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Binding status of elements in soil derived NOM as investigated by Chelex extraction and FFF-HR-ICPMS

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The relevance of colloid assisted contaminant transport is among others associated with the question how the contaminant is bound to or fixed in a colloidal structure.

In column experiments applying a natural cation exchanger as a column matrix and heavy-metal loaded inorganic colloids and natural organic matter (NOM), it was found that the breakthrough behaviour of lead spiked NOM could not be explained easily.

Therefore the long-term desortpion behaviour of metals from a NOM dominated soil extract was investigated by applying a Chelex100 resin to an the dispersion and determining the residual element concentration over time.

Instead of spiking commercially available NOM with the elements of interest, NOM was extracted under alkaline conditions (pH 9) from a natural topsoil (Ah horizon of a gleyic podsol).

The Chelex resin was applied for 60 days. The induced depletion ranged from nearly complete (Zinc: 99%; Wolfram: 96.5%) to nearly unaffected (Molybdenum: 8%; Cobalt 0%). The results show clearly that during the first 10 days only a small fraction of the total Fe, Cu and Pb is released from the NOM. After approx. 10 days a nearly constant concentration of Fe, Cu and Pb is observed.

After the Chelex employment the remaining NOM extract was recovered and analysed with Flow-Field Flow Fractionation (FlowFFF) together with the original untreated sample.

The Chelex treatment results in a shift of the molecular weight distribution towards

smaller M and the fluorescence signal is increased. The effect of the Chelex treatment on the fluorescence signal is even more significant in fluorescence excitation-emission-matrix determinations (EEM).

The application of FFF-HR-ICP-MS enables the size resolved determination of 50+ elements in a single fractionation at ultra-trace levels minimising the problems of isobaric interferences. This technique was applied to the original and the final Chelex treated NOM.

From the data retrieved it can be concluded that in the studied NOM dominated soil extract elements as Cu or Pb (and others) are only little affected by cation exchange processes. Depending on the respective element, the exchange to a Chelex resin affects different regions of the size distribution. Hence the different elements will be transported due to their affinity to certain size fractions. The presented technique allows a detailed analysis of element-colloidal carrier association in terms of time and size in a particle size region usually neglected by routine analysis.