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Nitrogen removal in Northern peatlands treating mine wastewaters

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Natural peatlands can be used as passive purification systems for mine wastewaters. These treatment peatlands are well-suited for passive water treatment as they delay the flow of water, and provide a large filtration network with many adsorptive surfaces on plant roots or soil particles. They have been shown to remove efficiently harmful metals and metalloids from mine waters due to variety of chemical, physical and biological processes such as adsorption, precipitation, sedimentation, oxidation and reduction reactions, as well as plant uptake. Many factors affect the removal efficiency such as inflow water quality, wetland hydrology, system pH, redox potential and temperature, the nature of the predominating purification processes, and the presence of other components such as salts. However, less attention has been paid to nitrogen (N) removal in peatlands.

Thus, this study aimed to assess the efficiency of N removal and seasonal variation in the removal rate in two treatment peatlands treating mine dewatering waters and process effluent waters. Water sampling from treatment peatland inflow and outflow waters as well as pore waters in peatland were conducted multiple times during 2012-2014. Water samples were analysed for total N, nitrate-N and ammonium-N. Additionally, an YSI EXO_2 device was used for continuous nitrate monitoring of waters discharged from treatment peatlands to the recipient river during summer 2014.

The results showed that the oxic conditions in upper peat layer and microbial activity in treatment peatlands allowed the efficient oxidation of ammonium-N to nitrite-N and further to nitrate-N during summer time. However, the slow denitrification rate restricts the N removal as not all of the nitrate produced during nitrification is denitrified. In summer time, the removal rate of total N varied between 30-99 % being highest in late summer. N removal was clearly higher for treatment peatland treating process effluent waters than for peatland treating dewatering waters probably due to more oxidizing conditions. During winter time there is not enough microbial activity to maintain oxidation of ammonium-N to nitrate-N. However, almost 20 % of N may be removed during winter season due to nitrate denitrification.