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Chemical characteristics of dissolved organic matter (DOM) in relation to heavy metal concentrations in soil water from boreal peatlands after clear-cut harvesting

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Boreal peatlands form an important terrestrial carbon reserve and are a major source of dissolved organic matter (DOM) to surface waters, particularly when disturbed through forestry practices such as draining or timber harvesting. Heavy metals show a strong affinity to organic matter and so, along with DOM, heavy metals can be mobilized and transported from the soil to surface waters and sediments where they may become toxic to aquatic organisms and pass up the food chain. The complexation of heavy metals with DOM can be expected to be related and determined by the chemical characteristics of DOM and oxidation/reducing conditions in the peat. We extracted interstitial water from peat samples and determined the concentrations of dissolved organic carbon (DOC), dissolved organic nitrogen (DON) and Al, Cu, Zn and Fe in various fractions of DOM isolated by adsorption properties (XAD-8 fractionation) and molecular-weight (ultrafiltration). The peat samples were taken from 0-30 and 30-50 cm depth in drained peatland catchments two years after whole-tree or stem-only clear-cut harvesting (Scots pine or Norway spruce) had been carried out. The samples from the upper layer had been subject to alternating saturation/aeration conditions while the deeper layer had been continuously under the water table.
The fractionation of DOC and DON according to both adsorption properties and molecular-weight fractions clearly differed between the upper and lower peat layers. While the hydrophobic acid fraction contained proportionally more DOC and DON than the hydrophilic acid fraction in the upper peat layer the results were vice versa in the lower peat layer. High-molecular-weight compounds (> 100 kDa) were proportionally more abundant in the upper and low-molecular-weight compounds (< 1 kDa) in the lower peat layer. These differences are assumed to reflect differences in the aerobic/ anaerobic conditions and degree of decomposition between the two layers.
The concentrations of Zn, Al, Fe and DON correlated positively with DOC concentrations whereas the concentration Cu did not correlate with DOC concentrations. Heavy metal concentrations in different molecular-weight fractions indicated that Al, Cu, Zn and Fe were mostly associated with high-molecular-weight compounds and only a small fraction existed as free metal ions in solution. There were no clear differences in the chemical characteristics of DOC or DON or heavy metal concentrations between the two harvesting treatments.