On the nonlinear relationship between dissolved cadmium and phosphate in the modern global ocean: Could chronic iron limitation of phytoplankton growth cause the kink?

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ABSTRACT: I report two vertical profiles of dissolved cadmium (Cd) and phosphate (PO_4) from the Bering Sea: one from a high-nutrient, low-chlorophyll (HNLC) area, in which phytoplankton growth is limited by iron (Fe) availability, and one in highly productive waters near the continental shelf, where Fe is sufficient. At both stations, dissolved Cd and PO_4 display nutrient-like profiles and are strongly correlated with depth. The surface-water dissolved Cd : PO_4 ratio in the Fe-limited HNLC (0.21 $\pm$ 0.03 nmol µmol^{-1}) is significantly lower than the ratio in the productive Fe-replete station (0.31 $\pm$ 0.02 nmol µmol^{-1}). A simple model based on the results of previously published laboratory culture studies by others and field incubation experiments with natural phytoplankton assemblages is proposed relating the availability of Fe to the Cd : phosphorus content of phytoplankton, the dissolved Cd : PO_4 of ocean surface waters, and the slope of Cd : PO_4 in the nutricline. The model is consistent with available data and suggests that the nonlinearity or kink in the global dissolved Cd versus PO_4 relationship exists because of chronic Fe-limiting conditions in high-latitude HNLC areas in the modern ocean.

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