Cycling of Strong and Weak Iron-Binding Ligands during and after a Simulated Phytoplankton Bloom

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The concentration and binding strength of dissolved iron-complexing organic ligands were examined using competitive ligand exchange-adsorptive cathodic stripping voltammetry with multiple analytical windows (α= 100, 60, 30) during a 9-day incubation experiment. Iron-poor near surface water was collected in the southern California Current off the Point Conception upwelling center. Changes in the iron-binding ligand pool in iron-amended and control incubations were tracked over 6 days in the light and 3 days in darkness in deckboard incubators. Despite the development of a diatom-dominated bloom in iron-amended treatments, excess iron ligand concentrations remained twice as high in the low-biomass controls throughout the experiment. The strongest ligands (log$K$ > 12) in the controls were measured on day 6, versus day 1 in iron-amended bottles. The weakest ligands (log$K$ <10) and some strong ligands increased from days 6 to 9 during the dark incubation period in the iron-amended bottles, concomitant with remineralization of 23% of the dissolved iron. Ligand production was not related to biomass growth, and modeling simulations suggest the microbial community is potentially responsible for active stronger ligand production in the light and passive weaker ligand production in the dark. High excess ligand concentrations found both in this study and in the water column appear to be related to high nitrate to iron (N:Fe) ratio water masses, a proxy for iron-limitation in many coastal upwelling regions.