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Nitrogen dynamics in peat bogs: Comparison of sites with contrasting pollution levels (Central Europe)

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Nitrogen belongs to chemical elements whose biogeochemical cycles are most heavily disturbed by human activities, and large regions worlwide experience elevated depositions of reactive N (NO_3-, NH4+). Peatlands contain as much as 15 % of the world's soil N. It it is unclear whether fertilizing by anthopogenic N will lead to higher storage of C in wetlands. Elevated N input may lead to both higher net primary productivity, but will also augment microbial decomposition.

Here we discuss two aspects of N cycling in Sphagnum-dominated bogs in the Czech Republic, an area characterized by a steep north-south pollution gradient and high annual N deposition (60 kg ha-1). These two aspects are N inventory in 210Pb-dated peat cores, and post-depositional mobility of N in peat.

We compared the N inventory in two Czech bogs, differing in pollution, with cumulative atmospheric N input. We hypothesized that the total amount of N in the peat cores would be smaller than the cumulative N input (leaching of excess N from the bog, denitrification). The two bogs were VJ (industrial north) and CB (rural south). The investigated period was 1885-2002. The total amount of N was 4020 kg ha-1 at VJ and 1530 kg ha-1 at CB. Peat in the north contained 2.6 times more N than in the south. Historical rates of N deposition in the Czech Republic are well known (numerous papers by Kopacek). To estimate cumulative N inputs into the bogs, we also used the monthly N depositions between 1994 and 2002, measured in two nearby catchments. The estimated cumulative atmospheric N input was 1350 kg ha-1 at VJ, and 530 kg ha-1 at CB. In both cases, the amount of N found in peat was 3 times higher than the estimated atmospheric N input. Such high storage of N in peat is surprising.

Post-depositional mobility of N may help to explain the discrepancies between atmospheric N inputs and N storage in peat. We found two-fold evidence for post-depositional mobility of N. Maximum N concentrations at VJ were observed in layers dated at 1950, whereas pollution level increased up to 1980, and dropped thereafter. At the end of an 18-month reciprocal peat transplant experiment between VJ and CB, we found that N isotope ratios N converged to the host site. The magnitude of the isotope change was 3 per mil, the affected depth was 10 cm.

Our results are consistent with the concept of Lamers et al. (2000) in that both [U+F064]15N and the found shift in N peaks downcore confirmed removal of N from surface moss under high N depositions. On the other hand, the excess of stored N relative to the cumulative N input remains unexplained, and merits further study.