Fluorescence, absorbance, and ion exchange: coupling analysis with water treatment for improved insight on copper complexation with natural organic matter

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Received 29 August 2014; Accepted 3 January 2015

ABSTRACT

Groundwater high in dissolved organic carbon (DOC) was spiked with 0–120 μmol/L of copper(II) (Cu) at pH 4, 6, and 8 to observe changes in fluorescence and UV absorbance of natural organic matter (NOM). The groundwater had a fluorescence excitation–emission matrix (EEM) characteristic of humic-like substances. Addition of Cu to the groundwater resulted in fluorescence quenching of EEM peak intensity and increase in UV absorbance at 254 nm (UVA254). Both fluorescence quenching and increase in UVA254 suggested the complex formation between Cu and NOM. Importantly, DOC measurements showed that physical loss of NOM did not play a measureable role in contributing to the observed fluorescence quenching and increase in UVA254, which supports the complex formation of Cu–NOM. The conditional stability constant for Cu–NOM was estimated using both fluorescence quenching and UVA254 increase at each pH and ranged from 4.26 to 5.77. As a follow up, anion exchange and cation exchange batch experiments were conducted using the groundwater spiked with 120 μmol/L Cu at pH 8 to gain insight on the behavior of Cu–NOM, and attempt to give physical meaning to the fluorescence quenching and UVA254 increase. The ion exchange results suggested the possibility of a neutral or partially negatively charged Cu–NOM complex. The significance of this work resides in the idea that fluorescence quenching and UV absorbance of NOM can be used as a tool to evaluate the co-removal of contaminants through water treatment processes.

Keywords: Fluorescence quenching; Natural organic matter; Copper; Ion exchange

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