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CONCENTRATIONS OF SILICATE COMPOUNDS IN SURFACE WATER OF SETIU WETLAND: A PRELIMINARY STUDY

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Abstract: The distribution of silicate compounds and chlorophyll-a concentrations was determined at Setiu Wetland which is located in the southern part of the South China Sea, Malaysia from July to October 2008. Parameters measured were dissolved inorganic silicate (DISi), dissolved organic silicate (DOSi) and particulate silicate (PSi). The concentrations of DISi, DOSi and PSi in the study area range from 101-529 μg/L Si, 21-187 μg/L Si and 114-502 μg/L Si, respectively with PSi being the most dominant form of silicate. In addition, low concentrations of chlorophyll-a was recorded which ranged from 0.0002-0.0101 μg/L. It is suggested that the main contribution of this nutrient originated from natural sources.

KEYWORDS: Silicate compounds, Chlorophyll *a*, Setiu Wetland, Southern South China Sea (Malaysia)

Introduction

Setiu Wetland is situated downstream of Setiu River basin, Terengganu, Malaysia. The main activities in the area are aquaculture. The wetland area receives freshwater inputs from the Setiu River that flows into the wetland. In addition, the wetland also receives freshwater inputs from a nearby natural lake (Berambak Lake) which is connected to the wetland via Ular River. Upstream activities from the freshwater inputs at present are limited to agricultural activities including palm-oil plantation. Seawater intrusion into the wetland occurs at Kuala Setiu Baharu.

Studies have been conducted in Setiu Wetland to monitor water quality for sustainable aquaculture use and the effect of the major pollutants in the aquatic environment such as hydrocarbons, heavy metals, pesticides and organic matter (Suratman *et al.*, 2005; 2012; Law *et al.*, 2006; Tahir *et al.*, 2006). Various activities in the wetland are expected to have increased the nutrient concentrations, especially the nitrogen and phosphorus compounds (Suratman *et al.*, 2005; Law *et al.*, 2006). These compounds have a major impact on net primary productivity and have been the subject of intensive study. However, study on silicate compounds does not appear to have received much attention even though this nutrient is also as important, especially in the marine system, owing to its role in the primary productivity of diatomaceous algae (Wu and Chou, 2003). Thus, a study was conducted to determine the concentrations of silicate compounds i.e. dissolved inorganic silicate (DISi), dissolved organic silicate (DOSi) and particulate silicate (PSi). The determination of chlorophyll-a (chl-a) was also carried out as an indicator of phytoplankton biomass.

Materials and Methods

Samplings were carried out monthly from July until October 2008 at ten sampling stations (S1, S2, S3, S4, S5, S6, S7, S8, S9 and S10) (Fig. 1). The water samples were collected at a depth of 0.5 meters from the surface water using a Van Dorn sampler and stored in high-density polyethylene bottles. Samples for DISi and total dissolved silicate (TDSi) determinations were filtered through pre-washed Whatman GF/C filter. DOSi was calculated as the difference between TDSi and DISi. The unfiltered water samples were used for PSi determination after the minus

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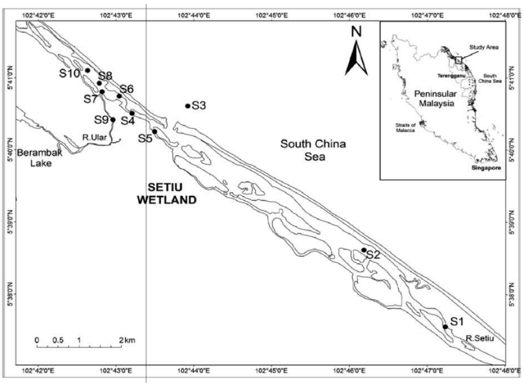

Fig. 1: Map showing the sampling stations at Setiu Wetland.

of TDSi concentration. All the silicate compounds were determined by the colorimetric method (Grasshoff *et al.*, 1983). For chl-a determination, standard method was employed (APHA, 1995). Appropriate analytical quality controls have been made during analysis. The recovery was determined by using standard additions and the results show more than 95% recovery. Each sample was analysed in triplicate and comparison was made between them. The deviations from precision between the triplicates were < 3%.

Results and Discussion

Data obtained in the present study are presented in Fig. 2. The concentrations of dissolved fractions i.e. DISi and DOSi varied between 101-529 µg/L Si and 21-187 µg/L Si, respectively. In addition, the concentration of PSi ranged from 114-502 µg/L Si. Higher mean concentration was recorded for PSi (274+107 µg/L Si) compared to DISi (191+107 µg/L Si) and DOSi (88+48 µg/L Si). This result suggests that the dominant form of silicate in the study area is in a particulate form.

The data were examined using ANOVA test two factor without replication to see whether there were any statistical significant differences between sampling dates and stations. The results indicate that there were significant differences between sampling dates ($p<0.05$) but none for sampling stations ($p>0.05$). However, in general, freshwater end-member station (S1) recorded relatively higher concentrations of silicate compounds compared to other stations in the wetland area suggesting major input of this

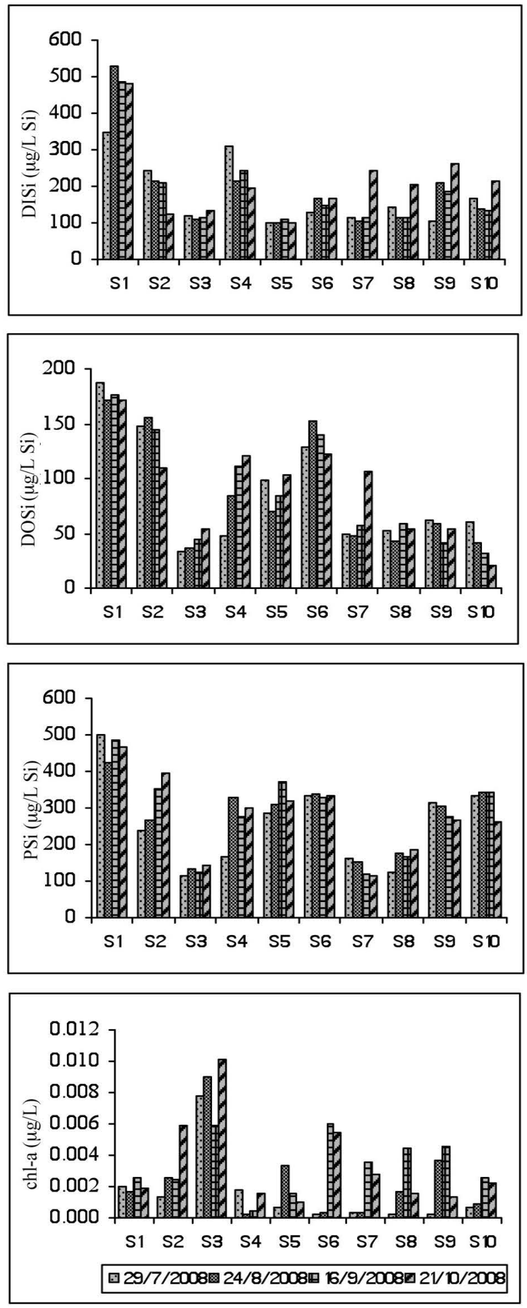

Fig. 2: The concentrations of silicate compounds and chl-a.

nutrient to the wetland originated from freshwater region. It has been suggested that about 80% of silicate is transported by river to the marine system (Ibrahim and Mustafa, 2010). In contrast to nitrogen and phosphorus inputs to the aquatic systems which mainly depend on anthropogenic activities (Law *et al.*, 2006; Tahir *et al.*, 2006), weathering of soils has been cited as major sources of silicate in the environment (Treguer *et al.*, 1995). Recently, Ibrahim and Mustafa (2010) have reported a study on silicate distribution in Linggi River Basin, Malaysia. These authors observed high content of silicate in the river and attributed their finding to weathering input even though the basin has undergone urbanisation and industrialisation. It is suggested that the silicate weathering is the main contributor of this nutrient in Setiu Wetland. In addition, correlation test of DISi with DOSi and PSi shows high correlation among them (correlation coefficient 0.44 and 0.51, respectively) suggesting silicate compounds originated from the similar sources.

Biological assimilation by phytoplankton has been cited as a possible mechanism for silicate removal in the water column, especially the DISi (Treguer *et al.*, 1995; Wu and Chou, 2003). Diatoms are the substantial user of this nutrient as it is taken up to construct their cell walls i.e. frustules. In this present study, the concentrations of chl-a have been used as an indicator of phytoplankton biomass. However, no attempt was made to determine the type of plankton in the study area. The concentration of chl-a varied between 0.0002-0.0101 μg/L. In general, result obtained in the present study showed an inverse correlation between all the silicate compounds and chl-a concentrations although the correlation coefficient was low (DISi (-0.24), DOSi (-0.04) and PSi (-0.21). This observation could suggest that the removal of silicate in the study area is not associated with the consumption by phytoplankton.

Conclusion

In conclusion, the results indicate that higher concentration of silicate is recorded at the freshwater inputs from Setiu River and particulate is the dominant form of silicate. The weathering process is an important source of silicate in the study area. No significant correlation is observed between the silicate compounds and chl-a concentration which suggests that the distribution of this nutrient is not controlled by phytoplankton.

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