Stable carbon isotopes in soils as indicators of environmental change

J. P. Krüger; J. Leifeld; C. Alewell
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The project deals with **stable isotopes as indicators of peatland degradation** and is supported by the SNF. Peatlands are an important component of the global carbon cycle. Even though they cover only about 3% of the global land area, they store approximately 600 Pg carbon (C) in their soils. Anaerobic conditions induce low decomposition and hence peatlands in pristine status act as a carbon sink. More than 50% of the European peatlands are degraded and change to a carbon source due to aerobic decomposition of the peat material. The main hypothesis is that degradation changes the depth distribution of the stable carbon isotope and the ash content. Aerobic decomposition leads to an enrichment of ^{13}C with depth, whereas anaerobic conditions induce either a depletion of ^{13}C due to an enrichment of recalcitrant material or a uniform depth trend due to very low degradation rates (Alewell et al. 2011). A transect of degraded and natural peatlands from the northern most Europe 200 km north of the polar circle down to the Alps will be investigated to test our hypothesis. The degradation of peatlands by drainage, climate change, land use change or nutrient input will be analysed in combining stable isotope ($\delta^{13}C$, $\delta^{15}N$), C/N ratio as well as ash content depth profiles. Furthermore, selected samples will be age dated by radiocarbon analyses.

We could show that **stable carbon isotopes** in depth profiles along a degradation gradient in three palsa peatlands in northern Sweden are a good tool to identify historical **palsa uplifting by permafrost** as well as recent **palsa degradation** by permafrost thaw (see **Krüger et al. 2014**; **Krüger and Alewell 2015**). In northern Germany a peatland with different land uses give us the opportunity to study the **influence of land use change on stable isotopes** as well as to **calculate the carbon loss** of grassland used peatlands by a profile-based method (see **Krüger et al. 2015a**). We compared three different methods for calculating carbon losses of managed peatlands along a land use gradient (see **Krüger et al. 2015b**). In the Black Forest, southern Germany we analysed the effect of drainage and nutrient input on the depth patterns of stable isotopes. We took samples from peatlands in central Sweden to compare the influence of natural and anthropogenic drainage on stable carbon isotope depth profiles. The effect of drainage for forestry on the soil carbon balance was calculated by four different profile-based methods with a comparison of minerotrophic and ombrotrophic sites in central Finland.

Soil ash content and radiocarbon signatures have the potential to provide quantitative estimates on peatland carbon loss whereas changes in stable isotope patterns serve as qualitative indicators and support the understanding of processes and mechanisms involved.

Related publications

Krüger, J. P., Leifeld, J. and Alewell, C. (2014): Degradation changes stable carbon isotope depth profiles in palsa peatlands. Biogeosciences 11:3369-3380. [link]

Krüger, J. P., Leifeld, J., Glatzel, S., Szidat, S. and Alewell, C. (2015a): Biogeochemical indicators of peatland degradation – a case study of a temperate bog in northern Germany. Biogeosciences 12: 2861-2871. [link]

Krüger, J. P. and Alewell, C. (2015): Stable isotopes as indicators of environmental change. In: Callaghan, T.V. and Savela, H. (eds): INTERACT Stories of Arctic Science. Aarhus University, Denmark: 60-61. [link]

Krüger, J. P., Leifeld, J., Glatzel, S. and Alewell, C. (2015b): Soil carbon loss from managed peatlands along a land use gradient - a comparison of three different methods. BGS Bulletin 36: 45-50. [link]

Related pictures


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