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The Influence of organic matter decay on the distribution of major and trace elements in ombrotrophic mires – a case study from the Harz mountains

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Mires have been frequently used as environmental archives of historical atmospheric deposition of trace elements and pollutants. This approach assumes that the element of concern is immobile in the peat through time and space, because it is associated with dust particles or strongly bound in the organic substrate. Based on this assumption records of element concentrations or accumulation rates are believed to reflect solely atmospheric fluxes. However, the influence of peat decomposition processes on element records in peat has only been poorly investigated. Here we present a study on the influence of peat decomposition and related mass loss on the fate of Si, Ti, Zr, Fe, Mn, Cr, Ca, Zn, Pb, As, Hg, Cl and Br in three ombrotrophic mires located in the Harz mountains, Germany. Major and trace element distribution in peat cores ($\sim$ 1m) have been directly determined in peat by means of micro-XRF and by CVAAS (Hg). Changes in peat decomposition and mass loss were based on C/N ratios. Relationship among the different elements and peat decomposition was statistically evaluated by Principal Component Analysis (PCA). Results show that long term trends of increasing peat decomposition are similar in the three bogs, but show some in-bog variability on a smaller time scale. Concentration records of all investigated elements are strongly influenced by peat decomposition processes. Zr, Ti and Si, which are predominately bound in dust particles are exponentially enriched during peat decay by mass (carbon) loss and increasing particle density. The organically bound elements N, Cl and Br are linearly enriched through mass loss and were not affected by changes in particle density. Redox-sensitive elements (Fe, Mn, Cr) and the mobile nutrients Ca and Zn are assumed to be initially bound in the organic substrate, but released during peat decay. Their distribution in the peat profiles is largely determined by mobilization/diffusion under changing redox conditions caused by water table fluctuations. The strong influence of peat decomposition on most of the investigated elements and the fact that peat decomposition in mires is to a large extent controlled by climatic/hydro¬logical changes reveals that variations in concentrations rather indicate changes in peat decomposition and weathering of dust particles than in atmospheric fluxes. However, historically high atmospheric fluxes of Pb, As and Hg, related to the Harz' mining industry, predominately determine the observed changes in concentrations of these elements in the peat so that any relation to peat decomposition processes is assumed to be overwritten and could not be determined.