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Rewetting drained peatlands: effects on aqueous substance emissions

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Peatlands are important ecosystems which store large amounts of carbon and therefore play a major role in efforts to combat climate change. However, to be able to use them for agriculture, a major part of the peatlands in Europe have been intensively drained since the 18th century. This drainage puts the peat in contact with atmospheric oxygen, which results in a degradation of the peat structure. To stop this degradation, a further deterioration in soil quality and the associated release of CO_2, peatlands are increasingly being rewetted. However, the great importance of rewetting peatlands for climate protection after many years of peat degradation, comes with the possibility of increased aqueous substance emissions threatening the quality of downstream groundwater and surface water resources. This opens up a broad field of research to identify responsible mobilization processes, to quantify these substance outputs more precisely and to find out which emissions can be expected. In our current studies, we are investigating a peatland north of Greifswald, northeastern Germany. This involves comparing the behavior of degraded, near-surface peat with rather undegraded, more pristine peat from deeper layers in batch and column laboratory experiments. The main focus is on the emissions of dissolved substances and the resulting water quality. The degraded peat released considerably higher amounts of almost all considered major, minor and trace elements, compared to the more pristine peat. The phosphate discharge in this study, differs little between degraded and undegraded peat. Nutrient inputs, such as nitrate, have a massive influence on the substance emissions from peatlands: both organic carbon and sulfides are oxidized by nitrate, releasing additional iron as well as DOC and sulphate, as long as sulphate is not reduced again after nitrate degradation. A repeated redox change thus favors mobility and aqueous discharge of dissolved substances. The mobilization of trace elements is another central aspect of this research, with e.g., As, U, Al, V, Ni or Pb being released much stronger from degraded peat. Dissolved substances emissions from peatlands should therefore be considered as an important research, management and monitoring component of rewetting endeavors in the future.