Institut Universitaire Européen de la Mer

Proposal for a Masters research project

THE CO-IMPACT OF IRON AND COPPER ON PHYTOPLANKTON GROWTH IN THE SOUTH ATLANTIC AND THE SOUTHERN OCEAN

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Abstract and objectives:

Since the 1990s, it has been convincingly shown that the subnanomolar oceanic concentrations of iron (Fe) are low enough to control phytoplanktonic production (in particular diatom growth) and the structure of the planktonic community in at least 40% of the ocean (de Baar et al., 2005), e.g. in the Southern Ocean (Martin et al., 1990, Boyd et al., 2000). Iron limitation also induces a decoupling in the use of major macronutrients by phytoplankton, likely to influence the cycling of the major biogeochemical cycles (C, N, P, Si, S) over geological time scales (de Baar and La Roche, 2003, Buesseler et al., 2004, Coale et al., 2004, Turner et al., 2004).

However, other abiotic parameters also control primary production and influence the elemental stoichiometry of phytoplankton, but the impact of co-limitation on the coupling of the major elements is rarely addressed. Amongst trace metals that are also essential for phytoplankton growth, copper (Cu) is involved in photosynthesis and respiration (Sunda, 1988-1989). It may also be an important micronutrient in low-Fe regions because of its role in Fe acquisition (Maldonado et al., 2006; Peers et al., 2005). Peers et al. (2005) showed, for the first time, that adding Cu to incubated seawater samples increased phytoplankton growth in the Subarctic Pacific, and that this increase was more important if Fe was added too. However, the impact on the planktonic community and the major biogeochemical cycles was not studied.

We recently investigated the co-impact of Fe and Cu in the sub-tropical South Atlantic and the Southern Ocean (36°S-51°S) during the BONUS-GOODHOPE cruise (Feb-March 2008). Deck-board incubations were performed at four stations. At all stations, after addition of major nutrients when needed, Fe addition enhanced chlorophyll-a (Chla) levels. Cu addition had contrasting effects. North of the Sub-Tropical Front, Cu addition enhanced Chla similarly to Fe addition. In the Sub-Tropical Front, Cu addition stimulated more the phytoplankton growth than Fe addition. Between the Sub-Antarctic Front and the Polar Front, Cu addition completely inhibited phytoplankton growth, and, in the North of the Weddell Gyre, Cu addition had no effect on phytoplankton growth (Sarthou et al., 2009).

During this Masters research project, to be conducted at LEMAR the student will have the opportunity to quantify the effects of Fe/Cu additions on the planktonic composition in our incubations, by determining the microphytoplankton (taxonomy by inversed microscopy) and pico- and nanophytoplankton (quantification by flow cytometry) composition.

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