Effect of iron limitation on the cadmium to phosphorus ratio of natural phytoplankton assemblages from the Southern Ocean

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ABSTRACT: There is considerable interest in the biogeochemical cycling of cadmium (Cd) and phosphate (PO_4) in surface waters, driven in part by the ongoing development of a paleonutrient proxy that utilizes Cd preserved in fossil planktonic foraminifera to determine past PO_4 utilization efficiencies in ocean surface waters. The present article reports the results of a field study into the effects of Fe limitation on the Cd : P composition of natural assemblages of marine phytoplankton in the Antarctic Zone of the Pacific sector of the Southern Ocean. Iron enrichment to shipboard incubation bottles led to increases in community growth rate and final biomass. After 10.7 d of incubation, the climax community was dominated by large diatoms of the genus *Fragillariopsis, Pseudonitzschia* , and *Nitzschia*. Direct measurements of phytoplankton metal : P ratios from controlled shipboard experiments indicate that Cd : P, Co: P, and Zn : P ratios decreased from control values with increasing initial dissolved Fe concentrations in the incubation bottles, by factors of ~2-10 at highest Fe additions. We suggest that the effect of Fe limitation on resident diatoms is to decrease growth rate, leading to elevated cellular Cd content. The dissolved Cd : P ratio in iron-limited surface waters of the Southern Ocean may, therefore, respond to the supply of Fe to the resident phytoplankton community, which has implications for the developing paleonutrient proxy. We suggest that the biological uptake of Cd and P is independent of the dissolved Cd: PO_4 ratio. As a consequence, the results argue against the use of empirical Rayleigh fractionation models or models with fixed phytoplankton uptake ratios to account for regional variability in surface water dissolved Cd : PO_4.