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$\delta^{15}N$, $\delta^{13}C$ AND RADIOCARBON IN DISSOLVED ORGANIC CARBON AS INDICATORS OF ENVIRONMENTAL CHANGE

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Abstract. Decomposition, humification, and stabilization of soil organic matter are closely related to the dynamics of dissolved organic matter. Enhanced peat decomposition results in increasing aromatic structures and polycondensation of dissolved organic molecules. Although recent studies support the concept that DOM can serve as an indicator for processes driven by changing environmental processes in soils affecting the C and N cycle (like decomposition and humification) and also permit insight in former conditions some 1000 years ago, it is unknown whether dissolved organic carbon (DOC) and nitrogen (DON) have an equal response to these processes.

1. INTRODUCTION

The main objective of this paper is the question if a change in the degree of humification of DOM caused by different environmental conditions in a recent fen area is linked with different dynamics of DOC and DON as a basis for interpretation of carbon and nitrogen isotopes of DOM in older groundwater [1].

As a first step we tested this hypothesis by analyzing DOC and DON concentrations of topsoils, groundwater and surface water of six differently used sites in a fen area. Furthermore, the degree of humification of DOM as deduced from synchronous fluorescence spectra were related to the natural variation of carbon (^{13}C, ^{14}C) and nitrogen (^{15}N) isotopes of DOM [5].

2. RESULTS AND DISCUSSION

We detected differences in the isotope signature between carbon and nitrogen at different stages of humification (Fig. 1). The degree of humification of soil organic matter was found to be not crucial for both DOC and DON release. Intact peatlands (low degree of decomposition and humification) favour the release of DOC whereas degraded peatlands (high degree of decomposition and humification) favour the release of DON.

DOC concentration in topsoil, groundwater and surface water depends on soil organic carbon content and therefore on the degree of peat decomposition. Whereas the inorganic N pool is more important for DON release than the whole organic N pool.

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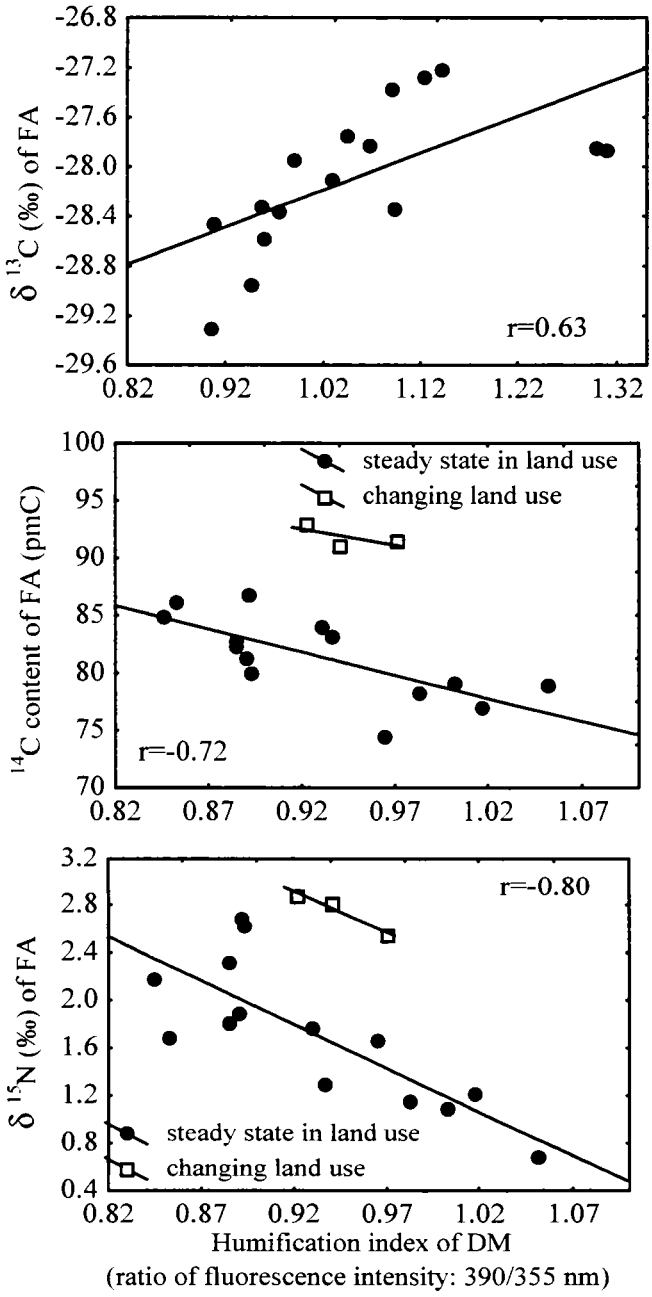

FIG. 1. Dependence of $\delta^{13}C$ ratio (topsoil water-soluble FA), ^{14}C content (groundwater FA) and $\delta^{15}N$ ratio (groundwater FA) on the humification index of DOM.

DOC and DON showed a similar dynamic after a short-term land-use change from crop production to an unimproved grassland as indicated by unchanged concentrations and humification of DOM and increased ^{14}C and ^{15}N values. A high humification of DOM is linked with a high C turnover and an increased microbial modification and age of DOC but with low $\delta^{15}N$ ratios. If one considers the promoting effect of inorganic N on DON release we assume that an addition of mineral fertilizer N increases the microbial mobilization of amino acids. These amino acids could be responsible for the low $\delta^{15}N$ ratios. Furthermore, the condensation of amino acids with carbohydrates to humic substances is accompanied by a high humification of DOM at these sites which got inorganic N fertilizers. However, an incorporation of fertilizer N into the DON fraction can not be excluded. At all, we have to

conclude opposite patterns of DOC and DON at different stages of humification of DOM. Therefore, both DOC and DON have to be considered in studies concerning the dynamic of DOM, especially the humification of DOM.

The degree of humification of soil organic matter is not crucial for both DOC and DON release. The amount of SOM which is, however, dependent on the degree of decomposition determines the release of DOC whereas the inorganic N pool affects the release of DON. Therefore, intact peatlands (low degree of decomposition and humification) favour the release of DOC whereas degraded peatlands favour the release of DON. Humification of DOM did not change after a short-term land-use from crop production to an unimproved grassland. Increased ^{14}C and ^{15}N values showed an equal response of DOC and DON to this land-use impact. A high humification of DOM is linked with a high C turnover and an increased microbial modification and age of DOC but with low $\delta^{15}N$ ratios. An incorporation of fertilizer N into the DON fraction is not proven but can also not excluded. It is more likely that an addition of mineral fertilizer N increases the microbial mobilization of amino acids followed by a condensation with carbohydrates to humic substances. At all, we have to conclude opposite patterns of DOC and DON at different stages of humification of DOM. Therefore, both DOC and DON have to be considered in studies concerning the dynamic of DOM, especially the humification of DOM.

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