

The binding of cadmium, copper and iron by fractions of dissolved organic matter and humic substances originating from compost

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Complexation by soluble organic ligands originating from composted municipal solid waste (MSW) and biosolids (BS) amended to the soil, were studied. Dissolved organic matter (DOM) from these composts were separated into six fractions and their complexation of Cd, Cu and Fe was quantified by performing titrations with an ion-selective electrode (ISE) at pH 5 (Cd, Cu) or by ligand exchange (Fe). The complexing capacity (CC) for Cd was highest for HoA, a fulvic-type, easily soluble fraction, at 1042 $\mu\text{mol Cd g}^{-1}\text{C}$ of ligand. The other DOM fractions exhibited distinctively lower CCs. The highest stability constants ($\log K_{\text{int}}$) measured were: 7.74 (HoA), 7.69 (HoN), 7.02 (HiA), 6.93 (HiN), and 8.11 (HiB); $\log K_{\text{int}}$ for the HA was 10.05 and that for the FA > 1000, was 7.98. Using a continuous distribution model to evaluate the titration data, the MSW fractions HiA and HiN demonstrated a rather narrow range of binding site strengths, as opposed to the broader distribution curves exhibited by HoA and HiB. The HoN distribution curve was markedly different from that of the other DOM fractions and was shifted towards higher binding strength. Using the same distribution model for Cu binding by compost derived humic substances (HS), it was shown that the HoA, HoN, and HiB exhibited a broader range of $\log K_{\text{int}}$ (9 to 10.5). Stability constants with Fe of the DOM and its fractions exhibited values for $\log K$ ranging from 7-8. A specific ligand exchange technique, which was developed in our laboratory, was used for the determination of the $\log K$ s for Fe with HS.

Quantifying uranium complexation in groundwater DOC using coupled detection methods

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The long-term mobility of actinides in groundwaters is important for citing nuclear waste facilities and managing waste-rock piles at uranium mines. Dissolved organic carbon (DOC) may influence the mobility of uranium, but few field-based studies have been undertaken to examine this in typical groundwaters. In addition, few techniques are available to isolate DOC and directly quantify the metals complexed to it. Determination of U-DOC association constants from analysis of field-collected samples compliments laboratory measurements, and these constants are needed for accurate transport calculations. The partitioning of U to DOC was tested on both laboratory prepared samples and samples (n=8) collected from a high DOC clay-rich aquitard. Laboratory tests were conducted to determine the partitioning of U(VI) onto a standard fulvic acid. In both cases, the association of U and DOC was examined directly using on-line coupling of Asymmetric Flow Field-Flow Fractionation (AsFIFFF) with UV absorbance (UVA), DOC, and inductively coupled plasma-mass spectrometer (ICP-MS) detectors. This method has the advantages of utilizing very small sample volumes (20-50 μl) as well as yielding molecular weight information on U-DOC complexes. UVA and DOC detection results were used to determine percentages of total uranium associated with DOC (and other colloidal materials). In all cases, AsFIFFF-ICP-MS suggested that only a small percentage of the U, likely present as U(VI), was complexed with the DOC. This result was in good agreement with U speciation modeling performed on the groundwater samples. This agreement suggests that the AsFIFFF-ICP-MS method may be very useful for determining U-DOC association in small volume samples. Because the pH (7.0-8.1) and carbonate concentrations of these waters are typical of many groundwaters, these data suggested that facilitated transport of U by DOC may be limited in its importance in many groundwater systems.