Light dependence of selenium uptake by phytoplankton and implications for predicting selenium incorporation into food webs

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ABSTRACT: The potentially toxic element selenium is first concentrated from solution to a large but highly variable degree by algae and bacteria before being passed on to consumers. The large loads of abiotic and detrital suspended particles often present in rivers and estuaries may obscure spatial and temporal patterns in Se concentrations at the base of the food web. We used radiotracers to estimate uptake of both selenite (Se(IV)) and C by intact plankton communities at two sites in the Sacramento/San Joaquin River Delta. Our goals were to determine (1) whether C and Se(IV) uptake were coupled, (2) the role of bacteria in Se(IV) uptake, and (3) the Se :C uptake ratio of newly produced organic material. Se(IV) uptake, like C uptake, was strongly related to irradiance. The shapes of both relationships were very similar except that at least 42-56% of Se(IV) uptake occurred in the dark, whereas C uptake in the dark was negligible. Of this dark Se(IV) uptake, 34-67% occurred in the 0.2-1.0- μm size fraction, indicating significant uptake by bacteria. In addition to dark uptake, total Se(IV) uptake consisted of a light-driven component that was in fixed proportion to C uptake. Our estimates of daily areal Se(IV) :C uptake ratios agreed very well with particulate Se :C measured at a site dominated by phytoplankton biomass. Estimates of bacterial Se :C were 2.4-13 times higher than for the phytoplankton, suggesting that bacteriovores may be exposed to higher dietary Se concentrations than herbivores.