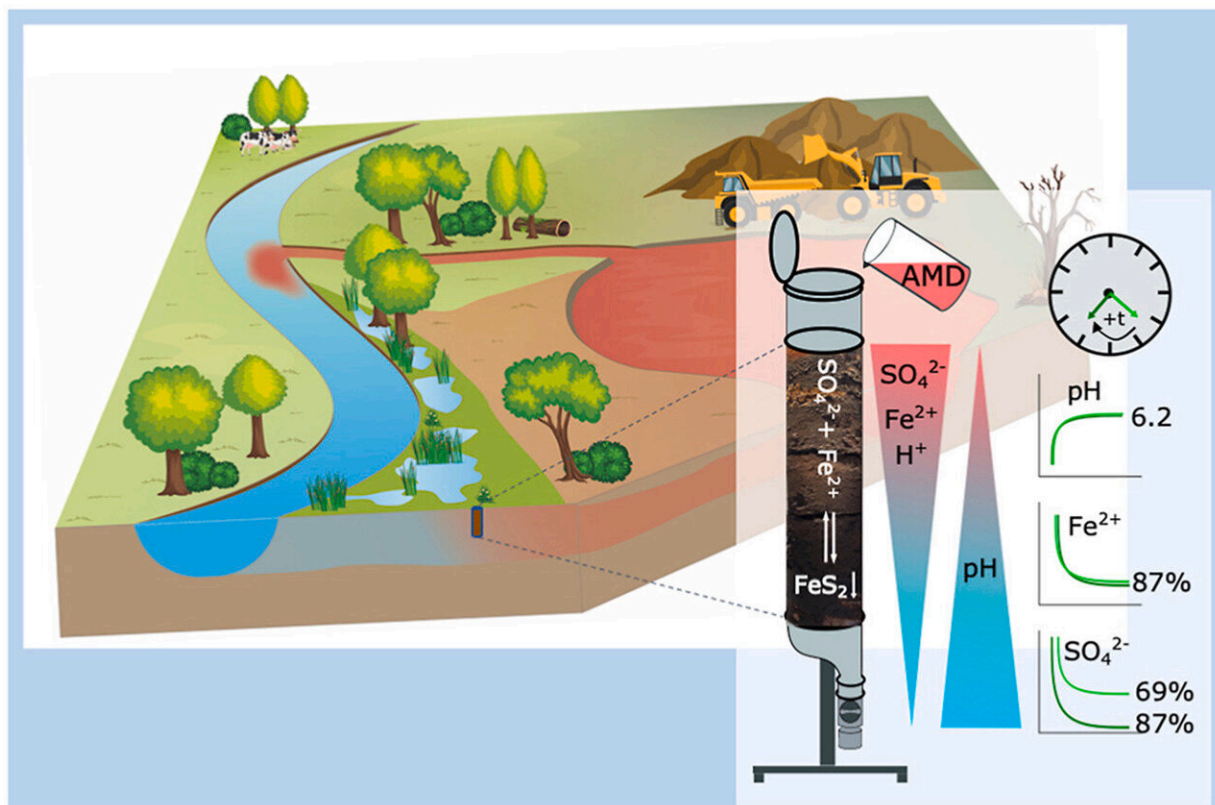


Peatlands clean up acid mine drainage

March 23 2022



Graphical abstract. Credit: *Journal of Environmental Management* (2022). DOI: 10.1016/j.jenvman.2022.114808

The pollution of groundwater and surface waters with sulfate and iron from acid mine drainage is a worldwide problem in post-mining landscapes. Researchers from the Humboldt University of Berlin (HU-Berlin) and the Leibniz Institute of Freshwater Ecology and Inland

Fisheries (IGB) have shown in the laboratory that fen soil can reduce the iron and sulfate contamination of mine water by over 80%.

During and after lignite mining, excavated material containing pyrite reacts with oxygen and water to form [sulfuric acid](#) and dissolved iron. Sulfate and iron compounds as well as an acidic pH value are the factors that make mine drainage a source of pollution for [water bodies](#). There are numerous technical solutions for treating acid mine water, but they are often costly and difficult to implement. The post-mining landscape in Lusatia, Germany, which is highly loaded by acid mine drainage is an example of the limits of treatment technologies. There, high concentrations of iron and [sulfate](#) are found in rivers—such as the Spree—lakes and aquifers. Different punctual treatments did not improve water quality.

Why could peat soil remove sulfate and iron?

Nature-based solutions in the landscape have been little explored. Rewetting peatlands could be an effective measure. "Under oxygen-free conditions, pyrite should ideally be re-formed in water-saturated peatland soils and iron and sulfur should be removed at the same time, eventually preventing renewed pyrite oxidation. Compared to other organic substrates, however, it was previously unclear to what extent the decomposed peat from the upper soil layers of drained peatlands is suitable," explained Lydia Roesel from HU-Berlin, the first author of the study.

Iron and sulfate concentrations reduced by about 80% each in the laboratory experiment

In the laboratory experiment, the researchers simulated the rewetting of [peatland](#) with acid mine water. They then quantified the iron and sulfate

removal and the pH changes at different loading rates. The initial low pH of 4 increased to 6, and the electrical conductivity dropped by up to 47%. The conductivity of the water is a measure of the particles dissolved in the water and thus, in freshwater, also an indicator of the quality of the water. The initially high concentrations of iron (more than 250 milligrams per liter) and sulfate (more than 770 milligrams per liter) fell on average by 87 and 78% respectively.

"The results imply that microbial degradation of sulfate and subsequent precipitation of [iron](#) sulfides was the most important mechanism in reducing pollution," explained Dominik Zak, guest scientist at IGB and scientist at the Danish University of Aarhus. The lower the hydraulic or material load, the more sulfate was removed. The hydraulic load determines the retention time and the higher it is, the shorter the contact time of the mine water with the peat substrate.

Example Spree: The rewetting of peatlands in mining regions could drastically reduce sulfate loads

The rewetting of peatlands would thus be an effective measure to reduce pollution from acid mine drainage. For the heavily polluted section of the Spree studied, the researchers were able to estimate on the basis of the rewetting experiment and extensive field data that a reduction in the river's sulfate load of about 20% (36,827 tons per year) would occur if all the peatlands in the sub-catchment were rewetted. This would be 6067 hectares and would correspond to 6.7% of the total area.

"Our results show once again that the rewetting of peatlands is an important measure for the protection of our environment. Peatlands stabilize the global carbon balance, they keep water in the landscape and also have an important purification function," said Lydia Roesel.

Future research into why pollutant degradation is slowing down and how mine water affects peatlands

The researchers emphasize that the laboratory experiments cannot be easily transferred to large-scale field conditions.

"In the future, it needs to be investigated whether pollutant degradation in decomposed peat layers decreases over time due to acidification or the lack of bioavailable carbon—or both—and how rewetting with acid mine drainage affects the restoration of the important further functions of peatlands in the long term," said Dominik Zak.

Bringing the bog into the lab

Biogeochemical processes in peatlands are naturally subject to high temporal and spatial variability. The main reasons for this are temperature fluctuations and hydrological changes over the course of the year as well as small-scale differences in physical and chemical soil properties. The significance of individual control variables for the purification of mining waters is therefore initially best investigated under controlled laboratory conditions. Transferring the results to the field is then possible under certain assumptions, but should be backed up by further investigations in the laboratory and in the field.

Why peatlands are important

As transition and [buffer zones](#) between terrestrial and aquatic ecosystems, peatlands have an important function for the material and water balance in the landscape. Growing or undrained peatlands are important sinks for carbon, phosphorus and nitrogen. The simultaneous storage of [water](#) has contributed to the term "kidneys in the landscape." If peatlands dry out, they can release nutrients and greenhouse gases in

return.

More information: Lydia K. Roesel et al, Treating acid mine drainage with decomposed organic soil: Implications for peatland rewetting, *Journal of Environmental Management* (2022). [DOI: 10.1016/j.jenvman.2022.114808](https://doi.org/10.1016/j.jenvman.2022.114808)

Provided by Forschungsverbund Berlin e.V. (FVB)

Citation: Peatlands clean up acid mine drainage (2022, March 23) retrieved 3 May 2024 from <https://phys.org/news/2022-03-peatlands-acid-drainage.html>

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