



Chemical composition and colloidal properties of dissolved organic matter in Norway spruce forest stands of different ages

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Dissolved organic matter (DOM) is the most mobile and actively cycling fraction of soil carbon and acts as a carrier of nutrients and contaminants. It is consumed by microbes, photodegraded, or adsorbed in soils and sediments on its way to the ocean. Despite intensive research in the last two decades, the formation and fate of DOM in soils and its response to changes in land use and climate are poorly understood [1-3]. The changes in temperature and chemical composition of soils affect substantially the rates of microbial decomposition. It has previously been observed that afforestation had a positive effect on carbon stocks approximately 3 decades after land-use change [4]. The aim of this study was to identify the role of afforestation on the chemical composition and colloidal nature of DOM. We compared water extractable DOM from an organic horizon in three differently aged (35-, 61-, 90-years-old) Norway spruce stands growing in the same Tönnersjöheden area located at Simlångsdalen, south-west Sweden. Arable fields that were adjacent to each of these three forests served as control DOM samples and represented the soil material before afforestation. Chemical composition of DOM was inferred from ¹³C solid-state nuclear magnetic resonance (NMR), high-resolution ¹H NMR, infrared spectroscopy (DRIFT) and elemental analysis measurements. Colloidal properties of DOM were investigated using small-angle X-ray and dynamic light scattering methods together with electrophoretic mobility measurements. The dialysis experiment was additionally performed in order to investigate the high molecular fraction of DOM.

Elemental analysis revealed an increase in the ratio between total organic C and total N with forest age and no differences between three field DOM extracts. ¹H and ¹³C NMR results showed that both field and forest DOM extracts were dominated by carbohydrates and also contained carboxylic and aliphatic compounds. The aromatic structures were not detected using NMR. However, some features of aromatics and phenolics were detected in IR spectra, especially in forest cold DOM. Scattering data showed that field and forest DOM contained locally stable colloidal aggregates of ca. 100 nm in radius. The structures of these aggregates are consistent with a combination of globular and cluster-like colloids. Field DOM contained slightly higher fraction of clusters than forest DOM. According to the dialysis experiment the half of DOM was presented in

high molecular weight fraction (> 12-14 kDa). Overall, our data suggest that DOM extracted from forest and field organic soils had similar chemical and colloidal properties. The relative composition was dictated more by temperature at which DOM was extracted.

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