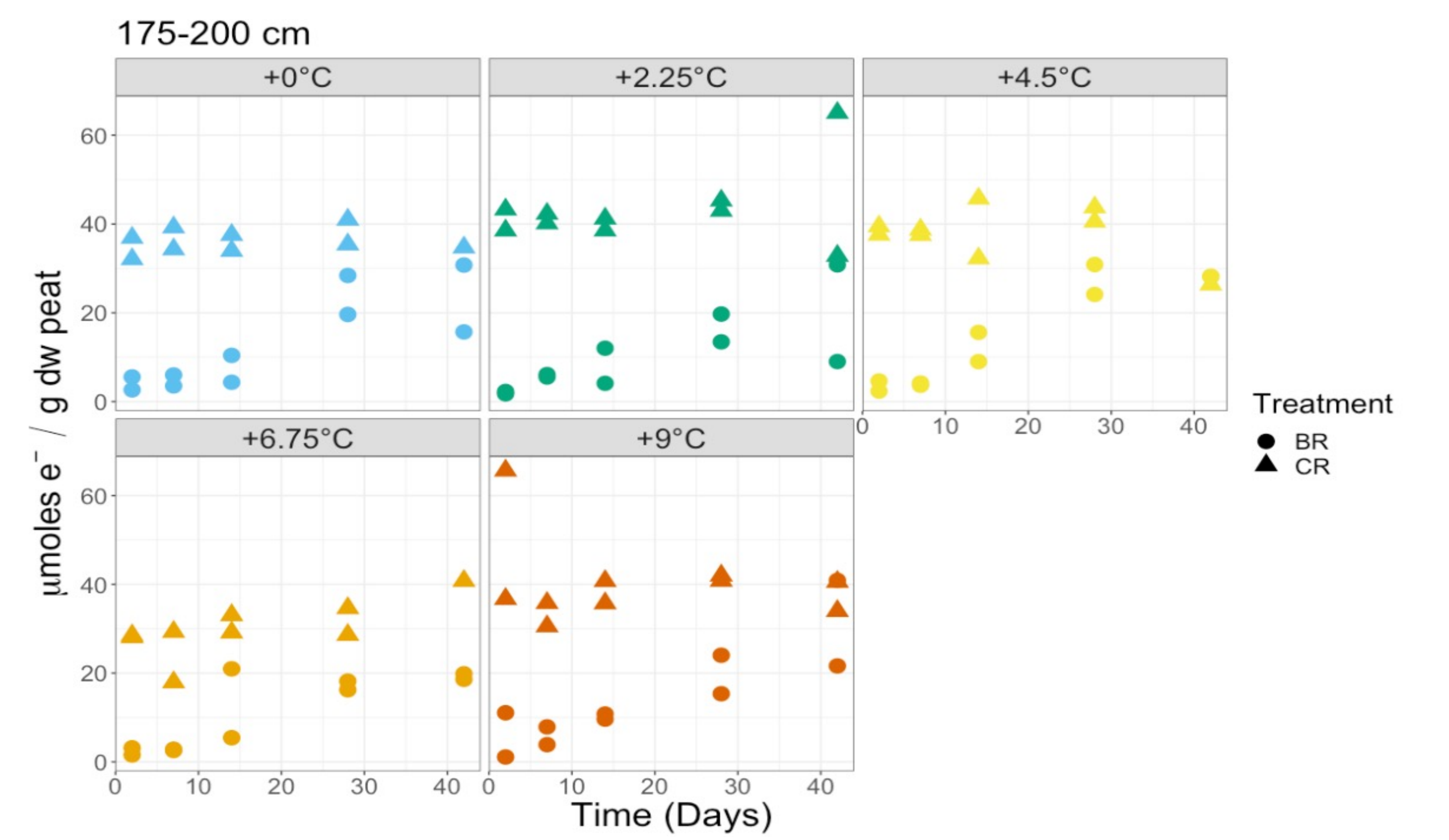

Fig 7. RAOM reduction of peat at 175-200 cm as represented in Fig 6.

Conclusions and Future Work

- Peat may be resilient to short-term effects of global climate change
- Future work will compare RAOM pools to a similar study done by Rush 2021 et. al

Acknowledgements & References

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