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The use of immobilized metal ion chromatography to investigate Cu-DOC complexes in soil solution

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DOC is the main factor influencing the mobilization, bioavailability and transport of copper in soils since copper exists almost completely in organically complexed form in soil solution. Our ability to monitor and regulate copper as a pollutant therefore depends on the understanding of the sources and characteristics of the copper-complexing ligands in soil solution.

We have developed and validated a method for the isolation of copper-complexing ligands from soil solution by immobilized metal ion affinity chromatography (IMAC). The principal factors of copper ligand behavior on the IMAC column were determined by investigating 20 model ligands with different structure and functional groups. Not all Cu ligands were retained on the column showing that retention was not a function of the stability constant of the Cu-complex. The results emphasize the important relationship between the ligand structure and the retention on the IMAC column. The potential to form ternary metal-like surface complexes was the dominant factor influencing ligand behavior on the IMAC column.

The new method was used to fractionate and extract copper-binding ligands from soil solution and percolation water from a model ecosystem experiment. The following parameters were examined: presence or absence of heavy metal pollution, soil depth, soil type and presence or absence of vegetation. All IMAC chromatograms of the soil solution samples contained two major resolved fractions. About 5-30% of the total DOC was retained on the column, therefore indicating the presence of Cu-binding ligands. Significant differences in the amount of retained ligands were observed between soil types, soil depth and between lysimeters, which were planted or plant-free.