THE ROLE OF BENTHIC MACROFAUNA IN INFLUENCING FLUXES AND SPECIATION OF DISSOLVED ZINC AND COPPER IN ESTUARINE SEDIMENTS

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ABSTRACT

Sediment flux experiments were carried out for sediment and water samples collected on April 23, 2001 and June 26, 2001 from a site in the lower CFR estuary. Benthic fluxes were determined for total dissolved copper (Cu) and zinc (Zn) and the ligands that bind these metals. Benthic fluxes of total dissolved Cu (TDCu) ranged from 130 to -180 $nmol \cdot m^{-2} \cdot d^{-1}$, where a negative flux represents the migration of a species from the sediment into the overlying water. The copper-complexing ligand fluxes ranged from 590 to -1030 $nmol \cdot m^{-2} \cdot d^{-1}$. Total dissolved Zn (TDZn) fluxes ranged from 56 to -300 $nmol \cdot m^{-2} \cdot d^{-1}$ and the Zn-complexing ligand fluxes ranged from 1220 to -980 $nmol \cdot m^{-2} \cdot d^{-1}$. Fluxes of both TDCu and TDZn were several times lower than the concentration of metal-binding ligands, suggesting that both Cu and Zn are largely complexed when they flux from sediments. There were no significant differences ($\alpha = 0.05$) between the two seasons in the fluxes of TDZn and Zn- and Cu-complexing ligands. However, fluxes of TDCu were significantly greater in April than in June.

The role of bioturbation in influencing benthic fluxes of these chemical species was also investigated using *Streblospio benedicti*, an opportunistic species common in the lower Cape Fear estuary. The presence of these polychaetes did not significantly affect fluxes of metals or ligands in any of the experiments.

Speciation analysis using competitive ligand equilibration – cathodic stripping voltammetry revealed that Cu was bound by a single strong class (L_1) whose K_{cond} ranged from $10^{13.5}$ to $10^{14.5}$, a result consistent with studies of Cu in this and other estuaries. Zn speciation analyses revealed qualitatively that there are two separate ligand classes

responsible for binding dissolved zinc. The conditional stability constants of the two ligand classes are too close in value (~ $10^{7.5}$) to compute values for each ligand class.

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DEDICATION

This thesis is dedicated to my parents, Ken and Una MacGillivray. Their faith, patience, optimism, and wisdom helped replenish my well whenever it ran dry.

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