Distributions of Dissolved Manganese in the Surface Waters of the Tropical North-Eastern Atlantic Ocean

FARAH AKMAL IDRUS*[1,2]

[1]Department of Aquatic Science, Faculty of Resource Science and Technology, University Malaysia Sarawak, 94300 Kota Samarahan, Sarawak, Malaysia; [2]National Oceanography Centre of Southampton, University of Southampton, Waterfront Campus, European Way, Southampton SO14 3ZH, UK
*Corresponding author: aifarah@unimas.my

ABSTRACT

The tropical North-Eastern Atlantic (TNEA) Ocean region receives high atmospheric input every year, mostly from the Saharan dust and soil. This atmospheric dust and its deposition in the surface ocean are considered to be an important supply of nutrients and trace metal (e.g. dissolved manganese (DMn)) to the euphotic zone of the open ocean regions. Therefore, the objective of this study was to investigate the input of DMn from atmospheric sources and from nearby islands into the TNEA Ocean. A set of surface samples were collected from the Tropical NE Atlantic Ocean, and were analysed for DMn by using the flow injection analyser with chemiluminescence (FIA-CL). Results suggest the land-sources of DMn near to the Canary Islands, the Cape Verde Islands and the African Continent contributed the major inputs of DMn, where high DMn concentrations were determined, with the highest is 3.87±0.05 nM. The lateral advective flux of DMn was higher (47 µmol/m^2/d) than the atmospheric flux of DMn (0.17 µmol/m^2/d), thus making the shelf and sediment as the most prominent sources of DMn in the seawater close to the islands. From this atmospheric flux of DMn, it was then possible to estimate the DMn enrichment at further offshore dust event regions of 0.73 nM/yr and consistent with the DMn background concentrations. This support the low residence time calculated in dust event regions of around 1 year. In conclusion, the shelf and sediment are the most prominent DMn sources in the seawater close to the islands and mainland, while in further offshore, the atmospheric inputs are dominant.

Keywords: Dissolved manganese, Tropical NE Atlantic Ocean, atmospheric input

INTRODUCTION

The distributions of DMn in the water column strongly reflect local sources, removal, and recycling processes. In remote ocean regions where there are low Mn inputs, the distribution of DMn are reported to be a scavenged type where the concentrations are depleted at depth relative to surface values. However, Mn distributions can be significantly modified when there are major atmospheric inputs (Statham & Burton, 1986; Spokes *et al.*, 2001; de Jong *et al*., 2007), sedimentary inputs from shelf and island systems (Gordon *et al.*, 1998; Bucciarelli *et al*., 2001; Chase *et al.*, 2005), and local biological activity (may remove manganese). Photochemical reactions can also enhance the concentrations of DMn in surface waters when this particulate Mn and Mn oxides are brought to the surface during upwelling or/and vertical mixing; or atmospheric inputs may be photo-reduced to the dissolved form, which can be measured using FIA methods (Chase *et al.*, 2005). Removal of DMn may occur by: (1) uptake by the biota (Luengen *et al*., 2007); (2) precipitation (Mendez *et al.*, 2010); and (3) scavenging removal of Mn from dissolved to particulate phases (Statham *et al.*, 1998). Therefore, in productive oceanic systems with high inputs from the atmosphere, shelf, and islands, there are a series of complex interacting processes that influence the biogeochemical cycles of DMn, and one of the factors is the water movement.

In the present study, DMn was determined in seawater samples collected across the TNEA Ocean which receives episodic atmospheric dust inputs from the Sahara Desert. These oceanic waters also contain islands (i.e. Cape Verde and Canary) which can also supply Mn from benthic sources in shallow waters. Therefore, this study was important in improving our understanding of the complex biogeochemistry of DMn in surface waters receiving high atmospheric dust deposition. The objective of this study was to investigate the input of DMn from atmospheric sources and from nearby islands into the TNEA Ocean.