SORPTIVE CONTROL ON DISSOLVED ORGANIC MATTER EXPORT FROM SOILS IN FOREST TUNDRA ECOSYSTEMS

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To test the hypothesis of sorptive control on the release of dissolved organic matter (DOM) from soil systems affected by permafrost in northern Siberia we examined the sorption of DOM (obtained from the respective organic layers by extraction with water) by mineral soils. The tested soils were Gelisols and Inceptisols with varying depth of the active layer. Water-soluble organic matter in the O layer of the Gelisols was less (~400 mg C kg^{-1}) and comprised more carbon in the hydrophobic fraction (HoDOC) (~70%) than that of the Inceptisols (~700 mg C kg^{-1}, ~45% HoDOC). All A and B horizons adsorbed DOM strongly with a preference for HoDOC. Inceptisol C horizons, having a weak overall DOM sorption, retained carbon in the hydrophilic fraction (HiDOC) stronger than HoDOC, probaby because their high pH (>7.0). A horizons released large amounts of carbon with a large share of HiDOC. The results indicate that soils with deep active layer, i.e. Inceptisols, may release little DOM. These results are in harmony with the situation observed for streams at lower latitudes. Where the active layer is thin, i.e. in Gelisols, DOM rich in HiDOC can pass the soil and enter streams. This is in agreement with the large DOM concentrations in more northern catchments. However, as the Inceptisols, the Gelisols preferentially retain HoDOC which dominates the DOM in streams towards north. This discrepancy can be explained by additional seepage water from the organic horizons discharged into streams without intensive contact with the mineral soil.

DETOXIFYING ABILITY OF THE HYDROXYLATED HUMIC DERIVATIVES WITH RESPECT TO COPPER

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The objective of this study was to evaluate detoxifying ability of the hydroxylated humic materials with respect to copper. The hydroxylation procedure included subsequent oxidation-reduction of the aromatic structures present in the parent humic material - leonardite humic acids. Three oxidizing agents were applied: Fenton reagent, Elbs reagent and Fremy's salt. The oxidized derivatives were reduced using sodium sulfite. Detoxifying ability of the oxidized and oxidized-reduced humic derivatives was assessed using seedling technique. The results of biotests were treated to calculate toxicological binding constant of copper to humic material (K_{OC}^{tox}, L/kg OC). K_{OC}^{tox} values ranges from 5.2×10^4 to

5.6×10^6 L/kg OC. K_{OC}^{tox} values for five out of six derivatives were an order of magnitude higher than K_{OC}^{tox} of the parent material. In addition K_{OC}^{tox} values preparations obtained by Elbs reagent increased after reduction from 7.0×10^4 to 4.0 10^5 L/kg OC. Similar effects were not registered for other preparations. Hence, the undertaken hydroxylation brought about a substantial increase in detoxifying ability of the parent humic material. The proposed approach can be considered as a promising tool for producing humic detoxicants efficient against heavy metal pollution.

ENVIRONMENTAL CATALYSIS BY HUMIC SUBSTANCES

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I. INTRODUCTION

Humic substances (HS) improve soil fertility, and they play a principal role in the turnover of organic carbon. Humic substances form the major part of the organic component of soil, peat and natural waters, and they affect groundwater properties and the formation of fossil fuels. Humic substances can complex heavy metals and persistent organic xenobiotics. The catalytic activity of humi substances has been little analyzed. However, they contain many groups and structures which in similar macromolecules are responsible for their catalytic activity or may increase reaction velocity due to structural conformation of the macromolecules. The main factor responsible for removal of organic xenobiotics (pesticides, PCB's, PAH's and many other substances) is considered to be microorganism activity, and in this regard the role of humic substances may have been unduly neglected. Considering the high concentrations of humic substances in natural environments and their potential catalytical activity, they may indeed be significant in the fate of different xenobiotics. Of the different reactions, it may be expected that the velocity of hydrolysis and condensation reactions can be influenced by the presence of humic substances. These reactions may be particularly important in the hydrolysis of xenobiotica, as many environmental pollutants contain ester linkages.

The aim of the present study was to study the catalytic activity of humic substances of different origin in the reactions of hydrolysis of esters and condensation reactions.

II. MATERIALS AND METHODS

Humic (HA) and fulvic (FA) acids were isolated from soil and peat by extraction with 0.1 M NaOH, and from water by a modification of the Malcolm and Thurman method. The concentrations of functional groups in humic substances were determined by standard methods. Commercial humic substances were used for comparison (Aldrich). UV spectra were obtained on a Hitachi 850 spectrometer. The velocity of the reaction was estimated using a spectrometer HACH DR/2000.