TABLE OF CONTENT

SPATIAL AND SEASONAL CHANGES OF SI COMPOUNDS IN BRUNEI BAY, NORTHERN BORNEO

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INTRODUCTION

Silicon (Si) compounds, especially silicate, are important macronutrients in the marine environment especially for diatom growth (Domingues & Galvao, 2007; Cabrini *et al.*, 2012). The Si concentration in the marine environment varies according to various factors depending on the source inputs such as riverine input, hydrothermal influx, seafloor weathering and from marine sediment pore water, with the majority of Si derived from riverine input in the coastal zone (Suratman & Mohd Tahir, 2012; Frings *et al.*, 2014; Ozkan *et al.*, 2014). Riverine transport of Si to the coastal area occurs in both dissolved and particulate forms, where the main source is from chemical weathering of mineral silicates, while the particulate Si is transported in suspended particulate matter load (Ding *et al.*, 2011; Cao *et al.*, 2013). On entering the marine water column dissolved Si, such as silicate, may be taken up by diatoms and other organisms for the production of a siliceous shell. The seasonal replenishment of silicate into the marine system especially from rivers and weathering of marine sediments may allow high levels of diatom production, with the spring bloom in temperate waters often dominated by diatoms (Conley & Malone, 1992; Biswas *et al.*, 2014).

Brunei Bay is situated on the northeast coast of Borneo and opens to the southern region of the South China Sea. This bay is shallow along the coastal area (<5 m) becoming deeper towards its outer part (20-40 m). Most of the bay is surrounded by mangrove forests with associated mudflats and sandflats at the mouth of the major estuaries. The bay receives freshwater input from a number of rivers, including Brunei, Limbang, Temburong, Trusan, and Pandaruan Rivers in Brunei, Sundar, Awat-Awat, Punang and Lawas Rivers in Sarawak and Sipitang, Weston and Padas Rivers in Sabah. Many industrial and agricultural activities occur within the catchment area of the bay, such as palm oil plantation development with associated deforestation,

construction of a wood-, pulp- and paper mill complex, the construction of an ocean harbour and various other infrastructures (Linden *et al.*, 1992; Dinor *et al.*, 2007).

The surface circulation of the bay changes seasonally in response to the prevailing monsoons, namely the dry Southwest (SW) and wet Northeast (NE) monsoons. The SW monsoon lasts from June to September, with an average wind speed of 6 m/s. Meanwhile, the stronger NE monsoon appears from November to March, with an average wind speed of 9 m/s and typically heavy rainfall (Guo *et al.*, 2006). These seasonal changes may influence the water column structure and vertical mixing on different time and spatial scales and therefore are likely to affect the distribution and cycling of nutrients as well as the biological processes in the water column. The strong prevailing NE monsoon tends to increase the nutrient mixing resulting from water column turnover thus enhancing primary production, resulting in higher primary production in the wet NE monsoon season (Chen & Chen, 2006; Liu *et al.*, 2007).

To date, no study has been carried out to investigate the spatial and seasonal changes of Si compounds in Brunei Bay. Thus, this study was initiated to generate a baseline data of Si compounds and determine its seasonal cycling. Sampling was carried out for throughout one year, covering dry and wet monsoon seasons. In addition, a fractionation study of organic Si was also carried out in order to determine the influence of the organic Si compounds on the growth of phytoplankton.

MATERIALS AND METHODS

Sampling was divided into two strategies i.e. sampling which covered the coastal stations and another sampling which covered the whole area of the bay (Figure 1). Five sampling trips (May 2013, June 2013, October 2013, January 2014 and April 2014) were conducted at the coastal stations (B1-B15). In addition, two sampling trips were performed for the whole area which covered stations T1-T34 and A1-A9; these were done in June 2013 (SW monsoon) and January 2014 (NE monsoon).