Long-term relationships between carbon sequestration, hydrology, and disturbance in a northern peatland; Kamchatka Peninsula, Russia

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Introduction

Kamchatka Peninsula, located in the Russian Far East (Fig. 1) is part of the Pacific 'Ring of Fire' and is one of the **most active volcanic regions of the world**. One of the most important phenomena generated by volcanism in Kamchatka is the deposition of large quantities of **volcanic ash (tephra)** upon the surface. These deposits can impact local environments by obliterating ecosystems or by supplying nutrients to the soils. **Kamchatka's peatlands**, and northern peatlands in general, are one type of ecosystem susceptible to change. **Northern peatlands** are important as they store ~1/3 to 1/2 of world soil carbon pool[1]. Any changes to a peatlands carbon balance has the potential to cause a positive feedback to climate change. While recent studies have made progress in understanding the climatic controls on the **global carbon (C) cycle**, important interactions between **disturbance regimes, C storage, and hydrology** as a casual continuum remain to be addressed. This study uses a 15,000-year peatland record from Kamchatka, Peninsula (Russia) to examine the interactions between carbon accumulation, hydrology, and volcanic ash deposition.

Aims and Objectives

To decipher ***if peat surface burial by volcanic ash changes the water table regime and carbon accumulation rates in affected peatlands*** by:

1) reconstructing long-term (millennial scale) water table depth (WTD) variation.
2) reconstructing long-term carbon accumulation rates and C/N chemistry.
3) determining if a synergy exists between repeated peat surface disturbance, carbon storage, and hydrology.

Materials and Methodology

- A 7-m long sediment core from a bog (Fig. 2).
- AMS radiocarbon dating (17 macrofossils and pollen).
- Bulk density and organic matter content (OC) to be measured through Loss on Ignition (LOI)[2].
- LORCA (g C m^{-2} yr^{-1}) to be calculated to reconstruct long-term carbon accumulation rates[3].
- C/N analysis to determine geochemistry (Fig. 3).
- WTD to be reconstructed using Testate Amoebae (TA) microfossil analysis[4] (Fig. 3)(Fig.4).

References

1. Holden. (2005). *Philosophical Transactions: Mathematics, Physical and Engineering Science,* 363(1837), 2891-2913.
2. Chambers, F.M., Beilman, D.W., & Yu, Z. (2010). *Mires and Peat,* 7(7), 1-10.
3. Hughes, P.D.M., et al. (2013). *Quaternary Science Reviews,* 67, 160-175.
4. Booth, R.K., Lamentowicz, M., & Charman, D.J. (2011). *Mires and Peat, 7,* 1-7.

Results

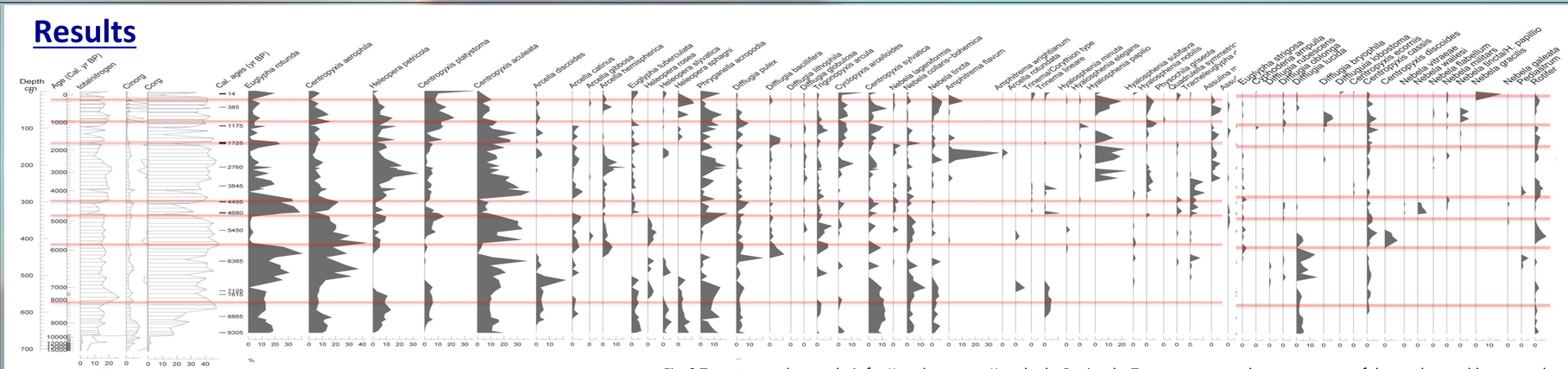


Fig. 3 Testate amoebae analysis for Krutoberegovo, Kamchatka Peninsula. Taxa are presented as percentages of the total assemblage, together with total carbon and nitrogen content. Results are presented alongside an age-depth model generated from 17 AMS radiocarbon age estimates. Shaded red bars indicate major tephra layers.

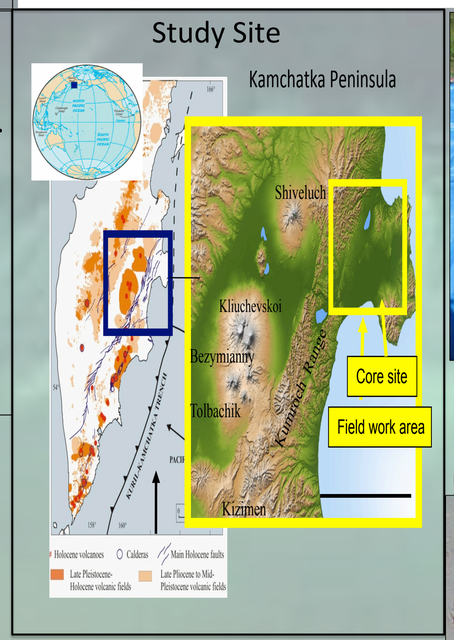
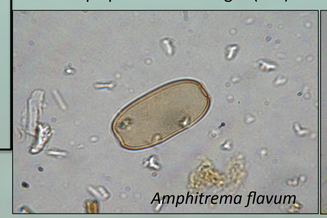
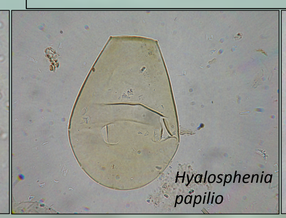


Figure 1. Study Site Location: Kamchatka Peninsula, Russian Far East

Figure 2 (Above): 7-metre long peat core. Photo credit: Dr. I. F. Pendea

Figure 4 (Below): Testate Amoebae microscope photo assemblages (40x)





Discussion and Significance

- Tephra loading has triggered changes in C/N dynamics, possibly through the physical effects of ash laying and nutrient induced-changes.
- Observed decelerations in C content and significant TA community re-organizations.
- Example: at ~ 4580-4495 YBP, observed decrease in C storage, increase in *E. rotunda* (low WTD indicator) and decrease in *C. aculeata* (high WTD indicator). A possible explanation for this is that ash deposition has caused surface drying and resulting in increased peat decomposition to occur (less carbon storage).
- Findings can provide an analogue for anthropogenic disturbance, which can allow climate modellers to make more accurate predictions on climate change.

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