Dissolved trace metals (Ni, Zn, Co, Cd, Pb, Al, and Mn) around the Crozet Islands, Southern Ocean

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[1] A phytoplankton bloom shown to be naturally iron (Fe) induced occurs north of the Crozet Islands (Southern Ocean) every year, providing an ideal opportunity to study dissolved trace metal distributions within an island system located in a high nutrient low chlorophyll (HNLC) region. We present water column profiles of dissolved nickel (Ni), zinc (Zn), cobalt (Co), cadmium (Cd), lead (Pb), aluminium (Al), and manganese (Mn) obtained as part of the NERC CROZEX program during austral summer (2004–2005). Two stations (M3 and M1) were sampled downstream (north) of Crozet in the bloom area and near the islands, along with a control station (M2) in the HNLC zone upstream (south) of the islands. The general range found was for Ni, 4.64–6.31 nM; Zn, 1.59–7.75 nM; Co, 24–49 pM; Cd, 135–673 pM; Pb, 6–22 pM; Al, 0.13–2.15 nM; and Mn, 0.07–0.64 nM. Vertical profiles indicate little island influence to the south with values in the range of other trace metal deprived regions of the Southern Ocean. Significant removal of Ni and Cd was observed in the bloom and Zn was moderately correlated with reactive silicate (Si) indicating diatom control over the internal cycling of this metal. Higher concentrations of Zn and Cd were observed near the islands. Pb, Al, and Mn distributions also suggest small but significant atmospheric dust supply particularly in the northern region.

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1. Introduction

[2] Artificial Fe enrichment experiments (summarized by *Boyd et al*. [2007] and *de Baar et al*. [2005]) confirmed Fe as the prime limiting micronutrient in HNLC regions. A range of other bioactive trace metals are also vital for biological productivity as they are often involved in enzymatic activity or become part of proteins [*Morel and Price*, 2003]. Some trace metals may be colimiting [*Morel et al*., 1994] when at low concentrations or toxic at elevated concentrations [*Mann et al*., 2002] and the bioavailability of trace elements such as Zn, Co, and Cd may be influenced by complexing ligands [e.g., Zn: *Bruland*, 1989; *Ellwood and van den Berg*, 2000; Co: *Ellwood and van den Berg*, 2001; *Saito et al*., 2004; Cd: *Bruland*, 1992].

[3] The Southern Ocean is the largest HNLC region and plays a key role in climate regulation via the ocean carbon pump [*Anderson et al*., 2009]. It is typically characterized by biolimiting concentrations of Fe, deep mixed layers in winter, with moderate seasonal warming and stratification. Therefore, this region can be very sensitive to climate change due to an increased stratification [*Sarmiento et al*., 1998] which may affect the biological pump and the water mass formation and circulation [*Marinov et al*., 2006; *De Vries and Primeau*, 2011]. However, studies of trace metals other than Fe are limited and only few of them cover the deep waters of the Southern Ocean [*Aparicio-Gonzalez et al*., 2012]. Data for the Indian sector of the Southern Ocean including the metals investigated here are particularly scarce. *van Beusekom et al*. [1997] provided the first water column and sedimentary distribution of Al and silicic acid along the Enderby and Crozet Basins. *Bucciarelli et al*. [2001] found coastal and offshore waters enriched in dissolved Mn and Fe with sedimentary and lithogenic origin in the wake of Kerguelen Islands, whereas *Bown et al*. [2012] suggested that lateral advection and dissolution of Co from basaltic sediments explain the high dissolved Co concentrations above the Kerguelen Plateau.

[4] The interdisciplinary CROZet natural iron bloom and EXport experiment (CROZEX) [*Pollard et al*., 2007b] confirmed that Fe released from the Crozet Islands and Plateau

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