Effect of Source and Composition of Dissolved Organic Matter on Fe(II) Oxidation in Freshwater and Coastal Seawater

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Iron (Fe) is one of the important trace nutrients for aquatic microorganisms and redox kinetics of Fe influence biogeochemical cycle of Fe including bioavailability by phytoplankton. In this study, we investigated the effect of source and composition of dissolved organic matter (DOM) on Fe(II) oxidation kinetics in freshwater and coastal seawater collected in the Shizugawa Bay watershed, Japan. The water samples were collected from various sources including river water, spring water and surface coastal seawater. Then, Fe(II) oxidation rate constants for the filtered samples were determined by using luminol chemiluminescence technique under laboratory condition.

As a result, freshwater samples generally showed higher oxidation rate constants compared to coastal seawater samples at the fixed pH. However, oxidation rate constants for freshwater samples were decreased to large extent after the removal of hydrophobic humic-type DOM using DAX-8 resin, indicating that terrigenous (allochthonous) DOM present in freshwater samples accelerated Fe(II) oxidation. Oxidation rate constants for coastal seawater were generally lower than those for organic ligand-free seawater and variation of Fe(II) oxidation in coastal seawater samples (at a fixed pH) was related to the proportion of DOM with autochthonous and allochthonous sources. Furthermore, laboratory culturing study indicated that Fe(II) oxidation rate constans are lower in the presence of cellular exudates from coastal phytoplankton. These results combined with the fact that Shizugawa Bay is characterized by high primary productivity suggest that microbially derived autochthonous DOM from phytoplankton (and other macroalgae) is likely an important factor that retards Fe(II) oxidation in coastal seawater. Our results indicate that source and composition of DOM exert important control on the Fe(II) oxidation in freshwater and coastal seawater systems.