Palsa degradation changes stable carbon isotope depth profiles

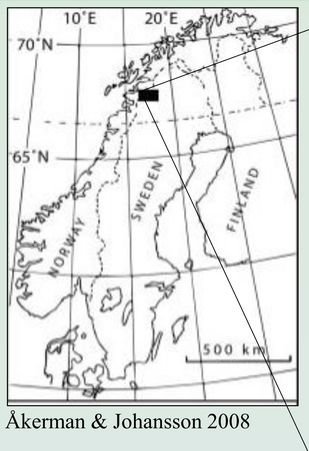
J.P. Krüger[1], J. Leifeld[2] & C. Alewell[1]

1) Environmental Geosciences, University of Basel, Switzerland, **janpaul.krueger@unibas.ch**
2) Agroscope Reckenholz-Tänikon ART, Zürich, Switzerland

Introduction

Peatlands are an important component in the global carbon cycle. They store approximately twice as much C as in the atmosphere though they only cover 3% of the global land surface. Palsa peatlands are common in the discontinuous permafrost region. The active layer (annual thawing soil) has become thicker in the region over the last three decades (Åkerman & Johansson 2008). Because of the permafrost thawing it is projected that the suitable area for palsas will likely disappear by the end of 21st century (Fronzek et al. 2010).

Aerobic decomposition leads to an enrichment of ^{13}C with depth (Fig. 1, Type A), whereas anaerobic conditions induce either a depletion of ^{13}C due to an enrichment of recalcitrant material (Fig. 1, Type C) or a uniform depth trend (Fig. 1, Type B) due to very low degradation rates (Alewell et al. 2011).



Åkerman & Johansson 2008

Fig. 2: Study site and degraded palsa at Torneträsk, Sweden

Aim of this Study

We want to use stable carbon isotopes as indicators of palsa degradation. Our hypothesis is, that degradation of palsas influences the stable carbon isotope depth profiles of the hollows.

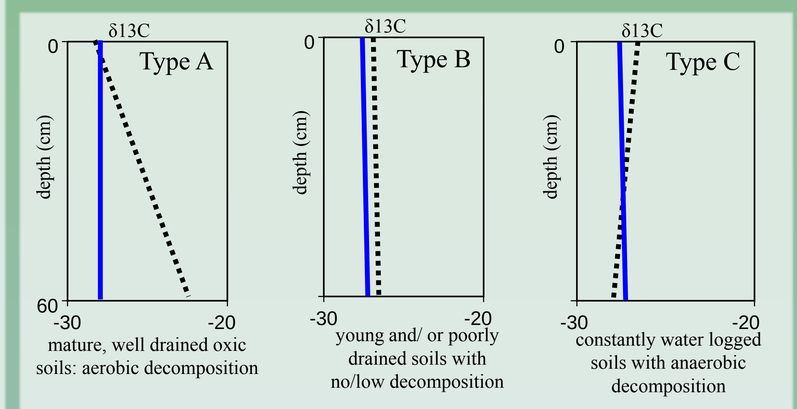


Fig. 1: Theoretical approach of isotope depth profiles in soils

Material and Methods

Samples were taken in September 2012 from the Torneträsk (TT) palsa peatland near Abisko, Sweden (Fig. 2). At two sites hollow (ho) and hollow degraded (hod) (Fig. 3) cores (n=3) were taken with a russian peat corer down to maximum of 50 cm.

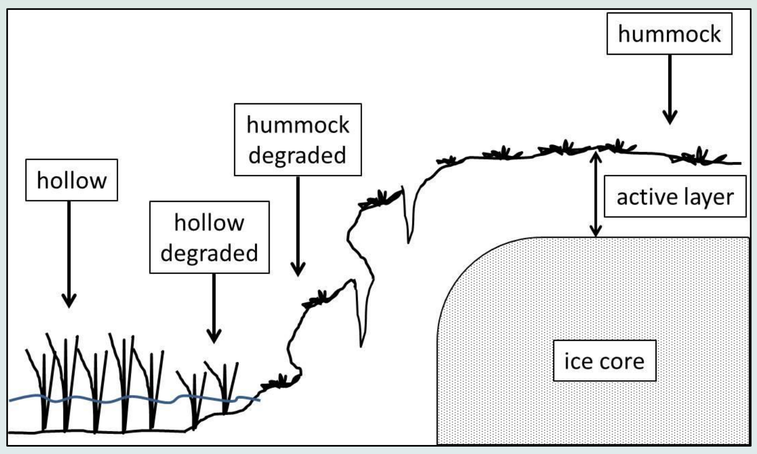


Fig. 3: Transect of sampling sites at the palsa peatland

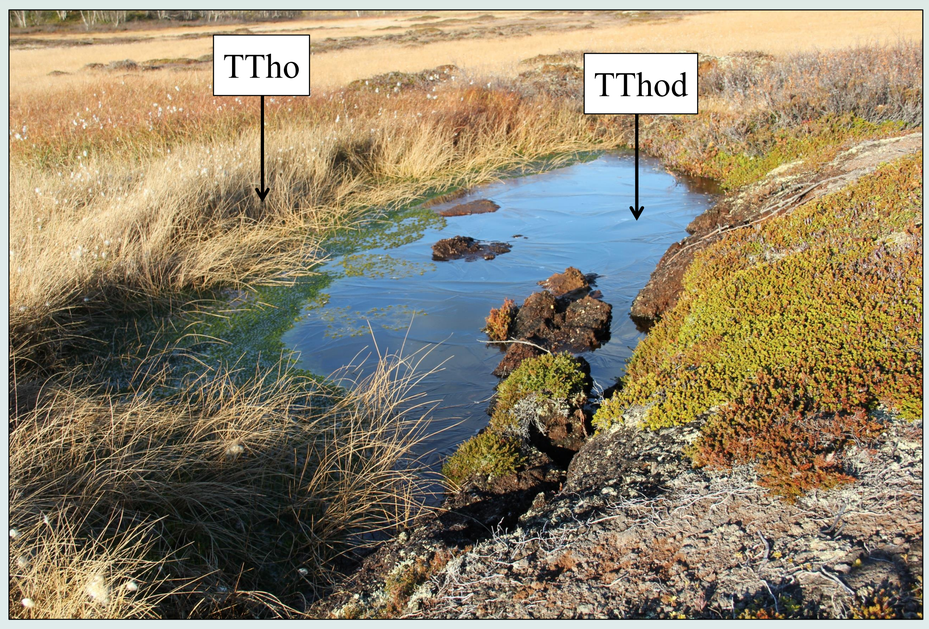


Fig. 4: Sampling sites at the Torneträsk palsa peatland

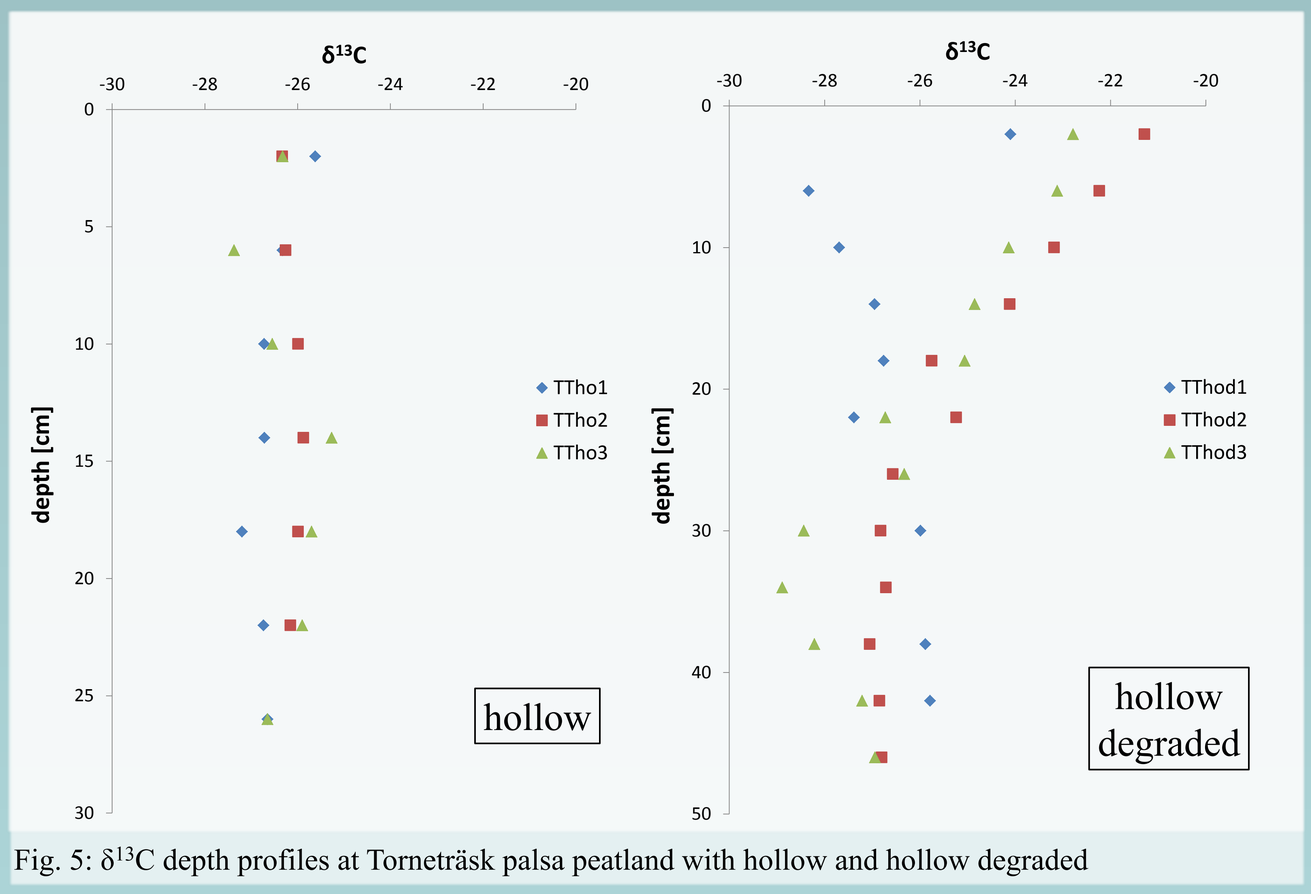


Fig. 5: $\delta^{13}C$ depth profiles at Torneträsk palsa peatland with hollow and hollow degraded

Results and Discussion

The stable carbon isotope depth profiles of the degraded and non degraded sites differ substantially (Fig. 5).

$\delta^{13}C$ profiles of non degraded hollows show a uniform trend (Type B) with low decomposition rates. However, $\delta^{13}C$ values of degraded hollows decrease (Type C) in the upper part (2 out of 3) and show a uniform depth trend only in deeper layers that may contain more recalcitrant material.

The hollows at the Torneträsk peatland are comparable to hollows in the Stordalen peatland (Alewell et al. 2011).

Fig. 6: Erosion at Torneträsk palsa peatland

Conclusion

- Pronounced differences in $\delta^{13}C$ depth profiles between hollows and degraded hollows at Torneträsk
- Deposited hummock material (Fig. 6) has changed the hollow profile and has likely increased degradation processes

Outlook

- Further analyses of peat samples from other palsa peatlands in the Abisko region
- Investigation of recalcitrance of peat material (ash method, infrared spectroscopy)
- ^{14}C dating of selected samples

References

Åkerman, H.J. & Johansson, M. (2008): Thawing Permafrost and Thicker Active Layers in Sub-arctic Sweden. Permafrost and Periglacial Processes 19: 279-292.

Alewell, C., Giesler, R., Klaminder, J., Leifeld, J. & Rollog, M. (2011): Stable carbon isotopes as indicators for environmental change in palsa peats. Biogeosciences 8: 1769-1778.

Fronzek, S., Carter, T.R., Räisän, J., Ruokolainen, L. & Luoto, M. (2010): Applying probabilistic projections of climate change with impacts models: a case study for sub-arctic palsa mires in Fennoscandia. Climate Change 99: 515-534.

Acknowledgements

This work is funded by Swiss National Foundation (SNF). The research leading to these results has received funding from INTERACT (grant agreement No 262693) under the European Community's Seventh Framework Programme. The Climate impacts Research Center (CIRC, Umea University, Sweden) substantially supported this study. Thanks to Mark Rollog and Axel Birkholz for the isotope analyses.