Geophysical Research Abstracts, Vol. 9, 00749, 2007
SRef-ID:

Cadmium and phosphate in coastal Antarctic waters: is there a global relationship?

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Insight into global nutrient cycling, and how it relates to population structure, primary and export production in the oceans, is essential for our understanding of how marine systems will react to present and future anthropogenic disturbance. Studies into micronutrient cycling have focused on iron availability, although other bioactive metals may be limiting under some circumstances. For example, cadmium is an essential micronutrient actively incorporated into diatom metalloenzymes such as carbonic anhydrase (CA), which is used as a catalyst in photosynthetic reactions. Cd has a similar depth profile and spatial distribution pattern to the macronutrient phosphate. The first compilations of oceanic datasets indicated a linear global relationship between Cd and P (e.g. Bruland, 1980), with a "kink" at $\sim 1.3\mu$molkg^{-1}P, which has been explained in terms of a constant Cd/P fractionation factor (Elderfield & Rickaby, 2000). However, the presence of a global relationship between Cd and P has been questioned due to the complex interaction of different influencing factors on Cd uptake by phytoplankton. Laboratory and field experiments show the activity of CA is affected by major nutrient levels, Fe limitation, Zn concentrations and pCO_2 (e.g. Cullen & Sherrell, 2005). Studies have also shown coastal Cd/P relationships to be significantly different to those in open oceans (e.g. Jones and Murray, 1984)

High latitude coastal regions are important to study as these areas are highly sensitive to global warming and changes to nutrient input related to melting of continental and sea-ice. The West Antarctic Peninsula is a key "hotspot" for nutrient cycling studies given it is experiencing rapid atmospheric and ocean warming (Meredith and King, 2005) together with glacial retreat and ice shelf collapse unprecedented during the Holocene (Cook et al., 2005).

The questions addressed here are 1) what are the seasonal variations of Cd uptake in a pristine coastal environment and how do these variations relate to macronutrient and Zn uptake; 2) is Cd a co-limiting micronutrient in the unique P-limited environment and 3) do we see the “global relationship” between Cd and P in coastal environments.